

Environmental Assessment (Scotland) Act 2005

Seaweed Policy Statement Consultation Document

Environmental Report

August 2013

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Abbreviations

ACOPS	Advisory Committee on Protection of the Sea
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
AIS	Automated Identification System
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
BRIG	Biodiversity Reporting and Information Group
CAR	Controlled Activities Regulations
CBD	Convention on Biological Diversity
CCS	Carbon Capture and Storage
CCRA	Climate Change Risk Assessment
CO ₂	Carbon Dioxide
CoC	Code of Conduct
CoP	Code of Practice
Defra	Department of Environment, Food and Rural Affairs
DOENI	Department of Environment Northern Ireland
EC	European Commission
ECC	European Economic Community
EHSNI	Environment and Heritage Service of Northern Ireland
ESG	Ecological Status Groups
EU	European Union
FAO	Food and Agriculture Organisation
FIDC	Falkland Islands Development Corporation
FSA	Food Standards Agency
GCR	Geological Conservation Review
GIS	Geographic Information System
GVA	Gross Value Added
HIE	Highlands and Islands Enterprise
HMPA	Historic Marine Protection Area
IMTA	Integrated Multi-Trophic Aquaculture
IMO	International Maritime Organisation
IPPC	Integrated Pollution Prevention and Control
ISA	Important Stonewart Area
JNCC	Joint Nature Conservation Committee
MAIB	Marine Accident Investigation Branch
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Marine and Coastguard Agency
MCAs	Marine Consultation Areas
MMO	Marine Management Organisation
MPA	Marine Protected Area
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MSS	Marine Scotland Science
Mt	Million tonnes
NHM	National History Museum
NMP	National Marine Plan
NORM	Naturally Occurring Radioactive Material
NSA	National Scenic Area
OSPAR	Oslo and Paris Convention
PMF	Priority Marine Features
pMPA	Possible Marine Protected Area

PPC	Pollution Prevention and Control
PPS	Plans, Programmes and Strategies
R&D	Research and Development
RBD	River Basin District
RBMP	River Basin Management Plan
RCAHMS	Royal Commission on the Ancient and Historical Monuments of Scotland
SAC	Special Area of Conservation
SAMS	Scottish Association of Marine Science
SE	Scottish Enterprise
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SHEP	Scottish Historic Environment Policy
SNH	Scottish Natural Heritage
SNIFFER	Scotland and Northern Ireland Forum for Environmental research
SPA	Special Protection Area
SPS	Seaweed Policy Statement
SSSI	Site(s) of Special Scientific Interest
TCE	The Crown Estate
UK	United Kingdom
UKBAP	UK Biodiversity Action Plan
UKCIP	UK Climate Impacts Programme
UNCLOS	UN Convention on the Law of the Sea
UNEP	United Nations Environment Programme
WEWS	Water Environment and Water Services
WFD	Water Framework Directive

1 Non-Technical Summary

1.1 What is the Seaweed Policy Statement Consultation Document?

1.1.1 The Seaweed Policy Statement Consultation Document (the Consultation Document) is the vehicle for consultation on the proposed Seaweed Policy Statement (SPS) currently being developed by Marine Scotland. The Consultation Document has been prepared to engage with stakeholders and other interested parties on policies being considered for inclusion in the proposed SPS, and to seek views on a range of issues relating to the future growth of the seaweed cultivation and wild harvesting industries in Scotland. The finalisation of the SPS will be informed by the views expressed in the consultation.

1.1.2 The SPS will set out the Scottish Government's policy on the suitability of seaweed cultivation in different scenarios. It will also explore the most suitable regime for licensing seaweed cultivation as a single species and the development of Integrated Multi-Trophic Aquaculture (IMTA), and indicate the issues considered in determining whether a proposal is acceptable, such as the species to be cultivated, and the scale of development planned.

1.1.3 It will provide greater certainty for the industry at an early stage in its development, informing potential developers of the Government's expectations, while ensuring that activities which may have an environmental impact are understood and mitigated. The statement will sit alongside the National Marine Plan (NMP), inform the (future) Regional Marine Plans and Local Development Plans, and complement a range of existing regulations and legislative instruments, plans, programmes and strategies (PPS) developed at the European, UK and Scottish levels.

1.2 What is the role of this SEA?

1.2.1 The Strategic Environmental Assessment (SEA) was undertaken in accordance with the Environmental Assessment (Scotland) Act 2005, and reflects a 'bottom-up' approach to assessment, integrated with the development of the SPS.

1.2.2 The SEA presents information relating to Scotland's seaweed industry and the important role of seaweed in the marine environment, and an assessment of potential broad environmental effects that may be associated with commercial seaweed cultivation in Scottish waters and expansion of harvesting of seaweed in the wild. The SEA has also examined reasonable alternatives, potential cumulative and synergistic effects, and monitoring requirements, and considered likely interactions

between the policies within the proposed SPS and those in other plans, programmes and strategies for the marine environment.

1.3 An integrated approach

- 1.3.1 The SEA was used to frontload the development of the SPS, and played a key role in the iterative policy development process from the outset. Via early engagement with the Consultation Authorities, the SEA scoping process served to inform the SPS development, identifying potential environmental considerations associated with growth of the commercial cultivation and wild harvesting industries, and helping to steer the direction of the SPS at the policy scoping stage.
- 1.3.2 The progression of the assessment continued to aid the development of the proposed SPS and its findings have prompted the inclusion of specific policies into the Consultation Document, whilst also considering, and in some instances identifying, reasonable alternatives. As such, many of the policies within the Consultation Document address concerns raised in the SEA, and several act to mitigate potential environmental impacts identified during this assessment process.

1.4 Why is seaweed important?

- 1.4.1 Scotland has a rich variety of seaweed species with many areas around the Scottish coastline containing suitable habitats, including the high natural nutrient levels and current flows considered to be necessary for seaweed growth. In consequence, Scotland's seashores and shallow marine intertidal and subtidal habitats are rich in macroalgal growth, providing a wide range of important and unique habitats for many marine plants and animals, demonstrated by the inclusion of some habitats as Priority Marine Features (PMF).
- 1.4.2 Seaweed communities play key roles in the marine environment by acting as a food source, the bio-accumulation and absorption of nutrients and pollutants, aiding in coastal wave protection and providing support for coastal habitat development, whilst also supporting a number of commercial industries. The use of wild seaweed stocks and the production of cultured or cultivated stocks have a rich global history, particularly in Asia, where seaweeds are used in a range of products and processes, with some species harvested or grown specifically for human consumption. Recently, research has focused on the large-scale culture of seaweed for industrial use, particularly in bioenergy production.
- 1.4.3 Historically, Scotland's seaweed industry has been based upon the small-scale harvesting of seaweed in the wild, a practice that continues to the present day. However, the Scottish Government and wider industry have

identified that there is potential for the growth of seaweed cultivation, its use in IMTA, and expansion of harvesting in the wild.

1.5 What are the potential environmental impacts of the expansion of Scotland's Commercial Seaweed Industry?

1.5.1 The assessment identified a range of potential environmental issues relating to both seaweed cultivation and commercial seaweed harvesting in the wild, largely relating to the key role that seaweed plays in Scotland's marine ecosystems and coastal areas, and the national and international value attributed to many of the habitats these support.

Commercial Seaweed Cultivation and IMTA

1.5.2 The SEA identified a range of potential generic environmental effects that could be associated with commercial seaweed cultivation development:

- Potential benefits in the creation of refuges for fauna, including juvenile wild fish stocks, and supporting marine and shoreline biodiversity.
- Potential for improvements to water quality, particularly in offsetting impacts of finfish aquaculture.
- Risks to aquatic and benthic fauna from the presence of farm cultivation sites and their infrastructure (e.g. entanglement, barriers to movement, smothering).
- Risks to ecosystem biodiversity through the use of non-native cultured species.
- Potential visual issues associated with the presence of cultivation infrastructure.
- Potential for changes to coastal processes, water flows and exchange rates associated with the presence of cultivated seaweed and infrastructure.
- Potential for hazards associated with storm damaged equipment and infrastructure.
- Potential interactions with other marine users associated with the siting of cultivation infrastructure and activities.

1.5.3 The SEA identified that any potential impacts associated with seaweed cultivation, either positive or adverse, are likely to be dependent on site-specific factors such as the location and scale of a development, and the composition and sensitivity of the corresponding marine ecosystems. As such, the SEA considered that many of these issues may be best considered and assessed at the project level.

1.5.4 In general terms, shellfish-scale or IMTA cultivation as outlined in the SPS is considered less likely to result in significant environmental impacts (such as benthic impacts, collision risk and navigational issues), than large-scale developments, if they are appropriately sited and designed. The SEA found that the use of seaweed cultivation in IMTA can have positive environmental effects for biodiversity and water quality, mitigating some negative impacts from finfish aquaculture. It also considered that undertaking cultivation operations in offshore areas may also overcome many of the potential issues that have been identified for near-shore developments, such as spatial competition and coastal impacts.

Commercial Harvesting in the Wild

1.5.5 The assessment identified a range of potential generic environmental effects that could be associated with growth in commercial harvesting of seaweed in the wild:

- Potential impacts associated with over-harvesting or harvesting practices (e.g. loss of habitat and species, reduced nutrient inputs).
- Potential for impacts on coastal processes from harvesting (e.g. changes to wave patterns and tidal flows, reduced storm resistance and impacts to shoreline biodiversity).

1.5.6 The SEA identified the importance of Scotland's natural seaweeds to the marine environment, noting concerns on the potential for adverse impacts from increased commercial harvesting of Scotland's natural seaweed stocks, particularly kelp. However, it was noted that there is presently no evidence to indicate that seaweed harvesting in the wild is currently resulting in adverse environmental impacts in Scottish waters.

1.5.7 It found that sustainable management of this resource is vital in the future growth of the industry, and that failure to implement appropriate harvesting practices could have adverse impacts on seaweed biodiversity in local and wider marine communities. In general terms, factors such as the method of harvesting, the harvesting intensity and frequency, seasonality, and the seaweed species being harvested can all influence the ecological impacts of commercial harvesting operations, and affect the sustainability of the resource and the flora and fauna it supports.

1.5.8 The SEA found that the SPS and its consultation may provide a valuable tool for engagement with the commercial wild harvesting industry and other stakeholders to discuss practical options for managing the sustainable growth of the industry, prompting the inclusion of wild harvesting in the Consultation Document and seeking views on the potential development of guidance for commercial harvesting in the wild.

1.6 How will the Seaweed Policy Statement affect the environment?

- 1.6.1 The SEA found that the proposed SPS will likely contribute to overall positive environmental effects for biodiversity and water quality, particularly in relation to IMTA. Policies such as the Scottish Government's requirement for the culture of seaweeds that are native to the area of cultivation were considered likely to complement wider policy to preserve the genetic integrity of Scotland's marine ecosystems. Other policies, such as the use of fit-for-purpose equipment and consideration of other marine users to address potential siting conflicts, have been included in the Consultation Document to address environmental issues identified in this SEA.
- 1.6.2 The SEA noted that the main role of the proposed SPS would be in the encouragement of avoiding adverse environmental impacts, and the potential for creating additional interest for seaweed cultivation and IMTA in the industry. However, the findings also demonstrate the interdependence of the SPS, the seaweed industry and its stakeholders, the processes currently in place, and the combined role that they will need to play in realising the benefits promoted by the proposed SPS and this SEA.

1.7 Interactions and Cumulative Effects

- 1.7.1 Together, the proposed SPS and other overarching PPS will likely contribute to overall positive environmental effects, particularly for biodiversity and water quality. The overarching principles of sustainable development and protection of Scotland's marine environment, in particular, form key threads in the SPS and wider Scottish policy.
- 1.7.2 Specific provisions in the Consultation Document (such as the use of fit-for-purpose equipment, promoting the cultivation of seaweed for human consumption in locations away from sewage outfalls and other pollution sources, and consideration of other marine users and activities in the siting of seaweed farms) have been included to address issues identified in the SEA and to complement existing policy and planning. Their identification in the iterative SPS development and SEA processes, and subsequent inclusion in the proposed SPS and its Consultation Document should add weight to their consideration by the commercial seaweed cultivation and wild harvesting industries.

1.8 Monitoring Opportunities

- 1.8.1 While no specific proposals for monitoring have been presented in the Consultation Document, this SEA outlines monitoring requirements within the current regulatory framework (e.g. monitoring detailed in marine licences issued by Marine Scotland), and provides an overview of the scope for monitoring with the future growth of the seaweed industry. The SEA identified opportunities for obtaining greater knowledge on Scotland's important wild seaweed communities.
- 1.8.2 These include scope for monitoring of environmental effects by developers of medium-scale cultivation sites in demonstrating that appropriate mitigation measures have been implemented, opportunities for further research on environmental effects associated with cultivation and wild harvesting operations, and the likelihood of additional spatial studies to be undertaken in the future expansion of Scotland's commercial wild harvesting industry.

1.9 Next Steps

- 1.9.1 Consultation on the Consultation Document and the Environmental Report is now open and will close on 17 November 2013. Public views and opinions on this Environmental Report, and the Consultation Document to which it relates, are now invited. A post adoption SEA statement will be prepared outlining how the findings of the SEA and the responses have been taken into account in the final SPS.

2 Introduction

2.1 Background

2.1.1 The Seaweed Policy Statement Consultation Document (the Consultation Document) is the vehicle for consultation on the proposed Seaweed Policy Statement (SPS) currently being developed by Marine Scotland. The Consultation Document has been prepared to engage with stakeholders and other interested parties on policies being considered for inclusion in the proposed SPS, and to seek views on a range of issues relating to the future growth of the seaweed cultivation and wild harvesting industries in Scotland.

2.1.2 The finalisation of the SPS, resulting from this consultation, should facilitate the growth of the industry by setting out the Scottish Government's policy on the suitability of seaweed cultivation in different scenarios. It will also explore the most suitable regime for licensing seaweed cultivation and indicate the issues considered in determining whether a proposal is acceptable, such as the species to be cultivated, and the scale of development planned. It will provide greater certainty for the industry at an early stage in its development, informing potential developers of the Government's expectations, while ensuring that activities which may have an environmental impact are understood and mitigated.

2.2 The Strategic Environmental Assessment (SEA) Process

2.2.1 The Environmental Assessment (Scotland) Act 2005 (the Act) requires that certain public plans, programmes and strategies (PPS) be assessed for their potential effects on the environment. Strategic Environmental Assessment (SEA) is the process used for fulfilling this requirement, and includes consultation with the public and the Consultation Authorities¹. The Act also sets out the information that is required to be provided in an Environmental Report. The Consultation Document for the SPS falls under Section 5(4) of the Act.

2.2.2 Marine Scotland undertook screening and determined, as the Responsible Authority, that the policies contained within the Consultation Document have the potential to give rise to significant environmental effects, both adverse and beneficial, and that an environmental assessment would therefore be undertaken². A scoping exercise was undertaken and a

¹ Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH) and Historic Scotland.

² The determination was sent to the SEA Gateway and published in The Edinburgh Gazette and The Herald in August 2012.

Scoping Report was prepared and issued to the Consultation Authorities in September 2012, setting out details of the proposed scope and level of detail of, and approach to, the SEA.

2.3 Purpose of this Report

2.3.1 The purpose of this Environmental Report is to document and set out the findings of the SEA undertaken by the Scottish Government's Environmental Assessment Team, on behalf of Marine Scotland, in accordance with the requirements of the Act.

2.3.2 The views of the public and the Consultation Authorities on this report are now being sought.

2.4 Content of this Report

2.4.1 This Environmental Report is structured as follows:

- **Section 1:** Non-Technical Summary
- **Section 2:** Introduction outlining the Consultation Document, the SEA process and the purpose of this report.
- **Section 3:** Context for the Consultation Document and the proposed SPS, outlining objectives, content, relationship with other plans, programmes, strategies, and the current regulatory framework in Scotland.
- **Section 4:** The scope and methodology of the SEA.
- **Section 5:** Background information on seaweed, its role in marine and coastal environments, its production and use, and an overview of Scotland's wild seaweed stocks.
- **Section 6:** The environmental baseline relevant to the assessment, the likely evolution of the baseline without the policies detailed in the Consultation Document and an outline of alternatives considered in the assessment.
- **Section 7:** The findings of the assessment of commercial seaweed cultivation and IMTA, including recommendations for mitigation of potential environmental impacts.
- **Section 8:** The findings of the assessment of commercial harvesting in the wild, including recommendations for mitigation of potential environmental impacts.
- **Section 9:** Assessment of reasonable alternatives.
- **Section 10:** Assessment of cumulative and synergistic effects.
- **Section 11:** Summary of assessment findings.

- **Section 12:** Proposals for monitoring.
- **Section 13:** Details of the consultation timescale and next steps.

3 Context of the Seaweed Policy Statement and its Consultation Document

3.1 Introduction

- 3.1.1 The Consultation Document prepared by Marine Scotland seeks comments on a range of policies proposed for inclusion in the SPS, and on issues relating to the potential growth of the commercial seaweed cultivation and wild harvesting industries in Scotland. These include the consideration of possible different consenting regimes for seaweed cultivation, the development of guidance on commercial seaweed harvesting in the wild, and the future diversification of cultivated species.
- 3.1.2 The finalisation of the SPS will be informed by the views expressed in the consultation. It will set out Scottish Government's aspirations for the sustainable development of a commercial seaweed cultivation industry in Scotland, including the cultivation of seaweed as a single species and the development of Integrated Multi-Trophic Aquaculture (IMTA). It will outline the Scottish Government's view of the suitability of seaweed cultivation in a number of different scenarios and provide industry with a better understanding of the Government's expectations on the types of development that would be considered to be most appropriate.
- 3.1.3 It is anticipated that the SPS will provide greater certainty for the industry at this early stage of the industry's development and inform potential developers of the Government's expectations. Once developed, it will sit alongside the National Marine Plan (NMP), inform the (future) Regional Marine Plans and Local Development Plans, and complement a range of existing regulations and legislative instruments, plans, programmes and strategies (PPS) developed at the European, UK and Scottish levels (Section 3.5). It is anticipated that the policies proposed for the SPS will assist potential developers in preparing informed planning and licensing applications.
- 3.1.4 This section of the report presents the content of the Consultation Document for the SPS and outlines the relationship of the proposed SPS with other relevant marine plans, programmes and strategies.

3.2 Objectives and Content of the Seaweed Policy Statement

- 3.2.1 The aim of the SPS and its Consultation Document is to facilitate and support the sustainable development of the industry in Scotland at an early stage in its growth, by providing greater certainty for potential developers. The SPS will likely cover commercial-scale cultivation, IMTA and commercial harvesting of seaweed in the wild.

3.2.2 The development of the SPS is being phased to accommodate current knowledge and practices, whilst allowing for future advances in the industry.

Commercial-scale Cultivation

3.2.3 The Consultation Document identifies three different scales of commercial-scale seaweed cultivation:

- Shellfish-Scale Cultivation – comprising sites that are similar in size to typical mussel farms (i.e. up to 40 x 200m lines of seaweed).
- Medium-Scale Cultivation – comprising sites that exceed the size of a typical mussel farm (i.e. 41 to 80 x 200m lines of seaweed) but are smaller than extensive-scale sites, such as those potentially used for biofuel production.
- Extensive-Scale Cultivation – comprising large-scale sites and utilising different equipment to that used in shellfish production. Such sites may have the potential for use in biofuel production.

3.2.4 The Consultation Document outlines the Scottish Government's support for shellfish-scale cultivation, subject to regulatory consideration, and sets out the following policies:

- Use of seaweed species that are native to the area of cultivation.
- Where seaweed is grown for human consumption, farms should be sited away from sewage outfalls and other potential sources of pollution.
- Fit-for-purpose equipment should be used in cultivation operations to prevent damage from adverse weather conditions.
- Other marine users and activities must be considered in the siting of farms.
- There is no spatial limitation on cultivation activities in Scotland.

3.2.5 The Consultation Document details the same broad policies for medium-scale farms, and acknowledges the potential for adverse environmental impacts. It notes that applications for medium-scale seaweed farms should demonstrate that mitigation measures have been considered to prevent adverse impacts (i.e. environmental impacts and interactions with other marine users). It also states that an application should set out how these will be delivered.

3.2.6 However, the Consultation Document does not contain a policy for extensive-scale development, as this is currently the subject of research and investigation, primarily for the production of biofuels. Rather, Marine Scotland proposes to consider the development of a policy for this scale of cultivation in the event that it should look likely to develop in the future.

IMTA

- 3.2.7 The Scottish Government supports the use of seaweed in IMTA alongside fed or farmed species, such as Atlantic salmon. The Consultation Document sets out the same policy considerations as those for shellfish-scale cultivation, but notes that the use of IMTA in finfish aquaculture will be limited to Scotland's west coast, the Western Isles, Shetland and Orkney due to the presumption against further finfish development on the north and east coasts^{3,4}.

Commercial Harvesting of Seaweed in the Wild

- 3.2.8 The Consultation Document seeks views on the potential development of guidance for managing the growth of a sustainable commercial harvesting industry utilising Scotland's natural seaweed stocks, as a means of promoting good practice and mitigating against potential negative impacts from growth in this industry.

3.3 Environmental Considerations in the Seaweed Policy Statement

- 3.3.1 Environmental issues have been a key focus in the development of the SPS and its Consultation Document from the outset, with particular attention paid to investigating the potential positive and negative effects on the marine and coastal environments from the cultivation of seaweed and the commercial harvesting of seaweed in the wild. This SEA has been used to 'front-load' the development of the SPS, thereby ensuring that environmental issues and options have been considered at an early stage and incorporated into the policy.

3.4 Key Facts

- 3.4.1 Key facts about the SPS and its Consultation Document are set out in Table 3.1.

³ Marine Scotland (2013) Planning Scotland's Seas: Scotland's National Marine Plan Consultation Draft [online] Available at: <http://www.scotland.gov.uk/Publications/2013/07/9185> [accessed 20/08/2013]

⁴ Scottish Government (2010) Scottish Planning Policy [online] Available at: <http://www.scotland.gov.uk/Publications/2010/02/03132605/0> [accessed 20/08/2013]

Table 3.1: Key Facts About the Proposed SPS and its Consultation Document

Responsible Authority	Marine Scotland
Title of PPS	Seaweed Policy Statement Consultation Document
Purpose of PPS	<p>Marine Scotland’s Aquaculture Planning Team has prepared a Consultation Document setting out the Scottish Government’s proposed policy for commercial seaweed cultivation as well as proposals for regulation of commercial seaweed harvesting in the wild.</p> <p>The aim of the Consultation Document is to seek views on policies being considered for inclusion in the proposed SPS, and on a range of issues relating to the future growth of the seaweed cultivation and wild harvesting industries in Scotland.</p>
What prompted the PPS	The development of the SPS and its Consultation Document has been prompted by the recognition of growing interest in seaweed cultivation in Scotland, and the potential for future growth of this industry and the existing industry for commercial harvesting of seaweed in the wild.
Subject	Commercial seaweed cultivation and commercial harvesting of seaweed in the wild.
Period covered by PPS	Not defined
Frequency of updates	Not specified
Area covered by PPS	Scottish territorial waters (0-12 nautical miles offshore)
Summary of nature/ content of PPS	<p>The SPS will sit within the existing legislation and policy framework for Scotland’s marine environment, and will complement a range of existing regulations and legislation and PPS developed at the European, UK and Scottish levels.</p> <p>It will set out the Scottish Government’s policy on the suitability of seaweed cultivation in different scenarios whilst providing greater certainty for the industry at an early stage in its development. The SPS will inform potential developers of the Government’s expectations whilst ensuring that activities which may have an environmental impact are understood and mitigated.</p> <p>The SPS will also explore the most suitable regime for licensing seaweed cultivation and indicate the issues considered in determining whether a proposal is acceptable, such as the species to be cultivated, and the scale of development planned.</p> <p>This SEA has been used to front-load the SPS and its Consultation Document to ensure that environmental factors have been integrated into the policy’s development.</p>
Are there any proposed PPS objectives?	Yes (see ‘Purpose of PPS’).

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3.5 Relationship with Other Plans, Programmes or Strategies

- 3.5.1 The Act requires that the Environmental Report include an outline of the relationships between the proposed SPS and other relevant PPS. Figure 3.1 shows the range of policy and legislative drivers at the European, UK and Scottish levels that are of relevance to both the seaweed production sector, and to Scotland’s wider marine environment.
- 3.5.2 At the European level, three European Commission (EC) Regulations (EC834/2007⁵, EC889/2008⁶ and EC710/2009⁷) prescribe goals, principles and rules for organic production in general, and practices for seaweed production. These regulations are set largely around ensuring the adoption of sustainable practices both in production and management of natural harvest areas, maintaining the integrity of the aquatic environment, and ensuring that the end product is suitable for human consumption. The SPS was developed to promote these principles and objectives for seaweed cultivation and harvesting within Scotland.
- 3.5.3 ‘Safeguarding our Seas’⁸ sets out the UK Government’s vision for clean, healthy, safe, productive and biologically diverse oceans and seas. It sets

⁵ EC 834/2007 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF> [accessed 28/06/2013]

⁶ EC 889/2008 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:250:0001:0084:EN:PDF> [accessed 28/06/2013]

⁷ EC 710/2009 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:204:0015:0034:EN:PDF> [accessed 28/06/2013]

⁸ Defra (2003) Safeguarding Our Seas – A strategy for the conservation and sustainable development of our marine environment [online] Available at: <http://archive.defra.gov.uk/environment/marine/legislation/strategy.htm> [accessed 20/09/2012]

out the adoption of an ecosystem-based approach to marine management, and is underpinned by six key principles:

- Sustainable development.
- Integrated management.
- Conservation of biological diversity.
- Robust science.
- The precautionary principle.
- Stakeholder involvement.



3.5.4 The strategy 'Our Seas – a Shared Resource'⁹ takes forward this vision, and sets out the high-level marine objectives for the UK as a whole, while allowing for the distinctive circumstances and responsibilities of each of the devolved administrative areas.

3.5.5 These documents also provide the foundation for the UK Marine Policy Statement (MPS)¹⁰. The MPS, adopted jointly by the UK Administrations, sets the marine policy framework for marine planning and decision-making across the UK. It was developed to contribute to the achievement of sustainable development in the United Kingdom marine area, thereby:

- Promoting sustainable economic development.
- Enabling the move towards a low-carbon economy to mitigate the causes of climate change and ocean acidification whilst adapting to their expected effects.
- Ensuring a sustainable marine environment and promoting healthy, functioning marine ecosystems, whilst protecting marine habitats, species and heritage assets.
- Contributing to the socio-economic benefits of the marine area and the sustainable use of marine resources in addressing local social and economic issues.

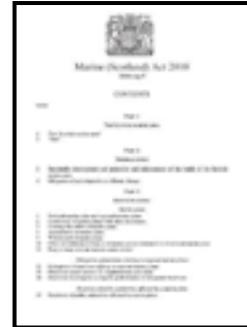


3.5.6 Together, the three documents set the policy context and overarching goals within which the SPS was prepared.

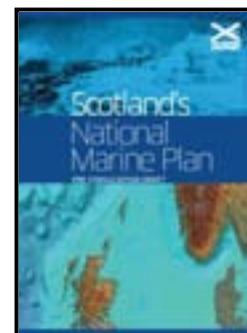
⁹ Defra (2005) Marine Objectives: Our seas – a shared resource [online] Available at: <http://archive.defra.gov.uk/environment/marine/legislation/hlmo-sharedseas.htm> [accessed 28/06/2013]

¹⁰ HM Government (2011) UK Marine Policy Statement, Prepared by HM Government, Northern Ireland Executive, Scottish Government and Welsh Assembly Government [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115242.pdf> [accessed 06/02/2013]

3.5.7 The Marine (Scotland) Act 2010¹¹ created a new legislative and management framework for Scotland's marine environment, to manage demands for the use of the sea. Part 3 of the Act includes a requirement for the preparation and adoption of a NMP. The NMP will set the wider context for marine planning in Scottish territorial and offshore waters. The NMP is in preparation, and a consultation draft NMP¹² was published in June 2013.



3.5.8 Once finalised, the NMP will sit alongside and interact with Scottish Planning Policy in managing the sustainable development of Scotland's marine resources. The future Regional Marine Plans will provide a focused framework to facilitate more local ownership and decision-making about specific issues in a smaller area.



3.5.9 The draft NMP outlines a set of planning policies for the aquaculture sector, including providing support for the development of seaweed production for a variety of products, and noting the potential for synergies with other sectors such as offshore renewables and in IMTA systems. The Consultation Document has been developed in accordance with these objectives.

3.6 Regulation of Seaweed Cultivation and Harvesting of Seaweed in the Wild

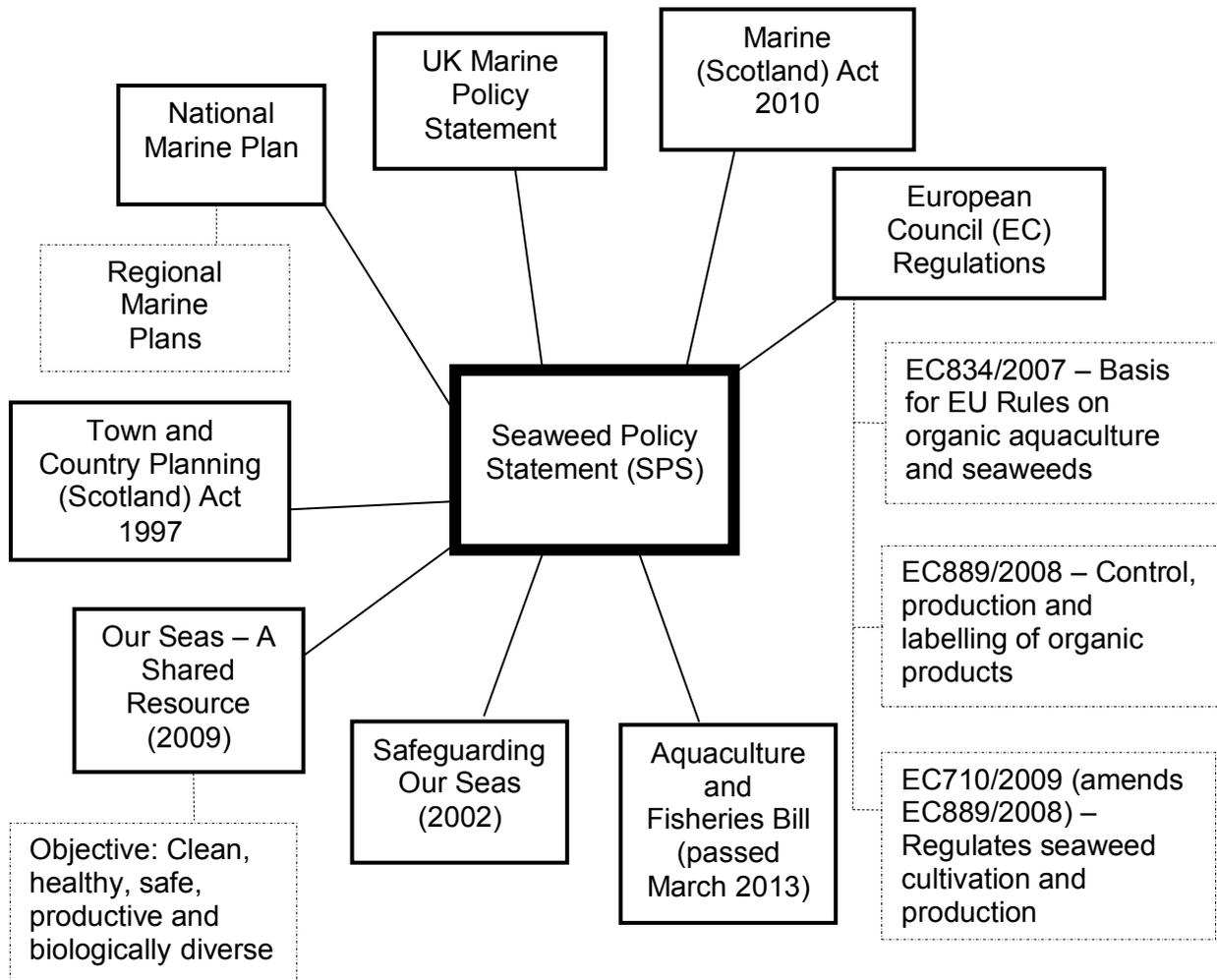
3.6.1 At present, the cultivation of seaweed is only regulated through the marine licensing regime. The Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007 gives planning authorities full planning responsibility for aquaculture developments in marine waters (i.e. 0 – 12 nm). However, the definition of fish farming set out in Section 26(6) of the Town and Country Planning (Scotland) Act 1997 does not include seaweed, referring only to the farming of finfish, shellfish and sea urchins.

3.6.2 Under the Marine (Scotland) Act 2010, the Scottish Government is responsible for the marine licensing of activities carried out in Scottish territorial waters (i.e. 0 – 12 nm offshore). These activities include making deposits in the sea, or on, or under the seabed, and therefore include the installation of equipment in the water to grow seaweed (i.e. rope lines and buoys attached to the seabed).

¹¹ Marine (Scotland) Act 2010 [online] Available at: <http://www.scotland.gov.uk/Topics/marine/seamanagement/marineact> [accessed 28/06/2013]

¹² Marine Scotland (2013) Planning Scotland's Seas: Scotland's National Marine Plan Consultation Draft [online] Available at: <http://www.scotland.gov.uk/Publications/2013/07/9185> [accessed 20/08/2013]

Figure 3.1: Policy Context for the Seaweed Policy Statement



3.6.3 The potential reform of the current regulatory system was discussed in the Aquaculture and Fisheries Bill Consultation Document in 2012, with the intention of ensuring that the regulatory framework for seaweed is proportionate and effective. Two options for reform were discussed:

- The provision for making seaweed cultivation a licensable marine activity under Section 21 of the Marine (Scotland) Act 2010.
- The amendment of the Town and Country Planning (Scotland) Act 1997 to bring seaweed cultivation into the planning system.

3.6.4 The responses from this consultation raised two main points. Firstly, there was strong support from all stakeholder areas for the regulation of seaweed cultivation, and, secondly, stakeholders generally considered that the regulatory framework should be the same for all aquaculture. However, respondents held differing views on the nature of regulation. Some, primarily from the marine fisheries, the voluntary sector and freshwater fisheries sector, supported regulation of seaweed farming by marine licensing.

- 3.6.5 However, the aquaculture industry felt that unless all aquaculture planning consents moved to the marine licensing system, the regulatory system for seaweed should also sit with the Planning Authority under the Town and Country Planning (Scotland) Act 1997. All planning authorities also felt that the regulatory regime should be the same for seaweed, finfish and shellfish farms, and that this should fall to the planning authorities under this Act.
- 3.6.6 The harvesting of wild seaweed in Scottish waters is not currently regulated. However, operations involving the harvesting of seaweed in the wild for commercial or personal use, with some exceptions (i.e. crofters¹³), usually requires the permission of the land owner (i.e. The Crown Estate (TCE) or other landowner). These arrangements can range from verbal agreements to formal contracts and specified periods of 'tenure'¹⁴. SNH were of the view that such wild harvesting should be regulated, because of the potential for ecological effects and the possibility that such harvesting may become large-scale in future.
- 3.6.7 This Consultation Document discusses the current consenting arrangements for the development of sites for seaweed cultivation, and also options for consent licensing in the future. The Document seeks views on which option, or options, are considered by respondents as being the best fit for the regulation of this activity.

3.7 Relationship with Environmental Protection Objectives

- 3.7.1 The development of the Consultation Document has been undertaken in the light of a number of environmental protection objectives set out in a wide range of PPS at the international, EU, UK and Scottish levels. Analysis of the relevant PPS and their context within the proposed SPS is set out in Appendix 1. These environmental protection objectives also form the basis for the SEA methodology (see Section 4).

¹³ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

¹⁴ James, M.A. (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

4 Approach to the SEA

4.1 Purpose of this SEA

4.1.1 The main purpose of this SEA was to inform the development of the SPS through the identification and assessment of the potential environmental effects associated with the future growth of seaweed cultivation operations and harvesting in the wild so that these could be considered, and where appropriate, addressed in the policy statement. One of main roles of the SEA has been to identify whether there are environmental issues that need to be taken into account at the national policy level.

4.1.2 The SEA reflects the broad and high level nature of policies proposed for inclusion in the SPS, whilst documenting the integration of the policy development and SEA processes.

4.2 An Integrated Approach

4.2.1 The SEA was undertaken using a ‘bottom-up’ iterative approach, and the findings of this assessment played a key role in steering and developing the policies in the Consultation Document from an early stage. The SEA process was initially used to engage with the Consultation Authorities at the scoping stage, to identify potential environmental considerations associated with growth of the commercial cultivation and wild harvesting industries and, as a consequence, helped to steer the direction of the SPS development process, and identify options to address potential concerns.

4.2.2 The progression of the assessment continued to aid the development of the SPS, its findings prompting the inclusion of specific policies into the Consultation Document itself, whilst also allowing the consideration and comparison of reasonable alternatives. As such, many of the policies within the Consultation Document address potential effects or concerns raised in the SEA, with several acting to mitigate against potential environmental impacts.

4.3 Assessment of Potential Environmental Effects

4.3.1 At an early stage, the SEA identified potential generic environmental effects associated with undertaking seaweed cultivation and harvesting seaweed in the wild at the local level (i.e. the single operation scale). In this process, existing knowledge of seaweed cultivation, wild harvesting practices and environmental issues was collated and used to assess small-scale cultivation operations in the first instance. It was assumed that small-scale or shellfish-scale seaweed cultivation developments were likely to be similar in design and infrastructure to shellfish farms.

- 4.3.2 The potential effects identified were then ‘scaled-up’ to consider larger-scale operations. Studies and research into larger-scale cultivation were used to consider likely impacts of such operations in isolation, and the potential for cumulative impacts from multiple operations at the local and regional levels. Ultimately, the potential significance of these effects was considered at the national level.
- 4.3.3 This process was started in the scoping phase (see Section 4.5) where it was used to engage with the Consultation Authorities (see section 4.4). The information gathered was used to inform the assessment (see Section 4.6).

4.4 Engagement During the SEA Process

- 4.4.1 In addition to the statutory periods of consultation for the screening and scoping reports, the Consultation Authorities were engaged during the assessment stage to obtain their views on the focus and direction of the proposed SPS, and to assist in the identification of potential environmental impacts for consideration in this SEA.
- 4.4.2 Additional input was also received from SNH in the gathering of baseline information and identifying of potential environmental impacts associated specifically with harvesting of seaweed in the wild. These contributions have been referenced in this report where appropriate.

4.5 Scoping of SEA topics for inclusion in the assessment

- 4.5.1 The Scoping Report for the proposed SPS was prepared in September 2012. It presented an initial overview of the seaweed cultivation and wild harvesting industries in Scotland and at the global scale, and outlined the initial stage of thinking in relation to seaweed policy and the potential for environmental impacts associated with the growth of these industries. The Scoping Report was prepared at an early stage in the SPS development to inform the development of the Consultation Document, and to build on the early engagement of the Consultation Authorities in assisting the identification of potential environmental effects for assessment.
- 4.5.2 The Scoping Report also identified the range of data sources to be used in identifying and analysing the baseline data for this SEA. The environmental topics considered likely to be affected by the development of the SPS and its Consultation Document, and therefore included in this assessment, were agreed with the Consultation Authorities (Table 4.1). Air was the only topic area scoped out of the SEA, as the activities involved in seaweed cultivation give rise to few atmospheric emissions (other than from the boats involved in operations). It was considered unlikely that the adoption of the SPS would result in significant effects on air quality.

Table 4.1: Scoping of Environmental Issues

Environmental Topics	Scoped In
Climatic Factors	✓
Biodiversity, Flora and Fauna	✓
Population and Human Health	✓
Water	✓
Soil, Geology and Coastal Processes	✓
Air	X
Cultural Heritage	✓
Landscape	✓
Material Assets (Shipping and Industry)	✓

4.5.3 Section 5 of this report presents background information on seaweed cultivation and harvesting in the wild, while Section 6 presents the environmental information relevant to the assessment, by environmental topic area. Together, these sections form the environmental baseline of this assessment.

4.6 Assessment Methodology

4.6.1 The environmental assessment has considered the two key sectors of the commercial seaweed industry included in the Consultation Document, each an industry in its own right with its own requirements and environmental issues:

- Commercial-scale seaweed cultivation operations, including cultivation as part of IMTA operations.
- Commercial harvesting of seaweed in the wild.

4.6.2 The SEA investigates the potential environmental effects of the policies contained in the Consultation Document in the context of these two sectors, both positive and negative. It also evaluates the reasonable alternatives to adoption of the proposed SPS and its policies, and identifies appropriate mitigation measures that could be introduced on a strategic scale for each of the topic areas.

4.6.3 The policies contained within the Consultation Document have been assessed against the environmental objectives developed in the scoping stage, and the assessment is presented in this report in a series of mind maps with accompanying narrative. The environmental assessment of these two key areas, consideration of reasonable alternatives and evaluation of the cumulative and synergistic effects, are presented in Sections 7 to 10.

4.7 Consideration of Options

- 4.7.1 A number of broad high-level alternatives in focus for the proposed SPS were discussed at an early stage in its development. Over the course of its development, a number of additional options were also considered for the management and/or mitigation of the potential generic environmental impacts identified in the SEA.
- 4.7.2 The consideration of these options and assessment of reasonable alternatives to the policies in the Consultation Document is outlined in Section 6.11 and assessed in Section 9 of this report.

5 Background to Seaweed

5.1 Introduction

5.1.1 In order to establish the environmental effects of the proposed SPS and the policies contained within the Consultation Document, it was necessary to develop an understanding of the seaweed industry and, through this, establish the features of the environment that are likely to be affected. This section of the report forms the start of the baseline for this SEA, presenting background information on Scotland's seaweed resources, the important role seaweed plays in the marine environment and an introduction to the commercial aspects that will likely fuel industry growth.

5.2 Algae and Seaweed

5.2.1 Algae are plant-like organisms with simple reproductive structures that live in the aquatic environment including the sea, freshwater and even damp conditions on land. They are usually photosynthetic and aquatic-based but, unlike terrestrial plants, do not have true roots, stems, leaves or vascular tissue. Algae can be classified into two distinct types. The first, and smallest, is micro-algae which are unicellular or multi-cellular (less than 0.4 mm in diameter) and typically possess high oil content. The second, called macro-algae, are multicellular with differentiated cell structure and function, with lower oil content than micro-algae and can have high carbohydrate and sugar contents¹⁵.

5.2.2 The term 'seaweed' is the collective name for a number of different groups of macro-algae living on seashores and in shallow marine waters, such as intertidal and subtidal habitats, throughout the world¹⁶. Seaweeds are considered to be near the base of marine food webs, and as such, play an important role in marine ecosystems with many marine animals relying on the food and shelter they provide. Seaweed also forms the basis for a large worldwide industry built upon the harvesting of wild seaweed and, more recently, the cultivation and production of seaweed for a variety of uses.

¹⁵ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

¹⁶ Oceanlink (undated) Seaweeds [online] Available at: <http://oceanlink.info/biodiversity/seaweeds/seaweeds.html> [accessed 18/02/2013]

- 5.2.3 The collective macro-algal group is often classified into three broad groups, based largely on their pigmentation and shared biological characteristics¹⁷. The three broad groups include:
- Brown seaweeds (*Phaeophyceae*) are usually large in size, ranging from giant kelp (often 20m long) to thick and leather-like seaweeds (2-4m long) and much smaller species (30-60cm in length). They include species such as the kelps and wrack.
 - Red seaweeds (*Rhodophyceae*) are usually smaller and generally range from a few centimetres to a metre in length. They also include seaweeds of purple and brown-red pigmentation.
 - Green seaweeds (*Chlorophyceae*) are also small, with a similar size range to the red seaweeds.
- 5.2.4 Different species of seaweed have developed through different evolutionary processes, and as such, the differences between three types involves more than colour¹⁸. It is estimated that there are some 10,000 species of red, brown and green seaweed globally¹⁹, and as such, seaweeds exhibit a wide variety of diverse life forms.
- 5.2.5 All seaweed species are allocated to Ecological Status Groups (ESG) under the Water Framework Directive (WFD), with each classified either ESG1, comprising late successional or perennial species, or ESG2 comprising opportunistic or annual species that are simpler in structure²⁰. The life span of different species of seaweeds varies markedly, ranging from weeks for annual species, to many years for some perennial species²¹ such as *Laminaria hyperborea* (a kelp) which can survive for up to 15 years²².

5.3 Habitat Requirements

- 5.3.1 The major environmental factors affecting seaweeds are light, temperature, salinity, water motion and nutrient availability^{23,24}. The

¹⁷ FAO (2003) FAO Technical Paper 441 – A guide to the seaweed industry [online] Available at: <ftp://ftp.fao.org/docrep/fao/006/y4765e/y4765e00.pdf> [accessed 19/02/2013]

¹⁸ Algaebase (2012) The Seaweed Site: Information on Marine Algae [online] Available at: <http://www.seaweed.ie/algae/seaweeds.php> [accessed 28/06/2013]

¹⁹ NHM (2010) Biodiversity and Conservation [online] Available at: <http://www.nhm.ac.uk/resources-rx/files/biodiversity-and-conservation-06-2010-102939.pdf> [accessed 28/06/2013]

²⁰ SEPA (2003) Type-Specific Reference Conditions For Macroalgae And Angiosperms In Scottish Transitional And Coastal Waters - Final Report 2003, SEPA Project reference 230/4136, Reported by Dr Martin Henderson and Paul Wood.

²¹ Plantlife (2010) The wild and wonderful world of Scotland's seaweeds [online] Available at: www.plantlife.org.uk/uploads/documents/PLINKS%20SeaweedLRes.pdf [accessed 28/06/2013]

²² FAO (2003) FAO Technical Paper 441 – A guide to the seaweed industry [online] Available at: <ftp://ftp.fao.org/docrep/fao/006/y4765e/y4765e00.pdf> [accessed 19/02/2013]

²³ Lobban C.S. and Harrison P.J. (1994) Seaweed Ecology and Physiology, Cambridge University Press, Cambridge UK.

²⁴ Sustainable Energy Ireland (2009) A Review of the Potential of Marine Algae as a Source of Biofuel in Ireland, January 2009 [online] Available at:

presence of seawater (or at least brackish water) and sufficient light to enable photosynthesis are the main common requirements for seaweed species to survive. All types of seaweed use sunlight, carbon dioxide and water to create food, and as such, seaweed grow within the reach of sunlight. Many areas around Scottish and UK coastlines contain the suitable habitats, high natural nutrient levels and current flows considered to be necessary for seaweed growth²⁵.

- 5.3.2 Most seaweeds live attached to hard substrata so that they hold their position in tidal areas²⁶, and hence seaweeds are found in the rocky intertidal areas in most of the world's oceans and, in temperate and polar regions, attached to rock surfaces in shallow subtidal areas²⁷.
- 5.3.3 However, with the wide variety of seaweed species, there is wide variation in the specific requirements and sensitivities of different seaweed species. For example, some species are more suited to warm climates, others require less sunlight to survive than others and can grow in deeper areas, while others, such as maerl²⁸, do not require an attachment and therefore grow unattached on the seabed.

5.4 The Role of Seaweed in Marine and Coastal Environments

Biodiversity and Ecosystem Processes

- 5.4.1 Seaweed plays a number of important roles in marine ecosystems, the most important being its support for marine biodiversity. Scotland's seaweed communities provide a range of different and unique habitats for marine plants and animals. For example, Scotland's kelp forests provide living spaces for a wide range of animals and plants, e.g. small animals such as worms and crustaceans living in gaps in branching holdfasts of the kelp on the seabed, fish seeking shelter from predators in the shade of plants, and other marine plants living amongst the kelp forest^{29,30}. Maerl

http://www.seai.ie/Publications/Renewables_Publications_/Bioenergy/Algaereport.pdf [accessed 19/02/2013]

²⁵ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁶ Algaebase (2012) The Seaweed Site: Information on Marine Algae [online] Available at: <http://www.seaweed.ie/algae/seaweeds.php> [accessed 28/06/2013]

²⁷ Algaebase (2012) The Seaweed Site: Information on Marine Algae [online] Available at: <http://www.seaweed.ie/> [accessed 28/06/2013]

²⁸ SNH (2012) Maerl – a rocky seaweed [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/maerl/> [accessed 28/06/2013]

²⁹ SNH (1999) Kelp Forests [online] Available at: www.snh.org.uk/pdfs/publications/livinglandscapes/kelpforests.pdf [accessed 28/06/2013]

³⁰ SNH (2012) Seaweed Harvesting [online] Available at: <http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/seaweed-harvesting/> [accessed 28/06/2013]

provides similar conditions: the 2010 site condition monitoring survey conducted by SNH found some 236 animal species living in the maerl within the Sound of Arisaig, with a further 185 animal and algal species associated with the surface of the maerl³¹.

- 5.4.2 Seaweed's position at the base of the marine food chain means that many different animals rely on it both as a food source and for the shelter a seaweed community can provide. Marine fauna such as fish, sea urchins and molluscs graze on seaweed, and the presence of these attracts other marine species that use them such as birds and mammals. For example, seabirds are known to use gaps in the seaweed forests to hunt for small fish and crabs.
- 5.4.3 This attraction of marine fauna is in part due to seaweed's role in the production of organic material. Like terrestrial plants, seaweeds grow by fixing carbon dioxide (CO₂) through photosynthesis, and when the seaweed dies, it breaks down and becomes a food source for bacteria and single-celled organisms³². Different types of seaweed capture sediment and nutrients, which can significantly improve surrounding ecosystems and food supplies for these biological communities. In addition, the relatively sheltered environment that seaweed can help to create provides protection for many marine animals from the high physical stresses found on high-energy coasts³³.
- 5.4.4 Seaweed provides important habitats for many fish and crustacean species. As such, disturbance of these communities can also disturb the fauna that use these areas³⁴. Unattached seaweed (cast seaweed or driftweed) washing up in coastal areas and on beaches can play a key role in supporting coastal habitats. As they degrade, these plants provide vital habitats for small creatures, such as crustaceans and insect larvae that hatch amongst the cast seaweed, and provide a vital source of food. These areas often become a valuable food source for other creatures, such as seabirds, that hunt through cast weed for food³⁵.

Water Quality

- 5.4.5 Seaweed's nutrient absorption properties have been widely investigated for commercial industry, but are also very useful in its role in the marine environment. The ability of many seaweeds to bio-accumulate nutrients

³¹ SNH (2010) Condition of Designated Sites [online] Available at: www.snh.gov.uk/docs/B686627.pdf [accessed 28/06/2013]

³² SNH (1999) Kelp Forests [online] Available at: www.snh.org.uk/pdfs/publications/livinglandscapes/kelpforests.pdf [accessed 28/06/2013]

³³ DOENI (2007) Environmentally Sustainable Seaweed Harvesting in Northern Ireland [online] Available at: www.doeni.gov.uk/niea/seaweedharvestingniehspositionstatement.pdf [accessed 28/06/2013]

³⁴ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

³⁵ SNH (1999) Kelp Forests [online] Available at: www.snh.org.uk/pdfs/publications/livinglandscapes/kelpforests.pdf [accessed 28/06/2013]

and pollutants (including heavy metals), contribute to improving water quality, assisting in reducing eutrophication and delivering associated benefits for the marine and coastal communities they inhabit.

Coastal Processes

- 5.4.6 Seaweed can contribute to wave attenuation and to reducing the erosive impact of waves on our coastlines, and has been shown to play an important role in protecting marine and coastal areas, particularly in storm events. For example, the large kelp forests (*Laminaria hyperborea*) west of the Western Isles have been observed to play an important role in reducing wave energy reaching the coast^{36,37}.
- 5.4.7 Driftweed or cast-weed, terms given to seaweed that has been washed ashore by the wind and sea, can also play a role in changing coastal processes by stabilising beach areas and assisting sand dune development, and enabling pioneering salt-tolerant plants to establish along the driftline amongst cast seaweed areas³⁸.

5.5 Scotland's Wild Seaweed Stocks

5.5.1 Hundreds of species of seaweed have been identified in the UK³⁹. Four broad groups of seaweed have been identified by SNH in Scotland's coastal waters⁴⁰, each containing a wide variety of species:

- Kelp: a brown seaweed growing on underwater rocks all around Scotland's coasts. It grows best in areas of strong water movement, requires good levels of sunlight and can grow in depths of 5m in sheltered sea lochs or greater than 30m in the clear waters around St Kilda⁴¹. While five varieties of kelp grow around Scotland (Tangle (*Laminaria digitata*), Cuvie, Dabberlocks (*Alaria esculenta*), Sugar kelp (*Laminaria saccharina*) and Furbellows (*Saccorhiza polyschides*))⁴², in general terms, Scotland's kelp forests mainly comprise cuvie (*Laminaria hyperborea*). These communities are found on suitable rocky areas all around the Scottish coastline, most extensively around

³⁶ SNH (2012) Seaweed Harvesting [online] Available at: <http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/seaweed-harvesting/> [accessed 1/10/2012]

³⁷ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

³⁸ DOENI (2007) Environmentally Sustainable Seaweed Harvesting in Northern Ireland [online] Available at: www.doeni.gov.uk/niea/seaweedharvestingniehspositionstatement.pdf [accessed 4/10/2012]

³⁹ National History Museum (2012) What are Seaweeds [online] Available at: <http://www.nhm.ac.uk/nature-online/british-natural-history/seaweeds-survey/importance-of-seaweeds/index.html> [accessed 2/2/2013]

⁴⁰ SNH (2012) Marine Algae [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/> [accessed 2/2/2013]

⁴¹ SNH (2012) Kelp – cool brown forests [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/kelp/> [accessed 2/2/2013]

⁴² SNH (undated) All About Kelp [online] Available at: www.snh.org.uk/pdfs/education/kelp.pdf [accessed 2/2/2013]

Skye and the nearby mainland, along the west coast of the Outer Hebrides, and around Orkney and Shetland. They are far less common on the east coast, where much of the sea bed is composed of sand⁴³. Certain kelp habitats are Priority Marine Features (PMF)⁴⁴. Several have been listed as Marine Protected Area (MPA) search features, with kelp and seaweed communities on sublittoral habitats included in four possible MPAs⁴⁵.

- Wrack: a brown seaweed which can grow either anchored to rocks between the tides on the seashore (egg wrack), or unattached and flowing with sea loch tides (sea loch egg wrack or wig wrack)⁴⁶. Wig wrack (*Ascophyllum nodosum*) only grows on sheltered, muddy, sandy or gravel shores in Western Scotland and Ireland⁴⁷. The species forms in the special conditions of Scotland's fjordic sealochs, and has been identified as a priority for action under the UK Biodiversity Action Plan (UKBAP)⁴⁸ taken forward as part of the Scottish Biodiversity Strategy. Sea loch egg wrack was also included in the list of MPA search features developed in 2012⁴⁹.
- Maerl: a purple/pink 'coraline' (or coral-like) seaweed that provides shelter for a wide range of marine creatures, that grows unattached on the seabed. Maerl is widespread along the west coast of Scotland, in the Western Isles, Orkney, Shetland and the north coast (e.g. Loch Eriboll), but is absent from the east coast. The occurrence of Maerl beds is typically associated with sounds or estuaries that are exposed to currents but protected from strong waves⁵⁰. Coral maerl (*Lithothamnion coralloides*) and common maerl (*Phymatolithon calcareum*) have been identified within the UKBAP as a priority species, and maerl beds are identified in the UKBAP list of habitats⁵¹. Maerl beds or maerl with coarse shell gravel with burrowing sea cucumbers were included in four possible MPAs.⁵²
- Stoneworts: a green algae with some 33 known species identified in the UK, grows in clear fresh and brackish water in coastal pools, such

⁴³ SNH (undated) Scottish Kelp Plants [online] Available at: <http://www.snh.org.uk/publications/online/livinglandscapes/kelp/whatis.asp> [accessed 20/8/2013]

⁴⁴ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

⁴⁵ SNH, JNCC and Marine Scotland (2012) MPA search feature descriptions catalogue.

⁴⁶ SNH (2012) Wig Wrack – a sea loch specialty [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/wig-wrack/> [accessed 2/2/2013]

⁴⁷ Plantlife (2008) Managing seashores for Sea Loch Egg Wrack [online] Available at: www.plantlife.org.uk/uploads/documents/SeaLochEggWrackFINAL.pdf [access 2/2/2013]

⁴⁸ SNH (2012) Wig Wrack – a sea loch specialty [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/wig-wrack/> [accessed 2/2/2013]

⁴⁹ SNH, JNCC and Marine Scotland (2012) MPA search feature descriptions catalogue.

⁵⁰ UK Marine SACs Project (2001) Synopsis of Maerl distribution in Europe and in the UK [online] Available at: http://www.ukmarinesac.org.uk/communities/maerl/m1_2.htm#a3 [accessed 2/2/2013]

⁵¹ Defra (2007) Report on the Species and Habitats Review: Report by the Biodiversity Reporting and Information Group (ACOPS) to the UK Standing Committee, June 2007 [online] Available at: http://jncc.defra.gov.uk/PDF/UKBAP_Species-HabitatsReview-2007.pdf [accessed 2/2/2013]

⁵² SNH, JNCC and Marine Scotland (2012) MPA search feature descriptions catalogue.

as those found amongst the machair in Scotland's Western Isles. Stoneworts are highly sensitive to pollution and many species are now rare in the UK⁵³. A total of 44 important stonewort areas (ISAs) were identified in 2004 in Scotland, 16 of which were also considered to be of European importance. These areas were mainly found in the Western Isles, Shetland, Orkney, and the western and northern Scottish coasts⁵⁴. While a macro-algal species, stoneworts are not generally considered a seaweed.

- 5.5.2 Research into the commercial availability of wild seaweed stocks has been undertaken in many parts of the world, and Scotland has been the subject of a number of surveys in the past⁵⁵. However, many of these studies were undertaken decades ago, and recent surveys of Scotland's wild seaweed stocks appear to be limited to specific locations, such as the Western Isles.
- 5.5.3 One such study, undertaken in 1994, assessed littoral seaweed resources and management options in the Western Isles, by surveying the distribution and abundance of potentially exploitable seaweeds (i.e. *A. nodosum*, *Porphyra umbilicalis*, *Mastocarpus stellatus*, *Chondrus crispus* and *Palmaria palmata*)⁵⁶. Another study, undertaken for SEPA in 2003, employed a wider geographic scope and used existing and new survey data on the presence and abundance of macrophyte species in 147 coastal sites on the west and east coasts, Outer Hebrides, Shetland and Orkney Isles⁵⁷.
- 5.5.4 The most recent such study, undertaken in the Outer Hebrides in 2010⁵⁸, focused specifically on the extent of the species *A. nodosum* and investigated the viability of sustainable harvesting of the wild stocks of this species. This study, commissioned by Scottish Enterprise (SE) and Highlands and Islands Enterprise (HIE), followed on from previous surveys

⁵³ SNH (2012) Stoneworts – algae of coastal lagoons [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/stone-wort/> [accessed 2/2/2013]

⁵⁴ Plantlife (2004) Important Stonewort Areas: An assessment of the best areas for stoneworts in the United Kingdom (summary) [online] Available at: <http://www.plantlife.org.uk/uploads/documents/Important-Stonewort-Areas-summary.pdf> [accessed 2/2/2013]

⁵⁵ FAO (undated) Seaweed Surveys [online] Available at: <http://www.fao.org/docrep/005/ac860e/AC860E06.htm> [accessed 28/06/2013]

⁵⁶ Environment & Resource Technology Ltd (1994) The Minch Project: Littoral Seaweed resource Management [online] Available at: <http://www.cne-siar.gov.uk/minch/seaweed/seaweed.htm#TopOfPage> [accessed 28/06/2013]

⁵⁷ Wilkinson M. and Wood P. (2003) Type-Specific Reference Conditions For Macroalgae And Angiosperms In Scottish Transitional And Coastal Waters: Final Report – 2003, SEPA Project Reference 230/4136, Produced for SEPA [online] Available at: http://www.sepa.org.uk/science_and_research/publications.aspx [accessed 2/02/2013]

⁵⁸ Burrows M.T, MacLeod M, Orr K (2011) Scottish Association for Marine Science Internal Report No. 269, Mapping the intertidal seaweed resources of then Outer Hebrides, Prepared by SAMS and the Hebridean Seaweed Company, Prepared for Highlands and Islands Enterprise and Scottish Enterprise, 45pp.

undertaken in the mid-20th century, and estimated a biomass of over 170,000 tonnes of wild stocks present within the isles. These resources were found to be predominantly located offshore in Lewis, North and South Uist, and Harris.

- 5.5.5 The PMF identified by Joint Nature Conservation Committee (JNCC) and SNH include a number of habitats (including kelp and seaweed communities of sublittoral sediments, sea loch egg wrack beds, maerl beds and tide-swept algal communities) ⁵⁹.

5.6 Commercial and Industrial Use of Seaweed

Historical Uses

- 5.6.1 Seaweed production and harvesting of wild stocks has a long history, particularly in South-East Asia. Seaweed has been a key food source in some parts of the world for centuries, with many species of red, green and brown seaweeds consumed⁶⁰. Today, harvesting of natural populations of seaweeds is primarily for human consumption in South East Asia, and for hydrocolloid (phycocolloid) production, producing algin, agar and carrageenan⁶¹ and much of the seaweed eaten today is in the form of these products. Today, large quantities of seaweed are cultivated, mostly in China, to meet the demand for seaweed product.
- 5.6.2 In terms of species, red and brown seaweeds are largely used to produce hydrocolloid extracts, non-crystalline substances with very large molecules that dissolve in water to make a viscous solution ⁶². Alginate, agar and carrageenan are water-soluble carbohydrates that are used to thicken aqueous solutions, and are used to form gels, water-soluble films, and in the stabilisation of some products. Green seaweeds are also widely harvested for human consumption.
- 5.6.3 Over the last two centuries, seaweed has also been used in the production of products such as potash, methane, acetone and butanol. Today, seaweed extracts are commonly used in a range of different products, often in niche markets, including animal feed (or seaweed meal),

⁵⁹ SNH (2007) Identification of Priority Marine Features in Scottish territorial waters, Scottish Natural Heritage Commissioned Report No. 388 [online] Available at:

http://www.snh.org.uk/pdfs/publications/commissioned_reports/388.pdf [accessed 28/06/2013]

⁶⁰ FAO (undated) Seaweeds Used as Human food [online] Available at:

<http://www.fao.org/docrep/006/y4765e/y4765e0b.htm> [accessed 2/2/2013]

⁶¹ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

⁶² FAO (undated) Introduction to commercial seaweeds [online] Available at:

<http://www.fao.org/docrep/006/y4765e/y4765e04.htm#TopOfPage> [accessed 2/2/2013]

shampoo, toothpaste, cosmetics, medicines, fertilisers and bathing gels, amongst others^{63,64}.

Research and Development

- 5.6.4 Over the past two decades, the potential use of seaweed products has expanded considerably, with much research and investigation conducted into its potential use and in developing technologies for its efficient cultivation.
- 5.6.5 The nutrient absorption properties of seaweeds, particularly in the accumulation of heavy metals (such as cadmium, copper, nickel, lead and zinc) have been widely investigated. These properties have been investigated and applied in research, particularly in the use of seaweed in waste treatment processes. The successful treatment of sewage and some agricultural wastes, through reducing nitrogen and phosphorus-containing compounds and the removal of toxic metals from industrial wastewater, have been demonstrated in scientific studies⁶⁵.
- 5.6.6 The use of specific native seaweeds for commercial purposes has also been investigated. For example, the commercial-scale extraction of the rich lime resource in maerl has been proposed in the Western Isles in the past, but has not been taken forward⁶⁶. The use of seaweed as part of an integrated aquaculture system (i.e. in IMTA with finfish and/or shellfish aquaculture) has been widely investigated as a method of reducing nutrient wastes and associated impacts on the surrounding marine environment from marine aquaculture⁶⁷. The cultivation of seaweed for IMTA is a key component of the Consultation Document, and as such, is discussed in greater detail in Section 7 of this report.
- 5.6.7 A significant amount of research has been undertaken into the use of seaweed as a source of biofuel. Global interest in the use of algae (both micro and macro-algae) for biofuels, primarily ethanol and biodiesel, is rising⁶⁸. However, both knowledge gaps and questions remain over the

⁶³ FAO (undated) Introduction to commercial seaweeds [online] Available at:

<http://www.fao.org/docrep/006/y4765e/y4765e04.htm#TopOfPage> [accessed 2/2/2013]

⁶⁴ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland, Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

⁶⁵ FAO (2003) FAO Technical Paper 441 – A guide to the seaweed industry [online] Available at: <http://www.fao.org/docrep/006/y4765e/y4765e04.htm#TopOfPage> [accessed 2/2/2013]

⁶⁶ SNH (2012) Maerl – a rocky seaweed [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/maerl/> [accessed 2/2/2013]

⁶⁷ FAO (2003) FAO Technical Paper 441 – A guide to the seaweed industry [online] Available at: <http://www.fao.org/docrep/006/y4765e/y4765e04.htm#TopOfPage> [accessed 2/2/2013]

⁶⁸ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland, Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

economic viability of bioenergy production using algae in the short to medium-term. While the future viability of this industry is presently subject to debate, the potential remains for the proposal of large-scale seaweed cultivation operations in the future, specifically for the production of biofuels.

5.6.8 In terms of cultivation techniques, several strategies for algal culture have been trialled since the 1950s, including land-based tanks, ponds, coastal lagoons and open waters. Although still in their infancy, many advanced propagation techniques are being investigated for application to the cultivation of a wide of variety seaweeds⁶⁹ including research in Scotland⁷⁰.

⁶⁹ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

⁷⁰ Atack T (2012) The Crown Estate Macro-algae Cultivation and Marine Biomass Forum, Seedling Production in Europe – From Laboratory to Industrial Scale, November 1, Edinburgh, The Royal Society of Edinburgh.

6 Environmental Baseline

6.1 Introduction

6.1.1 This section of the report contains detailed background information on Scotland's marine environment by environmental topic area, with a specific focus on aspects of relevance to the potential growth of Scotland's seaweed industries.

6.2 Climatic Factors

6.2.1 Climate change is a major issue in both a national and global context. In the marine context, climate change has been predicted to lead to an increase in water temperatures, rise in sea levels, changes in wave heights and changes to our coastlines. Since 1961, average temperatures in all parts of Scotland have risen for every season⁷¹ and over the last three decades, sea-surface temperatures around the UK coast have also risen by approximately 0.7°C⁷². At the same time, our seas are becoming more acidic, particularly those to the north and west of Scotland, as increasing amounts of atmospheric carbon dioxide are absorbed at the sea surface. This change in acidity is already causing concern for marine ecosystems and many organisms that share it⁷³.

6.2.2 Sea levels around the UK rose by about 1mm/yr in the 20th century (corrected for land movement), although it is estimated that recent increases have been higher than this⁷⁴. Under projections from the UK Climate Impacts Programme 2009 model (UKCIP09), further rises of between 12-76cm are projected by 2095⁷⁵, with lower probability scenarios suggesting this rise could be even greater with the potential for further adverse impacts on coastal areas and transitional waters.

6.2.3 The UK Climate Change Risk Assessment (CCRA)⁷⁶ states that there will be more frequent flooding arising from more frequent and intense rainfall, an increase in drought incidents during drier summers, and increases in the frequency of extreme weather events (i.e. storms and flooding). Associated changes to sea levels, increased wave height and storm

⁷¹ Sniffer (2006) A Handbook of Climate Trends Across Scotland, [online] Available at: http://www.sniffer.org.uk/files/5513/4183/8003/CC03_1_Handbook.pdf [accessed 8/2/2013]

⁷² UKCIP (2011) Recent Climate Trends [online] Available at: <http://www.ukcip.org.uk/essentials/climate-trends/> [accessed 8/2/2013]

⁷³ Scottish Government (2012) Climate Change and Ocean Acidification [online] Available at: <http://www.scotland.gov.uk/Topics/marine/science/atlas/climatechange> [accessed 8/2/2013]

⁷⁴ UKCIP (2011) Recent Climate Trends [online] Available at: <http://www.ukcip.org.uk/essentials/climate-trends/> [accessed 8/2/2013]

⁷⁵ Marine Scotland (2011) Scotland's Marine Atlas: Information for The National Marine Plan, pg 189.

⁷⁶ DEFRA (2012) UK Climate Change Risk Assessment (CCRA) Available at: <http://www.defra.gov.uk/environment/climate/government/risk-assessment/#report> [accessed 8/2/2013]

surges could have serious repercussions for marine and coastal environments, and many industries operating in them.

- 6.2.4 There is clear indication that the effects of climate change already affecting the marine environment⁷⁷ are likely to increase the vulnerability of some habitats and species to added pressure in the future⁷⁸.

Key pressures:

- Milder temperatures may affect the distribution of Scotland's natural seaweeds, increase habitat loss and increase the potential for the colonisation of species from warmer climates in Scottish waters.
- Expected increases in storm surge and larger waves could also significantly impact on seaweed communities susceptible to increased wave action, with the potential loss of coastal habitats through increased erosion.

6.3 Biodiversity, Flora and Fauna

- 6.3.1 With an estimated 18,672 km of coastline, some 53,638 km² of open sea (within the 0-12 nautical mile territorial limit) and a further 34,810 km² of internal waters, over half of Scotland's administrative territory is marine⁷⁹. These coasts and seas are home to a rich and diverse array of marine flora and fauna, with an estimated 6,500 species of animals and plants (excluding microbial flora)⁸⁰ with the primary producer role of seaweed being central to many of Scotland's marine ecosystems.

Scotland's Marine Habitats

- 6.3.2 As shown in Figure 6.1, six broad habitats are found in Scottish waters:

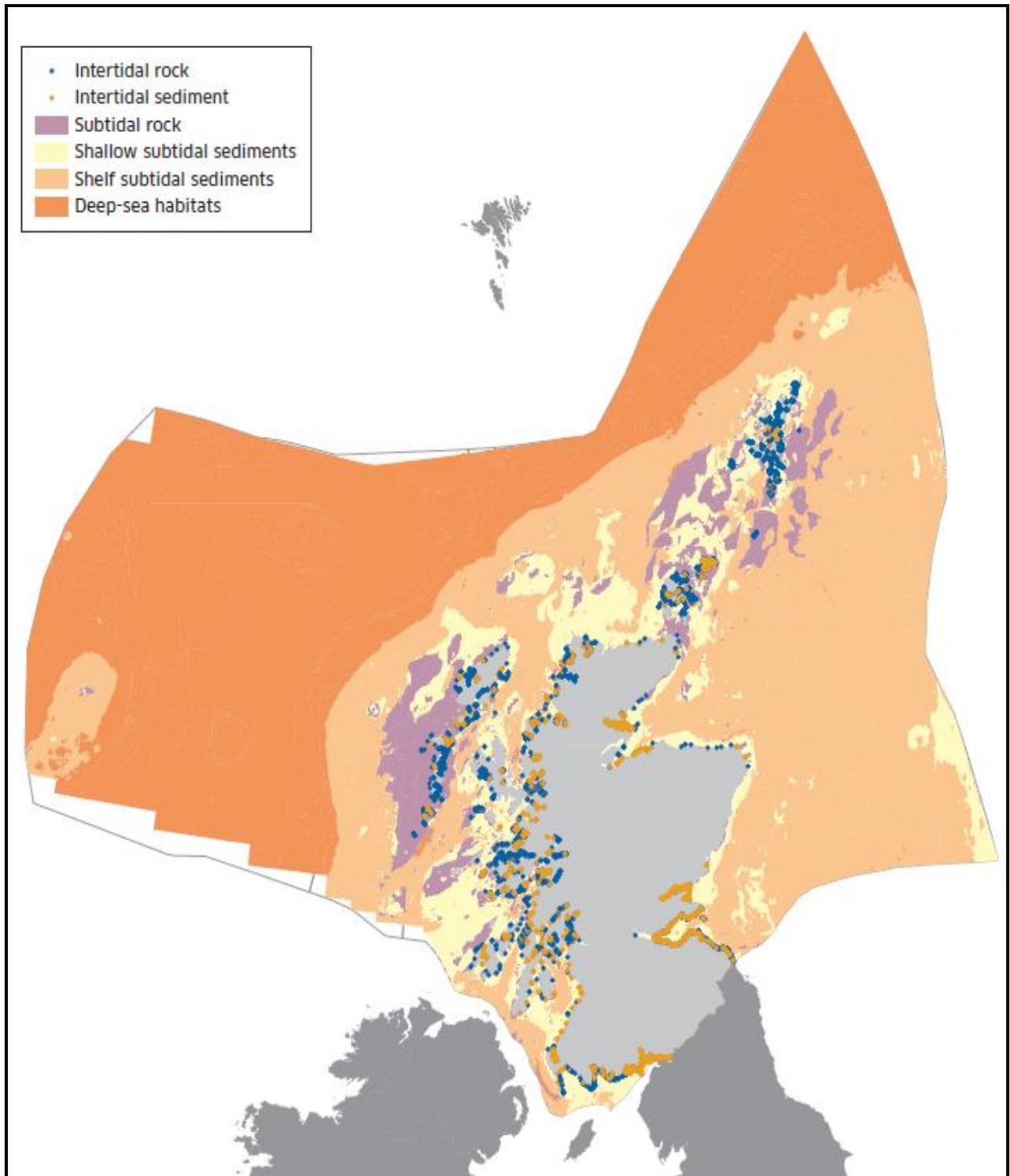
- Intertidal rock.
- Intertidal sediment.
- Subtidal rock.
- Shallow subtidal sediments.
- Shelf subtidal sediments.
- Deep-sea habitats.

⁷⁷ Marine Scotland (2011) Scotland's Marine Atlas: Information for The National Marine Plan, pg 189.
⁷⁸ JNCC (2010) Biodiversity and Climate Change – a Summary of Impacts in the UK [online] Available at: <http://jncc.defra.gov.uk/page-5145> [accessed 14/12/2012]

⁷⁹ Scottish Government (undated) Scotland's environment, estuaries and seas. [online] Available at: http://www.environment.scotland.gov.uk/our_environment/wildlife/estuaries_and_seas.aspx [accessed 21/02/2013]

⁸⁰ Marine Scotland (2011) Scotland's Marine Atlas: Information for The National Marine Plan, pg 71.

Figure 6.1: Modelled distribution of broad habitat types found in Scottish waters⁸¹



⁸¹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 071.

- 6.3.3 Intertidal rock represents around 48% of Scotland's coastline, and is of particular relevance to seaweed. These habitats, located at the shoreline, comprise bedrock, boulders and cobble substrate, and are characterised by wave exposure, salinity and tides. They host many of Scotland's seaweed communities and are popular for the harvesting of edible seaweeds, and as resting and foraging places for many animals (e.g. grey seal, otter and various wading birds)⁸².
- 6.3.4 Scotland's subtidal rock habitats, consisting of bedrock, boulders and cobbles occurring below the water mark, also support a range of seaweed communities. These habitats range in depth and, as such, the make-up of these marine communities is strongly affected by the availability of light. Shallow areas are typically dominated by seaweeds while the communities in deeper areas comprise exclusively marine animals. Extensive areas are located on the west coast, particularly to the west of the Hebrides and around Shetland⁸³.
- 6.3.5 Shallow (or inshore) and shelf subtidal sediment habitats cover an extensive area of the seabed, and comprise shingle, gravel, sand and mud substrates. They extend to depths below the effects of wave patterns (around 50-70m below sea level) with shelf sediments extending to 200m depth, and like deep sea habitats, are generally not supportive of seaweed communities. However, inshore sediment habitats can also include lagoons and maerl beds, supporting diverse marine communities in these areas⁸⁴.
- 6.3.6 Scotland's coastal habitats are subject to a range of physical disturbance pressures including temperature increases, changes in wave regimes, sea-level rise, coastal development and certain human activities (e.g. recreation, anchoring and some fishing activities)⁸⁵. In deeper areas such as shallow and shelf subtidal sediments, pressures can include physical damage from dredging, bottom trawling, fishing, seabed development, anchoring and pollution⁸⁶.

Scotland's Protected Marine Sites

- 6.3.7 The 40 Special Areas of Conservation (SACs) in marine and coastal areas cover seven different habitat types (sandbanks, sea caves, estuaries, mud flats, coastal lagoons, shallow inlets and bays and reefs) and three

⁸² Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 076.

⁸³ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 082.

⁸⁴ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 090.

⁸⁵ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 078 – 080.

⁸⁶ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 090.

species (bottlenose dolphin, grey seal and common seal). Of these, some 97% of protected features on these sites are recorded as being in favourable condition⁸⁷.⁸⁸. Two types of natural features have been designated in SACs, encompassing inter-tidal and sub-tidal hard substrata features (i.e. rocky shores, reefs, tidal rapids, caves). These habitats support an array of marine fauna and flora including kelp (*Laminaria spp*)⁸⁹.

- 6.3.8 Scotland's coastal and marine areas include many that are of international importance for bird species (i.e. seabirds, waders, ducks, geese and swans). In 2013, some 85 Special Protection Areas (SPAs) were identified with marine associations, affording protection to bird species dependent on the marine environment.
- 6.3.9 The 51 Ramsar sites designated as internationally important wetlands in Scotland and covering an area of approximately 313,500 hectares are also designated as SACs or SPAs, with many also named as Sites of Special Scientific Interest (SSSI)⁹⁰.
- 6.3.10 The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 introduced powers to designate nature conservation MPAs in Scottish territorial and offshore waters, to protect marine biodiversity and geodiversity. This will contribute towards achieving Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD) and deliver Scotland's contribution to an ecologically coherent network of MPAs under the OSPAR convention on the protection of the marine environment in the North East Atlantic. The Scottish Government is proposing that 33 MPA proposals now be considered, through public consultation, for designation as possible Marine Protected Areas (pMPAs) to supplement existing protected areas for marine species and habitats, and to create a wider network of MPAs⁹¹. Possible MPAs include a range of features that are important habitats for seaweed, as well as a number of seaweeds (e.g. kelp, maerl).

⁸⁷ Scottish Government (2011) Scotland's National Marine Plan Interim sustainability appraisal report [online] Available at: <http://www.scotland.gov.uk/Publications/2011/03/16135933/0> [accessed 21/2/2013]

⁸⁸ Scotland's Environment (2011) Coastal Waters [online] Available at: http://www.environment.scotland.gov.uk/our_environment/water/coastal_waters.aspx [accessed 28/6/2013]

⁸⁹ SNH (2012) Protected Areas [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/> [accessed 1/10./2012]

⁹⁰ SNH (2012) Ramsar Sites [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/international-designations/ramsar-sites/> [accessed 28/6/2013]

⁹¹ Marine Scotland (2013) Planning Scotland's Seas: 2013 - Possible Nature Conservation Marine Protected Areas Consultation [online] Available at: <http://www.scotland.gov.uk/Publications/2013/07/2072> [accessed 20/8/2013]

Other Designations

- 6.3.11 A SSSI represents areas that are considered to be of national importance for their plants, animals and habitats, rocks and landforms, and/or combinations of these. This designation also underpins European nature conservation designations (i.e. SACs and SPAs), and contributes to the development of Scotland's MPA network. In 2012, there were 1,439 SSSI in Scotland⁹². Of these, 188 have marine associations/components, of which 61 overlap with the intertidal environment⁹³. The remainder have been designated for bird interests associated with the marine environment. An example of the habitats and species protected at the national level (through SSSI designation) is provided in Table 6.1.

Table 6.1: Marine Notified Habitats and Species Features of SSSI

Habitats	Species
Eel grass bed	Brackish water cockle (<i>Cerastoderma lamarki</i>)
Mudflats	Egg wrack (<i>Ascophyllum nodosum</i> ecad <i>mackaii</i>)
Rocky shore	Common seal (<i>Phoca vitulina</i>)
Saline lagoon	Grey seal (<i>Halichoerus grypus</i>)
Sandflats	Stonewort (<i>Lamprothamnium papulosum</i>)
Sea caves	Vascular plant assemblage [covers eel grass communities in some sites]
Tidal rapids	

- 6.3.12 While not a statutory designation, Scotland's 29 Marine Consultation Areas (MCAs) highlight areas of conservation priority in the near-shore marine environment. Initially identified in 1986, Scotland's current MCAs serve an important conservation and management role, although these will be replaced by MPAs once designated. Some areas overlap marine SACs. Located around the coastlines of Scotland's islands, and western and northern mainland, these areas represent high quality and sensitive marine habitats and species.⁹⁴

UK biodiversity action plan (UKBAP) species and habitats.

- 6.3.13 Under the UKBAP, some 1,150 species are identified in the UK as priorities for conservation action⁹⁵. The UKBAP also identifies a range of coastal priority habitats including sand dunes, machair and coastal

⁹² SNH (2012) Where Are SSSIs Found? [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/sssisi/ssi-location/> [accessed 21/2/2013]

⁹³ Scottish Natural Heritage and the Joint Nature Conservation Committee (2012) *Advice to the Scottish Government on the selection of Nature Conservation Marine Protected Areas (MPAs) for the development of the Scottish MPA network*. Scottish Natural Heritage Commissioned Report No. 547. Available at: <http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1959>

⁹⁴ SNH (2011) Marine Consultation Areas [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-consultation-areas/> [accessed 21/2/2013]

⁹⁵ JNCC (undated) UK Biodiversity Action Plan List of Priority Species [online] Available at: <http://jncc.defra.gov.uk/page-5717> [accessed 21/02/2013]

lagoons which either support or are supported by seaweed⁹⁶. Many of these are naturally mobile features which are moved by wave action and storm events, and can also be affected by climate change and sediment supply, which in its turn may be affected by coastal defence structures. There are some 48,000 ha of dune and machair on Scotland's coasts, of which two-thirds is dune. They are particularly extensive in the Western Isles and Inner Hebrides⁹⁷.

Non-native and invasive species.

- 6.3.14 Non-native species become invasive when they become established, proliferating and spreading in ways that damage native biological diversity (i.e. habitat and food web alteration, out-competing native species, hybridisation)⁹⁸. Such species can be introduced via a number of pathways, although shipping and aquaculture are considered the most likely sources of their introduction to Scotland⁹⁹.
- 6.3.15 As of 2010, four algal species were classified as invasive in Scottish waters including one seaweed species known as wire weed (*Sargassum muticum*) which first reached Scotland in 2004 and has subsequently spread up the Scottish west coast. *S. muticum* is known to disperse by natural drift over wide areas, and can spread rapidly once established in a new region¹⁰⁰.

Key pressures:

- Potential displacement of Scottish seaweeds by invasive or introduced non-native species, and the potential for secondary impacts to wider marine biodiversity.
- Pressures of the marine environment from human activities (e.g. damage to seabed integrity, benthic habitats, etc.)
- Pressures on coastal environments, particularly dune and machair areas supporting a number of priority invertebrate and plant species from impacts from erosion, stabilisation and management.

⁹⁶ JNCC (undated) UK Biodiversity Action Plan List of Priority Habitats [online] Available at: <http://jncc.defra.gov.uk/page-5706> [accessed 21/02/2013]

⁹⁷ UK Biodiversity Action Plan Coastal Sand Dunes (undated) [online] Available at: <http://webarchive.nationalarchives.gov.uk/20110303145213/http://ukbap.org.uk/ukplans.aspx?ID=28> [accessed 21/2/2013]

⁹⁸ JNCC (1997) Non-native marine species in British waters: a review and directory [online] Available at: http://jncc.defra.gov.uk/pdf/pub02_nonnativereviewdirectory.pdf [accessed 08/03/2013]

⁹⁹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 139.

¹⁰⁰ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 139.

6.4 Population and Human Health

Potential for Conflicts

6.4.1 Marine recreation forms a valuable and growing industry for Scotland, with activities ranging from walking along coastal beaches to open-water activities¹⁰¹:

- Bathing is undertaken mainly in the south-west, east, north-east and northern parts of the Scottish mainland.
- Sailing in Scotland is concentrated in the Clyde and along the west coast, but is also common along the east coast, Orkney and Shetland (Figure 6.2).
- Surfing and windsurfing are popular in the Western Isles, along the east and north coasts of the Scottish mainland, and in Orkney (Figure 6.3).
- Diving on wrecks or offshore reefs is an important recreational activity in Orkney and along the Berwickshire coast.
- Canoeing and kayaking take place mainly around sea lochs and coastal areas, particularly on the west coast.
- Sea angling is carried out from most regions of the Scottish coastline, with a wide range of species caught depending on the region and the time of year (Figure 6.4).
- Coastal and marine wildlife tourism involving onshore activities such as bird and seal-watching, and offshore activities involving marine wildlife tourism specialist operators who provide access to areas for certain marine species (e.g. cetaceans, dolphins, basking sharks and seals). While carried out in many of Scotland's marine and coastal waters, it is most popular in Orkney, Shetland, the Western Isles and the west coast of the Scottish mainland¹⁰².

6.4.2 The principle of shared use and the need to ensure access to the marine environment for all users is a key concern to ensuring the sustainability of Scotland's marine resources. While some activities in coastal and marine environments can often be undertaken with little impact on other users, the potential for conflicts between activities exists.

Incidents

6.4.3 Scotland's ports play an important role in transporting passengers throughout Scotland, with an estimated 10 million passengers using ferries

¹⁰¹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 152-155.

¹⁰² Scottish Government (2010) The Economic Impact Of Wildlife Tourism In Scotland [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/311951/0098489.pdf> [accessed 08/03/2013]

every year. The busiest route in 2011 was the Clyde and Solway Firth/North Channel, followed by the Minches and Malin Sea routes¹⁰³ (Figure 6.5).

- 6.4.4 Despite Scotland's large marine areas, the high level of use of the marine environment for commercial and recreational purposes has proven to be potentially hazardous. Of the 407 water-related fatalities that occurred in marine and inland waters in the UK in 2011, some 79 incidents occurred in coastal, shore or beach areas, 41 at sea, 30 in lochs, 26 in ports or harbours, and the remainder in inland areas (i.e. rivers, etc.). In breaking these down further, and excluding those in inland waters, some 37 related to sailing or boating, 11 to angling, 36 to swimming, 8 to diving and three to surfing activities¹⁰⁴.
- 6.4.5 Marine Accident Investigation Branch (MAIB) incident report figures indicate that a total of five collisions¹⁰⁵ and 10 groundings¹⁰⁶ have been reported for all vessels in Scottish waters since 2005, largely occurring in the Inner Hebrides, Aberdeen Harbour and the Firth of Clyde. Of these, four collisions and eight groundings involved merchant vessels, one of each involved ferries, and one grounding involving a leisure craft.
- 6.4.6 The high volume of commercial and recreational use of Scotland's marine environment is demonstrated in Figures 6.2 to 6.5.

Key pressures:

- Increased spatial competition for marine resources between commercial and recreational users, and marine ecosystems.

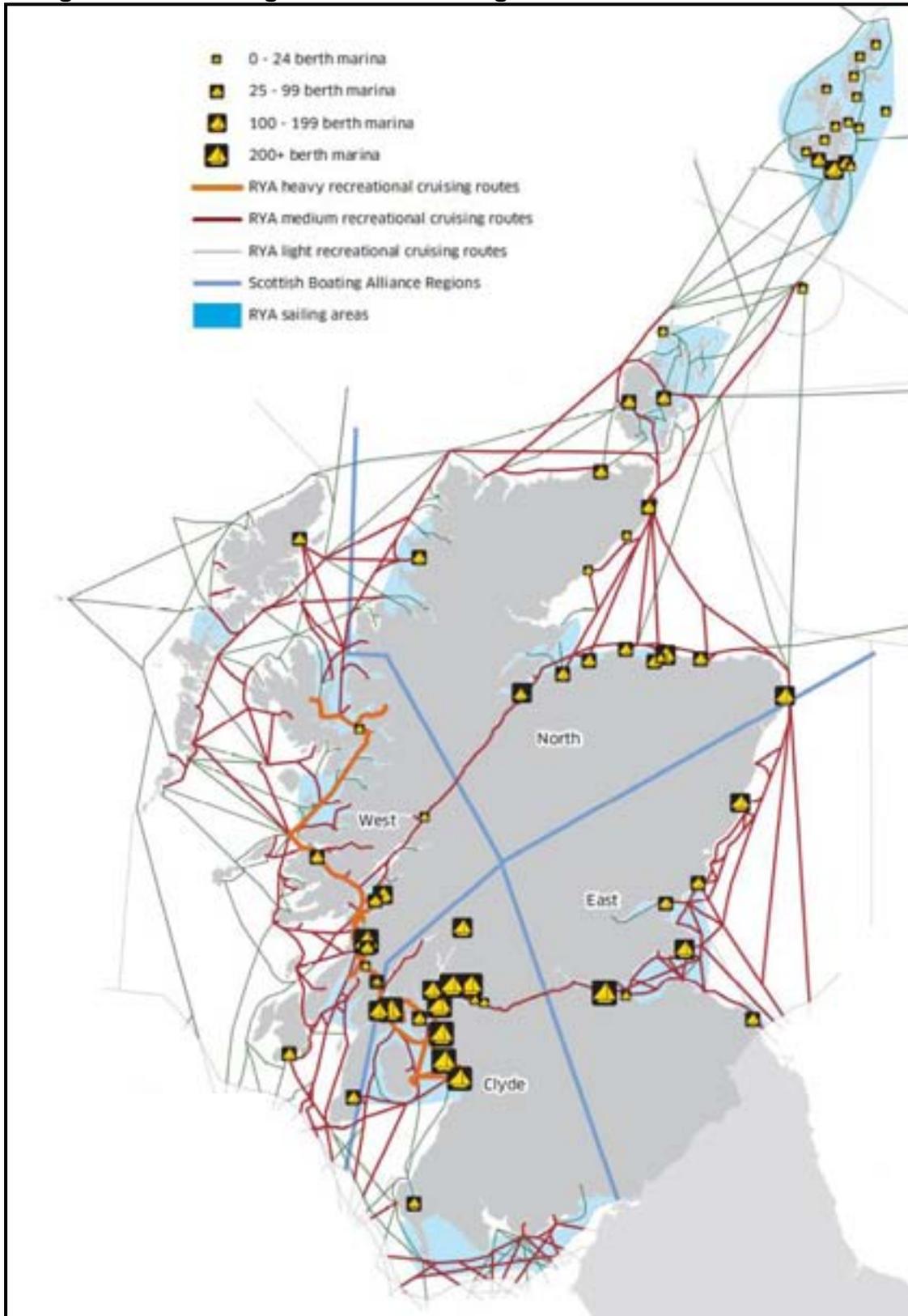
¹⁰³ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 172-175.

¹⁰⁴ National Water Safety Forum (2013) UK Water Related Fatalities 2011 – WAID Database Report [online] Available at: http://www.nationalwatersafety.org.uk/waid/info/waid_fatalincidentreport_2011.pdf (accessed 10/05/2013)

¹⁰⁵ MAIB (2011) Reports by Incident – Collision/Contact, [online] Available at: http://www.maib.gov.uk/publications/investigation_reports/reports_by_incident/collision_contact.cfm [accessed 10/05/2013]

¹⁰⁶ MAIB (2011) Reports by Incident – Grounding, [online] Available at: http://www.maib.gov.uk/publications/investigation_reports/reports_by_incident/grounding.cfm [accessed 10/05/2013]

Figure 6.2: Cruising routes and sailing areas¹⁰⁷

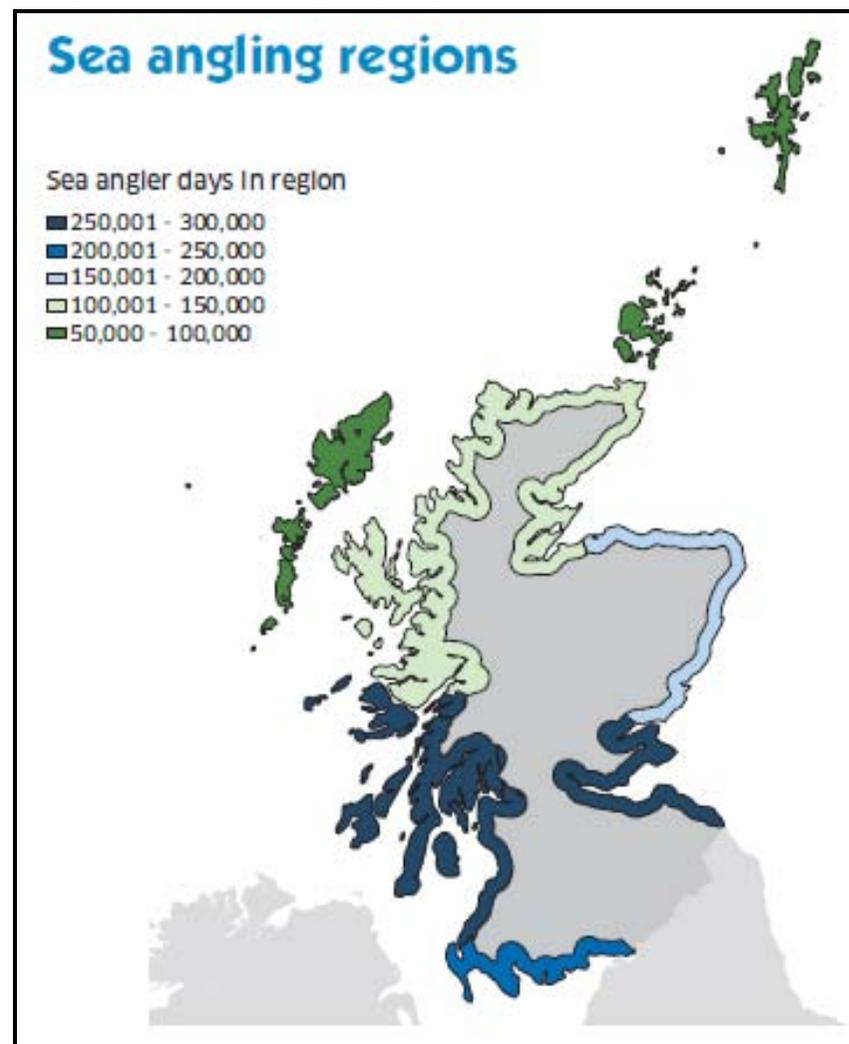


¹⁰⁷ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 153.

Figure 6.3: Surfing Locations¹⁰⁸



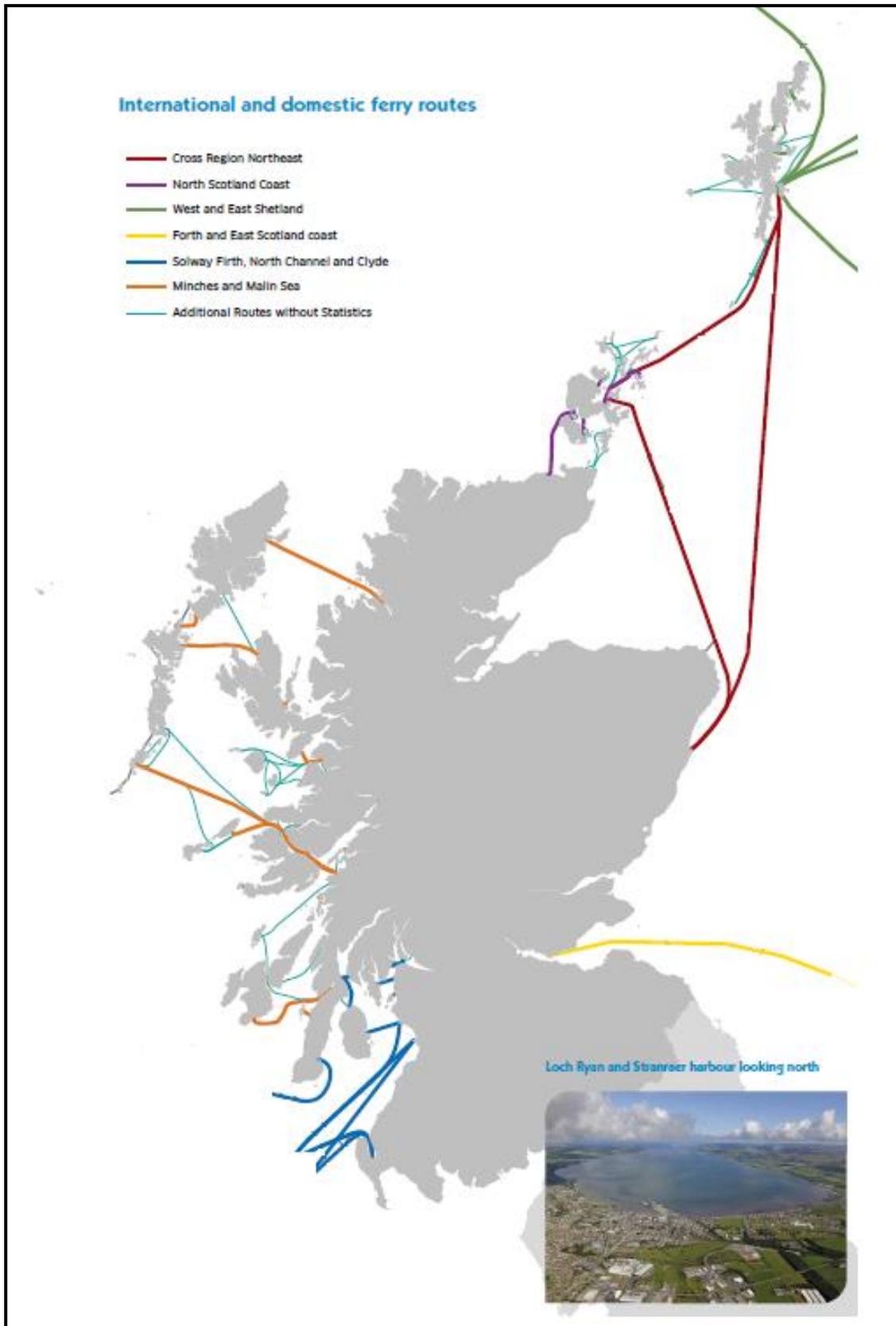
Figure 6.4: Sea angling regions¹⁰⁹



¹⁰⁸ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 155.

¹⁰⁹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 155.

Figure 6.5: International and Domestic Ferry Routes¹¹⁰



¹¹⁰ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 173.

6.5 Water

Water Quality and Ecological/Environmental Status¹¹¹

6.5.1 There are a number of mechanisms in place for monitoring and managing the quality of our waters:

- The WFD establishes a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater, with the aim of ensuring all aquatic ecosystems meet 'good status' by 2015^{112,113}.
- River Basin Management Plans (RBMP) have been prepared for the Scotland and Solway-Tweed River Basin Districts (RBD) to address the requirements of the Directive in relation to the management of Scotland's river systems. Both also provide an overview of the state of the water environment for their districts¹¹⁴.

6.5.2 Scotland's coastal waters are monitored by SEPA to measure performance and compliance with targets for coastal water quality status under the WFD. In all, 63% of Scotland's water bodies were at good or better status in 2010. Of these, some 96% of coastal waters, 86% of estuaries and 54% of sea lochs and freshwater lochs were classed as in 'good' or 'better' condition in 2010¹¹⁵. While 96% of coastal waters in Scotland were classified as excellent or good condition (grade A or B), 95% were reported as having achieved an improvement in condition¹¹⁶ (Figure 6.6).

Bathing Water Quality

6.5.3 Bathing waters are classed as protected areas under Annex IV of the WFD¹¹⁷ due to their sensitivity to pollution or their economic, social and environmental importance. The EC Bathing Water Directive (2006/7/EC), translated into Scottish law by the Bathing Waters (Scotland) Regulations

¹¹¹ Ecological status for 0 – 3 nm under the WFD; environmental status for 3 – 12 nm under the MSFD

¹¹² JNCC (2011) Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive), [online] Available at: <http://jncc.defra.gov.uk/page-1375> [accessed 21/02/2013]

¹¹³ European Commission (2012) The EU Water Framework Directive – integrated river basin management for Europe, [online] Available at: http://ec.europa.eu/environment/water/water-framework/index_en.html [accessed 21/02/2013]

¹¹⁴ SEPA (undated) River Basin Planning [online] Available at : http://www.sepa.org.uk/water/river_basin_planning.aspx [accessed 28/6/2013]

¹¹⁵ Scottish Government (2010) Implementation of the Water Environment and Water Services (Scotland) Act 2003 and the Flood Risk Management (Scotland) Act 2009: Annual Report to the Scottish Parliament – 2010, [online] Available at: <http://www.scotland.gov.uk/Publications/2011/03/21113203/6> [accessed 28/6/2013]

¹¹⁶ SEPA (2011) Water Classification Report 2007 - 2011. [online] Available at: http://www.sepa.org.uk/water/monitoring_and_classification/classification.aspx [accessed 22/02/2013]

¹¹⁷ EC (2012) Introduction to the EU Water Framework Directive 2000 [online] Available at: http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm [access 21/02/2013]

2008, aims to preserve, protect and improve the quality of the environment and to protect human health. It sets out two quality standards, the 'mandatory' and the stricter 'guideline' standard, stating that Member States should comply with the mandatory standard and aim to comply with the guideline standard¹¹⁸. The majority of monitored and sampled sites are located on the east, north-east and south-west coasts, with isolated sites on the north and west coasts, and no sampling sites located in Orkney, Shetland or the Western Isles.

- 6.5.4 The quality of Scotland's bathing waters, comprising 80 coastal and 3 inland waters, has steadily improved over recent years. In 2011, 95% of Scotland's bathing waters achieved the mandatory standard for bathing water quality, and of these, nearly half also met the more stringent guideline standard. Just four waters (Sandyhills, Irvine, Lossiemouth East and Eyemouth) failed to achieve mandatory quality compliance. The 2011 monitoring report indicates that pollutants (i.e. bacteria and diffuse pollutants) from agricultural or urban runoff mobilised from heavy rainfall are the most likely causes of these exceedances¹¹⁹.

Shellfish Waters

- 6.5.5 Aquaculture is a growing industry on the national and global scale, providing around 46% of total food fish supply in 2010¹²⁰. The Scottish aquaculture industry has increased by a third since 2000, and currently consists of both finfish and shellfish farming, with production sites for both located predominantly on the west coast of the Scottish mainland, Orkney, Shetland and the Western Isles^{121,122}.

¹¹⁸ SEPA (2012) Bathing Water Reports [online] Available at: http://www.sepa.org.uk/water/bathing_waters/bathing_water_reports.aspx [accessed 21/02/2013]

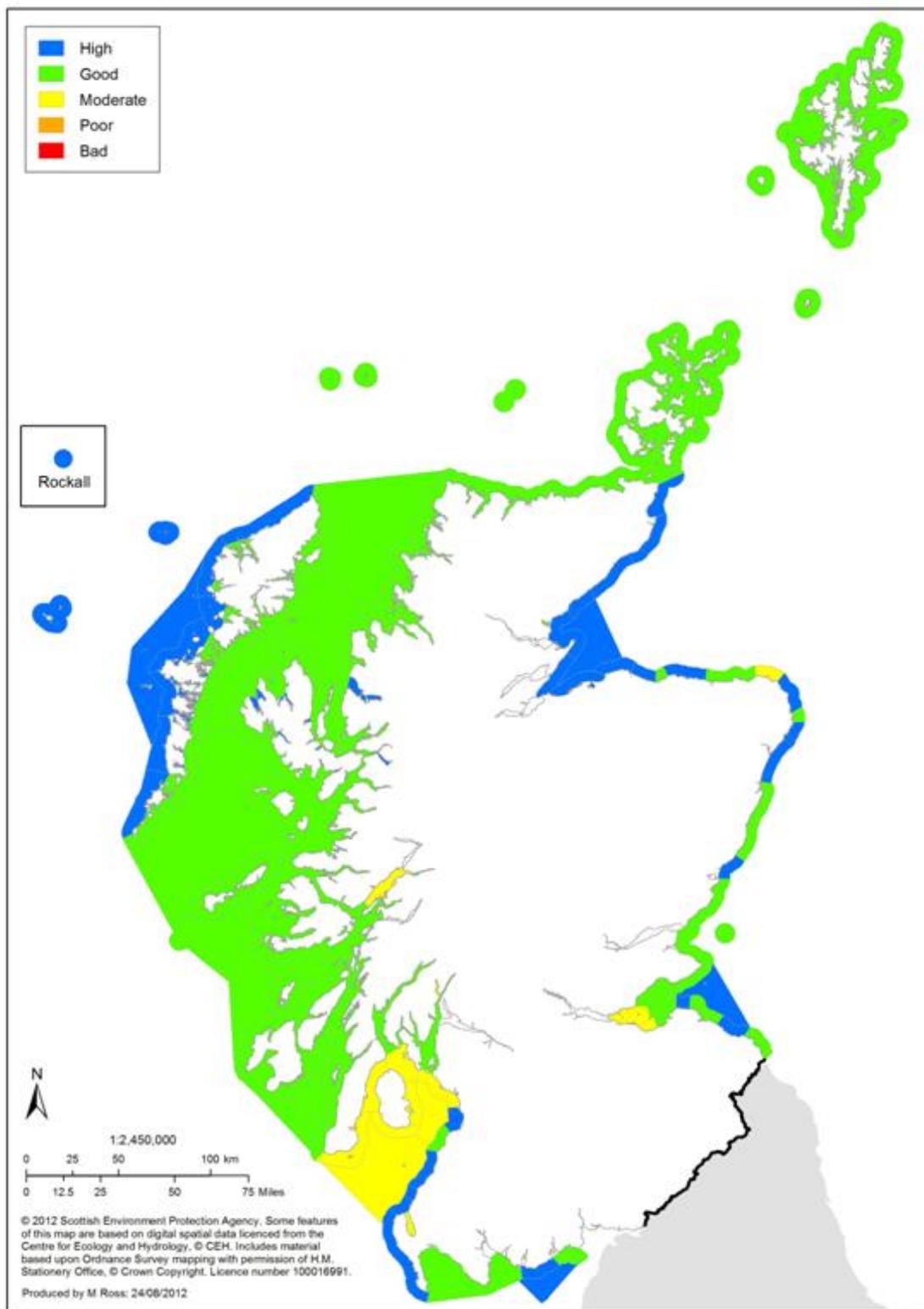
¹¹⁹ SEPA (2012) Bathing Water Reports [online] Available at: http://www.sepa.org.uk/water/bathing_waters/bathing_water_reports.aspx [accessed 21/02/2013]

¹²⁰ FAO (2010) The State of World Fisheries and Aquaculture 2010 [online] Available at: <http://www.fao.org/docrep/013/i1820e/i1820e00.htm> [accessed 22/01/2013]

¹²¹ Marine Scotland Science (2012) Scottish Shellfish Farm Production Survey 2011 [online] Available at: <http://www.scotland.gov.uk/Resource/0039/00392226.pdf> [accessed 21/02/2013]

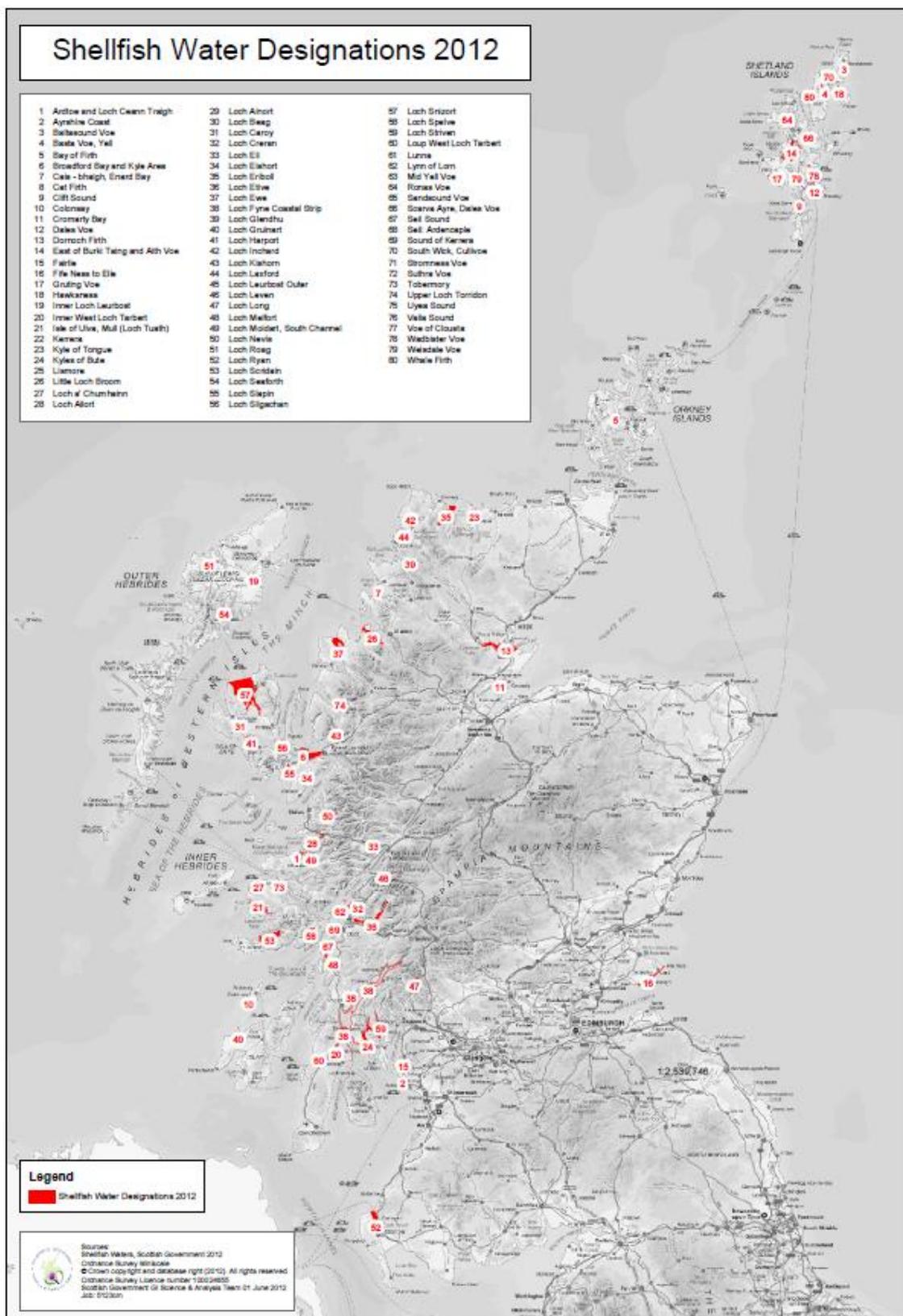
¹²² Marine Scotland Science (2012) Scottish Fish Farms Annual Production Survey 2010 [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/362930/0122953.pdf> [accessed 21/02/2013]

Figure 6.6: Coastal and Transitional Waters Classification¹²³



¹²³ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government.

Figure 6.7: Location of Shellfish Waters within Scotland¹²⁴



¹²⁴ Scottish Government (2012) Shellfish Waters – Overview Map [online] Available at: <http://www.scotland.gov.uk/Resource/0039/00394923.pdf> [accessed 08/05/2013]

- 6.5.6 The shellfish aquaculture industry in Scotland is based around the commercial culturing of (predominantly) mussels, oysters and scallops. Aquaculture is reliant on water conditions such as local water flow rate and wave exposure, and can be adversely affected by contamination. Shellfish are particularly sensitive, and can accumulate bacteria from the surrounding waters as they filter the water to feed, resulting in high bacterial levels in shellfish flesh farmed in areas with high concentrations of bacteria in surrounding waters.
- 6.5.7 One specific role of the WFD will be to achieve the level of protection afforded by the EU Shellfish Waters Directive (2006/113/EEC) scheduled to be repealed in December 2013¹²⁵. This was developed to ‘protect or improve shellfish waters’ and sets physical, chemical and microbiological water quality standards. It thus protects the aquatic habitat of bivalve and gastropod molluscs (i.e. oysters, mussels, cockles, scallops and clams)¹²⁶. Some 80 coastal waters in Scotland have been designated ‘shellfish growing waters’ (Figure 6.7); these areas are predominantly located on the west coast of the Scottish mainland and the islands¹²⁷.
- 6.5.8 In 2011, water quality monitoring undertaken by SEPA indicated that all designated sites (i.e. all 80 sites that were designated) met the minimum environmental quality standards (the ‘mandatory’ standard) set by the EC Shellfish Waters Directive. However, just 55% of shellfish waters were found to have achieved the more stringent guideline quality standard (the ‘guideline’ standard)¹²⁸. While most designated sites (71) met the stricter guideline values for physical and chemical parameters, exceedances of the stricter bacteriological guideline value were recorded at 29 of these sites.¹²⁹
- 6.5.9 The classification of shellfish harvesting areas is a separate process undertaken in the UK by the Food Standards Agency (FSA) and is based on the terms of the Shellfish Hygiene Directive (91/492/EEC)¹³⁰. The classification system is focused on the quality of the end product rather

¹²⁵ SEPA (2010) Regulation of Designated Shellfish Waters [online] Available at: http://www.sepa.org.uk/water/protected_areas/shellfish_waters/regulation.aspx [accessed 28/06/2013]

¹²⁶ Defra (2011) Shellfish Waters Directive [online] Available at: <http://www.defra.gov.uk/environment/quality/water/water-quality/shellfish-directive/> [accessed 28/06/2013]

¹²⁷ Scottish Government (2012) Shellfish Waters – Overview Map [online] Available at: <http://www.scotland.gov.uk/Resource/0039/00394923.pdf> [accessed 28/06/2013]

¹²⁸ SEPA (2013) Designated Shellfish Waters in Scotland [online] Available at: http://www.sepa.org.uk/water/protected_areas/shellfish_waters.aspx [accessed 28/06/2013]

¹²⁹ SEPA (2013) Regulation of Designated Shellfish Waters [online] Available at: http://www.sepa.org.uk/water/protected_areas/shellfish_waters/regulation.aspx [accessed 28/06/2013]

¹³⁰ FSA (2012) Shellfish Harvesting Classifications Scotland [online] Available at: <http://www.food.gov.uk/scotland/safetyhygienescot/shellmonitorscot/shellclassesscot/> [accessed 28/06/2013]

than environmental factors, and involves a tiered system based on the presence of faecal indicator organisms¹³¹.

- 6.5.10 In 2011/2012, around 49% of identified shellfish harvesting waters achieved the highest standard providing Class A products all year round, allowing for direct marketing after harvesting. A further 42% of harvesting waters provided Class A products for part of the year, and Class B products for the remainder of the year requiring additional cleaning before they were allowed to be marketed.

Potential Contamination Sources

- 6.5.11 While most sources are likely to be localised and site-specific, the sources of pollutants entering the water environment vary greatly. These can include shipping and boating (i.e. the use of anti-fouling tributyltin and copper paints¹³², and other synthetic substances¹³³); oil discharges from incidents, collisions or the release of oil in ballast water¹³⁴; the introduction of non-native species from ballast or attached to vessel hulls¹³⁵; discrete and diffuse terrestrial sources (i.e. natural weathering, industrial discharges and agriculture¹³⁶), atmospheric sources (i.e. chemical contaminants and dust¹³⁷); radioactive contamination (i.e. naturally occurring radioactive material (NORM), wastes¹³⁸ and accidental releases); and munitions contamination and military waste (i.e. up to ten known disposal sites have been identified in Scottish waters¹³⁹).

¹³¹ SEPA (2010) Regulation of Designated Shellfish Waters [online] Available at: http://www.sepa.org.uk/water/protected_areas/shellfish_waters/regulation.aspx [accessed 28/06/2013]

¹³² OSPAR Commission (2010) Quality Status Report 2010 – Assessment of the Impact of Shipping on the Marine Environment [online] Available at: http://qsr2010.ospar.org/media/assessments/p00440_supplements/p00440_suppl_5_release_of_anti-fouling_chemicals.pdf. [accessed 14/12/2012]

¹³³ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 182.

¹³⁴ Advisory Committee on Protection of the Sea (ACOPS) (2010) Annual survey of Reported Discharges attributed to vessels and offshore oil and gas installations operation in the United Kingdom Pollution Control Zone 2010 [online] Available at: <http://www.acops.org.uk/documents/annual-marine-pollution-survey-2010.pdf> [accessed 21/2/2013]

¹³⁵ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 138.

¹³⁶ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 039.

¹³⁷ Marine Scotland (2012) Clean Seas [online] Available at: <http://www.scotland.gov.uk/Topics/marine/marine-environment/cleanseas> [accessed 14/12/2012]

¹³⁸ Defra (2010) Charting Progress 2 [online] Available at: http://chartingprogress.defra.gov.uk/feeder/Section_3.16_Waste_Disposal.pdf [accessed 14/12/2012]

¹³⁹ OSPAR (2010) Quality Status Report 2010: Assessment of the impact of dumped conventional and chemical munitions [online] Available at: http://qsr2010.ospar.org/media/assessments/p00365_supplements/p00365_suppl_1_concerns.pdf. [accessed 9/7/12]

Climate Change

- 6.5.12 The effects of climate change may exacerbate impacts from other sources, by reducing the ability of the water environment to safely absorb and break down pollutant inputs. The likelihood of reduced summer rainfall¹⁴⁰ may mean less water is available in rivers and inland waters for diluting pollutants. Conversely, expected higher annual river flows, particularly during winter months, may help dilute pollutant discharges to rivers while increasing the quantity of pollutants reaching coastal and marine waters.

Key pressures:

- Pressures on marine, transitional and sea loch environments include eutrophication, point-source and diffuse pollution, acidification and alteration of flows and water levels, with the potential for associated adverse impacts on wild seaweed communities.

6.6 Soil, Geology and Coastal Processes

Our soils and sediments

- 6.6.1 Much of the Scottish landscape and coastline was formed initially through the processes of glacial erosion and deposition¹⁴¹, and the land continues to change through coastal processes such as wave action, sediment movement, erosion and accretion¹⁴². Scotland's coast comprises hard coasts composed of rocks and cliffs (70%); soft coasts considered potentially susceptible to erosion impacts, composed of unconsolidated gravels, sand and silts (29%); and artificial i.e. harbours and sea walls (less than 1%)¹⁴³.
- 6.6.2 The offshore environment in Scottish waters ranges from shelf sea areas to deep ocean regions with depths greater than 2,000 m. The continental shelf includes the Malin and Hebrides Shelf Seas, Orkney and Shetland Shelf Seas, and the North Sea. The shelf seas are marked by notable features such as banks (e.g. Stanton Banks, Viking Bank) and deep channels.

¹⁴⁰ DEFRA (2012) UK Climate Change Risk Assessment (CCRA) Available at: <http://www.defra.gov.uk/environment/climate/government/risk-assessment/#report> [accessed 9/7/12]

¹⁴¹ Gordon JE, Lees G, Leys KF, MacFayden CCJ, Puri G, Threadgould R and Kirkbride V (2002) Natural Heritage Zones: Earth Sciences, [online] Available at: <http://www.snh.gov.uk/docs/A337648.pdf> [accessed 28/06/2013]

¹⁴² SNH (2001) Natural Heritage Futures – Coasts and Seas, [online] Available at: www.snh.gov.uk/docs/A306281.pdf [accessed 28/06/2013]

¹⁴³ SNH (undated) information on coastal erosion [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/coasts/erosion/> [accessed 28/06/2013]

6.6.3 In general, the marine sediments around Scotland are sandy or gravelly and originate from deposits during the Quaternary glaciation. Strong currents and wave action may also have prevented deposition of recent muddy sediment or have winnowed it to leave a coarse-grained lag deposit. Muddy sediments occur principally near shore or, further offshore, in depressions on the sea floor, where currents may be relatively weak. They also occur beyond the shelf break (200 m water depth) to the west of Scotland. The concentration of calcareous material varies greatly in seabed sediments, reflecting the amount of shell material in different areas; locally, this can be very high.¹⁴⁴

Designations

6.6.4 Protection of Scotland's geodiversity interests, in the main, is currently focused on terrestrial geodiversity. Current protection comprises¹⁴⁵:

- Geoparks: There are currently two UNESCO Geoparks in Scotland: North West Highlands Geopark, and Shetland Geopark.
- National Parks: Geodiversity is one of the special qualities of Scotland's National Parks, and both National Parks contain internationally important geodiversity.
- National Nature Reserves: Many contain significant geological and geomorphological interest.
- SSSI: These are the primary statutory mechanism for geodiversity protection in Scotland. Many of these sites, also designated as SPAs or SACs, are underpinned by the Geological Conservation Review (GCR) undertaken by the JNCC. As such, the majority of the GCR sites are now designated as geological features in SSSI¹⁴⁶.
- Local Nature Conservation Sites: These include Local Geodiversity Sites, sometimes also called Regionally Important Geological and Geomorphological Sites.

Coastal change

6.6.5 SNH participated in a Europe-wide assessment of coastal change in 2004. The EuroSION project categorised Scotland's coast, and summarised the nature of the coastline and its stability and behaviour. Based on the findings of this assessment, three-quarters of the coast is broadly stable and of the remaining quarter, 8% is accretional and 12% is erosional

¹⁴⁴ Marine Scotland (2008) Scotland's Seas: Towards Understanding their State, Chapter 2 [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/218570/0058690.pdf> [accessed 28/06/2013]

¹⁴⁵ SNH (2013) Protecting our geodiversity [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/safeguarding-geodiversity/protecting/> [accessed 20/8/2013]

¹⁴⁶ SNH (undated) Geological Conservation Review (GCR) Sites [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/safeguarding-geodiversity/protecting/geological-conservation/> [accessed 28/06/2013]

(data was lacking for the remaining 5%)¹⁴⁷ (Figure 6.9). The erosional portion of coastlines largely consists of beaches, sand dunes, conglomerates/soft-rock cliffs, machair and marshes with muddy sediments¹⁴⁸.

- 6.6.6 Coastal erosion and accretion are significant problems affecting many coastal communities around the world. Both are natural processes; however, they can be exacerbated by human activities (e.g. land reclamation, coastal development, dredging, etc.) or natural disasters¹⁴⁹. There is a strong interaction between the energies within coastal seas in the form of waves, tides and currents, and the processes of erosion and sedimentation. Sections of Scotland's coastline are already subject to erosion or accretion, particularly the east coast from Montrose to Dunbar, the Firth of Clyde, the inner Moray Firth, Orkney, Shetland and the Western Isles, with coastal protection plans introduced in these areas¹⁵⁰ (Figure 6.10). The presence of living seaweed and castweed can play an important role in coastal processes and assist in stabilising coastlines (see Section 5.4)¹⁵¹.
- 6.6.7 Sediment supplies along soft shorelines controls their stability, where surplus sediment can promote accretion and the removal of sediment can cause erosion. Coastal sediment supply is generally thought to be at an all-time low, in part due to river bank and coastal defences. Hard defences can transfer erosion along the coast¹⁵².
- 6.6.8 While natural wave action, tidal currents and drainage have typically been the main drivers of coastal erosion, in more recent times, human activities have played a significant role in coastal erosion. Practices such as land reclamation and the construction of infrastructure such as harbours, jetties and marinas, can affect coastal processes by restricting the movement of coastal sediments¹⁵³ and increase the vulnerability of an area to erosion. While impacts are likely to be site-specific, erosion processes are likely to

¹⁴⁷ SNH (2012) Coastal Erosion [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/coasts/erosion/> [accessed 28/06/2013]

¹⁴⁸ European Commission (2004) EuroSION: Living with Coastal Erosion in Europe – Sediment and Space for Sustainability – Results for the EuroSION Study, [online] Available at: <http://www.euroSION.org/reports-online/reports.html> [accessed 28/06/2013]

¹⁴⁹ Prasetya G (unknown) Chapter 4: Protection From Coastal Erosion, Thematic paper: The role of coastal forests and trees in protecting against coastal erosion [online] Available at: <ftp://ftp.fao.org/docrep/fao/010/ag127e/ag127e07.pdf> [accessed 28/06/2013]

¹⁵⁰ SNH (2001) Natural Heritage Futures – Coasts and Seas, [online] Available at: www.snh.gov.uk/docs/A306281.pdf [accessed 28/06/2013]

¹⁵¹ Northern Ireland Environment and Heritage Service (2007) Environmentally Sustainable Seaweed Harvesting in Northern Ireland [online] Available at: www.doeni.gov.uk/niea/seaweedharvestingniehspositionstatement.pdf [accessed 28/06/2013]

¹⁵² SNH (undated) information on climate change at the coast [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/coasts/climate-change/> [accessed 28/06/2013]

¹⁵³ Marine Climate Change Impacts Partnership (2010) Coastal erosion and Coastal Geomorphology, [online] Available at: <http://www.mccip.org.uk/annual-report-card/2007-2008/marine-environment/coastal-erosion.aspx> [accessed 28/06/2013]

increase in the future, with additional pressures from rising sea levels and erosion/deposition associated with climate change¹⁵⁴.

Key pressures:

- Pressures on sensitive and soft shorelines, and their associated habitats, from coastal erosion.
- Potential impacts on inshore and near-shore environments from land reclamation, and coastal and marine development.

¹⁵⁴ SNH (2010) Climate Change at the Coast, [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/coasts/climate-change/> [accessed 28/06/2013]

Figure 6.8: Coastal Survey and Erosion Potential (Source: GIS from SNH)

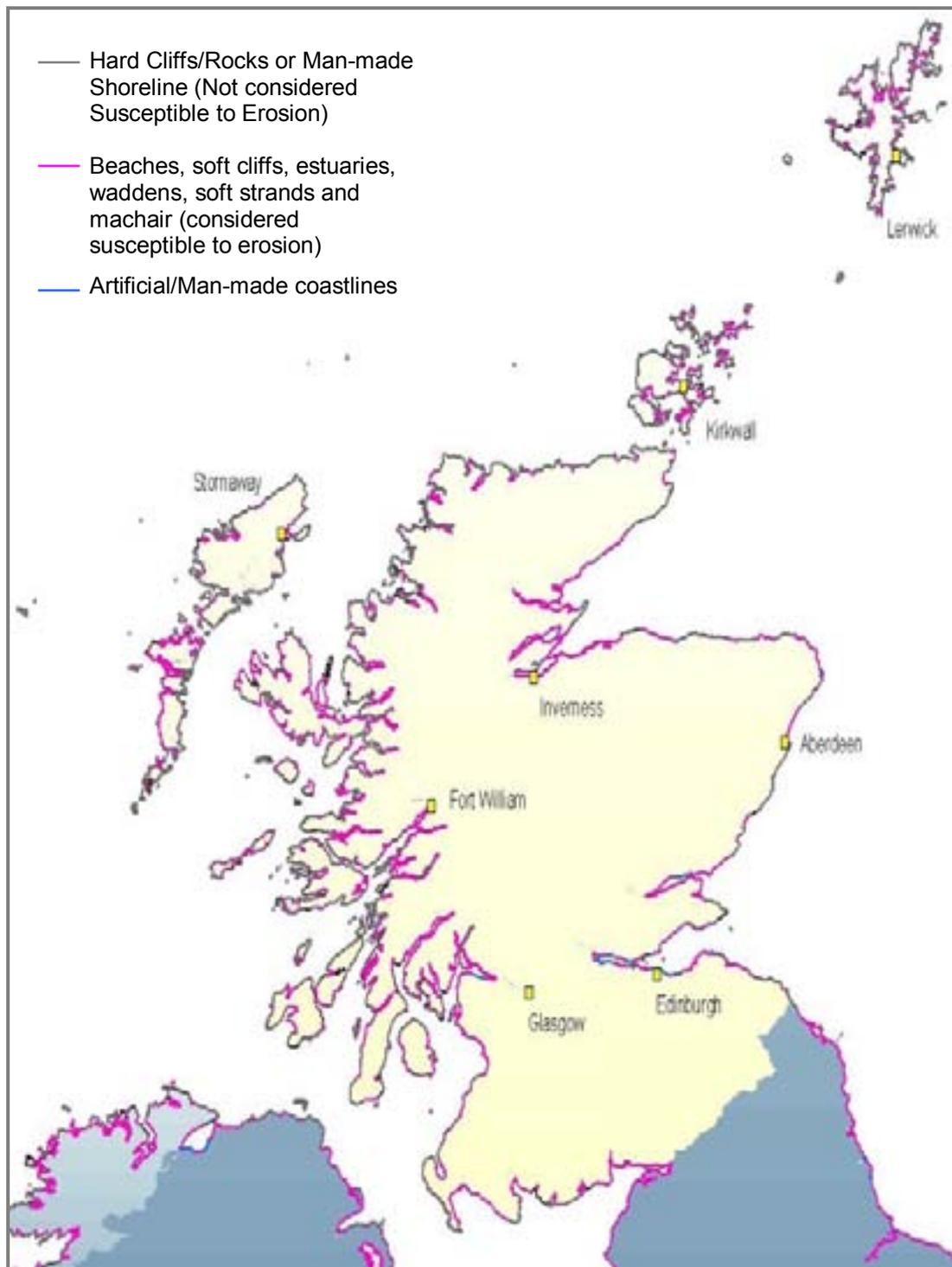
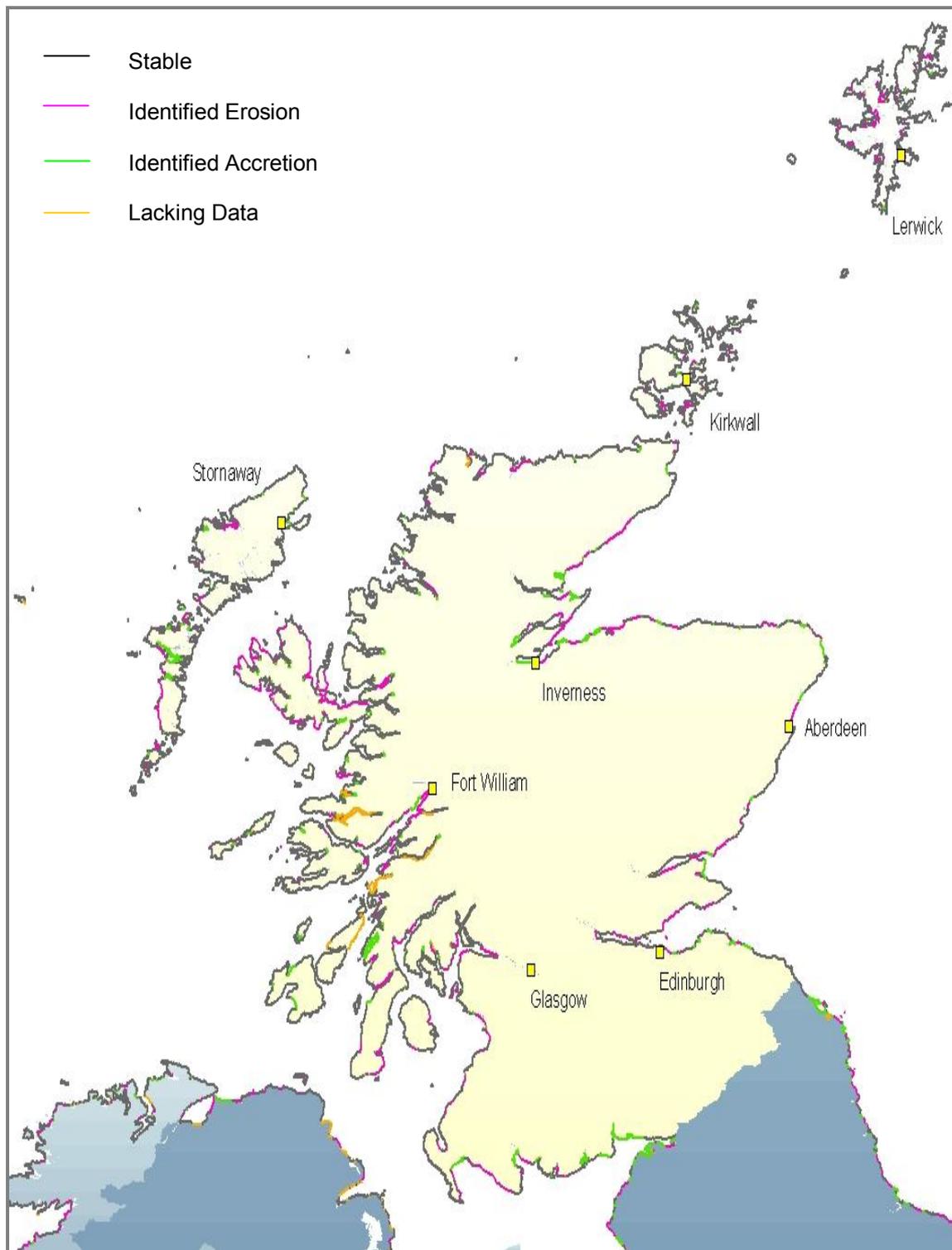


Figure 6.9: Coastal Erosion Survey 2000 Findings (Source: GIS from SNH)



6.7 Cultural Heritage

- 6.7.1 Scotland's historic environment and cultural heritage help to create a sense of place, wellbeing and identity, enhancing the distinctiveness of the coast and attracting visitors to Scotland¹⁵⁵. A wide range of archaeological sites can be found on the foreshore and seabed, ranging from the remains of ships and aircraft lost at sea to harbours, lighthouses and other structures at the coastal fringe. These historic assets are a non-renewable resource, and their survival is conditioned by a complex interplay of natural and man-made factors.
- 6.7.2 Natural factors such as seabed movement from wave and tidal energy, relative sea-level rise, seabed topography and sediment type, biological colonisation, salinity, water acidity or alkalinity and levels of oxygenation often present conditions suitable for their preservation. Coastal erosion poses a major issue for archaeological sites in many areas, and one that is likely to be exacerbated given predictions of the likely effects of global warming (i.e. sea level rise, increased intensity of storms, erosion and risk of flooding). Additionally, man-made activities such as anchoring, certain types of fishing, and coastal and marine development are also known pressures on the marine historic environment¹⁵⁶.
- 6.7.3 At present, more is known about our historic assets on land than those on our coastlines or in the sea. Historically, there has been a heavy reliance on ad hoc discoveries of sites rather than through data gathered in structured research frameworks and survey programmes¹⁵⁷. However, since 1995, the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) has recorded maritime information from readily available sources, a process that is undertaken regularly for terrestrial sites.
- 6.7.4 While many sites lie wholly within the marine environment, it is believed that there are many more unprotected sites of interest on and around Scotland's coastline.¹⁵⁸ The Orkney and Shetland coasts, in particular, contain many Neolithic and Mesolithic structures that are now below sea level. As such, Scotland's seabeds and inter-tidal areas contain the remains of many important historic assets, ranging from artefacts and structures deposited on the seabed, structures built on the seabed or in inter-tidal areas, and submerged sites that were previously above sea level.

¹⁵⁵ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 156.

¹⁵⁶ Historic Scotland (undated) Towards a Strategy for Scotland's Marine Historic Environment [online] Available at: www.historic-scotland.gov.uk/marine-strategy.pdf [accessed 28/06/2013]

¹⁵⁷ Historic Scotland (undated) Towards a Strategy for Scotland's Marine Historic Environment [online] Available at: www.historic-scotland.gov.uk/marine-strategy.pdf [accessed 28/06/2013]

¹⁵⁸ Scottish Government (2011) Scotland's National Marine Plan Interim Sustainability Appraisal Report [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/345728/0115074.pdf> [accessed 21/02/2013]

Designated sites

- 6.7.5 It is estimated that there are some 38,000 historic and unprotected sites of interest around Scotland's coast. There are 97 managed and accessible coastal and marine heritage sites ranging from the World Heritage Sites of St Kilda and Heart of Neolithic Orkney, coastal properties in care of Historic Scotland, maritime and coastal heritage museums, and designated wreck sites currently in Scotland.¹⁵⁹ For these sites the sea can be an integral part of their setting and a key element in how they are experienced, understood and appreciated.
- 6.7.6 The Inventory of Gardens and Designed Landscapes recognises 390 sites nationally important sites, some of which have coastal locations and are relevant to the coastal environment¹⁶⁰.
- 6.7.7 Scotland has 34 statutory designated sites wholly within the marine environment. These include eight designated wreck sites around the coast, nine scheduled monuments including seven wrecks in Scapa Flow, four A-listed lighthouses and 13 sites designated under the Protection of Military Remains Act 1986.¹⁶¹ It is thought that many such sites are likely to be known locally, but remain unreported as archaeological sites.¹⁶²
- 6.7.8 The Marine (Scotland) Act 2010 provides for the designation of Historic Marine Protection Areas (HMPAs)¹⁶³. One HMPA has been designated to date, an historic wreck in Drumbeg, Sutherland. A recent consultation¹⁶⁴ sought views on proposed amendments to the Drumbeg HMPA and proposals for a further six HMPAs:
- Campania, Firth of Forth.
 - Dartmouth, Sound of Mull.
 - Duart Point, Sound of Mull.
 - Kinlochbervie, Sutherland.
 - Mingary, Ardnamurchan.
 - Out Skerries, Shetland.

¹⁵⁹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 156.

¹⁶⁰ Historic Scotland (2012) The Inventory of Gardens and Designed Landscapes in Scotland: A guide for owners, occupiers and managers [online] Available at: www.historic-scotland.gov.uk/gardens.pdf [accessed 28/06/2013]

¹⁶¹ Scottish Government (2011) Scotland's National Marine Plan Interim Sustainability Appraisal Report [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/345728/0115074.pdf> [accessed 21/02/2013]

¹⁶² Scape Trust (undated) Shorewatch [online] Available at: <http://www.scapetrust.org/html/shorewatch.html> [accessed 28/06/2013]

¹⁶³ Scottish Government (2010) Marine (Scotland) Act 2010 [online] Available at: <http://www.scotland.gov.uk/Topics/marine/seamanagement/marineact> [accessed 08/04/2013]

¹⁶⁴ Available at: <http://www.historic-scotland.gov.uk/index/about/consultations/hmpa-consultations.htm>

- 6.7.9 The designation process covers the transition of existing designated wreck sites and underwater scheduled monuments to MPA status and identification of further priority sites.

Key pressures:

- Man-made factors such as anchoring, commercial fishing, dredging, and marine construction disturbance have the potential to adversely affect these resources.
- Coastal development, (i.e. piers, wharves and breakwaters) can result in changes to marine ecosystems and coastal processes, potentially exacerbating erosion with secondary effects on these ecosystems and the historic marine environment.

6.8 Landscape and Seascape

6.8.1 Scotland's seascapes and coastal landscapes are highly varied with features ranging from sea lochs to open water, machair plains to towering cliffs, and dunes and sandy beaches to rocky headlands. Although there are many settlements on the coast, less than 15% of its length has been developed, giving much of the coast a natural character. While largely undeveloped, the Scottish coastline is generally highly accessible and there is an ongoing commitment to improve public access¹⁶⁵.

6.8.2 Over 12% by area of Scotland has been classified as National Scenic Areas (NSAs)¹⁶⁶ and two national parks have been established, in the Cairngorms and in Loch Lomond and The Trossachs¹⁶⁷. Scotland contains 40 NSAs, a designation given to identify areas of outstanding scenery and locations considered to represent Scotland's finest landscapes¹⁶⁸. Of these, 27 are located within or adjacent to coastal areas and include views of transitional or coastal waters¹⁶⁹. These are predominantly located on the west coast, Orkney, Shetland and the Western Isles,

¹⁶⁵ Scottish Government (2010) Offshore Wind Strategic Environmental Assessment Environmental Report, 2010 [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf> [accessed 14/02/2012]

¹⁶⁶ SNH (undated) National Scenic Areas [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/nsa/> [accessed 21/02/2013]

¹⁶⁷ SNH (2012) National Parks, [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/national-parks/> [accessed 21/02/2013]

¹⁶⁸ SNH (undated) National Scenic Areas [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/nsa/> [accessed 21/02/2013]

¹⁶⁹ Scottish Government (2011) Scotland's National Marine Plan Interim Sustainability Appraisal Report [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/345728/0115074.pdf> [accessed 21/02/2013]

- 6.8.3 SNH have been progressing work to identify areas of ‘wild land’ within Scotland¹⁷⁰. This work has considered the perceived naturalness of the land cover, ruggedness of the terrain, the remoteness from public roads and ferries, and visible lack of development (i.e. buildings, roads, pylons, etc.). While mapping of such areas does not include offshore areas, the relationship between landscape and seascape is of relevance to the analysis. As such, the locations of areas with stronger wild characteristics shows a strong correlation with the north and west of Scotland, particularly areas of higher ground and some coastal and island areas¹⁷¹.
- 6.8.4 Many of Scotland’s cultural heritage sites have coastal locations, and as such, may be sensitive to landscape or seascape changes. Coastal erosion and impacts from man-made sources (i.e. coastal or offshore development) can potentially result in irreversible changes to coastal processes and increase erosion or accretion in some areas¹⁷². This potential is expected to increase in the future, with additional pressures from rising sea levels, storm events and erosion/deposition associated with climate change¹⁷³.

Key environmental issues:

- Potential landscape/seascape and visual impacts from increased inshore and offshore development.
- Changes to coastal processes having the potential to impact on marine and transitional water ecosystems, and increase erosion or accretion in sensitive coastal areas.

6.9 Material Assets (Aquaculture and Shipping)

- 6.9.1 Scotland seas are a shared resource, and one considered valuable for a wide variety of industries. Our territorial and offshore waters support the oil and gas industry (predominantly off the east coast and to the east of Shetland and Orkney), commercial fishing (throughout our inshore and offshore waters), aquaculture (mainly off the west coast, Orkney, Shetland and the Western Isles) and recreational and tourism industries (around the Scottish coastline)¹⁷⁴.

¹⁷⁰ SNH (2013) Mapping Scotland’s wildness and wild land [online] Available at: <http://www.snh.gov.uk/protecting-scotlands-nature/looking-after-landscapes/landscape-policy-and-guidance/wild-land/mapping/> [accessed 28/06/2013]

¹⁷¹ SNH (2013) Map 1 – Relative Wildness throughout Scotland [online] Available at: <http://www.snh.gov.uk/docs/A914531.pdf> [accessed 20/8/2013]

¹⁷² Prasetya G (unknown) Thematic paper: The role of coastal forests and trees in protecting against coastal erosion [online] Available at: <ftp://ftp.fao.org/docrep/fao/010/aq127e/aq127e07.pdf> [accessed 25/09/2012]

¹⁷³ SNH (2012) Climate Change at the Coast, [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/coasts/climate-change/> [accessed 28/06/2013]

¹⁷⁴ Scottish Government (2011) Scotland’s Marine Atlas, Information for the National Marine Plan, Scottish Government, pg 144.

- 6.9.2 These waters generate a significant amount of economic output and are a valuable asset to the future of the Scottish economy. Overall, the core marine sector, less the extraction of oil and gas, contributed around 3.5% of Gross Value Added (GVA) and accounted for 1.6% of Scottish employment. Of these, 31% of those employed worked in the fishing, fish farming or fish processing sectors¹⁷⁵.

Aquaculture

- 6.9.3 Aquaculture is a growing and increasingly important industry, helping to underpin sustainable economic growth in rural and coastal communities. Scotland's aquaculture industry is dominated by finfish and shellfish farming or culture. Scotland's finfish aquaculture industry is based on the west coast, Orkney, Shetland and the Western Isles. Shellfish aquaculture is also primarily in these areas, with a few sites on the east coast (Figure 7.1).
- 6.9.4 The fish farming industry in Scotland is dominated by Atlantic salmon production, although a variety of other species are grown including, trout, cod and halibut, amongst others¹⁷⁶. Shellfish production is dominated by mussel and Pacific oyster, although small quantities of scallop, queen scallop and native oyster are also produced¹⁷⁷. Production in the finfish aquaculture sector has progressively grown over the last twenty years, particularly Atlantic salmon production. There have been recent decreases in production of other species, such as rainbow trout, halibut and cod¹⁷⁸.

Of particular interest to a future seaweed cultivation industry is the potential for inclusion with aquaculture under IMTA. Like many other sectors, marine and freshwater aquaculture both use the available natural resources and interact with their respective environments, and issues such as environmental impacts and the need for sustainability have been identified¹⁷⁹. While there is considerable disagreement amongst stakeholders over the nature and extent of some impacts (e.g. sea lice impacts on wild salmonids, and breeding between wild and escaped farmed fish) it is generally agreed that impacts to the marine environment can occur due to the discharge of nutrients, solid waste, chemicals (or

¹⁷⁵ Scottish Government (2011) Scotland's Marine Atlas, Information for the National Marine Plan, Scottish Government, pg 142.

¹⁷⁶ SEPA (2011) Marine Aquaculture [online] Available at: http://www.sepa.org.uk/water/water_regulation/regimes/aquaculture/marine_aquaculture.aspx [accessed 26/09/2012]

¹⁷⁷ Marine Scotland Science (2012) Scottish Shellfish Farm Production Survey 2012 Report [online] Available at: <http://www.scotland.gov.uk/Resource/0042/00422964.pdf> [accessed 27/06/2013]

¹⁷⁸ Marine Scotland Science (2012) Scottish Fish Farm Production Survey 2001 Report [online] Available at: <http://www.scotland.gov.uk/Resource/0040/00401446.pdf> [accessed 27/06/2013]

¹⁷⁹ FAO (2012) Impact of Aquaculture on Environment [online] Available at: <http://www.fao.org/fishery/topic/14894/en> [accessed 14/2/2013]

chemo-therapeutants) used in the control of sea lice, and the historical use of antifoulants on sea cages¹⁸⁰.

- 6.9.5 The addition of nutrients is one such aspect, arising from excess (or waste) feed and fish faeces from sea cage farming operations passing down the water column and impacting on the marine environment below. These materials can collect on the seabed beneath fish farm cages, and the presence of these wastes can result in increases in organic matter within the underlying sediments, and have adverse impacts on the benthic environment and the organisms that live there¹⁸¹.
- 6.9.6 While fish such as cod and halibut are also farmed at sites in Scottish waters, these species do not potentially interact in the same way with wild fish as Atlantic salmon (i.e. sea lice), but similar issues in waste production apply. However, the rates of release of nitrogen in particulate or dissolved forms differ. For example, studies have indicated that these rates for halibut can be 50% or less than those for salmon, and as such, the potential for both benthic impacts and for water column nutrient enhancement is lower¹⁸².

Shipping

- 6.9.7 Scotland's ports and seas play a key role in providing for the transport of freight and passengers by ferry services and wider shipping. In 2009, over 85 million tonnes (Mt) of cargo was handled through Scottish ports (a reduction of around 11% from 2008 and over 21% from 2005 figures). Of this, over 96% was handled by the 11 major ports, with the Forth ports¹⁸³ accounting for around 44%¹⁸⁴. The British Ports Association have estimated that the trade value of the Scottish freight in 2006 amounted to around £65 billion, equivalent to 17% of the value of the UK's total trade¹⁸⁵.
- 6.9.8 The movement of vessels within Scottish waters is recorded by several organisations, including the Maritime and Coastguard Agency (MCA), Lloyds List Intelligence and individual ports. As such, data sets are not

¹⁸⁰ Scottish Government (2012) Environmental Impacts ([online] Available at: <http://www.scotland.gov.uk/Topics/marine/Fish-Shellfish/18716/environmentalimpact> [accessed 28/06/2013])

¹⁸¹ Scottish Government (2012) Environmental Impacts ([online] Available at: <http://www.scotland.gov.uk/Topics/marine/Fish-Shellfish/18716/environmentalimpact> [accessed 28/06/2013])

¹⁸² Fisheries Research Services Scotland (undated) Comparison of Nitrogen Discharge Rates from Cultivated Marine Finfish Species [online] Available at: www.scotland.gov.uk/Uploads/Documents/Species%20factors.pdf [accessed 12/11/2012]

¹⁸³ Forth Ports include Burntisland, Grangemouth, Granton, Inverkeithing, Leith, Methil and Rosyth.

¹⁸⁴ Scottish Government (2011) Scotland's Marine Atlas, Information for the National Marine Plan, Scottish Government, pg. 172.

¹⁸⁵ British Ports Association (2008) Scottish Ports Committee, Ports in Scotland – Delivering Value, 2008, [online] Available at: http://www.britishports.org.uk/sites/default/files/scottish_ports_committee_delivering_value_report_-_low_res_new.pdf [accessed 14/12/2012]

always comparable as different categories are used by these organisations, and certain types of ports or vessels are not featured in some statistics.

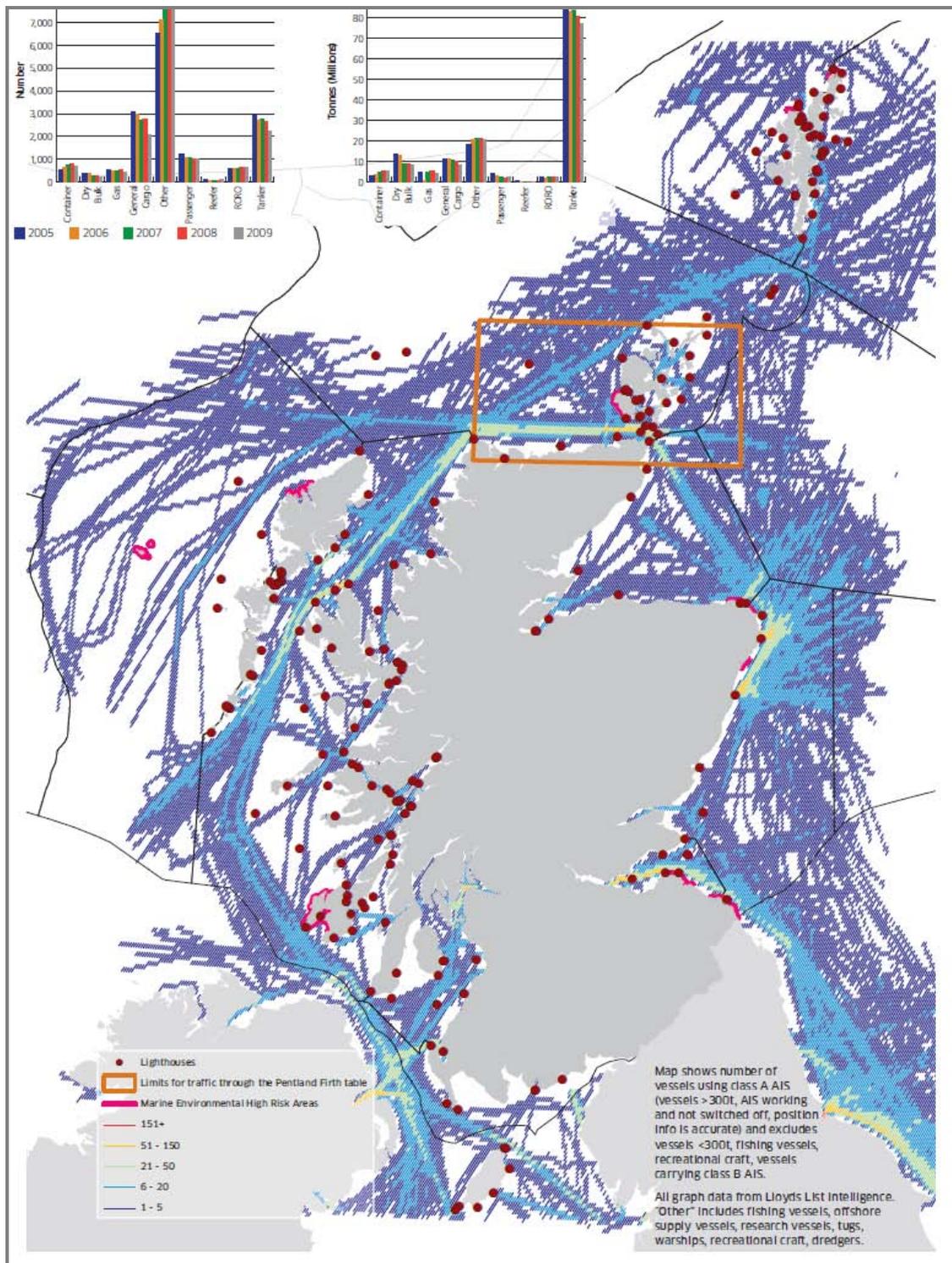
- 6.9.9 Lloyds List Intelligence data indicates there were 15,225 vessel arrivals at the main Scottish ports in 2009 (excluding Cairnryan, Stranraer and Glensanda). Of these, over 82% arrived at three ports: Aberdeen (45.8%), Forth ports (19.3%) and Lerwick (17.1%). Given the high number of vessels, data from tracking the movements is difficult to convey¹⁸⁶.
- 6.9.10 Figure 6.10 details a snapshot of shipping traffic data, showing vessel routes taken during the first week of January 2010. While only a snapshot, indicates the high level of shipping traffic in the Firth of Forth, the Firth of Clyde, off the north east coast near Aberdeen, and through the Minches, the North Channel and the Pentland Firth.

Key environmental issues:

- Potential benefits in using seaweed cultivation in IMTA, particularly in reducing adverse impacts from finfish aquaculture.
- Potential impacts on or displacement of other marine users (i.e. shipping and aquaculture) from the growth of large-scale seaweed cultivation operations in marine waters.

¹⁸⁶ Scottish Government (2011) Scotland's Marine Atlas, Information for the National Marine Plan, Scottish Government, pg 172.

Figure 6.10: Shipping traffic showing number of vessels in a given area during the first week of January 2010 (based on MCA Automated Identification System (AIS) data)¹⁸⁷



¹⁸⁷ Scottish Government (2011) Scotland's Marine Atlas, Information for the National Marine Plan, Scottish Government, pg. 175.

6.10 Evolution of the Environmental Baseline without the Proposed SPS

- 6.10.1 Some trends identified in the environmental baseline will be independent of both the adoption of the proposed SPS, and the growth of Scotland's seaweed cultivation and wild harvesting industries. For example, many pressures from the effects of climate change (e.g. rising sea levels, increased frequency of extreme weather, acidification of seas) are unlikely to be affected by growth of these industries. The same may apply to biodiversity (e.g. introduction of invasive species) and water quality (e.g. acidification and eutrophication) pressures associated with changes in climate and water temperatures.
- 6.10.2 Opportunities to develop this industry would likely still be available without the policies contained in the Consultation Document, although these opportunities would be driven by industry and commercial markets under the current licensing and planning frameworks. Under this scenario, an opportunity for the Government to influence the sustainable development of the seaweed cultivation and wild harvesting industries at an early stage would likely be missed. Additionally, the potential for the industry to assist in the adaptation to climate change (e.g. via protection of coastal processes and storm protection at the local level) and improvements to water quality (i.e. potential benefits associated with IMTA) may not be given the same focus as that provided under the proposed SPS.
- 6.10.3 It is considered unlikely that growth in this sector, with or without the proposed SPS, would lead to a substantial increase in activities over the short-term. As such, current trends in relation to cultural heritage, landscape/seascape, population and human health, soil and geology would likely continue. However, it is noted that the potential for significant growth in large-scale cultivation due to future development in biofuel production could significantly alter the environmental baseline.

6.11 Alternatives under Assessment

- 6.11.1 The Act requires the SEA to assess the significant environmental effects of the proposed SPS and its reasonable alternatives. The identification of potential environmental issues in the SEA process has driven the development of the SPS, both through the consideration of potential environmental issues during its development, and assisting in refining its content and focus.
- 6.11.2 This has also led to the consideration of a number of alternatives to the proposals presented in the Consultation Document, with the SEA process playing a key role in both the identification of options to mitigate against potential environmental effects, and also in the comparison of alternatives.

Reasonable Alternatives

6.11.3 As detailed in Section 4.7, in the early stages of the SPS development process, a number of different focuses were considered. The following four broad and high-level alternatives were considered:

- A focus on commercial-scale seaweed cultivation – considers an SPS focused on commercial seaweed cultivation operations. It considers the impacts of an SPS developed to facilitate the future growth of a seaweed cultivation industry, and specifically catering for larger-scale seaweed production sites (i.e. biofuels).
- A focus on seaweed cultivation as part of IMTA – considers an SPS focused on integrated seaweed cultivation activities (i.e. IMTA). It considers the potential growth of a Scottish seaweed cultivation industry based around integrating seaweed cultivation with marine finfish and shellfish farming operations, with the aim of reducing environmental impacts from these operations.
- A focus on commercial harvesting of seaweed in the wild – considers an SPS focused on the consolidation and growth of existing commercial harvesting of seaweed in the wild. It considers a scenario where the expansion of existing wild harvesting activities and the development of new operations taking advantage of Scotland’s wild seaweed stocks are pursued in combination with cultivation.
- The ‘do nothing’ scenario – proposes adopting a ‘hands-off’ approach to the seaweed industry where growth of the seaweed cultivation and commercial harvesting in the wild may be promoted by Government, but not in policy, and operators and market-forces are left to drive industry growth under the existing regulatory framework.

Other Options for Consideration

6.11.4 In addition to these broad options, the SEA process considered a number of different options for provisions within the Consultation Document to manage or mitigate potential adverse impacts identified in the assessment. In addition to the policies contained within the Consultation Document, these options included:

- Introducing spatial limitations on industry growth (i.e. allowing operations in certain areas, exclusion from others). For example, would the potential environmental effects of seaweed cultivation require the identification of ‘no-go’ areas?
- Potential for overcoming issues at the local level through planning and design.
- Identifying issues to be dealt with at the regional/local level and therefore by other PPS (including Regional Marine Planning, and future spatial aquaculture plans).

- Identification of opportunities for further investigation (e.g. modelling of water flows and sedimentation, etc.).

6.11.5 The SEA explored the implications of these alternatives for facilitating the potential growth of the seaweed industry in Scotland, and compared these against the proposed policies contained in the Consultation Document, reflecting on the similarities and contrasts between them. The findings of this comparison are presented in Section 9.

7 Commercial Seaweed Cultivation and IMTA

7.1 Current Situation

Commercial Cultivation

- 7.1.1 In 2010, the worldwide production of seaweed and other aquatic algae was around 19 million tonnes, of which 95% was cultivated¹⁸⁸. World seaweed production is currently focused in the far east: 99.8% of global production by quantity and 99.5% by value in 2008. China accounted for 62.8% of this world production by quantity¹⁸⁹. In Europe, seaweed production is comparatively small in scale, with production undertaken in France, Ireland, Norway, Portugal, the UK and Spain¹⁹⁰. In both European and global terms, therefore, Scotland's role in seaweed production is small.
- 7.1.2 The potential for growth of the seaweed cultivation industry in Scotland has been identified by both public bodies (e.g. The Crown Estate and Scottish Government) and industry, not just in incorporating seaweed cultivation into existing aquaculture operations (IMTA), but potentially for larger-scale production in the future. However, Scotland's seaweed cultivation industry is still in its early stages.
- 7.1.3 At present, there are a number of seaweed sites, either in planning or operation, in Scottish waters. These sites are largely located in the Western Isles, Shetland or on Scotland's west coast. Marine licencing records indicate that these farms are being developed for algal production trials or as part of IMTA with either finfish or shellfish aquaculture (Figure 7.1).
- 7.1.4 Hatchery trials for the production of breeding stock and the cultivation of seaweeds have also been undertaken at a commercial hatchery in Argyll. These trials have been undertaken to determine the viability of laboratory culture of seaweed for transfer to marine cultivation sites¹⁹¹.

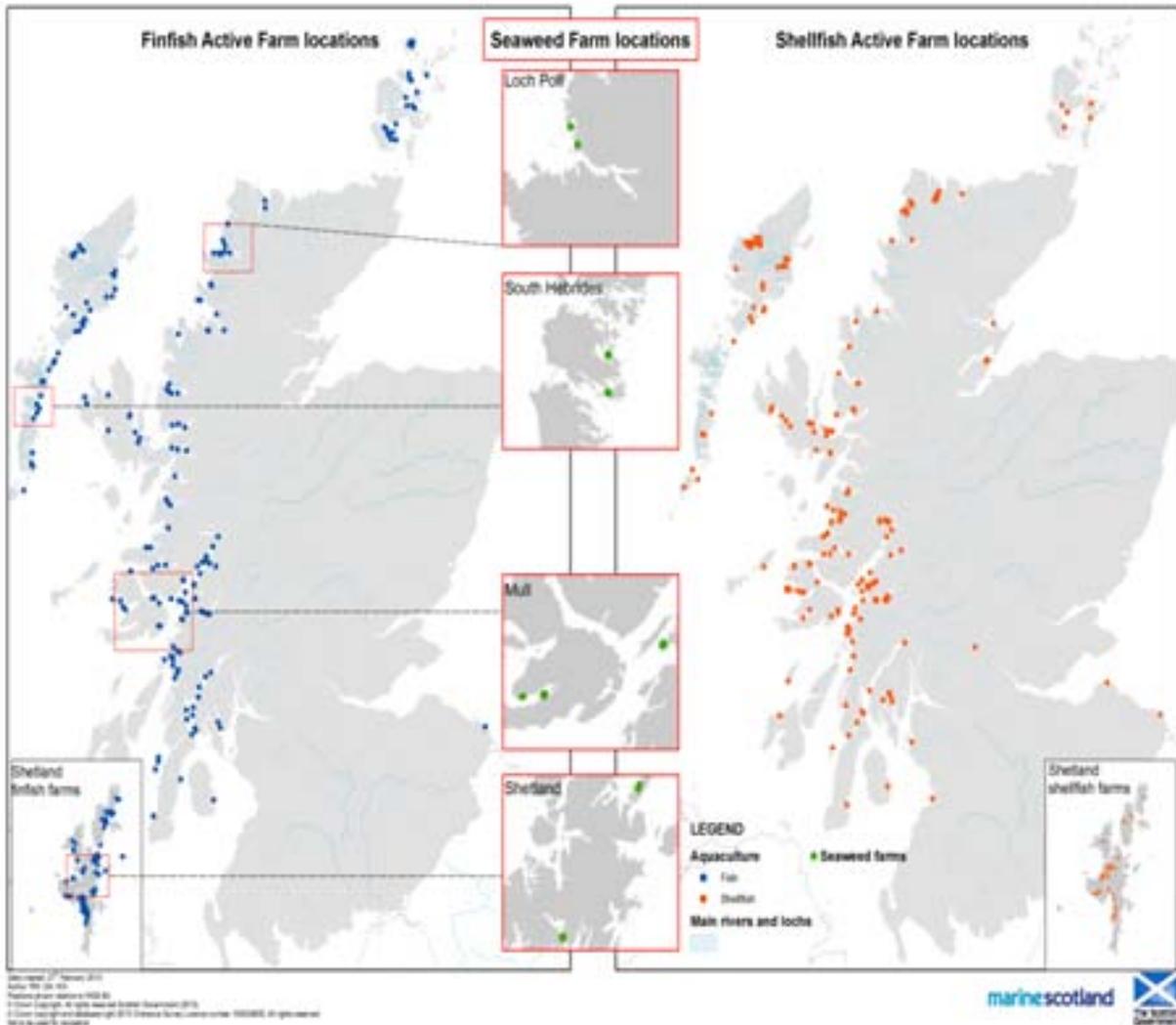
¹⁸⁸ FAO (2011) Statistics – Introduction, Statistical Collections, Overview: Major Trends and Issues [online] Available at: ftp://ftp.fao.org/FI/STAT/summary/YB_Overview.pdf [accessed 20/02/2013]

¹⁸⁹ FAO (2010) The State of World Fisheries and Aquaculture 2010 [online] Available at: <http://www.fao.org/docrep/013/i1820e/i1820e.pdf> [access 4/10/2012]

¹⁹⁰ FAO (2010) The State of World Fisheries and Aquaculture 2010 [online] Available at: <http://www.fao.org/docrep/013/i1820e/i1820e.pdf> [access 4/10/2012]

¹⁹¹ Atack T (2012) The Crown Estate Macro-algae Cultivation and Marine Biomass Forum, Seedling Production in Europe – From Laboratory to Industrial Scale, November 1, Edinburgh, The Royal Society of Edinburgh.

Figure 7.1: Finfish Farm, Shellfish Farm and Seaweed Cultivation Sites in Scotland (Source: Marine Scotland)



7.1.5 The potential for large offshore-scale production of seaweed is being investigated internationally, including work in recent years in the North Sea^{192,193}. Current efforts are focusing on the feasibility of such cultivation to support biofuel production.

Cultivation in IMTA

7.1.6 Scotland's finfish farming industry has the potential to increase organic matter and nutrient loading concentrations in coastal waters, as a result of the dispersal of waste feed and faeces from fish cages directly into the

¹⁹² James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland, Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

¹⁹³ Gregerson O. (2012) The Crown Estate Macro-algae Cultivation and Marine Biomass Forum, Faroese Seaweed Cultivation Interests and Associated Projects, November 1, Edinburgh, The Royal Society of Edinburgh.

water column^{194,195}. In consequence, between 52 – 95% of the nitrogen, 85% of the phosphorus and 80 – 88% of the carbon input into a marine finfish farm can be lost to the marine environment. These losses occur as feed wastage, faeces production and respiration¹⁹⁶, with a substantial portion of waste materials settling on the seabed below or near the cage. This increase in organic matter can impact on benthic ecosystems, and result in changes to the nature and chemistry of sediments, e.g. increased biochemical oxygen demand, with associated reductions in biodiversity¹⁹⁷.

- 7.1.7 Nutrient enhancement of the water column can also be of concern, with these loadings, either suspended or dissolved, capable of being transported further afield. In Scotland, SEPA currently limits the biomass of farms, (and hence the amount of food and nutrients entering the water column) through licences whose limits are based on the results of modelling¹⁹⁸. However, enhancement of nutrients has been identified up to 300m from farm cages in the direction of currents and flows in Scottish waters, and these nutrients can concentrate in quieter areas of flow¹⁹⁹.
- 7.1.8 A potential solution to these problems is the use of IMTA, the multi-trophic form of integrated mariculture, which has been widely investigated both in Scotland and around the world²⁰⁰. As shown in Figure 7.2, the practice of IMTA combines the cultivation of fed aquaculture species (e.g. finfish) with species that extract both organic and inorganic material (e.g. shellfish/herbivorous fish and seaweed respectively) 'to create balanced systems for environmental sustainability (biomitigation), economic stability (product diversification and risk reduction) and social acceptability (better management practices)'²⁰¹. In this system, the nutrient waste from one species becomes the nutritional input for another.

¹⁹⁴ Fisheries Research Services (undated) Environmental Impacts of Fish Farming [online] Available at: www.scotland.gov.uk/Uploads/Documents/AE01EnvironImpact.pdf [accessed 26/10/2012]

¹⁹⁵ Chopin T, Buschmann, A.H, Halling C, Troell M, Kautsky N, Neori A, Kraemer G.P, Zertuche-Gonzalez J.A, Yarish C, Neefus C (2001) Integrated Seaweeds in Marine Aquaculture Systems: A Key Toward Sustainability, *Journal of Phycology*, 37, pg 975-986.

¹⁹⁶ Sanderson J.C (2009) Bioremediation Using Seaweed Culture: Reducing the Environmental Impact of Sea-Cage Fish Farming Through the Cultivation of Seaweed, VDM Verlag Dr. Muller Aktiengesellschaft and Co. KG.

¹⁹⁷ Fisheries Research Services (undated) Environmental Impacts of Fish Farming [online] Available at: www.scotland.gov.uk/Uploads/Documents/AE01EnvironImpact.pdf

¹⁹⁸ SEPA (2012) Marine Aquaculture [online] Available at: http://www.sepa.org.uk/water/water_regulation/regimes/aquaculture/marine_aquaculture.aspx [access 26/10/2012]

¹⁹⁹ Sanderson J.C (2009) Bioremediation Using Seaweed Culture: Reducing the Environmental Impact of Sea-Cage Fish Farming Through the Cultivation of Seaweed, VDM Verlag Dr. Muller Aktiengesellschaft and Co. KG.

²⁰⁰ Sanderson J.C (2009) Bioremediation Using Seaweed Culture: Reducing the Environmental Impact of Sea-Cage Fish Farming Through the Cultivation of Seaweed, VDM Verlag Dr. Muller Aktiengesellschaft and Co. KG.

²⁰¹ FAO (2009) FAO Fisheries And Aquaculture Technical Paper 529: Integrated Mariculture – A Global Review [online] Available at: <ftp://ftp.fao.org/docrep/fao/012/i1092e/i1092e.pdf> [accessed 20/02/2013]

- 7.1.9 The concept of IMTA is well-established in Asia²⁰² and is considered by the Fisheries and Aquaculture Organisation (FAO) to be an important tool to achieve sustainable development. The effectiveness of coupling low trophic extractive suspension feeders (i.e. shellfish and seaweed) to higher trophic fed (i.e. finfish) organisms has been demonstrated for a wide range of species combinations in both fresh and marine waters²⁰³. Studies have also demonstrated the successful growth of a range of seaweed species (e.g. *P. palmata* and *L. saccharina*) in the vicinity of finfish aquaculture cages in Scottish waters, and that significant increases in seaweed yield can be achieved from being in close proximity to these operations²⁰⁴.
- 7.1.10 The results of testing of IMTA on a small scale, using combinations of marine cage salmon farms, long line mussels, sea urchins and seaweeds in countries such as Canada, Scotland and Norway^{205,206} suggest a potentially promising future for the integration of seaweed cultivation and finfish aquaculture. With the exception of some companies cultivating sea urchins and seaweed alongside Atlantic Salmon in integrated systems, IMTA has had limited penetration into Scotland's mainstream salmon farming industry to date. This may change as the need to improve the productivity and sustainability of Scotland's aquaculture sites increases in the future²⁰⁷ and as the benefits of IMTA are demonstrated to the industry.

²⁰² Chopin T, Buschmann, A.H, Halling C, Troell M, Kautsky N, Neori A, Kraemer G.P, Zertuche-Gonzalez J.A, Yarish C, Neefus C (2001) Integrated Seaweeds in Marine Aquaculture Systems: A Key Toward Sustainability, *Journal of Phycology*, 37, pg 975-986.

²⁰³ FAO (2009) FAO Fisheries And Aquaculture Technical Paper 529: Integrated Mariculture – A Global Review [online] Available at: <ftp://ftp.fao.org/docrep/fao/012/i1092e/i1092e.pdf> [accessed 4/10/2012]

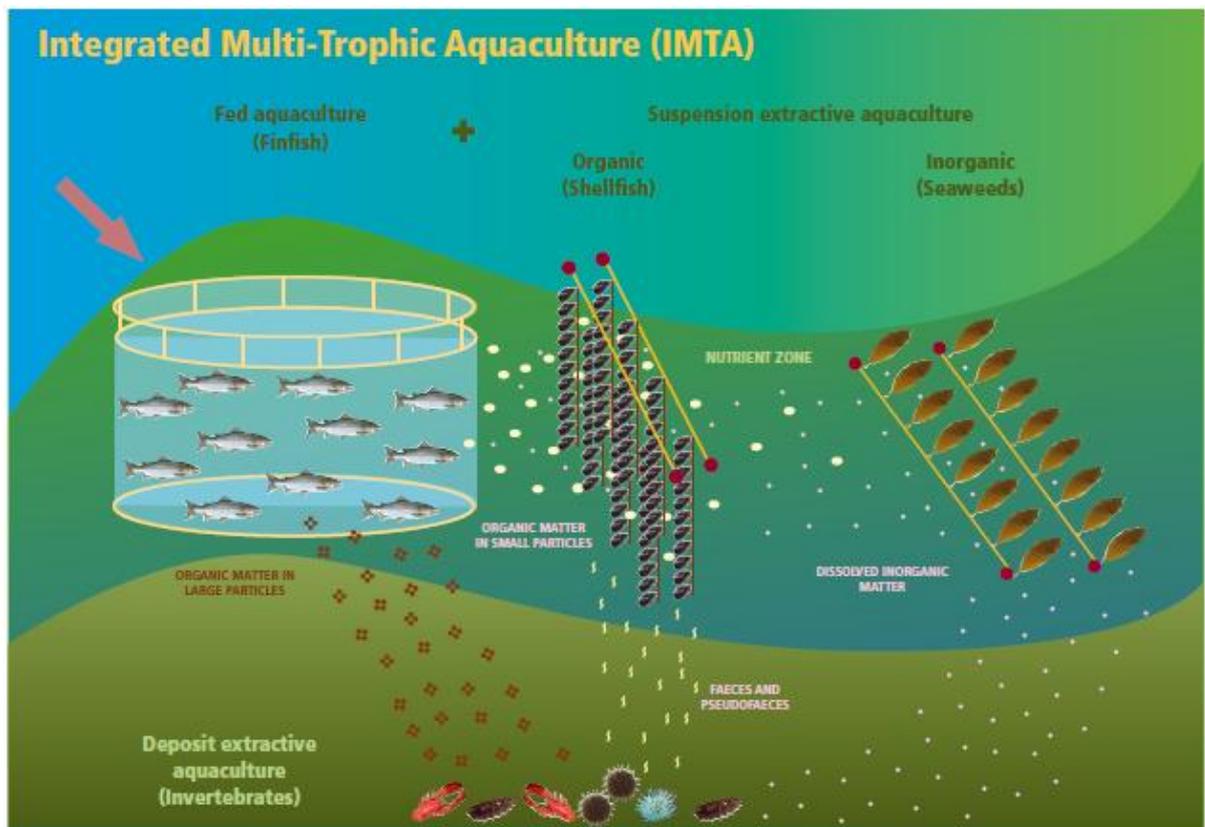
²⁰⁴ Sanderson J.C (2009) Bioremediation Using Seaweed Culture: Reducing the Environmental Impact of Sea-Cage Fish Farming Through the Cultivation of Seaweed, VDM Verlag Dr. Muller Aktiengesellschaft and Co. KG.

²⁰⁵ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁰⁶ Xunta de Galicia (2012) Integrated Multi-Trophic Aquaculture, English version, Salvador Guerrero and Javier Cremades (Eds.) Vilanova de Arousa (Pontevedra), 58 p., 2012 [online] Available at: http://hal.archives-ouvertes.fr/docs/00/74/33/95/PDF/AMTI_Galicia_EN.pdf [accessed 20/02/2013]

²⁰⁷ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

Figure 7.2: Conceptual Diagram of an IMTA Operation using Fed Aquaculture and Extractive Aquaculture ²⁰⁸



- 7.1.11 The scale and extent of any benefits will likely rely on design factors such as proximity of the seaweed and shellfish (where present) to the nutrient source (i.e. the fish cages), and environmental factors such as local water conditions (i.e. flows, shallow depth of the nutrient zone, etc.). The latter may limit the potential success of an IMTA system, for example, the light requirements of many seaweed species for photosynthesis may limit adoption of IMTA in deeper waters, and may introduce limitations in the species of seaweed that could be used for such sites.

7.2 Environmental Effects

- 7.2.1 The potential environmental effects of seaweed cultivation and IMTA are illustrated in Figures 7.3 and 7.4 respectively, and the likelihood and significance of these effects is discussed in the following paragraphs.

²⁰⁸ Xunta de Galicia (2012) Integrated Multi-Trophic Aquaculture, English version, Salvador Guerrero and Javier Cremades (Eds.) Vilanova de Arousa (Pontevedra), 58 p., 2012 [online] Available at: http://hal.archives-ouvertes.fr/docs/00/74/33/95/PDF/AMTI_Galicia_EN.pdf [accessed 20/02/2013].

Figure 7.3: Potential Impacts for Commercial Cultivation of Seaweed

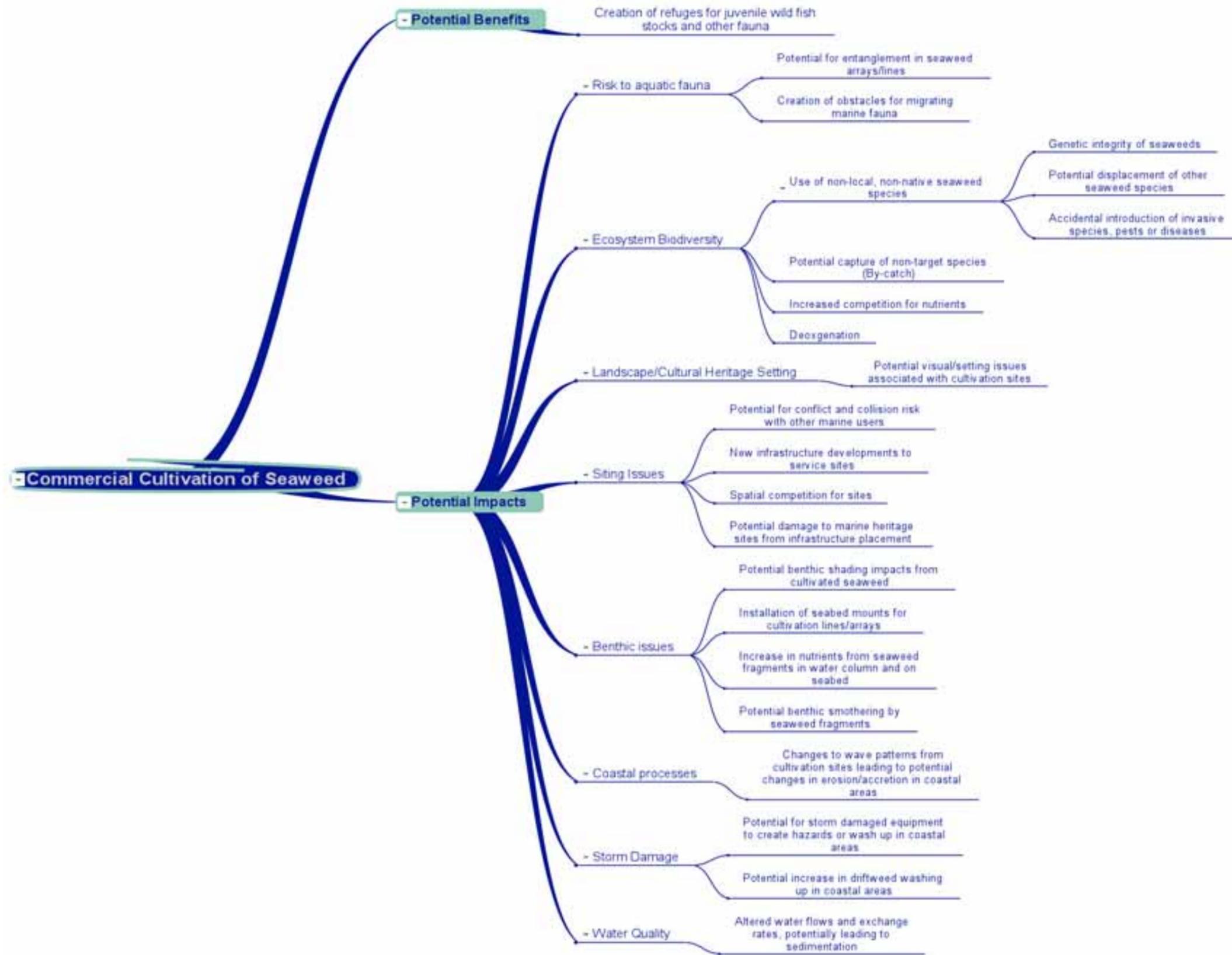
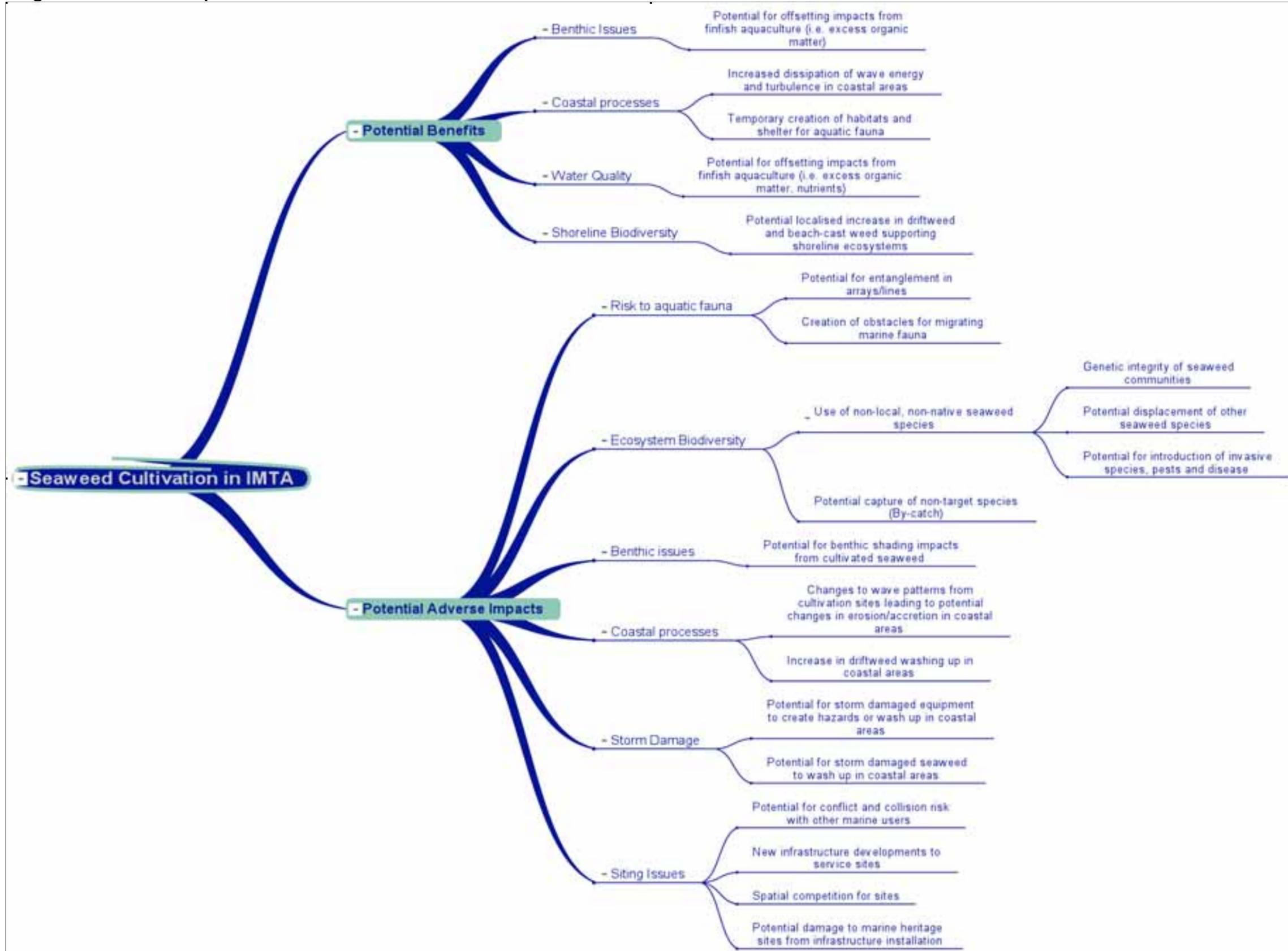


Figure 7.4: Potential Impacts for Seaweed Cultivation in IMTA



Creation of Refuges for Wild Stocks

- 7.2.2 As with wild seaweed communities, cultivated seaweed, either as a monoculture or in IMTA, may provide food resources and habitat for marine fauna such as wild fish (including juveniles), if only temporarily. This may have direct benefits for biodiversity and indirect benefits for local fishing interests.

Benefits in Managing Environmental Impacts from Aquaculture

The primary benefit of seaweed cultivation in IMTA is the potential alleviation of water quality and benthic habitat impacts from aquaculture, particularly finfish aquaculture (see Section 7.1). Similar benefits may occur in the event of co-location of seaweed cultivation sites in the vicinity of existing finfish farms.

Risks to aquatic fauna

- 7.2.3 Potential impacts on aquatic fauna include entanglement, obstacles to migration and by-catch during harvesting. The first, potential entanglement of fauna, would result from the presence of farm infrastructure such as lines and arrays and is of particular relevance to marine mammals (e.g. cetaceans). The second relates to the creation of potential obstacles to marine species, particularly migratory cetaceans.
- 7.2.4 Migratory fish species include Atlantic salmon, sea trout, and lamprey and eel species. At present, there are significant data gaps in relation to the migratory routes of these species²⁰⁹.
- 7.2.5 Marine mammals are commonly sighted in Scottish waters and include both resident and migratory species. Marine mammals include:
- Otters found all around the coast.
 - Seals (both harbour and grey seals) found in most of Scotland's coastal and inshore waters.
 - Small cetaceans (porpoises and dolphins) with a range of distributions²¹⁰.
 - Migratory cetacean species (e.g. minke whales).

²⁰⁹ Malcolm I.A., Godfrey J. and Youngson A.F. (2010) Scottish Marine And Freshwater Science Volume 1 No 14 – Review Of Migratory Routes And Behaviour Of Atlantic Salmon, Sea Trout And European Eel In Scotland's Coastal Environment: Implications For The Development Of Marine Renewables, Prepared for Marine Scotland Science [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0111162.pdf> [accessed 18/02/2013]

²¹⁰ Scottish Government (2011) Scotland's Marine Atlas, Information for the National Marine Plan, Scottish Government, pg. 124 – 129.

- 7.2.6 At present, little is known about cetacean migration, including migration routes. Accordingly, large-scale cultivation sites, located either inshore or offshore in deeper waters, may be an obstacle to movement, but it is not clear how important this may be. Given that shellfish-scale and medium-scale farms will likely be located in similar areas to existing inshore aquaculture sites, their presence is unlikely to pose a significant obstacle to cetaceans or to migratory fish, due largely to their location in shallow waters. However, location of seaweed farms on migratory routes, where these are known, should be avoided. This will also be important for the siting of large-scale offshore sites in the future.
- 7.2.7 Cetaceans are known to become entangled in fishing gear, including nets, and minke whales in particular can become entangled in creel ropes²¹¹. We have not found any evidence of minke whales or other small cetaceans becoming entangled in aquaculture anti-predator nets and/or the ropes used for mussel farms. The same applies to seals. The risk of entanglement in seaweed cultivation ropes associated with shellfish-scale or IMTA inshore sites is therefore considered to be quite low. The risk may be different for larger sites, including those located further offshore, and this will need to be investigated further once more information is available on both migratory routes and the feasibility of such cultivation.
- 7.2.8 It is likely that seaweed cultivation sites will be colonised by other marine flora and fauna (e.g. snails, shellfish, starfish, etc.). Some of these may attach to the cultivation ropes. At this stage it is not clear how cultivated seaweed will be harvested, since the method will likely depend on the species being farmed. In consequence, two broad methods of harvesting have been considered in this assessment: direct harvesting of the seaweed in situ, using methods similar to those used in harvesting wild seaweeds (i.e. by hand or mechanical means), and ex-situ methods, involving the removal of the seaweed ropes by boat for harvesting. Harvesting may have adverse effects on colonising flora and fauna through the removal of seaweed habitat and/or the capture of non-target species when harvesting (known as by-catch).
- 7.2.9 Little information is available on current levels of by-catch associated with seaweed harvesting. It is considered likely that the majority of by-catch using both these methods would be limited to colonising flora and fauna and that these species will be relatively abundant in the marine environment. In consequence, we anticipate that these effects are unlikely to be significant at a national level for shellfish-scale, IMTA or medium-scale sites. However, the potential significance of impacts may be greater

²¹¹ Northridge S., Cargill A., Coram A., Mandleberg L., Calderan S. and Reid B. (2010) Entanglement of Minke Whales in Scottish Waters: An Investigation into Occurrence, Causes and Mitigation, Prepared for The Sea Mammal Research Unit, Final Report to Scottish Government CR/2007/49.

for large-scale offshore sites and this will need to be considered should such sites be progressed in the future.

Genetic Integrity/Displacement of Native Species

- 7.2.10 The cultivation of seaweed has the potential to affect seaweed species, and therefore wider ecosystem biodiversity, in the following ways:
- Use of non-local spat could result in weakening of the genetic integrity of local seaweed species.
 - Use of non-local species could result in displacement of local seaweed species, with consequent effects on community structure and composition, e.g. through competition, displacement of wild seaweed stocks by cultivated species, etc.
- 7.2.11 The accidental or deliberate introduction of seaweeds has precedent both in Scotland and internationally. The accidental introduction and spread of *S. muticum* throughout Western Europe in the 1980s has had a range of negative effects, including impacts on the biodiversity of seaweed communities through outcompeting local species, and has also created navigation issues. Now regarded as a major nuisance species²¹², *S. muticum* is tolerant to environmental issues such as low levels of sunlight and variations in salinity and temperature, which enables it to occupy a broad range of habitats, including those with sparse algal development²¹³. As such, it has become established in sheltered shores in low intertidal and shallow subtidal habitats in parts of Europe and off Scotland's west coast²¹⁴, colonising predominantly highly disturbed habitats, but has also be found to invade saturated macroalgal communities²¹⁵.
- 7.2.12 The introduction of pests and disease through cultivation activities has also been identified as a potential concern. Shipping and aquaculture have, in the past, contributed to the introduction and spread of non-native marine invasive species and disease²¹⁶, and continue to present concerns today. However, unlike finfish, crustacean and mollusc culture, there is no

²¹² Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 21/02/2013]

²¹³ Algaebase (2012) The Seaweed Site: information on marine algae - *Sargassum muticum* / Wireweed [online] Available at: <http://www.seaweed.ie/sargassum/index.php> [accessed 11/1/2013]

²¹⁴ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 139.

²¹⁵ Sandchez I and Fernandez C. (2005) Impact Of The Invasive Seaweed *Sargassum Muticum* (Phaeophyta) On An Intertidal Macroalgal Assemblage, *J. Phycol.* 41, 923–930 (2005) [online] Available at: <http://www.unioviado.es/chely/CHELY/publicaciones/exclusi%F3n.pdf> [accessed 20/02/2013]

²¹⁶ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg. 139.

evidence to show that seaweed diseases have been transferred as a result of seaweed culture²¹⁷.

- 7.2.13 This is of particular concern, given the status of many seaweed species within the UK BAP, their identification within PMF, and their presence and contribution to European designated sites. The focus in the SPS on using local provenance and local species in cultivation was included to address these issues, and to preserve the genetic integrity of Scotland's seaweed communities by reducing the potential spread of non-native or translocated native species from cultivation activities to the wider ecosystem. This policy should also assist in limiting the opportunities for introduction of invasive non-native marine species and/or disease. This requirement is already being implemented through the marine licenses issued for seaweed cultivation in Scottish Waters (see Section 7.1). These do not identify the species of seaweeds that may be cultivated, but specify that only macro-algal species present in the local or regional area, and native to Scotland should be used in cultivation.

Ecosystem Biodiversity

- 7.2.14 Scotland's kelp forests provide important nursery and refuge grounds for fish²¹⁸ such as juvenile gadoids and salmon²¹⁹, as do other seaweed communities, and it is likely that creation of seaweed farms would similarly attract marine fauna²²⁰. The removal of the 'created' habitat that a seaweed farm provides could have adverse impacts on the marine fauna that have come to rely on it, as harvesting would force these species elsewhere. The significance of this effect would depend on the species under cultivation. Some seaweeds can be harvested eight weeks after seeding, and a short growth period such as this is unlikely to provide significant habitat for other marine fauna. However, other (perennial) species are harvested annually, and this longer growth period may be of more benefit in providing habitat. In the latter case, the loss of habitat from harvesting would be a temporary effect, as the seaweed would begin to grow again.

²¹⁷ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical Resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 20/02/2013]

²¹⁸ Werner A. and Kraan S. (2004) Review Of The Potential Mechanisation Of Kelp Harvesting In Ireland, Marine Environment and Health Series, No. 17, 2004, Prepared for Marine Institute and Taighde Mara Teo [online] Available at: http://www.seaweed.ie/irish_seaweed_contacts/doc/No%2017%20Marine%20Environment%20and%20Health%20Series.pdf [accessed 21/02/2013]

²¹⁹ Kelly, E. (ed.) (2005) The role of kelp in the marine environment. Irish Wildlife Manuals, No. 17. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland [online] Available at: <http://www.npws.ie/publications/irishwildlifemanuals/IWM17.pdf> [accessed 28/06/2013]

²²⁰ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 21/02/2013]

- 7.2.15 Anecdotal evidence suggests that staged harvesting or ‘crop rotation’ of seaweed farms, as is undertaken for harvesting in the wild in Norway²²¹ and in Scotland²²², may assist both in aiding seaweed regrowth and in mitigating disturbance of species residing in seaweed habitats, through extending the ‘residence period’ and, through staging, providing alternate refuge habitat. However, there are significant data gaps in relation to this issue.

Nutrient Supply

- 7.2.16 Seaweed cultivation relies on nutrients supplied naturally in seawater, and this has the potential to result in nutrient depletion in surrounding waters; such depletion has been observed in China. This may affect secondary productivity and thereby affect the wider ecosystem²²³. In addition, there may be increased competition for nutrients between seaweed farms in close proximity to one another, and between cultivated and wild seaweed stocks.
- 7.2.17 Nutrient capacity will therefore be a key issue for seaweed cultivation, as a consistent input of nutrients is required for growth. Studies in the far east have shown that it is possible to over-intensify seaweed farming, and that such over-production can result in nutrient decline. It has been suggested that this decline may be linked to outbreaks of disease in seaweeds, leading to reduced production. The carrying capacity of the local coastal environment should therefore be considered in seaweed cultivation proposals²²⁴.

Landscape and Cultural Heritage

- 7.2.18 Given the common equipment and similar scale of development proposed, it is likely that the visual impact of a shellfish-scale seaweed cultivation farm will be similar to that of current shellfish farms. Medium-scale developments are likely to be more visible, particularly those located near coastal areas, and as such, have the potential for greater landscape and seascape impacts. Extensive-scale developments may affect seascape as well as landscape along the coastline, and potentially the setting of coastal sites of historic importance. However, the significance of such impacts will depend on their extent, as well as their distance from the coast.

²²¹ Norway Directorate of Fisheries (2011) Marine Protected Areas [online] Available at: <http://www.fiskeridir.no/english/fisheries/marine-protected-areas> [accessed 13/11/2012]

²²² The Hebridean Seaweed Company (undated) Harvesting Practices & the Manufacturing Process: Manual Harvesting [online] Available at: <http://www.hebrideanseaweed.co.uk/harvesting-theprocess.html> [accessed 21/02/2013]

²²³ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical Resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 28/06/2013]

²²⁴ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical Resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 28/06/2013]

- 7.2.19 The potential for cumulative impacts from multiple marine or aquaculture developments is considered to be of primary concern, particularly in areas such as the west coast, Orkney, Shetland and the Western Isles. Such impacts depend on the nature and extent of the development and the sensitivity of the surrounding area. For example, the introduction of seaweed cultivation to an existing aquaculture site as part of IMTA may not significantly impact on landscape or seascape by itself, but may contribute to the impact of the existing developments, particularly if large in size and located some distance from the existing infrastructure. SNH has published guidance on the siting and design of aquaculture²²⁵ to assist developers in integrating landscape and visual issues into the planning and design of aquaculture developments, and this will likely be helpful for seaweed farmers.
- 7.2.20 Given that the potential effects of seaweed cultivation on landscape, seascape and the setting of historic coastal sites will be site-specific, it is not considered that this issue requires to be addressed at the national policy level, for example in spatial terms. However, the Consultation Document notes that environmental considerations, such as visual and coastal impacts, must be taken into account in the planning, siting and design of seaweed farms (reflecting terrestrial and marine planning policy). Future spatial aquaculture plans will also include such considerations.

Benthic Issues

- 7.2.21 The potential effects of seaweed cultivation on benthic habitats and fauna include:
- Benthic shading – due to presence of cultivated seaweed on ropes in the water column, which could potentially affect the composition of benthic communities through inhibiting the growth of photosynthetic organisms and affecting primary production in the water column²²⁶, or through decreasing the amount of light reaching species growing on the seabed (e.g. eelgrass/sea grass²²⁷).
 - Benthic smothering – for example, by fragments released from cultivation ropes, or by sediment trapped as a result of changes to hydrodynamic processes (see Section 5.4).

²²⁵ SNH (2011) The siting and design of aquaculture in the landscape: visual and landscape considerations [online] Available at <http://www.snh.org.uk/pdfs/publications/heritagemanagement/marineaquaculture.pdf> [accessed 20/02/2013]

²²⁶ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical Resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [accessed 20/02/2013]

²²⁷ Fisheries and Oceans Canada (2011) Canadian Science Advisory Secretariat Science Advisory Report 2011/058: Definitions Of Harmful Alteration, Disruption Or Destruction (Hadd) Of Habitat Provided By Eelgrass (*Zostera Marina*) [online] Available at: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2011/2011_058-eng.pdf [accessed 18/02/2013]

- Nutrient enrichment by organic material (e.g. fragments) released from cultivation ropes.
- Habitat loss and/or damage from the installation of infrastructure (e.g. placement of concrete anchoring structures) on the seabed.

7.2.22 The extent and scale of such impacts will depend on several factors, most notably the size of the cultivation development, the infrastructure required, and the sensitivity of the benthos in the vicinity of the proposed cultivation site.

7.2.23 While shellfish-scale cultivation may have local shading, smothering or nutrient enrichment effects, such effects are unlikely to be significant, particularly if appropriately sited. The main risk of such impacts is likely to be associated with large-scale cultivation, both inshore and offshore. There is little information available on this issue, but it is considered significant enough to warrant the inclusion of mitigation in the SPS, focusing on appropriate siting and design of cultivation sites.

Spatial and Siting Issues

7.2.24 There is the potential for conflict between seaweed cultivation and other marine users, largely associated with the potential for collisions and competition for space in the marine environment.

7.2.25 While the available information suggests that commercial activities result in relatively few marine accidents or fatalities (see Section 6.4), the potential for incidents (i.e. collisions with vessels and/or site infrastructure) and safety concerns remain. Navigational issues are dealt with through marine licences and, in consequence, these issues will be managed at the project level. Seaweed farm developers will need to consider such navigational issues when planning and designing development, including the proximity of sites to known recreational areas and the potential for an increase in collision risk.

7.2.26 Shellfish-scale cultivation developments are likely to be located in Scotland's sheltered in-shore waters, for economic and proximity reasons. However, with increased competition for these areas, it is possible that future cultivation sites will be located further away from the coastline (depending on exposure levels). Accordingly, there is the potential for conflict with existing and future marine users in these areas (e.g. shipping, renewables and recreational users), particularly for large-scale inshore and offshore sites, and the Consultation Document therefore includes a requirement that 'other marine users and activities should be considered in the siting of farms'.

Coastal Processes, Storm Protection and Water Quality

7.2.27 As noted in Section 5.4, seaweed can play an important role in coastal processes, by absorbing wave energy. Just as wild seaweed can alter wave patterns with associated impacts on coastal processes and exchange rates, the introduction of cultivated seaweed can also affect these processes^{228,229}. When a wave passes through a marine structure, it interacts with the structure in the same way as any other current, resulting in a loss of energy in the wave as this interaction occurs²³⁰. Such impacts will vary with the species under cultivation and the associated harvesting practices (as set out in paragraph 7.2.8). Seaweed at the shellfish-scale, with a short growing and harvesting period, is unlikely to affect coastal processes significantly. However, seaweed farms with longer growing times and annual (or longer) harvesting regimes have more potential for significant effects, particularly large-scale inshore and offshore farms.

7.2.28 These effects can include:

- Increased sediment deposition in and around the seaweed farm, resulting from decreases in wave energy. This has the potential to alter local coastal processes over the long-term.
- Improved storm protection by cultivating seaweed adjacent to coastal areas that are subject to storm and tidal surges. This could be of benefit for Scotland's vulnerable coastlines, including those identified as being subject to erosion, and those under increasing pressure from the effects of climate change.
- Changes in water flows and nutrient dispersion. This may affect local biodiversity interests by slowing water flows and exchange rates, and changing nutrient supplies. In addition, a new seaweed farm can affect the viability of an existing one, for the same reasons.

7.2.29 The most significant effects are envisaged as arising from medium and extensive-scale cultivation and this will need to be investigated further as this becomes more feasible and the SPS is updated in the future. In the meantime, the Consultation Document notes that coastal processes may

²²⁸ Phillips M.J (1991) Environmental Aspects of Seaweed Culture, FAO Technical Resource Paper [online] Available at: <http://www.fao.org/docrep/field/003/AB728E/AB728E05.htm> [20/02/2013]

²²⁹ Venayagamoorthy S.K., Ku H., Fringer O.B., Chiu A., Naylor R.L. and Koseff J.R. (2011) Numerical modeling of aquaculture dissolved waste transport in a coastal embayment, Environ Fluid Mech DOI 10.1007/s10652-011-9209-0 [online] Available at: http://woods.stanford.edu/sites/default/files/files/Ocean-Salon-Jeff-Koseff-Numerical-20101130_0.pdf. [accessed 13/11/2012]

²³⁰ Forrest B, Keeley N, Gillespie P, Hopkins G, Knight B, Govier D. 2007. Review of the ecological effects of marine finfish aquaculture: final report. Prepared for Ministry of Fisheries. Cawthron Report No. 1285. 71p [online] Available at: http://aquaculture.org.nz/wp-content/uploads/2011/06/Review_of_ecological_effects_of_finfish_farming.pdf. [accessed 14/01/2013]

need to be considered in consenting medium-scale seaweed farms, particularly those located near to shore, depending on local conditions. It is also likely that the work currently underway on spatial planning of aquaculture will also include such considerations.

- 7.2.30 Where existing aquaculture equipment (i.e. fish cages, shellfish ropes) is already present, this is likely to have reduced wave energy levels to a degree, and the addition of cultivated seaweed downstream of the nutrient source may further contribute to these impacts. In some instances, it may create additional effects if located some distance from the existing infrastructure. For new seaweed IMTA developments, the potential cumulative impacts of the system should be considered in the design stage
- 7.2.31 Benefits to local water quality may also occur due to seaweed taking up nitrogen from seawater, a well-documented benefit of macro-algae²³¹. The role of seaweed in this regard may be beneficial for waters subject to high nutrient inputs, including marine and coastal areas near aquaculture sites, diffuse pollution or near waste outflows.

Storm Damage

- 7.2.32 Storm damage has been identified as an issue for finfish aquaculture (e.g. in terms of equipment, escapes and introgression) and, in consequence, the industry has been working to agree a technical specification for equipment to withstand storm damage. Seaweed cultivation, including IMTA, will similarly need to be able to withstand storm damage.
- 7.2.33 As well as affecting equipment, storms can also affect the cultivated seaweed itself. For example, in calm conditions, seaweed fragments may be released into the water column and settle on the seabed and/or along coastlines. During storm conditions, however, large increases in driftweed volumes, potentially whole plants or groups of plants, may occur. These may be transported away from the cultivation site by the prevailing currents, and be washed up on the shoreline as cast weed.
- 7.2.34 This may have benefits (increased beach stabilisation, improved sand dune development) and could contribute to the creation of stable shoreline habitats, attracting a range of species that live and feed amongst the cast weed (see Section 5.4), whilst also increasing cast weed for 'gathering' by crofters (see Section 8.1). However, the decomposition of cast weed within two or three days of becoming washed up along the high tide line is

²³¹ Sanderson J.C (2009) Bioremediation Using Seaweed Culture: Reducing the Environmental Impact of Sea-Cage Fish Farming Through the Cultivation of Seaweed, VDM Verlag Dr. Muller Aktiengesellschaft and Co. KG.

often considered to reduce the aesthetic quality of the beach and can be seen as a nuisance, especially in areas of high tourist value²³².

- 7.2.35 Derelict fishing gear, including nets, lines and floats amongst others, makes up around 9% of coastal marine litter in Scotland²³³. Accordingly, the Consultation Document identifies the need to ensure that equipment used in seaweed cultivation be 'fit for purpose' to prevent damage from adverse weather conditions, thereby reducing potential risks of farm equipment (i.e. ropes, buoys, etc.) washing up in coastal areas or creating navigational hazards for other marine users or wildlife.

Summary

- 7.2.36 While seaweed cultivation and IMTA are in their infancy in Scotland, the potential for a number of significant impacts on the marine environment has been identified, particularly for Scotland's sensitive or vulnerable marine and coastal ecosystems. The nature of these impacts relates largely to the key role that Scotland's natural seaweeds play in these ecosystems and in coastal areas, and the national and international value attributed to the habitats that they service.
- 7.2.37 In general terms, shellfish-scale or IMTA cultivation is considered much less likely to result in significant environmental impacts than larger-scale development if appropriately sited and designed (i.e. benthic impacts, collision risk, navigational issues), while offshore development may overcome many of the potential issues (i.e. spatial siting, coastal impacts, etc.) identified for near-shore developments. Many of the potential impacts identified from the introduction of cultivation operations are likely to be site-specific, and as such, will be largely dependent on both design factors (i.e. the scale of the development, infrastructure, etc.) and environmental factors (i.e. location, water depth, the composition and resilience of the areas proposed for development). Importantly, the need to consider and assess environmental issues associated with future developments at the project level was identified.
- 7.2.38 The SPS is being developed to promote Marine Scotland's aspirations that growth in this industry is both sustainable and not at the expense of the wider marine environment. As such, it will likely contribute to overall positive environmental effects for biodiversity and water quality, particularly in relation to IMTA. In particular, the Scottish Government's support for the use of seaweeds of native provenance in cultivation to preserve genetic integrity of natural seaweeds, use of fit-for-purpose

²³² DOENI (2007) Environmentally Sustainable Seaweed Harvesting in Northern Ireland [online] Available at: www.doeni.gov.uk/niea/seaweedharvestingniehspositionstatement.pdf [accessed 14/01/2013]

²³³ Potts, T. and Hastings E. (2011) Marine Litter Issues, Impacts and Actions, Prepared for the Macaulay Land Use research institute, SAMS and Marine Scotland [online] Available at: <http://www.scotland.gov.uk/Resource/0040/00402421.pdf> [accessed 20/8/2013]

equipment and consideration of other marine users to address potential siting conflicts are likely to be the most relevant and beneficial in addressing the issues identified in this SEA.

- 7.2.39 However, it is noted that while the proposed SPS will encourage the sustainable development of seaweed cultivation and IMTA, and potentially create additional interest in the industry, the industry itself will play an important role in driving its future growth and managing the site selection process under the existing regulatory framework. As such, it is considered that the realisation of any benefits promoted by the SPS and this SEA, particularly those associated with IMTA, will be subject to the willingness of the aquaculture industry to drive these practices.

7.3 The Consultation Document and the Proposed SPS

- 7.3.1 The Consultation Document outlines Marine Scotland's support for shellfish-scale cultivation seaweeds, both as a single enterprise or as part of IMTA systems. This support is conditional, with the document detailing a series of policies stating that only seaweeds native to the area of cultivation should be cultivated, fit-for-purpose equipment should be used in cultivation operations to prevent damage in adverse weather conditions, and that consideration should be given to other marine users and marine activities in the siting of these operations. It also states that where seaweed is grown for human consumption, cultivators should site farms away from sewage outfalls and other potential sources of pollution.

- 7.3.2 Marine finfish aquaculture is spatially limited to the west coast of Scotland, the Western Isles, Shetland and Orkney and, in consequence, the cultivation of seaweed in IMTA will be similarly limited. The Consultation Document details no other spatial limitations.

It also sets out Marine Scotland's view that applications for medium-scale seaweed farms (i.e. 41 to 80 x 200m lines of seaweed) should demonstrate that mitigation measures have been considered to prevent adverse environmental impacts. While the Consultation Document does not detail a policy position on extensive-scale developments (i.e. for use in biofuel production) as this sector is currently in the research and investigation stage of development, it is intended that should this sector progress and develop in the future, the development of policy will be revisited at that time.

7.4 Mitigation

- 7.4.1 The environmental issues identified by the SEA are such that very few issues need to be addressed at the national level. The SEA found that many such impacts and benefits were likely to be site and activity specific, and would benefit from being addressed at the regional or project level.

- 7.4.2 Issues that do require treatment in the proposed SPS were considered to include the preservation of genetic integrity, conflicts with other marine users, and risks associated with storm damage. The Consultation Document has been developed to identify and mitigate potential environmental issues. As such, the broad policies outlined in the Document have been progressively developed alongside the SEA to address these issues at the national level, whilst promoting their consideration in future applications for seaweed cultivation and IMTA.
- 7.4.3 Issues to be addressed at the regional and project level include risks to aquatic fauna, coastal processes, benthic issues, water quality and ecosystem and shoreline biodiversity, and visual issues. Activity-specific factors such as the size and scale of cultivation operations, the proximity to other marine activities or to sensitive marine areas, the type of species cultivated, and harvesting techniques are also likely to have an influence on these issues. Site-specific and environmental factors such as wave patterns, coastal processes, ecosystem composition and species sensitivity will also likely exert influence over the occurrence and extent of impacts from seaweed cultivation operations.
- 7.4.4 Individual projects will need to be progressed to planning and consenting in light of the policies contained in the draft NMP, future Regional Marine Plans, and in local development plans and/or supplementary guidance relating to aquaculture. Siting and design work at the project level will wish to front-load these considerations.

8 Commercial Harvesting of Wild Seaweeds

8.1 Current Situation

In Scotland

- 8.1.1 Scotland's wild seaweed 'production' is currently based around the harvesting and picking of wild seaweed stocks on Orkney, Shetland and the Western Isles, with only a small number of small-scale operations in these areas²³⁴. This industry is estimated to make up only a small part of the European market²³⁵.
- 8.1.2 Scottish operators 'harvest' a range of wild brown, red and green seaweed stocks, although the main type harvested is egg wrack (*Ascophyllum nodosum*)²³⁶ with around 5,000 tonnes of wild plants harvested from intertidal waters in the Western Isles each year²³⁷. Smaller volumes of saw wrack (*Fucus serratus*)²³⁸, and kelp in Orkney²³⁹ and Shetland²⁴⁰ are also harvested on a smaller-scale. Other activities, such as the commercial scale extraction of the rich lime resource in maerl, have been proposed in the Western Isles in the past but have not been taken forward²⁴¹.
- 8.1.3 'Picking' is a term given to the small-scale removal of smaller species, typically red seaweeds, that live at the top of the shore. Smaller seaweed species such as carrageens (i.e. *Matocarpus stellatus* and *Chondryus crispus*), the channel wrack (*Pelvetia canaliculata*), dulse (*Palmaria*

²³⁴ SNH (2012) Seaweed Harvesting [online] Available at: <http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/seaweed-harvesting/> [accessed 26/06/2013]

²³⁵ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²³⁶ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

²³⁷ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²³⁸ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

²³⁹ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁴⁰ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Produced for the Scottish Government, 12 December 2012.

²⁴¹ SNH (2012) Maerl – a rocky seaweed [online] Available at: <http://www.snh.gov.uk/about-scotlands-nature/species/algae/marine-algae/maerl/> [accessed 10/10/2012]

palmate and *Dilsea spp.*), pepper dulse (*Laurencia spp.*) and laverbread (*Porphyra spp.*) are also picked commercially in Scotland²⁴².

- 8.1.4 An unknown quantity of cast seaweed is 'gathered' from the shore in many of Scotland's island communities, for use as a soil conditioner or fertiliser. The Crofters (Scotland) Act 1993 (as amended) gives crofters access to reasonable use of seaweed under Common Grazings regulations, although it is understood that this is largely confined to the gathering of beach-cast *Laminaria spp.* and other species mixed with it for spreading on machair land in the Western Isles²⁴³. As such, little information is available about the extent or size of such gathering.

Seaweed Uses

- 8.1.5 Brown seaweeds such as *A. nodosum*, *Laminaria saccharina* and *Macrocystis spp.* have been harvested for use as alginates, liquid fertilisers and pharmaceutical production²⁴⁴. *A. nodosum* has also been used as an ingredient in animal feedstuffs and fodder supplement.
- 8.1.6 Red seaweeds, such as *C. crispus*, *Mastocarpus stellatus*, *Porphyra spp.*, have been harvested and used as additives in food products and in the pharmaceutical industry. *Gracilaria spp* and *Gelidium spp* have been used to produce Agar, an extract used in cell culture²⁴⁵.
- 8.1.7 Green seaweeds have traditionally been harvested for human consumption, albeit on a smaller scale than brown and red seaweeds.

Current Permissions

- 8.1.8 At present, wild harvesting or picking of seaweed in Scotland does not require planning permission or a licence/permit, other than the permission of the land-owner. In cases where TCE is the landowner, licences for wild harvesting operations are issued to operators, and this can involve the consideration of the following environmental factors²⁴⁶:
- Impacts on the sustainability of wild seaweed stocks and associated habitats and species supported.
 - Potential implications for coastal processes.

²⁴² SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Produced for the Scottish Government, 12 December 2012.

²⁴³ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Produced for the Scottish Government, 12 December 2012.

²⁴⁴ SNH (2012) Seaweed Harvesting [online] Available at: <http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/seaweed-harvesting/> [accessed 10/10/2012]

²⁴⁵ Comhairle nan Eilean Siar (undated) Economic Appraisal - Markets For Seaweeds And Associated Products [online] Available at : <http://www.cne-siar.gov.uk/minch/seaweed/seaweed-04.htm> [accessed 20/02/2013]

²⁴⁶ Adrian A. (2012) Email sent to Fiona Watt, 10th October 2012.

- Use of harvesting methods and frequency including the proportion of individual plant or plant population to be harvested.
- The particular species and the proposed area for harvesting.
- Proposed use of rotational fallowing and harvesting regimes.
- Adoption of monitoring programmes.

Harvesting Methods

- 8.1.9 Natural seaweed beds have historically been overexploited globally, often with the use of equipment such as dredges and dragnets²⁴⁷. In Scotland, hand cutting has previously been the most common method of harvesting in the wild²⁴⁸, with tools such as serrated sickles or scythes used from the rocks at low tide²⁴⁹. Anecdotal evidence indicates that this method is still being used today.
- 8.1.10 Mechanical harvesting has also been used in Scottish water where the seaweed and harvest area are amenable to such methods²⁵⁰. Mechanized harvesting methods vary, and can involve mowing seaweed areas with rotating blades, cutting seaweed plants with suction methods, and dredging of areas with cutters. Modern harvesting vessels have been specifically developed for these purposes²⁵¹, although harvesting methods vary. For example, some harvesting operators use boats to access harvest areas, and then use mechanized tools to target seaweed floating on the water surface. Others use mechanised equipment to cut the top of the plant stalks as they float beneath the water surface²⁵².

²⁴⁷ Titlyanov E.A. and Titlyanova T.V. (2010) Seaweed Cultivation: Methods and Problems, Russian Journal of Marine Biology, 2010, Vol. 36, No. 4, pp. 227 – 242.

²⁴⁸ Burrows M.T, MacLeod M, Orr K (2011) Scottish Association for Marine Science Internal Report No. 269, Mapping the intertidal seaweed resources of then Outer Hebrides, Prepared by SAMS and the Hebridean Seaweed Company, Prepared for Highlands and Islands Enterprise and Scottish Enterprise, 45pp.

²⁴⁹ Scottish Executive (2001) Flora Celtica: Sustainable Development Of Scottish Plants [online] Available at: www.scotland.gov.uk/Resource/Doc/156712/0042122.pdf [accessed 10/10/2012]

²⁵⁰ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁵¹ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁵² Hebridean Seaweed Company (undated) Harvesting Practices and the Manufacturing Process-Mechanical Harvesting [online] Available at: <http://www.hebrideanseaweed.co.uk/harvesting-theprocess.html> [accessed 06/02/2013]

Impacts of Harvesting on Plant Regrowth

- 8.1.11 Regrowth of a plant or group of plants after harvesting can vary depending on a range of factors:
- The species harvested.
 - The proportion of a plant harvested.
 - The age of the plant.
 - The extent and pattern of branching.
 - The level of exposure to waves and coastal processes.
 - The presence or absence of grazers.
- 8.1.12 From the perspective of an individual plant, the method of harvesting is important to plant regeneration. Harvesting techniques vary and can range from the removal of a whole plant at the holdfast, to cutting of the blades of the plant above the holdfast²⁵³. Many species, such as *A. nodosum*, can regenerate quickly if the frond is not cut back to the rock with some studies suggesting that cutting of the blades around 36 cm above the holdfast does not adversely impact on regrowth in this species²⁵⁴. The removal of a plant in its entirety or close to the holdfast is unlikely to permit regrowth of an individual plant. This may allow for the natural recolonisation of the harvested area by new plants, whether they be of the same or a different species²⁵⁵.
- 8.1.13 The rate of regeneration and community regrowth can also vary by species. For example, mature kelp forests normally contain an understory vegetation of recruits that can recolonize an area once the adult plants are harvested²⁵⁶, and the recolonisation may also be influenced by how successfully invertebrates are able to re-establish themselves in the community²⁵⁷ and grazing pressures²⁵⁸.

²⁵³ James, M.A., (2010) A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/295194/0115064.pdf> [accessed 28/06/2013]

²⁵⁴ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

²⁵⁵ Kelly L, Collier L, Costello M.J, Diver M, McGarvey S, Kraan S, Morrissey J and Guiry M.D (2001) Marine Resource Series No. 19 (2001) Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity [online] Available at: www.irishseaweed.com/documents/r19.pdf [accessed 11/10/2012]

²⁵⁶ Kelly, E. (ed.) (2005) The role of kelp in the marine environment. *Irish Wildlife Manuals*, No. 17, National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland [online] Available at: <http://www.npws.ie/marine/marinereports/IWM17.pdf> [accessed 28/06/2013]

²⁵⁷ Burrows M.T, MacLeod M, Orr K (2011) Scottish Association for Marine Science Internal Report No. 269, Mapping the intertidal seaweed resources of then Outer Hebrides, Prepared by SAMS

- 8.1.14 Several studies into the impacts of harvesting techniques and regeneration of seaweeds have observed changes in the composition of seaweed communities after harvesting. An Irish study observed short-term increases in cover of some macro-algae species, particularly opportunistic and fast-growing species such as *Fucus vesiculosus*, after the mechanical harvesting of the targeted seaweed species (i.e. *A. nodosum*). These changes are often temporary until the targeted and harvested species has undergone sufficient regrowth²⁵⁹.

Lessons Learned

- 8.1.15 Several countries have adopted protocols and/or regulations to address sustainability and environmental concerns held over wild harvesting. These include:
- In Norway, harvesting is conducted under harvest plans that outline areas for harvest rotation over a five-year period with specific no-take zones developed for the protection of seabird habitats. In these plans, only one-fifth of seaweed in these harvest areas is harvested every year, allowing the seaweed community in these areas four years of regrowth before being harvested again²⁶⁰.
 - In France, seaweed harvesting is regulated by the French Government and the National Syndicate of Marine Algae, a group consisting of representatives from the industry, fishermen and scientific advisers. Licensing of boats for harvesting of specific species (i.e. *L. digitata*), restrictions on seaweed landings, and regulation of harvesting times are imposed to allow for the growth, reproduction and regeneration of wild stocks²⁶¹.
 - The Environment and Heritage Service of Northern Ireland (EHSNI) prepared a position statement and a Draft Environmentally

and the Hebridean Seaweed Company, Prepared for Highlands and Islands Enterprise and Scottish Enterprise, 45pp.

²⁵⁸ Kelly L., Collier L. Costello M.J., Diver M., McGarvey S., Kraan S., Morrissey J. and Guiry M.D. (2001) Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity, Marine Resource Series No. 19 (2001) Prepared by Irish Seaweed Industry Organisation for the Marine Fisheries Services Division [online] Available at: <http://www.irishseaweed.com/documents/r19.pdf> [accessed 21/02/2013]

²⁵⁹ Kelly L., Collier L. Costello M.J., Diver M., McGarvey S., Kraan S., Morrissey J. and Guiry M.D. (2001) Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity, Marine Resource Series No. 19 (2001) Prepared by Irish Seaweed Industry Organisation for the Marine Fisheries Services Division [online] Available at: <http://www.irishseaweed.com/documents/r19.pdf> [accessed 21/02/2013]

²⁶⁰ Norwegian Directorate of Fisheries (2012) Marine Protected Areas [online] Available at: <http://www.fiskeridir.no/english/fisheries/marine-protected-areas> [accessed 10/10/2012]

²⁶¹ Werner A. and Kraan S. (2004) Review Of The Potential Mechanisation Of Kelp Harvesting In Ireland, Marine Environment and Health Series, No. 17, 2004, Prepared for Marine Institute and Taighde Mara Teo [online] Available at: http://www.seaweed.ie/irish_seaweed_contacts/doc/No%2017%20Marine%20Environment%20and%20Health%20Series.pdf [accessed 18/02/2013]

Sustainable Seaweed Harvesting Code of Conduct (CoC)²⁶². The position statement outlines the preference for manual harvesting over mechanical means on the basis that it is less ecologically damaging, and adoption of practices such as the preparation of pre-harvesting plans, site-specific baseline reports, rotation cycles, hand harvesting methods for specific species, and use of harvesting records by operators²⁶³.

- In Canada, several provinces regulate commercial harvesting in the wild via leases. Those involved in the actual harvest of seaweed must have a valid licence issued by Fisheries and Oceans Canada. These licences and leases detail a series of conditions for harvesting operations and can include stipulations that harvesting be undertaken by hand, limits on the species harvested, where a plant can be cut and how many plants in a given area can be harvested^{264,265}. Licensed operators have also reverted from Norwegian-type mechanical harvesting to hand cutting and a rake-type method of harvesting kelp following over-exploitation of kelp beds by mechanical means in the early 1990s²⁶⁶.

8.2 Environmental Effects

8.2.1 The potential impacts of wild seaweed harvesting identified in this SEA are divided into two broad groups:

- Over-harvesting and Harvesting Practices.
- Impacts on Coastal Processes from Wild Harvesting.

8.2.2 These impacts are illustrated in Figure 8.1 and the likelihood and significance of these effects is discussed in the following paragraphs.

²⁶² EHSNI (2006) Comments For FIDC On The Environment And Heritage Service's Sustainable Seaweed Harvesting Workshop [online] Available at: www.ukfit.org/reports/Sustainable%20Seaweed%20Harvesting.pdf [accessed 21/02/2013]

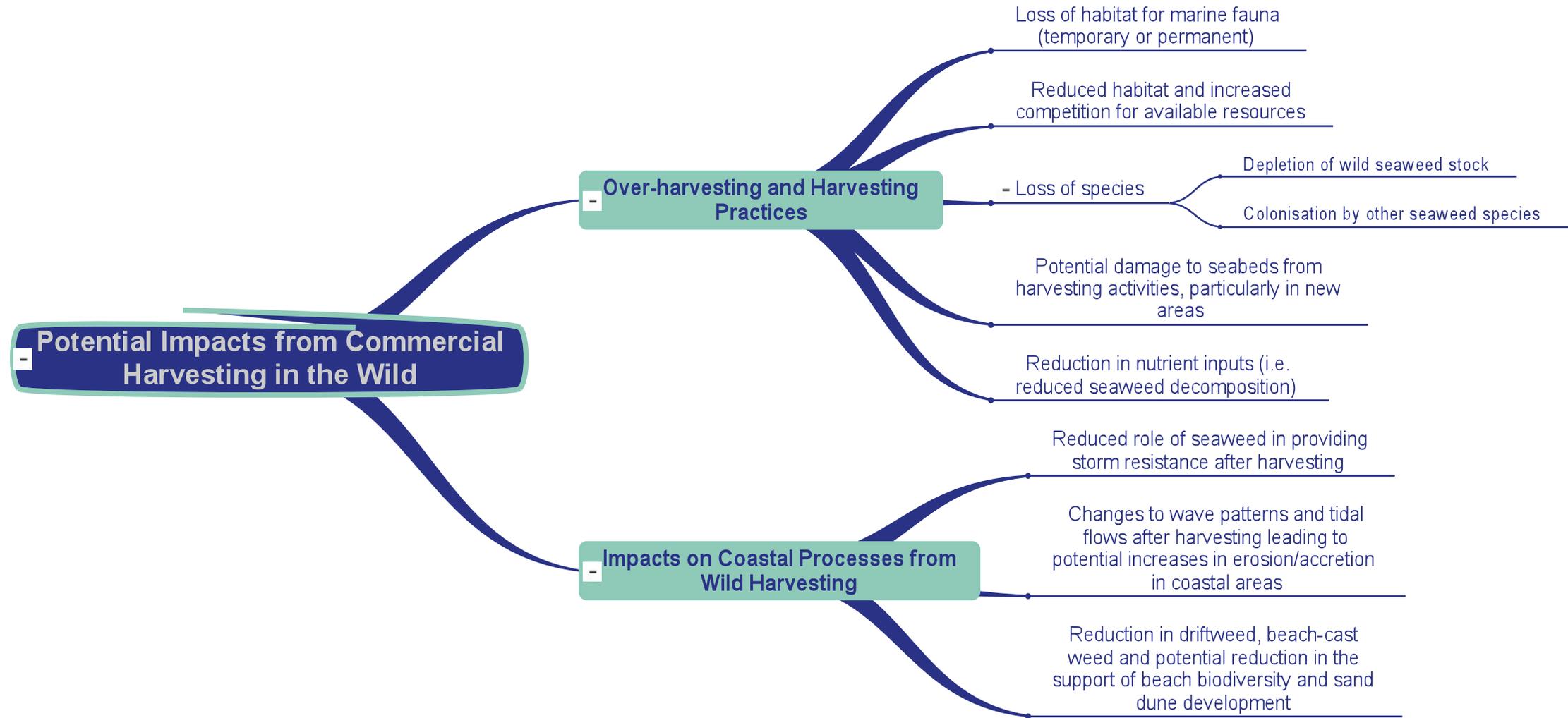
²⁶³ DOENI (2007) Environmentally Sustainable Seaweed Harvesting in Northern Ireland – March 2007 [online] Available at: www.doeni.gov.uk/niea/seaweedharvestingniehspositionstatement.pdf [accessed 28/06/2013]

²⁶⁴ British Columbia Ministry of Agriculture (undated) Commercial Fisheries: Harvest of Marine Plants in British Columbia [online] Available at: http://www.agf.gov.bc.ca/fisheries/commercial/commercial_mp.htm [accessed 19/02/2013]

²⁶⁵ Nova Scotia Fisheries and Aquaculture (2011) Rockweed Lease [online] Available at: <http://www.gov.ns.ca/snsmr/paal/fish/paal189.asp> [accessed 19/02/2013]

²⁶⁶ Sharp G.J, Ang Jr J. and MacKinnon D (1994) Rockweed (*Ascophyllum nodosum* (L.) Le Jolis) harvesting in Nova Scotia: its socioeconomic and biological implications for coastal zone management. *Proc. Coastal Zone Canada* 94: 1632-1644.

Figure 8.1: Potential Impacts for Commercial Wild Harvesting of Seaweed



Loss of Seaweed Stocks and Habitats for Marine Fauna

- 8.2.3 Factors such as the frequency, magnitude and seasonality of harvesting activities can all influence the ecological impacts of seaweed harvesting operations²⁶⁷ (see Section 8.1). The main risk in expanding wild harvesting in Scotland is likely to be over-harvesting and the use of harvesting practices that impair the regeneration capability of seaweed communities (i.e. removal of plants at or close to the holdfast). These can lead to significant changes in the composition of the seaweed communities (i.e. fewer species or changes in species proportion) and have secondary impacts on the marine ecosystems that they inhabit (i.e. adverse impacts on biodiversity of marine fauna).
- 8.2.4 Studies into the effects of intensive harvesting (i.e. near-total removal of plants from an area) indicate that significant changes such as reductions in both seaweed numbers and animal abundance can occur²⁶⁸. By contrast, the regeneration of some species and seaweed communities can be comparatively quick and successful if harvesting is appropriately undertaken. Frequent harvesting of the same natural seaweed communities, even if just a proportion of the plant is harvested, may limit effective regrowth and contribute to long-term loss of habitat in consequence and adversely affect future harvest yields. Several countries (i.e. Canada and Norway) have set limits on harvesting in the wild, including measures such as setting protected areas, five-year harvest cycles, and rotation of harvest areas (see Section 8.1.15).
- 8.2.5 Harvesting of wild seaweed stocks may also lead to a range of secondary effects, including:
- Increased susceptibility of marine fauna to predation.
 - Greater susceptibility of marine fauna and seaweed communities to wave effects.
 - Scouring through loss of cover.
- 8.2.6 In the short-term, increased predation and greater susceptibility to wave patterns can be a consequence of harvesting simply due to a loss in seaweed cover. In the longer-term, regular seaweed harvesting can reduce the structural diversity of a marine community, with seaweed beds gradually changing from complex to more simple structures. Over time,

²⁶⁷ Vasquez J.A. (1995) Ecological Effects of Brown Seaweed Harvesting, *Botanica Marina*, 1995, Vol. 38, Pt. 3, pp. 251 – 257.

²⁶⁸ Kelly L, Collier L, Costello M.J, Diver M, McGarvey S, Kraan S, Morrissey J and Guiry M.D (2001) Marine Resource Series No. 19 (2001) Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity [online] Available at: www.irishseaweed.com/documents/r19.pdf [accessed 11/10/2012]

and with the added effects of predation, this could lead to further changes in community structures²⁶⁹.

Increased Competition for Resources

- 8.2.7 A reduction in natural seaweed volumes after harvesting of a given area would likely see reductions in nutrient inputs from seaweed, if only over the short-term. This could create increased competition amongst flora and fauna for fewer resources²⁷⁰, with potentially adverse effects for some species, particularly those that are vulnerable.

Loss of Seaweed Species

- 8.2.8 The potential for over-harvesting of Scotland's seaweed communities may create opportunities for invasive non-native species, such as *S. muticum*²⁷¹, to spread and colonise in Scottish waters via transport or dispersal in water currents²⁷².
- 8.2.9 In general terms, non-native species are considered to present a significant threat to Scotland's marine biodiversity and economy²⁷³. This could potentially be exacerbated by other factors including the predicted effects of climate change (i.e. milder sea temperatures) and our adaptation to them (i.e. likely increases in marine shipping) which could contribute to altering of the composition of seaweed communities by creating conditions suitable for non-native species to spread and survive in Scottish waters²⁷⁴. Given the important role that seaweeds play in supporting Scotland's many varied marine ecosystems, the potential also exists for adverse effects on marine biodiversity.

Potential Damage from Harvesting Activities

- 8.2.10 The potential may also exist for additional impacts from undertaking harvesting activities, including:

²⁶⁹ Kelly L, Collier L, Costello M.J, Diver M, McGarvey S, Kraan S, Morrissey J and Guiry M.D (2001) Marine Resource Series No. 19 (2001) Impact Assessment of Hand and Mechanical Harvesting of *Ascophyllum nodosum* on Regeneration and Biodiversity [online] Available at: www.irishseaweed.com/documents/r19.pdf [accessed 11/10/2012]

²⁷⁰ Ministry for Primary Industries (2010) Harvest Management Measures To Support The Introduction Of Attached Bladder Kelp Stocks (KBB3G, KBB4G) Into The QMS [online] Available at: http://www.fish.govt.nz/NR/rdonlyres/C04D6279-4EB1-41E2-AD0F-C588D96C0C9D/0/BKelp_KBB3G_KBB4G_HarvestMgmtMeasures_IPP.pdf. [accessed 12/10/2012]

²⁷¹ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 138.

²⁷² JNCC (2012) Non-native Species [online] Available at: <http://jncc.defra.gov.uk/default.aspx?page=1532> [accessed 14/02/2013]

²⁷³ Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan, Scottish Government, pg 138.

²⁷⁴ Environment and Heritage Service (2006) Comments For FIDC On The Environment And Heritage Service's Sustainable Seaweed Harvesting Workshop [online] Available at: <http://www.ukfit.org/reports/Sustainable%20Seaweed%20Harvesting.pdf> [accessed 11/10/2012]

- Harvesting methods, particularly relating to the use of mechanised systems.
- The capture or injury to non-targeted species (i.e. by-catch).

8.2.11 The extent and scale of such impacts will depend on several factors, most notably the harvesting equipment used, the nature and sensitivity of the benthos in the vicinity of the harvesting site, and the species being harvested. For example, harvesting of species with generally low biodiversity, such as *A. nodosum*, is likely to contain smaller levels of by-catch than other seaweed species known to host greater biodiversity²⁷⁵.

8.2.12 However, the extent of by-catch from harvesting of seaweed in the wild, and its significance is not presently known. It is noted that discussion with the industry through the consultation may assist in informing this assessment.

Storm Protection and Coastal Processes

8.2.13 The removal of seaweed could potentially alter wave patterns and impact on coastal processes, and affect the stability of nearby coastlines, particularly those susceptible to erosion or accretion. It can increase the susceptibility of coastlines to impacts from storm events, particularly the high energy coasts located in Scotland's Western Isles where the role of *L. Hyperborea* in the Western Isles has been documented in providing important ecosystem services such as the reduction of wave energy²⁷⁶. Potential changes to coastal processes are considered by The Crown Estate in granting individual leases for harvesting in the wild²⁷⁷ (see Section 8.1), and this should not change under the proposed SPS.

8.2.14 It is noted that the predicted effects of climate change may place greater importance on the ecosystem services provided by seaweed communities, particularly in relation to wave dissipation and the protection of coastal areas from erosion. Predicted increases in sea level, increased frequency of storm surges and larger waves have the potential to significantly alter the coastline shape and the depth of near-shore areas, which could have associated impacts on the distribution and abundance of seaweed in these areas.

Coastal Biodiversity and Stabilisation

8.2.15 The removal of wild seaweed stocks through harvesting may lead to a reduction in the deposition of cast-weed on nearby beaches. This could result in secondary effects, including a reduction in the availability of

²⁷⁵ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

²⁷⁶ SNH (2012) Seaweed Harvesting and Gathering in Scotland: the Legal and Ecological Context, Report Prepared for the Scottish Government, 12 December 2012.

²⁷⁷ Adrian A. (2012) Email sent to Fiona Watt, 10th October 2012.

beach-cast weed for gathering at nearby locations, and reduction in the supporting services that cast weed provides for shoreline biodiversity and the sand dune development process.

Summary

- 8.2.16 Scotland's natural seaweeds are an important resource. However, sustainable management is not straightforward and experiences in other countries indicate the importance of implementing sustainable practices to avoid adverse impacts on both the local and wider marine communities, and demonstrate their successful implementation.
- 8.2.17 There is presently no evidence that seaweed harvesting in the wild is currently resulting in adverse environmental impacts in Scotland. However, the SEA has identified that the adverse effects are possible with the future growth of this industry, particularly relating to marine biodiversity and coastal processes, and that this may be further exacerbated in the future with the predicted effects of climate change.
- 8.2.18 Harvesting practices, most notably the extent and scale of harvesting (i.e. frequency of harvesting, the proportion of a seaweed community harvested, and the proportion of an individual plant harvested) and the species harvested have been identified as key factors in ensuring plant regeneration and recovery of harvest areas, and ensuring the sustainability of the resource and the biodiversity it supports. Many of the potential impacts are likely to be site-specific and will be largely dependent on the composition and resilience of the areas to harvesting.
- 8.2.19 It is considered that engagement with the commercial wild harvesting industry and stakeholders on a number of topics (i.e. regulation of the industry, assessment of environmental impacts for proposed wild harvesting operations) may prove beneficial in promoting sustainable development in the future growth of the industry.

8.3 The Consultation Document and the Proposed SPS

- 8.3.1 Scotland's current operations for the commercial harvesting of seaweed in the wild are small in scale and are not currently regulated. The practice of commercial harvesting in the wild has been reviewed in this SEA to inform the SPS development through the identification of potential impacts of these practices that may be associated with the future growth of this industry.
- 8.3.2 While the consideration of harvesting in the wild in the proposed SPS is currently limited, the Consultation Document raises these issues and provides a vehicle to consult with stakeholders on options such as development of guidance and promoting good practice in managing the future sustainability of the industry.

8.4 Mitigation

- 8.4.1 While harvesting operations, by their very nature, are likely to result in a degree of impact at the local level, the scale and permanence of any impacts is likely to be limited if these activities are undertaken in a sustainable manner. As such, it is not considered that expansion of the wild harvesting industry is likely to have significant adverse effects on the marine and coastal environments at the national level, provided adequate mechanisms are in place to prevent over-harvesting and ensure sustainable harvesting practices are implemented by industry operators.
- 8.4.2 Many of the potential environmental impacts identified in this SEA are likely to be both site and operation specific. Factors such as wave patterns, coastal processes, ecosystem composition and sensitivity, species harvested, scale of harvesting operations, the proximity to sensitive marine areas, and harvesting techniques are likely to exert influence over the occurrence and extent of any such impacts. The potential benefit in identifying likely adverse impacts has been noted from undertaking project level and ecosystem-based environmental assessment of prospective wild harvesting or picking operations. As such, this has been raised in the consultation to gauge stakeholder views.
- 8.4.3 The SEA also identified potential benefits in the development of guidance, such as a Code of Practice (CoP), for commercial harvesting in the wild for promoting the use of sustainable practices, particularly for new operators entering this industry. As such, the SEA prompted the inclusion of the development of guidance as an option for discussion in the Consultation Document.
- 8.4.4 Whilst not necessarily in the remit of the proposed SPS or this SEA, the potential for benefits in aiding coastal protection and reducing the gathering of cast weed on Scotland's beaches (through education on the role of beach-cast weed to coastal ecosystems in stabilisation and supporting biodiversity) was also identified.

9 Alternatives

Reasonable Alternatives

- 9.1.1 At its initiation, several alternative focuses of the proposed SPS were considered. These broad and high-level scenarios were based around the different sectors within the seaweed industry, and a fourth based around an industry-lead scenario under the current regulatory framework.
- 9.1.2 The consideration of taking a 'hands-off' approach in preference to development of the proposed SPS was made at the initiation stage, and involved evaluating the very need for a policy statement. This assessment identified that the industry itself would remain a key driver of growth regardless of the development of an SPS. However, it was also considered that taking a 'hands off' approach was not likely to engage with industry, nor would it address the objectives of encouraging the industry or inform potential developers of the Scottish Government's expectations for applications (i.e. sustainable development and the importance of identifying and mitigating any potential environmental impacts). It found that this option may miss the opportunity to pro-actively manage the growth of the industry and any associated potential environmental effects.
- 9.1.3 Much like the assessment itself, consideration of these alternative scenarios found that while there was some commonality, each sector brought its own positives and negatives. The main commonality was the key theme of sustainable development in industry growth being a shared thread across each of the sectoral scenarios. However, the consideration of these alternatives found that narrowing the focus towards one sector would likely miss the realisation of potential benefits associated with the other sectors. For example, focusing the SPS and its Consultation Document on large-scale seaweed cultivation would likely miss opportunities to expand IMTA and realise the potential benefits that it may provide. Similarly, an opportunity to explore future options for growing the existing industry based around commercial harvesting in the wild would also be missed.
- 9.1.4 The timescales associated with each scenario were also considered. The first scenario was considered likely to be a long-term possibility, with a high degree of uncertainty over realisation. The SEA baseline assessment identified that the alternatives based around focusing on IMTA or commercial harvesting in the wild were more aligned to short-term realisation, with these industries either already in operation or in the process of being trialled. As such, these alternatives were considered to be more immediate, and this led to the adoption of a staged approach in the development of the SPS.

- 9.1.5 Consideration was given to inclusion of personal harvesting of seaweed in the wild (i.e. picking) and gathering of beach or rock-cast weed in the SPS development process. However, as this practice is considered to be smaller in scale and largely undertaken on an ad hoc basis, it is considered unlikely to result in significant environmental effects. Further, the alternatives assessment found that the inclusion of these practices was unlikely to be manageable at present.

Other Options for Consideration

- 9.1.6 The consideration of broad options as provisions in the Consultation Document was also undertaken during the SPS development process. The first option involved the consideration of the value of introducing spatial elements into the SPS, specifically spatial limitations on industry development and 'no-go' areas. Benefits in mitigating the potential for significant adverse impacts to marine biodiversity that were identified in the SEA were acknowledged; although it was also considered that insufficient information on these possible impacts is available at present. Spatial elements relating to the potential for siting issues and competition for space are likely to be important for the medium to extensive-scale cultivation of seaweed, and the SPS will need to be updated to review this once more information becomes available. Spatial considerations have been included in the SEA (Section 7.2).
- 9.1.7 The management of industry growth at lower level PPS was also considered. The SEA identified the site-specific nature of the potential impacts of seaweed cultivation and commercial wild harvesting operations, and it found that many of the environmental issues identified may potentially be managed at the project planning and design level. The potential for a role for addressing these operations at the Regional Marine Planning level was also identified.
- 9.1.8 It was considered that at present, many of the issues identified in this SEA would likely be addressed under the existing regulatory framework (i.e. Crown Estate lease and Marine Licensing approvals). Given the high-level focus of the proposed SPS and its Consultation Document, these spatial and site-specific aspects were not considered suitable for inclusion at the present time. However, in accordance with the staged approach to industry growth set out in the Consultation Document, these options have been noted for future consideration.

10 Cumulative and Synergistic Effects

- 10.1.1 The Environmental Assessment (Scotland) Act 2005 requires the consideration of cumulative and synergistic effects that may arise, in this case, from the implementation of the policies outlined in the Consultation Document in conjunction with other plans, programmes and policies, including those of TCE. Table 10.2 provides a summary of the likely effects of the proposed SPS relating to seaweed cultivation, IMTA and commercial harvesting in the wild on the environmental topic areas presented in the environmental baseline, and how these are likely to act together.
- 10.1.2 Together, the proposed SPS and other overarching PPS will likely contribute to overall positive environmental effects, particularly for biodiversity and water quality. The provisions in the Consultation Document have been developed to largely complement existing policy and planning, and add weight to their consideration in the context of the seaweed cultivation and wild harvesting industries. The principles of sustainable development and protection of Scotland's marine environment demonstrated in the Consultation Document are also key threads of wider Scottish policy (e.g. the National Marine Plan, Scottish Biodiversity Strategy).
- 10.1.3 The proposed SPS is also likely to aid industry in developing a better understanding on expectations for future applications in relation to seaweed cultivation, and in this regard, should further complement the current application process for the industry and Marine Scotland, mainly by improving efficiency and understanding for both. Whilst included as a condition in previous marine licenses issued for seaweed cultivation, the inclusion of a provision in the Consultation Document for the use of seaweed in cultivation operations that are native to the cultivation area adds further weight to this topic. It reflects wider policy objectives in conserving, and where possible, enhancing biodiversity in our marine environment, and should provide overarching support for current processes.
- 10.1.4 The inclusion of other provisions such as the use of fit for purpose equipment, siting of farms growing seaweed for human consumption away from sewage outfalls and other potential sources of pollution, and consideration of other marine users and activities in the siting of seaweed farms also reflect key policy threads running through wider Scottish Government marine planning. Their inclusion in the proposed SPS should also provide consistency in thinking across wider planning policy and for other marine industries (i.e. finfish and shellfish aquaculture), with the potential for additional benefit in the promotion of seaweed cultivation in

IMTA and the realisation of positive environmental effects for biodiversity and water quality in particular.

On the whole, this SEA and the consideration of potential cumulative and synergistic effects demonstrates how the nature and extent of any potential impacts, either positive or negative, depends on the location and scale of development, and the composition and sensitivity of the corresponding marine ecosystems. It also demonstrates the interdependence of the proposed SPS, the seaweed industry and its stakeholders, the processes currently in place, and the combined role that they will need to play to ensure the successful growth of the seaweed cultivation and wild harvesting industries into the future.

Table 10.1: Legend for Summary of Likely Cumulative Environmental Effects of the Proposed SPS and Wider Marine Policy and Planning

	Potential for significant benefits identified
	No significant impacts identified
	Potentially significant adverse impacts identified.

Table 10.2: Summary of Likely Cumulative Environmental Effects of the Proposed SPS and Wider Marine Policy and Planning

Environmental Topic	Commercial-Scale Seaweed Cultivation	Seaweed Cultivation in IMTA	Commercial Harvesting in the Wild	Cumulative and Synergistic Effects
Overall Effect of the proposed SPS and its Consultation Document	<ul style="list-style-type: none"> • Encouragement of shell-fish scale cultivation with potential for increase in interest in the sector. • Conditional support for medium-scale cultivation subject to appropriate mitigation. • Promotion of sustainable management and mitigating potential environmental impacts in industry growth. 	<ul style="list-style-type: none"> • Encouragement of seaweed cultivation in IMTA. • Promotion of sustainable management and mitigating potential environmental impacts in industry growth. 	<ul style="list-style-type: none"> • Investigation of options for the sustainable management of commercial harvesting in the wild, including the potential for development of guidance to promote good practice. 	<ul style="list-style-type: none"> • Support and encouragement of the growth of the seaweed cultivation industry including IMTA. • Promotion of sustainable management and mitigating potential environmental impacts in industry growth.
Climatic Factors – Adaptation	<ul style="list-style-type: none"> • Demonstration of mitigation measures under the SPS for potential wave and coastal process impacts for medium-scale sites. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects in relation to IMTA. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Demonstration of mitigation measures against potential wave and coastal process impacts for medium-scale sites.
Biodiversity, Flora and Fauna	<ul style="list-style-type: none"> • Preserving the genetic integrity of local ecosystems through the use of seaweeds that are native to the area of cultivation and the use of 'fit-for-purpose' equipment under the SPS and Marine Licensing. • Demonstration of mitigation measures under the SPS for preserving biodiversity for medium-scale sites. 	<ul style="list-style-type: none"> • Preserving the genetic integrity of local ecosystems through the use of seaweeds that are native to the area of cultivation under the SPS and Marine Licensing. • Potential for reducing impacts from finfish aquaculture through encouragement of seaweed cultivation in IMTA under the SPS. • Reduction in environmental damage risks associated with equipment failure via promotion of the use of 'fit-for-purpose' equipment under the SPS. 	<ul style="list-style-type: none"> • While the SPS will likely have no direct effects, engagement with stakeholders and discussion of options for promoting good practices for harvesting seaweed in the wild may complement wider biodiversity objectives and have long-term benefits in the management of natural seaweed stocks and the ecosystems they service. 	<ul style="list-style-type: none"> • Preserving genetic integrity of native seaweed communities through the cultivation of seaweeds native to the area of cultivation. • Demonstration of biodiversity considerations at consenting stage and mitigation where necessary. • Potential for reducing adverse impacts from finfish aquaculture through encouragement of seaweed cultivation in IMTA. • Reduction in environmental damage risks associated with equipment failure risks via the promotion of 'fit-for-purpose' equipment. • Potential for co-ordinated management of natural seaweed stocks via engagement with stakeholders and industry.
Population and Human Health	<ul style="list-style-type: none"> • Promoting cultivation of seaweed for human consumption at locations away from sewage outfalls and other potential pollution sources under the SPS. • Reduction in risk to other marine users from navigation hazards from farm siting and use of 'fit-for-purpose' equipment in the SPS. 	<ul style="list-style-type: none"> • Promoting the cultivation of seaweed for human consumption at locations away from sewage outfalls and other potential pollution sources under the SPS. • Reduction in risk to other marine users from navigation hazards from farm siting and use of 'fit-for-purpose' equipment in the SPS. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Promoting the cultivation of seaweed for human consumption at locations away from sewage outfalls and other potential pollution sources. • Reduction in risk to other marine users from navigation hazards from farm siting and use of 'fit-for-purpose' equipment.
Water	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Potential for localised benefits in water quality from promotion of IMTA with marine finfish aquaculture in the SPS. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Potential for improved water quality from increased adoption of IMTA
Soil, Geology and Coastal Processes	<ul style="list-style-type: none"> • Demonstration of mitigation measures under the SPS for potential wave and coastal process impacts for medium-scale sites. 	<ul style="list-style-type: none"> • Potential for greater resource efficiency in aquaculture, with the potential for benefits to benthic ecosystems from the promotion of IMTA with marine finfish aquaculture in the SPS. 	<ul style="list-style-type: none"> • Engagement with stakeholders and discussion of options for the future management of wild seaweed stocks and promoting good commercial harvesting practices may complement climate change adaptation actions and the mitigation of potential wave and coastal process impacts. 	<ul style="list-style-type: none"> • Consideration of wave and coastal process impacts and promotion of practices to mitigate against such impacts. • Potential for localised benefits to water quality and benthic ecosystems from promotion of IMTA with marine finfish aquaculture.
Cultural Heritage	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. However, cultural heritage issues are likely to be addressed and mitigated in the project design, and via the framework of historic designations, supporting legislation and marine planning. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. However, cultural heritage issues are likely to be addressed and mitigated in the project design, and via the framework of historic designations, supporting legislation and marine planning. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Cultural heritage issues are likely to be addressed and mitigated in the project design, and under the current framework of historic designations, supporting legislation and marine planning.
Landscape and Visual Amenity	<ul style="list-style-type: none"> • Landscape and visual impacts are likely to be addressed and mitigated in the project design, and under the current planning and licensing system. 	<ul style="list-style-type: none"> • Landscape and visual impacts associated with IMTA sites are likely to be addressed in the project design, and under the current planning and licensing system. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Landscape and visual impacts are likely to be addressed and mitigated in the project design phase, and under the current planning and licensing system.
Material Assets (Aquaculture and Shipping)	<ul style="list-style-type: none"> • Consideration of other marine users and activities in the siting of farms under the SPS. 	<ul style="list-style-type: none"> • Consideration of other marine users and activities in the siting of IMTA operations under the SPS. 	<ul style="list-style-type: none"> • The SPS will likely have no significant effects. 	<ul style="list-style-type: none"> • Consideration of other marine users and activities in the siting of seaweed cultivation and IMTA operations.

11 Conclusions

11.1 Potential for Environmental Effects of Industry Growth

11.1.1 The assessment identified a range of potential environmental issues, both positive and adverse, relating to both seaweed cultivation and commercial seaweed harvesting in the wild. These potential impacts largely relate to the key role that seaweed plays in Scotland's marine ecosystems and coastal areas, and the national and international value attributed to many of the habitats they support.

11.1.2 The assessment found that many of the potential impacts identified with seaweed cultivation operations and commercial harvesting in the wild are likely to be site-specific. In terms of cultivation, the potential impacts are likely to be dependent on both project design and environmental factors.

11.1.3 In general terms, shellfish-scale or IMTA cultivation as outlined in the Consultation Document is considered less likely to result in significant environmental impacts, such as benthic impacts, collision risk and navigational issues, than larger-scale developments. However, it is also considered that undertaking cultivation operations in offshore areas may overcome many of the potential issues that have been identified for near-shore developments (e.g. spatial competition, coastal impacts). The SEA found that the use of seaweed cultivation in IMTA can have positive environmental effects for biodiversity and water quality, mitigating some negative impacts from finfish aquaculture.

11.1.4 The assessment identified that Scotland's natural seaweeds are an important resource. It found that sustainable management of this resource is vital, and that failure to implement appropriate harvesting practices could have adverse impacts on seaweed biodiversity in local and wider marine communities. Factors such as the method of harvesting, the harvesting intensity and frequency, seasonality, and the seaweed species being harvested can all influence the ecological impacts of commercial harvesting operations, and affect the sustainability of the resource and the flora and fauna it supports.

11.2 Likely Effects of the Policies Contained in the Consultation Document

11.2.1 The SEA also assessed the policies presented in the Consultation Document and evaluated their potential for significant environmental effects. The assessment found that the policies detailed in the Consultation Document will likely contribute to overall positive environmental effects for biodiversity and water quality, particularly in relation to IMTA. Policies such as the Scottish Government's support for

the cultivation of seaweeds that are native to the area of cultivation were considered likely to complement wider policy to preserve genetic integrity of natural seaweeds. Others, such as the use of fit-for-purpose equipment and consideration of other marine users to address potential siting conflicts, were included to address environmental issues identified in this SEA.

- 11.2.2 The SEA noted that the main role of an adopted SPS would be in the encouragement of the sustainable development of seaweed cultivation and IMTA, and its potential for creating additional interest amongst industry.

11.3 Additional Considerations

- 11.3.1 Due to the site-specific nature of many potential environmental issues associated with future seaweed cultivation developments, these may be best considered and assessed at the project level.
- 11.3.2 The concerns expressed on the potential for adverse impacts associated with increased commercial harvesting of Scotland's natural seaweed stocks, particularly kelp, were also noted. It was considered the Consultation Document and the consultation process may provide a valuable tool for engagement with the commercial wild harvesting industry and other stakeholders to discuss practical options for managing the sustainable growth of the industry (i.e. development of guidance for commercial harvesting in the wild).

12 Monitoring

12.1 Proposals

- 12.1.1 While no specific proposals for monitoring have been presented in the Consultation Document, this SEA outlines monitoring requirements within the current regulatory framework, and gives an overview of the scope for monitoring with the future growth of the seaweed industry.

12.2 Cultivation and IMTA

- 12.2.1 There is a wide range of research being undertaken worldwide into the large-scale viability and methods of seaweed cultivation, particularly relating to large-scale biofuel production, and into the benefits and impacts of IMTA. However, there has been comparatively little research undertaken into potential environmental effects of seaweed cultivation, particularly in the Scottish context.
- 12.2.2 There is significant scope for adding to this research here in Scotland, and the growth of this industry in the future should provide scope for additional study in this industry. At present, the inclusion of supplementary conditions for monitoring in marine licences issued by Marine Scotland provides an avenue for requiring environmental monitoring by operators of cultivation sites. The inclusion of a policy in the Consultation Document placing the onus on the applicant to demonstrate that mitigation measures have been considered for medium-scale sites and to set out how these will be delivered, may also provide an opportunity for monitoring of environmental effects.

12.3 Harvesting in the Wild

- 12.3.1 While much is known about Scotland's rich and varied wild seaweed resources, increases in commercial harvesting in the wild will likely require increased species and spatial knowledge of these resources. The implementation of the SPS and the growth of the seaweed industry will likely provide further opportunity for additional spatial studies to be undertaken.
- 12.3.2 The investigation of options for managing the potential growth of industry for harvesting in the wild also presents an opportunity to develop this knowledge-base. This opportunity to engage with the industry, in discussion of options and the potential for future growth, would likely be beneficial in adding practical knowledge and experience in an environmental context to the work currently being undertaken by Marine Scotland and Scottish Association of Marine Science (SAMS).

12.3.3 In the environmental context, the large degree of uncertainty and the site-specific nature of potential environmental impacts identified in this SEA demonstrates clear gaps in current knowledge. Factors such as impacts of both cultivation and wild harvesting on coastal processes, regrowth and regeneration of harvesting seaweed, the effects of different harvesting techniques and the potential significance of benthic shading are some examples of the aspects of the industry that could be studied further in the Scottish context.

13 Next Steps

13.1 Proposed consultation timescales

13.1.1 The consultation on the Consultation Document and the Environmental Report is now open and will close on 17 November 2013. Public views and opinions on this Environmental Report, and the Consultation Document to which it relates, are now invited.

13.1.2 Comments should be made to the following address:

Seaweed Policy Statement Consultation

1-B (North)

Victoria Quay

Edinburgh EH6 6QQ

E-mail – spsconsult@scotland.gsi.gov.uk

Telephone – 0131 244 6418

13.2 Questions for Consultees

13.2.1 Consultees may find the following questions helpful to provide a focus for their responses on the Environmental Report:

- To what extent does the Environmental Report set out an accurate description of the current environmental baseline (Please give details of additional relevant sources)?
- Do you agree with the predicted environmental effects as set out in the Environmental Report?
- Do you agree with the recommendations and proposals for mitigation of the environmental effects set out in the Environmental Report?
- Are you aware of any further environmental information that will help to inform the findings of the environmental assessment (Please give details of additional relevant sources)?

13.2.2 Responses need not be confined to these questions, and more general comments on the Environmental Report and the Consultation Document are also invited.

13.3 Analysis and Use of Responses

13.3.1 Following the conclusion of the consultation period, the responses received on the Consultation Document and the Environmental Report will be analysed and reported. Key messages from the various stakeholder groups will be highlighted, and the findings of the analysis will be taken

into account in the finalisation of the SPS scheduled for completion in late 2013 / early 2014.

- 13.3.2 Upon adoption of the SPS, a post-adoption SEA Statement will be prepared, reflecting the findings of the assessment and the views expressed in the consultation, and outlining how the issues raised have been considered in the finalisation of the SPS.

Appendix 1: Environmental Protection Objectives

Plan, Programme or Strategy	Objectives	Implications / Comments
Marine Policy		
<i>International</i>		
UN Convention on the Law of the Sea 1982 (UNCLOS) ²⁷⁸	Defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of natural resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole. Provides the framework for the establishment of territorial waters to 12 nautical miles.	This framework emphasises the need to balance competing interests and objectives within the marine environment.
<i>European</i>		
European Marine Strategy Framework Directive 2008 (MSFD) ²⁷⁹	The MSFD is the most recent marine obligation on EU Member States. It extends the requirements of the WFD into seas beyond 1nm. The MSFD requires Member States to ' <i>take necessary measures to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest</i> '. Coastal waters are also covered by the directive, and the Directive sets out the requirement for member states to develop a marine strategy.	Important overarching protective policy for the marine environment, and the SPS should seek to ensure that it supports the objectives of good environmental status.
European Integrated Maritime Policy 2007 ²⁸⁰	Aims to deliver a sustainable development approach for Europe's oceans and seas. Its scope includes: a marine transport strategy and new ports policy; research and data collection and management strategies, and work to mitigate climate change and reduce the impact of and adapt to the effects of climate change on coastal regions. It aims to promote the development of an environmentally safe aquaculture industry.	Recognises the conflicting demands on the marine environment and supports improved management. This provides an important framework within which the SPS will be developed.
<i>United Kingdom</i>		

²⁷⁸ United Nations Convention on the Law of the Sea of 10 December 1982 [online] Available at: http://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm [accessed 12/02/2013]

²⁷⁹ Directive 2008/56/EC Establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF> [accessed 12/02/2013]

²⁸⁰ An Integrated Maritime Policy for the European Union [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF> [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
Coast Protection Act 1949 (as amended by The Coast Protection (Notices) (Scotland) Regulations 1988 ²⁸¹ and The Coast Protection (Notices) (Scotland) Amendment Regulations 1996) ²⁸²	Sets out the licensing and regulatory framework within which activities including navigation and flood defences are set. Aims to protect the coast from erosion and encroachment and to ensure safety in navigation. Excludes some tidal waters in Scotland. Local authorities which include coastline within their boundaries are designated as coastal protection authorities and given specific duties and powers to undertake coastal defence works where necessary.	The potential changes in coastal processes associated with seaweed industry activities suggest that the SPS should consider the aims of the legislation (coastal and navigational protection) in its development.
Marine and Coastal Access Act 2009 ²⁸³	The key issues covered by the Act comprise: the creation of a Marine Management Organisation (MMO); planning in the marine area; licensing activities in the marine area; marine nature conservation and access to coastal land.	This sets out the broader policy context within which the SPS is being developed.
Our seas – a shared resource – High level marine objectives for the UK ²⁸⁴	Sets out high level objectives for the UK marine environment. This includes achieving a sustainable marine economy, ensuring a strong, healthy and just society, living within environmental limits, promoting good governance and using sound science responsibly.	This provides a broader framework within which the SPS will be developed, supporting sustainable development of the marine environment.

²⁸¹ The Coast Protection (Notices) (Scotland) Regulations 1988 [online] Available at: <http://www.legislation.gov.uk/uksi/1988/957/contents/made> [accessed 12/02/2013]

²⁸² The Coast Protection (Notices) (Scotland) Amendment Regulations 1996 [online] Available at: <http://www.legislation.gov.uk/uksi/1996/141/contents/made> [accessed 12/02/2013]

²⁸³ Marine and Coastal Access Act 2009 [online] Available at: http://www.legislation.gov.uk/ukpga/2009/23/pdfs/ukpga_20090023_en.pdf [accessed 12/02/2013]

²⁸⁴ HM Government in association with Northern Ireland Executive, The Scottish Government and the Welsh Assembly Government (2009) [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/1057/0080305.pdf> [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
<i>Scotland</i>		
Marine (Scotland) Act 2010 ²⁸⁵	Provides a framework to manage activities with Scotland's marine environment in a sustainable way. Notes the importance of protecting seas whilst facilitating sustainable economic growth. Introduces a new statutory marine planning system, a simpler licensing system, improved marine nature and historic conservation with new powers to protect and manage areas of importance for marine wildlife, habitats and historic monuments; improved protection for seals and enforcement powers.	This provides a broader framework within which the SPS will be developed.
Biodiversity, Flora & Fauna		
<i>International</i>		
UN Convention on Biological Diversity (CBD) (1992) ²⁸⁶	<p>The three main objectives of the CBD are:</p> <ul style="list-style-type: none"> • the conservation of biodiversity; • the sustainable use of biodiversity; and • the sharing of benefits from the use of genetic resources (including by appropriate access to these resources). <p>Article 6 requires that all parties to the Convention develop national biodiversity strategies, plans or programmes, and that they seek to integrate the provisions of these across other policy sectors. Article 7 requires the identification of key resources and their protection. Monitoring of potentially damaging processes and activities should also be undertaken.</p> <p>Two policy decisions came from the 1995 Conference of the Parties known as the Jakarta Mandate on marine and coastal biodiversity. Commitments include the development of a global system of marine and coastal protected areas, blocking the pathways of invasions of alien species, increasing ecosystem resilience to climate change, and developing, encouraging, and enhancing</p>	This broader framework sets the context within which specific environmental protection objectives have been developed. The principles defined within the Convention should be supported by the SPS.

²⁸⁵ Marine (Scotland) Act 2010 [online] Available at: http://www.legislation.gov.uk/asp/2010/5/pdfs/asp_20100005_en.pdf [accessed 12/02/2013]

²⁸⁶ Convention on Biological Diversity [online] Available at: <http://www.cbd.int/convention/text/> [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
	implementation of wide-ranging integrated marine and coastal area management. ²⁸⁷	
Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979 ²⁸⁸	Aims to conserve terrestrial, marine and avian species throughout their range through international co-operation.	As with the previous Convention, these conservation objectives should be considered in the development of the SPS.
Convention on Wetlands of International Importance 1971 (amended 1982/87) ²⁸⁹	Otherwise known as the Ramsar Convention, this emphasises the special value of wetlands, particularly as a key habitat for waterfowl, and this includes estuaries, tidal flats and near shore marine areas. The Convention resulted in designation of sites for management, sustainable use and conservation.	The SPS should uphold commitments to environmental protection.
Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) (1992) ²⁹⁰ and Council Decision 2000/340/EC of 8 May 2000 concerning the approval, on behalf of the Community, of the new Annex V to the Convention for the Protection of the Marine Environment of the North-East Atlantic	<p>The aim of the Oslo and Paris Convention (OSPAR Convention) is to prevent and eliminate pollution and to protect the maritime area against the adverse effects of human activities. This Convention led to establishment of a cross-regional commission promoting an ecosystems approach to marine management, including establishment of a network of Marine Protected Areas. Its five work areas are biodiversity and ecosystems, eutrophication, hazardous substances, offshore industry, and radioactive substances). Climate change is also a key cross-cutting theme. Also includes a Biological Diversity and Ecosystems Strategy.</p> <p>The scope of the OSPAR Convention was limited to four main areas defined in four Annexes (on the prevention and elimination of pollution from land-based sources, by dumping or incineration, and from offshore sources, and on the assessment of the quality of the marine environment). A new Annex V was prepared, on the protection and conservation of the ecosystems and biological</p>	The ecosystems approach to marine planning should be considered in the development of the SPS.

²⁸⁷ CBD and the Jakarta Mandate [online] Available at: <http://www.cbd.int/ldb/2012/?title> [accessed 12/02/2013]

²⁸⁸ Introduction to the Convention on Migratory Species [online] Available at: <http://www.cms.int/about/intro.htm> [accessed 12/02/2013]

²⁸⁹ Convention on Wetlands of International Importance 1971 (amended 1982/87) [online] Available at: http://www.ramsar.org/cda/en/ramsar-documents-texts/main/ramsar/1-31-38_4000_0 [accessed 12/02/2013]

²⁹⁰ Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) [online] Available at: http://www.ospar.org/html_documents/ospar/html/ospar_convention_e_updated_text_2007.pdf [accessed 12/02/2013]

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	diversity of the maritime area. Under it, the Contracting Parties must adopt the necessary measures in order to protect and conserve the ecosystems and the biological diversity of the maritime area, and to restore, where practicable, maritime areas which have been adversely affected.	
Agreement on the Conservation of African-Eurasian Migratory Waterbirds 1995 (AEWA) ²⁹¹	An independent international treaty developed under the auspices of the United Nations Environment Programme (UNEP)/Convention on Migratory Species. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including species of divers, grebes, cormorants, herons, ducks, swans, geese, waders, gulls, and terns. An action plan ²⁹² addresses issues including: species and habitat conservation, management of human activities, research, monitoring, education and implementation.	The development of the SPS should take into account the priority afforded to the protection of bird species present within the Scottish terrestrial, coastal and marine environment.
Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas 1992 (ASCOBANS) ²⁹³	An agreement on the protection of small cetaceans, noting that the migratory nature of dolphins, porpoises and whales means that they can be vulnerable to a range of marine activities and issues including marine pollution and by-catch.	As noted above, the high priority given to protection of these species should be taken into account in the development of the SPS.
<i>European</i>		
Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) ²⁹⁴	Established a commitment to designating networks of sites of ecological importance across Europe. These are known as Natura 2000 sites and include special protection areas (SPAs designated under the Birds Directive – see following paragraph) and special areas of conservation (SACs).	Commitments to protecting habitats and species should be upheld within the SPS.
Council Directive	Protects all wild birds (together with their nests and eggs) and their associated	Objectives to protect important

²⁹¹ African-Eurasian Waterbird Agreement [online] Available at: http://www.cms.int/species/aewa/aew_text.htm [accessed 12/02/2013]

²⁹² African-Eurasian Waterbird Agreement Action Plan [online] Available at: http://www.cms.int/species/aewa/aew_ap.htm [accessed 12/02/2013]

²⁹³ Convention on migratory species Agreement on the conservation of small cetaceans of the Baltic and North Seas [online] Available at: http://www.cms.int/species/ascobans/asc_bkrd.htm [accessed 12/02/2013]

²⁹⁴ Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) [online] Available at: http://europa.eu/legislation_summaries/environment/nature_and_biodiversity/l28076_en.htm [accessed 12/02/2013]

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79/409/EEC on the conservation of wild birds (the Birds Directive) ²⁹⁵	habitats. Commitment to designation of SPAs (included in Natura 2000 sites - see preceding paragraph).	species and habitats, including internationally designated sites, should be supported within the SPS.
Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979) ²⁹⁶	Aims to ensure conservation and protection of wild plant and animal species and their natural habitats and to promote co-operation between European states to protect biodiversity. Implemented in UK law by the Wildlife and Countryside Act (1981 and as amended).	The broader framework for environmental protection across Europe should be supported by the SPS.
The Pan-European Biological and Landscape Diversity Strategy (1995) ²⁹⁷	<p>The Strategy aims to reverse the decline of landscape and biological diversity, by promoting innovation and proactive policy making. It supports preceding measures for protecting natural heritage, and aims to supplement this by further promoting a number of action themes relating to different environmental resources. The long-term objectives of the strategy are:</p> <ul style="list-style-type: none"> • The establishment of a Pan-European Ecological Network to conserve ecosystems, habitats, species and landscapes that are of European importance. • The sustainable management and use of Europe's biodiversity. • Integrating biodiversity conservation and sustainability into the activities of other sectors, such as agriculture, forestry, fisheries, industry, transport and tourism. • Improving information on and awareness of biodiversity and increasing public participation in conservation actions. • Improving our understanding of the state of Europe's biodiversity. • Assuring that adequate funds are made available to implement the strategy. 	The SPS should support the objectives of conservation and sustainability.

²⁹⁵ Council Directive 79/409/EEC on the conservation of wild birds [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:020:0007:0025:EN:PDF> [accessed 12/02/2013]

²⁹⁶ The Convention on the Conservation of European Wildlife and Natural Habitats [online] Available at: <http://conventions.coe.int/Treaty/EN/Treaties/Html/104.htm> [accessed 12/02/2013]

²⁹⁷ Pan-European Biological and Landscape Diversity Strategy [online] Available at: <http://www.peblids.org/index.php?ido=20514351&lang=eng> [accessed 12/02/2013]

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Our life insurance, our natural capital: an EU Biodiversity Strategy to 2020 ²⁹⁸	<p>The strategy has six main targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU by 2020.</p> <p>The six targets cover:</p> <ul style="list-style-type: none"> • Full implementation of EU nature legislation to protect biodiversity • Better protection for ecosystems, and more use of green infrastructure • More sustainable agriculture and forestry • Better management of fish stocks • Tighter controls on invasive alien species • A bigger EU contribution to averting global biodiversity loss 	The SPS should support these targets by taking into account integration of biodiversity protection and enhancement.
<i>United Kingdom</i>		
Wildlife and Countryside Act 1981 ²⁹⁹	Provides the framework for protection of species other than European Protected Species. Sets out protection objectives for specified birds and wild animals. The Act's various schedules detail the species that are protected under the Act, including dolphins, porpoises, and numerous birds such as geese and ducks. This was reviewed and updated in December 2008 and it was recommended that several further species of marine fish should be added to the lists attached to the Act, including shark, seahorse and ray species.	The SPS should take into account the particular protection afforded to key terrestrial, coastal and marine species.
The Conservation (Natural Habitats, &c) Regulations 1994 ³⁰⁰	Transposes the requirements for protection of designated sites under the Habitats and Birds Directives, and the framework for protection of European Protected Species. Applies within 12nm. Several marine species are protected by various development consenting regimes covered by the Act. This includes marine turtles, all species of dolphins, porpoise and whale, seals and several types of marine fish (Atlantic salmon, barbel, etc.)	The SPS should take into account the particular protection afforded to key terrestrial, coastal and marine species.
UK Biodiversity Action Plan 1994 (UKBAP) (Since the creation of the UK BAP,	In response to the 1992 Convention on Biological Diversity (CBD), this describes the UK's biological resources, commits a detailed plan for the protection of these resources. Sets out 1150 species and 65 habitats which are priorities for	The UKBAP specifically identified numerous habitats and species in the coastal and marine

²⁹⁸ Our life insurance, our natural capital: an EU biodiversity strategy to 2020 [online] Available at: http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7%5b1%5d.pdf [accessed 12/02/2013]

²⁹⁹ Wildlife and Countryside Act 1981 [online] Available at: <http://www.legislation.gov.uk/ukpga/1981/69> [accessed 12/02/2013]

³⁰⁰ The Conservation (Natural Habitats, &c) Regulations 1994 [online] Available at: <http://www.legislation.gov.uk/uksi/1994/2716/contents/made> [accessed 12/02/2013]

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<p>devolution has led the four countries of the UK (England, Northern Ireland, Scotland and Wales) to produce their own country biodiversity groups and country biodiversity strategies. In 2007, however, a shared vision for UK biodiversity conservation was adopted by the devolved administrations and the UK governments, and is described in 'Conserving Biodiversity – the UK Approach'³⁰¹</p>	<p>conservation action in the UK. The list was last updated in 2007 and includes 87 species in the marine group. Numerous habitats are also relevant to Scotland's marine environment, including several which are specific to coastal areas (salt marsh, sand dunes) or the marine environment (including machair, maerl beds, kelp and seaweed communities, and sea loch egg wrack beds amongst others).</p>	<p>environment which should be protected. The SPS should seek to ensure that fisheries activity does not adversely affect these priorities.</p>
<p>Conserving Biodiversity – the UK Approach (2007)³⁰²</p>	<p>A framework document for biodiversity identifies six priorities for implementing biodiversity objectives within the integrating framework of an ecosystem approach:</p> <ul style="list-style-type: none"> • Protecting the best sites for wildlife; • Targeting action on priority species and habitats; • Embedding proper consideration of biodiversity and ecosystem services in all relevant sectors of policy and decision-making; • Engaging people, and encouraging behaviour change; • Developing and interpreting the evidence base; • Ensuring that the UK plays a proactive role in influencing the development of Multilateral Environmental Agreements, and contributes fully to their domestic delivery. 	<p>Emphasises an ecosystem approach to managing biodiversity, and recognises the need to allow for the impacts of climate change within the network of marine protected areas.</p>

³⁰¹ Conserving Biodiversity the UK Approach (2007) [online] Available at: http://jncc.defra.gov.uk/PDF/UKBAP_ConBio-UKApproach-2007.pdf [accessed 12/02/2013]

³⁰² Conserving Biodiversity – the UK Approach (2007) [online] Available at: http://jncc.defra.gov.uk/PDF/UKBAP_ConBio-UKApproach-2007.pdf [accessed 12/02/2013]

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<i>Scotland</i>		
Nature Conservation (Scotland) Act 2004 ³⁰³	Introduced a 'duty to further the conservation of biodiversity' for all public bodies, and sets out more specific provisions within this including for Sites of Special Scientific Interest. Also states a requirement for the preparation of a Scottish Biodiversity Strategy, to which all public bodies should pay regard. Applies to 12nm around Scotland and includes protection measures for marine species.	Biodiversity protection objectives cover the coast and the immediate offshore environment. The SPS should seek to contribute positively to biodiversity protection objectives.
Scotland's Biodiversity – It's In Your Hands. A strategy for the conservation and enhancement of biodiversity in Scotland (2004)	Sets out Scottish aims relating to biodiversity over 25 year period. Seeks to go beyond a previous emphasis on protecting individual sites to achieve conservation at a broader scale. Aims to halt loss and reverse decline of key species, to raise awareness of biodiversity value at a landscape or ecosystem scale, and to promote knowledge, understanding and involvement amongst people. The Strategy notes the importance and health of Scotland's ecosystems, and summarises key trends.	The SPS should note and aim to support recognised ecosystems and recognise potential impacts on these.
A Consultation on the 2020 Challenge for Scotland's Biodiversity (2012)	<p>The consultation paper is focused on desired outcomes for 2020 in response to the European Union's Biodiversity Strategy for 2020 and the 'Aichi Targets' set by the United Nations Convention on Biological Diversity. These call for a step change in efforts to halt the loss of biodiversity and restore the essential services that a healthy natural environment provides. The document aims to:</p> <ul style="list-style-type: none"> • Increase the general level of biodiversity on land and in our seas, and support healthy, well-functioning ecosystems; • Engage people with the natural world, for the health and well-being benefits that this brings, and empower them to have a say in decisions about their environment; • Maximise the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth. <p>The consultation includes a section on the Marine environment seeking to protect marine and coastal biodiversity and maintain marine productivity. The strategy paper that follows the consultation in summer 2013 will form part of the Scottish Biodiversity Strategy, alongside the 2004 document. This would</p>	The SPS should help to maintain and enhance marine and coastal biodiversity

³⁰³ Nature Conservation (Scotland) Act 2004 [online] Available at: http://www.legislation.gov.uk/asp/2004/6/pdfs/asp_20040006_en.pdf [accessed 12/02/2013]

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	make it relevant to public bodies' biodiversity duty under the Nature Conservation (Scotland) Act 2004.	
Population and Human Health		
<i>United Kingdom</i>		
Food and Environment Protection Act 1985 ³⁰⁴	Part II protects the marine ecosystem and human health by controlling the deposit of articles or materials or scuttling of vessels in the sea, tidal waters or seabed.	The SPS should contribute to the protection of health via the marine environment.
<i>Scotland</i>		
Bathing Waters (Scotland) Regulations 2008 ³⁰⁵	Details the requirement for the designation of bathing waters and determination of bathing season, monitoring and investigations to be undertaken by SEPA and local authorities, and classification of bathing waters as 'poor', 'sufficient', 'good' or 'excellent' from 2015.	The SPS should contribute to the protection of health via the marine environment.
Water		
<i>International</i>		
International Maritime Organisation (IMO) International Convention for the Prevention of Pollution from Ships 1973 (MARPOL) ³⁰⁶	Aims to prevent marine pollution from ships from operational or accidental causes. It includes annexes covering pollution by oil, noxious liquids, harmful substances, sewage, garbage and air pollution. Recent changes focus on reducing the sulphur content and particulate emissions from fuel in the shipping sector.	The SPS should be developed taking into account the broader protection provided by the convention.
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 ³⁰⁷	Provides a framework for international co-operation in combating major incidents or threats of marine pollution from ships or offshore units.	The SPS should recognise the protective framework provided by this Convention.

³⁰⁴ Food and Environment Protection Act 1985 [online] Available at: <http://www.legislation.gov.uk/ukpga/1985/48> [accessed 12/02/2013]

³⁰⁵ Bathing Waters (Scotland) Regulations 2008 [online] Available at: <http://www.legislation.gov.uk/ssi/2008/170/contents/made> [accessed 12/02/2013]

³⁰⁶ International Convention for the Prevention of Pollution from Ships (MARPOL) [online] Available at: [http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-\(marpol\).aspx](http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx) [accessed 12/02/2013]

³⁰⁷ International Convention on Oil Pollution Preparedness, response and co-operation (1990) [online] Available at: [http://www.imo.org/about/conventions/listofconventions/pages/international-convention-on-oil-pollution-preparedness,-response-and-co-operation-\(oprc\).aspx](http://www.imo.org/about/conventions/listofconventions/pages/international-convention-on-oil-pollution-preparedness,-response-and-co-operation-(oprc).aspx) [accessed 12/02/2013]

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London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (as amended) and London Protocol (2006) ³⁰⁸	Prohibits the dumping of certain hazardous materials, requires a prior special permit for the dumping of a number of other wastes, and a prior general permit for other wastes or materials. It also creates a basis in international law to allow and regulate carbon capture and storage (CCS) in sub-seabed geological formations.	The SPS should recognise the protective framework provided by this Convention.
<i>European</i>		
Water Framework Directive (WFD) 2000/60/EC ³⁰⁹	This provides an overarching strategy, including a requirement for EU Member States to ensure that they achieve 'good ecological status' by 2015. RBMPs were defined as the key means of achieving this. The Recent Marine Strategy Directive will extend coverage of coastal waters beyond 1nm.	The WFD sets out an overarching framework that aims to ensure that good ecological status is met by 2015. Plans to achieve this are detailed in the RBMPs.
<i>United Kingdom</i>		
Environmental Protection Act 1990	Covers pollution control and waste management. Also covers litter, radioactive substances and genetically modified organisms. Pollution at sea is specifically controlled and covers deposits of substances and articles in the sea and oil pollution from ships.	Provides for control of pollution at sea.
Pollution Prevention and Control Act 1999 Implements Directive 96/61/EC (Integrated Pollution Prevention and Control (IPPC)). Pollution Prevention and Control	The (the PPC Regulations) enact the IPPC Directive in Scotland and were made under the Pollution Prevention and Control Act 1999. Aims to prevent or minimise emissions to air, water and soil, as well as waste, from industrial and agricultural installations.	The SPS should take into account wider pollution prevention measures relating to the water environment.

³⁰⁸ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter [online] Available at: <http://www.imo.org/about/conventions/listofconventions/pages/convention-on-the-prevention-of-marine-pollution-by-dumping-of-wastes-and-other-matter.aspx> [accessed 12/02/2013]

³⁰⁹ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF> [accessed 12/02/2013]

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(Scotland) Regulations 2000 ³¹⁰ (SSI 2000/323)		
<i>Scotland</i>		
Environmental Liability (Scotland) Regulations 2009 (transpose the EU Environmental Liability Directive (2004/35/EC)) ³¹¹	Covers incidents of significant damage to biodiversity, water or land. In accordance with the European Environmental Liability Directive (2004/35/EC), aims to apply the polluter-pays principle by requiring restoration in such instances.	This forms an important regulatory context within which the SPS should be developed.
Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) ³¹²	Transposes the WFD into Scots law and gives Scottish ministers powers to introduce regulatory controls over water activities, in order to protect, improve and promote sustainable use of Scotland's water environment. This includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater	The SPS should support the protection of the water environment.
The Water Environment (Controlled Activities) (Scotland) Regulations 2011 ³¹³	Sets out the process by which activities that have the potential to affect Scotland's water environment are regulated. Authorisation under the Controlled Activities Regulations (CAR) is required for discharging to waters, disposal of pollutants to land, abstractions, impoundments and engineering works affecting water bodies.	The CAR provides an important tool for controlling activities relating to the water environment.
Pollution Prevention and Control (PPC) (Scotland) Regulations 2000	See Pollution Prevention and Control Act 1999	The SPS should support the protection of the water environment.

³¹⁰ The Pollution Prevention and Control (Scotland) Regulations 2000 [online] Available at: <http://www.legislation.gov.uk/ssi/2000/323/contents/made> [accessed 12/02/2013]

³¹¹ Environmental Liability (Scotland) Regulations 2009 – Summary [online] Available at: <http://www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/ELD> [accessed 12/02/2013]

³¹² Water Environment and Water Services (Scotland) Act 2003 [online] Available at: <http://www.legislation.gov.uk/asp/2003/3/contents> [accessed 12/12/2012]

³¹³ The Water Environment (Controlled Activities) (Scotland) Regulations 2011 [online] Available at: http://www.legislation.gov.uk/ssi/2011/209/pdfs/ssi_20110209_en.pdf [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
River Basin Management Plans for the Scotland and Solway Tweed River Basin Districts 2009 - 2015 ³¹⁴	Notes the key pressures and their environmental impacts on Scottish water bodies including coastal areas. Key issues affecting coastal areas include diffuse and point source pollution, organic matter and ammonia, faecal pathogens, toxic substances, and loss of intertidal areas. Some of these issues may be exacerbated by climate change. Environmental objectives for coastal waters include improving the status of coastal waters and estuaries, and improving the structure and condition of the bed and shores of coastal water bodies.	The objectives defined by RBMPs covering Scotland are of indirect relevance to the SPS.
Flood Risk Management (Scotland) Act 2009 ³¹⁵	Includes new measures for sustainable flood risk management. This includes co-ordination and co-operation between relevant organisations, development of flood risk assessment and planning and tools for delivery and enforcement. Applicable to coastal flood protection measures.	The SPS should consider this, particularly as potential impacts have been identified in increased storm protection for coastal areas in the vicinity of seaweed cultivation and harvesting sites.
Soil, Geology and Coastal Processes		
<i>Scotland</i>		
Scottish Soil Framework 2009	Provides an overarching policy framework for protection of soils in Scotland. While this relates largely to the onshore environment, it includes coastal areas and the principles are applicable more widely.	The SPS should consider potential effects in coastal zones.
Climatic Factors		
<i>Scotland</i>		
Climate Change Sector Adaptation Action Plan: Marine and Fisheries (2011) ³¹⁶	Sets out a number of objectives including raising awareness of climate change to the wider marine stakeholder community (through the Marine Strategy Forum). Also aims to build evidence to support future adaptation action and build further policies that respond to impacts.	The SPS and its assessment should take into account the need to adapt to the impacts of climate change in the future.

³¹⁴ Scotland River Basin Management Plan and Solway Tweed River Basin Management Plan [online] Available at: http://www.sepa.org.uk/water/river_basin_planning.aspx [accessed 12/02/2013]

³¹⁵ Flood Risk Management (Scotland) Act 2009 [online] Available at: <http://www.scotland.gov.uk/Topics/Environment/Water/Flooding/FRMAct> [accessed 12/02/2013]

³¹⁶ Scotland's Climate Change Adaptation Framework Marine and Fisheries Sector Action Plan [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/175776/0114919.pdf> [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
Climate Ready Scotland: Scottish Climate Change Adaptation Programme (Consultation Draft) 2013 ³¹⁷	Currently out to consultation, the Programme addresses the impacts identified for Scotland in the UK Climate Change Risk Assessment (CCRA) published under section 56 of the UK Climate Change Act 2008. It sets out Ministers' objectives in relation to adaptation to climate change, targeting three key themes: the Natural Environment, Buildings and Infrastructure Networks, and Society. It outlines proposals and policies for meeting these objectives, the period within which the proposals and policies will be introduced, and setting out arrangements for wider engagement in meeting these objectives.	The Plan and its assessment should take into account the commitment to adapt to the impacts of climate change.
Cultural Heritage		
<i>International</i>		
UNCLOS 1982 was ratified by the UK in 1997 ³¹⁸	Article 303 stipulates that 'states have the duty to protect objects of an archaeological and historical nature found at sea and shall co-operate for this purpose' and provides for coastal states to exert a degree of control over the archaeological heritage to 24 nautical miles.	The SPS should support commitments to protect the offshore historic environment.
<i>United Kingdom</i>		
Protection of Wrecks Act 1973	The 1973 Act provides protection for designated wrecks and for the designation of dangerous sites.	The SPS should take into account effects on protected wrecks.
Ancient Monuments and Archaeological Areas Act 1979	Provides for the protection of archaeological heritage, including the scheduling of 'monuments'. The Act, which is administered by Historic Scotland, primarily deals with terrestrial locations but there is provision to designate nautical sites.	The SPS should take into account potential impacts on nautical archaeology as a result of fishing activities ³¹⁹ .
Protection of Military Remains Act 1986	Identifies scope for protected places and controlled sites, covering vessels. This reflects the status of these sites as war graves.	The SPS should take into account the protection afforded to these types of sites.

³¹⁷ Scottish Government (2013) Scottish Climate Change Adaptation Programme [online] Available at: <http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptationProgramme> [accessed 28/06/2013]

³¹⁸ United Nations Convention on the Law of the Sea [online] Available at: http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf [accessed 12/02/2013]

³¹⁹ McMullen, P. (2011) Underwater Cultural Heritage, An assessment of risks from Commercial Fishing, Seafish [online] Available at: http://www.jnpsc.org.uk/CR643_WrecksandFishing.pdf [accessed 12/02/2013]

Plan, Programme or Strategy	Objectives	Implications / Comments
<i>Scotland</i>		
Scottish Historic Environment Policy (SHEP) (Updated 2011) ³²⁰	Provides the overarching framework for historic environment policy in Scotland, consolidating and replacing the previously separate SHEPs. Aims to promote effective conservation and to enhance enjoyment and understanding of the historic environment, linking it with the Scottish Government's central purpose. The updated SHEP includes provisions to broaden the types of sites which can be designated on the basis of their national importance, arrangements for consultation in advance of designation, and proposals for powers and provisions to allow for site maintenance.	The aims of protecting the historic environment should be taken into account in development of the SPS, in particular any designated HMPAs.
The Marine Historic Environment Strategy for the protection, management and promotion of marine heritage 2012-15 ³²¹	Historic Scotland's strategy has the vision to protect and, where appropriate, enhancing the most important marine heritage assets in such a way that they can be valued, understood, and enjoyed. The aims of the Strategy are: <ul style="list-style-type: none"> • helping to advance knowledge about marine heritage and make information widely available; • improving stewardship of key marine heritage sites; and • developing wider understanding and enjoyment of marine heritage. 	The SPS should take account of the selection and designation of Historic MPAs..
Landscape		
<i>Scotland</i>		
SNH Natural Heritage Futures Coasts and Seas (2002) ³²² Update: Coasts and Seas (2009) ³²³	Provides baseline information and draws attention to particularly important issues, assets and changes. The key objectives for nature and landscape are to: <ul style="list-style-type: none"> • Achieve sustainable use of our coasts and seas through better management, knowledge and understanding of the marine environment. • Manage the coast in sympathy with natural processes; • Safeguard and enhance maritime biodiversity and ecosystems. 	The SPS should consider the principles and issues identified in the Futures documents.

³²⁰ Scottish Historic Environment Policy December 2011 [online] Available at: <http://www.historic-scotland.gov.uk/index/heritage/policy/shep.htm> [accessed 28/06/2013]

³²¹ Historic Scotland (2012) Marine Historic Environment Strategy for the protection, management and promotion of marine heritage 2012-15 [online] Available at: <http://www.historic-scotland.gov.uk/marine-strategy-2012-15.pdf> [accessed 28/06/2013]

³²² SNH Natural Heritage Futures Coasts and Seas (2002) [online] Available at: <http://www.snh.gov.uk/docs/A306281.pdf> [accessed 12/02/2013]

³²³ Update: Coasts and Seas (2009) [online] Available at: <http://www.snh.gov.uk/docs/A306270.pdf> [accessed 12/02/2013]

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	<ul style="list-style-type: none"> • Safeguard and enhance the fine scenery and diverse character of coastal seascapes and landscapes. • Achieve sustainability in Scottish sea fisheries through responsible fishing that keeps stocks within safe biological limits and minimises adverse impact on the marine ecosystem. • Ensure that salmon farming and other types of aquaculture are environmentally sustainable. • Improve the water quality of estuaries and seas; and Promote access to the sea and coast for public enjoyment and recreation.	
Material Assets (Infrastructure and Harvest Stocks)		
<i>European</i>		
Council Regulations EC 834/2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91 ³²⁴	Contains clearly defined goals, principles and general rules for organic production, including farm management and food production systems that combine best environmental practices, a high level of biodiversity and the preservation of natural resources. The regulation provides a basis for EU rules on organic aquaculture and seaweeds, including: <ul style="list-style-type: none"> • The growing areas are to be of high ecological quality as defined by Directive 2000/60/EC of the European Parliament. • The seaweed product is not unsuitable from a health point of view. • The collection does not affect the long term stability of the natural habitat or the maintenance of the species in the collection area. • Sustainable practices are used in all stages of production, from collection of juvenile seaweed to harvesting. • Ensuring that a wide gene-pool is maintained. The collection of juvenile seaweed in the wild should take place on a regular basis to supplement indoor culture stock.	The SPS should promote the principles and measures detailed in the regulations.
Council Regulations EC 889/2008 on organic production and labelling of	The regulations cover the control, production and labelling of organic products, including seaweed. Provisions include: <ul style="list-style-type: none"> • Limited use of fertilisers and conditioners of low solubility. 	The SPS should promote the principles and measures detailed in the regulations.

³²⁴ EC 834/2007 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF> [accessed 21/09/2012]

Plan, Programme or Strategy	Objectives	Implications / Comments
organic products with regard to organic production, labelling and control ³²⁵	<ul style="list-style-type: none"> • Restricted use of pesticides that may have detrimental effects. • Giving preference to the application of preventive measures in pest, disease and weed control. 	
Council Regulations EC 710/2009 laying down detailed rules on organic aquaculture animal and seaweed production and amending EC 889/2008 laying down detailed rules for the implementation of EC 834/2007 ³²⁶	<p>Regulates seaweed cultivation, contains detailed rules on organic aquaculture production and seaweed cultivation, and applies to the production of all multi-cellular marine algae or phytoplankton and micro-algae for further use as feed for aquaculture animals.</p> <p>The provisions state:</p> <ul style="list-style-type: none"> • Member State authorities may designate locations or areas which they consider to be unsuitable for organic aquaculture or seaweed harvesting. • Promotes sustainable management to ensure wild seaweed beds are not over-harvested in order to allow regeneration. • Production does not cause a significant impact on the state of the aquatic environment. • Promotes the use of renewable energy sources and re-cycle materials by aquaculture and seaweed business operators. • Seaweed culture at sea to utilise nutrients naturally occurring in the environment or from organic aquaculture animal production, preferably located nearby as part of a polyculture system. • Limits on culture density or operational intensity to maintain the integrity of the aquatic environment. 	The SPS should promote the principles and measures detailed in the regulations.
<i>Scotland</i>		
Scottish Aquaculture: A Fresh Start: The Renewed Strategic Framework for	Update to the existing aquaculture strategy. This includes five main themes: healthier fish and shellfish – in relation to sea lice management and disease control; improved systems for licensing aquaculture developments – taking a	Given the potential use of seaweed cultivation in IMTA, the development of the SPS should

³²⁵ EC 889/2008 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:250:0001:0084:EN:PDF> [accessed 21/09/2012]

³²⁶ EC 710/2009 [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:204:0015:0034:EN:PDF> [accessed 21/09/2012]

Plan, Programme or Strategy	Objectives	Implications / Comments
Scottish Aquaculture (2009) ³²⁷	strategic approach to the siting of sites for aquaculture in Scotland; improved containment – managing escapes and welfare issues around control of seals; better marketing and improved image – developing the shellfish sector.	consider the principles in this framework.
Shellfish Waters Directive 2006/113/EC (supersedes the Shellfish Growing Waters Directive (79/923/EC) Note: the Shellfish Waters Directive will be repealed in 2013 and superseded by the WFD. The Surface Waters (Shellfish) (Classification) (Scotland) Regulations 1997 ³²⁸ transpose the Directive into Scottish law.	<p>The Directive concerns the quality of shellfish growing waters. Along with other Member States, the UK has designated those coastal and brackish waters needing protection or improvement in order to support shellfish (bivalve and gastropod molluscs) life and growth and to contribute to the high quality of directly edible shellfish products. There are 80 designated shellfish waters in Scotland.</p> <p>The Regulations establish classification and sampling criteria and confer a duty on SEPA to investigate and adopt appropriate measures where monitoring results indicate that the waters do not meet the minimum quality standards specified in the Directive.³²⁹</p>	While not strictly relevant, given the commonalities between shellfish and seaweed cultivation (i.e. potential locations, importance of water quality, etc.) the SPS should consider these principles, and support the protection and improvement of the quality of designated coastal and brackish waters.

³²⁷ Scottish Aquaculture: A Fresh Start: The Renewed Strategic Framework for Scottish Aquaculture (2009) [online] Available at: <http://www.scotland.gov.uk/Resource/Doc/272866/0081461.pdf> [accessed 12/02/2013]

³²⁸ Shellfish Waters Directive 2006/113/EC [online] Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:376:0014:0020:EN:PDF> [accessed 22/07/2013]

³²⁹ SEPA (undated) Regulation of Designated Shellfish Waters [online] Available at: http://www.sepa.org.uk/water/protected_areas/shellfish_waters/regulation.aspx [accessed 12/02/2013]