



Towards developing a climate change adaptation action plan for the marine and fisheries sector in Scotland.

Report of event:

‘New Climate Change Tools and information for decision makers in the marine and coastal sectors’, Edinburgh, 17th March 2010

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EXECUTIVE SUMMARY

Scotland's Climate Change Adaptation Framework was published in 2009. It contained an action for the Scottish Climate Change Impacts Partnership (SCCIP) in conjunction with Marine Scotland (Scottish Government) to hold a marine stakeholder event in 2010 to equip decision makers with skills and tools. Organised in conjunction with the Marine Climate Change Impact Partnership (MCCIP), UK Climate Impact Programme (UKCIP), Scottish Natural Heritage (SNH) and Scottish Environment Protection Agency (SEPA) the event was held in March 2010.

It provided an opportunity for delegates to comment on key priorities for the development of the Marine and Fisheries Sector Action Plan. Delegates were asked to consider and respond to three questions. This report has been produced and edited by SCCIP, based on the compilation of notes taken at the event.

Question 1 - What would you see as the key issues for Marine and Fisheries Sector Adaptation?

- Limited knowledge of marine environment, uncertainty, different timeframes and scales, resource and funding issues, dynamics and complexity mean there are difficult decisions to be made, avoiding business-as usual modes. Need to try to encourage sustainability, innovation and flexible adaptive approaches.
- Who pays for what, when and how? The prioritising and channeling of limited funds for adaptation is a huge issue.
- With coastal flood risk, sea level rise, increased storminess, changing sea conditions and circulation patterns, a range of impacts and potential risks (benefits as well as detrimental effects) was identified (eg coastal erosion, flooding, biodiversity, new northern transport routes, new fisheries products, disruption and damage to infrastructure and transportation).
- Assets will be at risk and there is the possibility of over or under adaptation. Reducing risk may not be the optimum approach. Accepting or offsetting loss may be valid in some cases. Need to identify opportunities, eg new fisheries, products and markets.
- Resilient ecosystems will be challenged under changing climate conditions. There is a need to develop adaptation actions that recognise and integrate ecosystem dynamics and the interactions between land, sea and coastal processes. Wider ecosystem issues will affect fisheries. Need to develop greater understanding about changes in fish species - stocks, recovery, distribution, migration and species new to Scottish waters.
- Need to reduce the risk to social, economic, cultural heritage – human health, wealth, and asset protection (critical infrastructure). How is this done?
- Issues were raised in relation to enhanced access and sharing, including increased co-ordination and availability of information (uncertainty, quality, usage, and provision of guidance, best practice and case studies).
- Information needs to reach policy makers, politicians, marine planners and regulators and be presented in a clear way that can be both understood and used to make appropriate decisions.
- Identifying strategic mapping and monitoring needs and filling key gaps will be essential to inform decision making.
- The UK Climate Projections (UKCP09) need to be applied and good practice usage determined. Guidance on appropriate use of the projections in decision making is needed.

Question 2 - Are there marine climate change issues you are aware of which you already have adaptation plans in place to address?

The direct climate change adaptation activities identified were:

- Scottish Climate Change Adaptation Framework (Scottish Government)
- Sector Action Plans (Scottish Government with others)
- UKCCRA - Risk assessment and costings of adaptation options (Defra)
- Public sector climate change strategies and position statements (SEPA, SNH, FC and Historic Scotland)
- Shoreline Management Plans and Local Climate Impact Profiles (Local authorities)

However, many actions already address adaptation, but are not explicitly labeled as adaptation. For instance, flood risk management & planning, strategic environmental assessment, fisheries management, site condition monitoring, EU and Scottish demonstration projects, coastal protection plans, Estuary Forum management plans, Biodiversity Action Plans, Local Transport Plans, fish quota developments, promotion of new fish stocks, and Bathing Waters Directive enforcement measures.

There is a need to map what is happening and raise awareness of those involved.

Question 3 - Are there marine climate change issues you suspect exist and which a) you do not have enough information/research; and/or b) you would like to see something done (what done by who and by when etc.)?

- There were many areas identified where further research and information is required covering environmental, economic and social aspects, but also some views were raised that enough information is available for key decisions to be made.
- Uncertainties were expressed about the range of information available and its accessibility, including a need for improved co-ordination of the available data and a possible role for Scottish Government. A one-stop data library or effective inventory is required.
- A need to provide better, more consistent interpretation of existing data in order to effectively inform decision making processes was identified. The UK Climate Change Risk Assessment will give more information on impacts, risks, actions and costs.
- Clear and consistent communication was regarded as vital to progressing the adaptation agenda. Senior managers need to agree key messages.
- A lack of research and information in relation to the interface between marine and coastal environments was noted. Coastal flooding and mapping erosion rates, habitats at risk, ecosystem processes, building models, the value of habitats and socio-economic impacts were all identified as issues for consideration. Include in Marine Scotland Science Strategy.
- Maintenance of long-term physical and biological monitoring programmes is required to detect climate change and understand the processes going on.
- There was a lack of clarity regarding funding to build adaptive capacity and deliver actions.
- Scottish Government should set specific requirements for Shoreline Management Plans.
- Many regions do not have access to risk assessments.
- The development of real and practical case studies and guidance explaining the appropriate use of data in real life examples was regarded as a key step forward.

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SECTION 1: INTRODUCTION

In December 2009, the Scottish Government released its [Scotland's Climate Change Adaptation Framework](#)¹. The [sector summary](#)² for the marine and fisheries sector contained an action for the Scottish Climate Change Impacts Partnership (SCCIP)³ in conjunction with Marine Scotland to hold a marine stakeholder event in 2010 to equip decision makers with skills and tools.

The event, *'New Climate Change Tools and information for decision makers in the marine and coastal sectors'* delivered this action and was held on 17th March 2010 at the Royal Society of Edinburgh. It was organised by the Scottish Climate Change Impacts Partnership (SCCIP), in partnership with the Marine Climate Change Impact Partnership (MCCIP), UK Climate Impact Programme (UKCIP), Marine Scotland, Scottish Government and Scottish Natural Heritage (SNH) and Scottish Environment Protection Agency (SEPA). The event aimed to:

- Provide information about climate change impacts for the marine and coastal sectors;
- Raise awareness of the latest marine and coastal climate projections; and
- Provide an opportunity for delegates to comment on the development of the Scottish Climate Change Adaptation Framework – Marine and Fisheries Sector Action Plan.

The event provided an opportunity for delegates to comment on key priorities for the development of the [Marine and Fisheries Sector Action Plan](#)⁴. Delegates were asked to consider the following three questions:

1. What would you see as the key issues for Marine and Fisheries Sector Adaptation?
2. Are there marine climate change issues you are aware of which you already have adaptation plans in place to address? (Possibly good practice to share)
3. Are there marine climate change issues you suspect exist and which a) you don't have enough information/research; and/or b) you would like to see something done (what done by who and by when etc.)?

This report has been produced and edited by SCCIP, based on the compilation of notes taken on the day by five group discussion note takers. A copy of the source notes is available from SCCIP if required.

The full event programme is provided in Appendix 1. It was attended by 50 participants listed in Appendix 2. A note on the organising bodies is provided in Appendix 3. The presentations provided during the event are now available from the [SCCIP website](#)⁵.

¹ <http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptaitonFramework/TheFramework>

² <http://www.scotland.gov.uk/Publications/2009/12/08131340/0>

³ The SCCIP work programme is managed and delivered by the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER). www.sniffer.org.uk

⁴ <http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptaitonFramework/MarineandFisheries>

⁵ <http://www.sccip.org.uk/default.aspx?pid=1>

SECTION 2: RESPONSES TO THE WORKSHOP QUESTIONS

Question 1. What would you see as the key issues for Marine and Fisheries Sector Adaptation?

The following issues were raised.

General

- Though the scope of the event was labelled 'marine and coastal' so as to introduce the new climate projections and tools, the sector action plan that it focused on was Marine and Fisheries, to mirror the UK Climate Change Risk Assessment sectors.
- Engaging 'collectively' in the climate change debate when the marine and fisheries sector is so diverse and being able to convince them that they need to adapt.
- What do we consider 'marine' to be?

Leadership and Decision making

Limited knowledge of the marine environment, uncertainty, different timeframes and scales, resource and funding issues, dynamics and complexity mean there are difficult decisions to be made.

- Leadership and coordination are required at all levels.
- Stakeholder engagement / representation as part of a democratic process.
- There is a need for good communications to raise public awareness about some of the key issues so that they can be better informed so as to support the right kind of policy/political decisions that will need to be made. A key issue raised was – where you want to end up is societal choice – some tough decisions. Winners and losers.
- Difficult decisions need to be made, avoiding business-as usual modes. Political pressure needs to be applied also.
- Need to try to encourage sustainability. Accepting that we will have to act in the face of uncertainty. Precautionary and risk assessment approaches required.
- Business cannot be as usual. Flexibility and innovation are important in establishing adaptation actions. Options include avoidance, reduction and acceptance of potential loss. New innovative decisions, potential costly, and out-of-the-box, set in longer time frames than is current practice are required.
- Better links are needed between mitigation and adaptation. Aspects of climate change (eg flood risk, or carbon foot printing) may be being addressed appropriately within a sustainable development context by one unit, but key decisions are then made by other departments without adequate joining up (eg planning decisions may lead to development in flood prone areas or compromise carbon budgets).
- How to build adaptation into marine & terrestrial plans? There is a need to identify and make available the relevant information for marine planners and policy makers to make the appropriate development decisions. But what is relevant and the most appropriate format for busy officers?

Funding / resources

Who pays for what, when and how? Prioritising and channelling of limited funds for adaptation – is a huge issue.

- Investments and implementing the right type of effective measures over different time frames.
- Having strategies in place, with resources is required ahead (preventative) of potential problems.
- Who is financing coastal protection – some sectors exposed to high risk? Who finances adaptation e.g. when it comes to soft engineering on the ground e.g. Grangemouth – Local Authority? Private business? Scottish Government? A combination?
- The opinions of the marine insurance industry could well be very important.
- Linking climate change projections to real schemes and better use of public funds.

Impacts and risks

A range of impacts and potential risks (benefits as well as detrimental effects) was identified (eg coastal erosion, flooding, biodiversity, new northern transport routes, new fisheries products).

- Need to avoid over-emphasising negative aspects/threats.
- Cumulative impacts and aspects of uncertainty require precautionary and adaptive approaches.
- Uncertainty of the indirect impacts of climate change on the marine environment will influence what adaptation is possible. This factor underpins all others.
- Understanding and addressing the socio-economic and cultural impacts of climate change, especially in the more established industries, and including the need to consider the importance of the marine historic environment.
- Cumulative impacts of developments resulting in loss of the inert-tidal natural defence. There is a need for shoreline management plans or other guidance for managing the coast.
- Impacts on coastal developments, disruption and damage to infrastructure (ports, harbours, ferry terminals, ferries, shipping, offshore and coastal structures).
- Impact on fisheries, species migration due to changes in sea surface temperature.
- Changes to sea conditions and changes to coastal, marine and land interactions – effects on coastal habitats, the built environment, infrastructure (eg ports, ferries, bridges) and coastal flood risk.
- Sea level rise will affect coastal communities (erosion, flood risk). Need adaptation and good communication.
- What effect will changes in circulation patterns have on marine biodiversity?
- Increased storminess: what impact will this have on fisheries, aquaculture and transportation how can we adapt?
- Need to address potential impacts on coastal habitats (ability to adapt). Rare coastal habitats may change and be replaced with others, perhaps more common and with detrimental effects, eg machair becomes saltmarsh. In lagoons, habitats will move (roll back) to new lochs, but will biota?

- How resilient will Marine Protected Areas be if ecological conditions change?
- Impacts on water quality, eg bathing water though changes in micro-organisms and dilution of discharge. Algal blooms and levels of dissolved oxygen.
- Effects on marine GHG fluxes and carbon sequestration.
- Identify sites vulnerable to wave impacts – potential for sites of wave energy converters. Use of marine space for ‘wet’ renewables.

In terms of risk, a number of key issues were raised for the Marine and Fisheries sector as follows:

- Increased sea level – (coastal protection, flood risk management). Climate change projections suggest that low-lying and preferentially developed areas are at risk from sea level rise, surge and other combined pressures. Relocating buildings and assets over the next 50 years requires support and funding.
- Fluvial flooding, urban flooding, river run-off.
- Need to reduce the risk to social, economic, cultural heritage – human health, human wealth, and asset protection (critical infrastructure). How is this done?
- The possible effects of coastal flooding. Assets will be at risk and there is the possibility of over and under adaptation (build a sea wall too low and it is flooded, build it too high and you don’t have enough money to protect other assets).
- Adaptation and avoidance is relevant in certain areas – some land uses are quite fixed assets / not mobile i.e. harbours. Some of these land uses increasingly exposed. Many of the land uses are not supported financially / do not have investment behind them. E.g., Grangemouth has investment, but communities beside it also need to be protected.
- Reducing the risk is sometimes not valuable – difficult decisions will need to be made. How to present these to the public will be difficult particularly if the decisions are not favourable. One example is historical sites – is it still viable to protect them? Small communities often perceive their risk to be great, however, local authorities do not have the money to fund adaptation in all cases – need balance between competing priorities.

Ecosystems and biodiversity

- Resilience of ecosystems will be challenged under changing climatic conditions.
- Need to develop adaptation actions that recognise and integrate ecosystem dynamics and the interactions between land, sea and coastal processes. Changes to ecosystems should be addressed through the marine and fisheries sector adaptation work.
- In particular, groups identified a need to better understand changes in ecosystem services and at different scales from local to regional levels.
- Considerable lack of knowledge of ecosystem processes required to be able to assess the effect of climate change.
- The definition of good environmental status (GES) under the Marine Strategy Framework Directive. It must be robust and take into account a ‘moving baseline’ affected by climatic changes – but that shouldn’t just be a get out to say you can’t achieve GES because of climate change.

- May be opportunities (see Fisheries) as well as problems. Species leaving or arriving in Scottish waters. Implications of non-native (including invasive and pest) species.
- Need to review wording of ‘pre-climate change’ international commitments (e.g. Convention on Biodiversity) which may no longer be achievable.
- Disruption in timing of natural events & cycles.
- Ecosystem changes – food webs, etc. and the services they can support.

Fisheries

- Wider ecosystem issues will affect fisheries, for example ecosystem shifts, population dynamic changes, temperature changes and the need to be able to monitor / predict location changes.
- There was a general acceptance that healthy fish stocks and a healthy coastline would be resilient to climate change and create less management problems for us.
- There is a need to develop greater understanding about changes in fish species - stocks, recovery, distribution, migration and species new to Scottish waters.
- Changing distribution of fish stocks (fishing industry must adapt, including targeting new stocks, more efficient use of resource and efficiencies in fleet).
- Opportunities for new fisheries and markets, as well as impacts on biodiversity, and social/economic/communities.
- Conservation credits & stock recovery – how do plans need to change to accommodate climate change?
- Economic impacts on fragile fishing communities (struggle to diversify).
- Effects on salmon (tourism & aquaculture) and shellfish. Salmon fisheries and rod fishing industries: economic and social implications.
- Knowing what the public will be prepared to accept from fisheries after potential changes in stock for example, will the “new” species being available be acceptable to the market / how could it be promoted as a “new dish” for consumers.

Marine Planning

- Need to ensure flexibility of planning and management zones (including marine protected areas) to alter boundaries and adapt to movement of species or habitats.
- Need to plan for impacts of marine renewable infrastructure around the coast (e.g. on fisheries & shipping).

Shipping & marine transport

- Effects of climate change on transport and shipping generally. Also, disruptions caused by more frequent extreme weather events.
- The appropriate siting of new coastal developments.

- North West passage opening up – the number of days that a ship can sail ice free from the Atlantic to the Pacific via the Arctic will increase with climate change. This will lead to greater shipping along this shorter route.
- Ports further north in the UK, due to the opening of the North West Passage, shipping from the North will increase and so the viability of Northern ports will also increase.

Ocean acidification

- Not strictly climate change but related to CO2 levels in atmosphere. Lack of information but work now underway, including coordinated monitoring of chemistry and lessons from geological history.

Data and availability of information

Access and Use

- Need to better link science to policy (including socioeconomic issues) and consider needs of data users when designing research.
- Providing “relevant enough” data (i.e. relevant to business planning horizons) to economic sectors that adaptation is actually undertaken.
- Enhanced access and sharing, including increased co-ordination and availability of data was consistently identified as a key issue.
- Need for information to be available for marine planners and regulators to be able to make appropriate decisions.
- We need to ensure that information reaches the people it needs to (e.g. policy makers and politicians) and is presented in a clear way that can be both understood and used.
- How will the data that is available be used on the ground to inform the decision making?
- Whose data do we use? UKCP09 good starting point.
- When do we use the information and how? What advice do we give out when commenting on planning? Currently there is a feeling that there is not a very clear steer from Scottish Government down through SEPA to Local Authorities that a certain emissions scenario should be used. At some point, practitioners will want a number / line. Adapting to a range – do we design for the worse-case scenario.
- Use of central data repositories (e.g. SEPA for flood risk management data). Resolve data licensing issues to assist in data sharing. Links to MEDIN framework (Scotland needs to have clear view on need for a separate Scotland data archive).

Availability and quality

- Relative lack of knowledge regarding future climate change at the regional level - this needs addressing to create correct adaptation.
- How good does information about adaptation have to be to be useful – we don’t really know? If adaptation was a relatively cheap and quick process, then we probably wouldn’t be so concerned about accurate data.

- Where we have high levels of confidence in the data then we need to take specific preparatory action to adapt.
- Similarly, where there is more uncertainty we need to be more precautionary.
- Understanding the uncertainty in the projections – in the UKCP09, the uncertainty of a projection was quantified where possible (e.g. the mean sea level chapter gave the 5th and 95th percentile, and so 90% of the models gave values between these limits). This additional information can aid the user in a number of ways, and allows the user to consider the level of protection that their asset requires (i.e. a large city may look to the higher end of the range compared to a small village?). The Marine Report includes a case study (the Thames Estuary) to illustrate how to use this information to inform decisions.
- Ensure data is robust with good metadata and quality assurance (time consuming task!).
- Need an agreed code of practice on standards for research and ensure that academic research also targets national priorities (Marine Science Strategy / MASTS links).

Monitoring

- The need to monitor the marine environment and making data spatially relevant for a mobile environment.
- Strategic mapping and monitoring needs were identified as essential to develop informed decision making and yet remain as key gaps (eg LIDAR surveys and monitoring to report on trends).
- Improve coordination of monitoring networks (especially given likely cutbacks in funding).
- Prioritise research on gaps in knowledge and target monitoring effort at key pressure points to identify impacts / change.
- Increase understanding of ecosystem dynamics to be able to predict natural / climatic drivers in ecosystem and suggest adaptation strategies (EU KNOWSEAS project).

Guidance and best practice

- There is a need for cooperation and information sharing between stakeholders. Repository of adaptation knowledge - how do we document and disseminate best practice examples?
- Who provides this guidance on what information should be used? SEPA?
- The UKCP09 projections were identified as a useful source of information, but have yet to be applied and good practice usage to be determined / communicated.
- Workshop participants noted the need for guidance on the appropriate use of the projections as part of decision making processes.

Question 2. Are there marine climate change issues you are aware of which you already have adaptation plans in place to address? (possibly good practice to share)

The direct climate change adaptation activities identified were:

- Scottish Climate Change Adaptation Framework (Scottish Government)
- Sector Action Plans (Scottish Government with others)
- UKCCRA - Risk assessment and costings of adaptation options (Defra)
- Public sector / agency climate change strategies (eg SEPA, SNH)
- Four agency climate change position statement (SNH, SEPA, FC and Historic Scotland)
- Active partner in Marine Climate Change Impacts Partnership (MCCIP)
- Shorelook – coastal vulnerabilities (SNH)
- Shoreline Management Plans (Local authorities)
- Local Climate Impact Profiles (Local authorities / SCCIP)
- Adaptation Plan (Environment Agency)

However, many actions already address adaptation but are not explicitly labeled as adaptation. For instance, flood risk management & planning, strategic environmental assessment, fisheries management, site condition monitoring, EU and Scottish demonstration projects/case studies, coastal protection plans, Estuary Forum management plans, Biodiversity Action Plans, Local Transport Plans, developments on fish quotas, and measures to enforce the Bathing Waters Directive. There is a need to map what is happening and raise awareness of those involved.

Strategic

- Development of [Sectoral Action Plans](#) linked to the Scottish Climate Change Adaptation Framework.⁶
- [Four agency statement – Action on climate change](#). SEPA, Scottish Natural Heritage (SNH), Forestry Commission Scotland and Historic Scotland with responsibilities for different aspects of Scotland's environment and heritage have come together to make a joint statement on climate change.⁷
- [Climate change and the natural heritage: SNH's approach and action plan](#). Outlines mitigation and adaptation.⁸
- [A climate change plan for SEPA](#) - This is an adaptation plan in terms of how SEPA does its business. SEPA has re-thought the way WFD monitoring is carried out. years.⁹
- Strategic Environmental Appraisal/Assessments offer opportunities.
- Strategic Environmental Assessments and Environmental Impact Assessments (e.g. for marine renewables) – include need to build in possible climate change adaptation strategies (e.g. resistance of proposed developments to projected wave heights, etc.).

⁶<http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptaitonFramework/TheFramework>

⁷http://www.sepa.org.uk/climate_change.aspx

⁸<http://www.snh.org.uk/pubs/results.asp?Q=climate+change&rpp=10>

⁹http://www.sepa.org.uk/climate_change.aspx.

- Scottish Government has identified need for a centre of expertise on climate change, with allocated funding (RERAD plan 2011-16). It may be possible to build in a marine aspect to the centre.
- Map based advice to inform decision making – build resilience to climate change business (SEPA)
- Biodiversity Action Plans (UK and Local).
- Environment Agency (England) adaptation plan is looking at marine sector.
- Considerations beyond this century.
- Local Transport Plans – carbon footprint for new projects assessed.

Flooding

- Flooding Act – includes coastal areas.
- Flood risk management planning - approach takes into account potential climate change impacts.
- Principle of avoidance – do not allow development in areas that are at risk of flooding - mitigation and adaptation. Flood Map is available.¹⁰
- Flood management – coastal realignment projects.
- Coast Adapt project in Western Isles– (Uists). Cooperative strategies and consultative approach, covering habitats and human communities. Identifying very low-lying areas at risk from sea damage/flooding/storm surges. For instance, no new building in areas in areas below 5m above sea level without evacuation plans in place. Sharing good practice is built in, at an international level.
- Fife Flood Alleviation Group guidance, including Flood Risk Assessment for coastal sites.
- Falkirk Council has a flood prevention scheme in progress - £5.8 million 'Bo'ness FPS' and is looking to address risks to authority from coastal flooding through FRM Act – inclusion of high risk areas in local flood risk management plans. This will be the way forward as funding will have to be addressed here, cost benefit etc.

Coastal/ marine

- Shoreline Management Plans (eg Fife), to include 20, 50 and 100 year projections considering the effects of climate change.
- Measures to enforce the Bathing Water Directive (eg the control of diffuse faecal inputs).
- Nutrient reduction measures to reduce run-off from land – applicable to coastal and estuarine situations.
- Coastal Sustainable Urban Drainage Systems.
- Coastal retreat for habitat creation.
- SNH research on coastal climate change

¹⁰ http://www.sepa.org.uk/flooding/flood_map/view_the_map.aspx

- Shorelook, SNH project to anticipate habitat and geomorphological related impacts and to identify strategic responses.
- Network of sites – monitoring. Site Condition Monitoring of designated sites – should highlight climate change effects. If climate change studies of designated site(s) show the reason that the site(s) was originally designated no longer exists, will they be de-designated? Yes.
- Developing resilience via the Marine Protection Area network.
- Tay Estuary Forum’s Management Plan.
- Small-scale examples of managed realignment (e.g. Nigg Bay in Cromarty Firth and Skinflats, Forth Estuary).
- Perth and Kinross Structure Plan identifies the need to address managed retreat along the Estuary.
- Skinflats – is there enough information on the soft engineering to say if it is a good plan? Significant amount of land-owners, which could make this difficult. Visualisations are now possible, but were not 10 years ago when this was first discussed. Considering technology has moved on – would it be worth going back over the plan? RSPB going back with more ideas. Winning the public over is a big challenge.
- EU demonstration projects on coastal changes (e.g. CoastAdapt, ClimATIC) – need to disseminate best practice.
- The University of the West of Scotland has a number of reactive adaptation projects: coastal protection plans to protect against coastal erosion; schemes that provide fish nets from aquaculture to retain sand in sand dune openings; and planting of marram grass.
- Some Local authorities are assessing their vulnerability to climate change via the Local Climate Impacts Profile approach developed by UKCIP and promoted/supported in Scotland by SCCIP.
- Warning system: buoy networks for surge and coastal flooding.

Fisheries

- Fisheries management – does this address need to adapt to changing distributions (quota / discards, etc.)?
- Fish quotas – moves to seek to remove barriers to swap and trade quotas to allow fisherman to adapt to changing abundance of fish stocks.
- Fisheries products – promotion of new stocks to public as an alternative to more traditional stocks/fisheries products.

Question 3. Are there marine climate change issues you suspect exist and which: a) you do not have enough information/research; and/or b) you would like to see something done (what done by who and by when etc.)

Most groups did not differentiate their responses between a) and b). Quite a few of the issues identified under this section were also issues that had been raised in response to question 1.

- There were many areas identified where further research and information is required covering environmental, economic and social aspects, but also some views were raised that enough information is available for key decisions to be made. For instance, ‘we know enough about risk – what we need now is political and societal action’.
- Uncertainties were expressed about the range of information available and its accessibility, including a need for improved co-ordination and maintenance of the available data and a possible role for Scottish Government.
- A need to provide better, more consistent interpretation of existing data in order to effectively inform decision making processes was identified.
- Clear and consistent communication was regarded as vital to progressing the adaptation agenda.
- A lack of research and information in relation to the interface between marine and coastal environments was noted. More detailed information and / or improved access to existing data is required in order to inform planning and decision making processes in these areas. Coastal flooding and erosion, more information about at habitats at risk and information about the value of habitats were all identified as key issues for consideration.
- There was a lack of clarity regarding funding to build adaptive capacity and deliver adaptation action.
- The development of real and practical case studies and guidance explaining the appropriate use of data in real life examples was regarded as a key step forward.

Decision making, funding and communication

- Increased public awareness to facilitate better decisions. Communication with the public so that adaptation will not be resisted.
- Information for elected members (Councils) to inform key developmental decisions.
- Funding of adaptation actions that are required – need information on likely costs and who will meet them. UKCCRA will give more information on the cost of adaptation actions, but decisions will need to be made on who should fund actions.
- Need enough certainty and data to substantiate investment / government support. However, also need to be confident to know when we have enough data to act! Agreement that enough information exists to make changes (e.g. to monitoring and data sharing) instead of constant talk! Need to get confident and coordinated message out and for all senior management to agree key messages. Need to better explain issues of scientific uncertainty.
- Investigate ways to explain scientific information to public (how to convince cynical public about key facts).

- Case studies and worked examples (perhaps based on demonstration projects) are very useful for knowledge transfer.
- Stakeholder representation. Representatives' personal agendas being pushed? Would like to see a prescribed democratic process.

Research and modelling

- Good basic research into ecosystem processes and their physical background to allow us to build good models to be used in forecasting once good climate change projections are available at the appropriate resolution.
- Good regional (relatively small scale) climate change projections to cover meteorology and marine (currents, temperature, salinity, turbulence, chemistry).
- Understanding how the physics and biology of the oceans work and interact is critical to know how climate change will affect the oceans.
- HR Wallingford and PML were developing a UK capability for ecological modelling including the marine environment.¹¹
- Climatic changes versus natural processes as drivers in ecosystem – how will dynamics change? Look at impacts of climate change on biodiversity and ecosystem productivity and services. Need to include these aspects in Marine Scotland Science Strategy.
- Need more research on possible socio-economic impacts of climate change. (SNIFFER could follow-up Differential Social Impacts of Climate Change study and investigate impacts on coastal communities).
- Lack of knowledge of the 'value' of habitats: ie if they are lost and how much would it cost to replace the services they provide?
- Ocean acidification - need better information on the different forms of CaCO₃ in marine organisms and how these will be affected.
- Ordnance Survey data is not enough – need other sources, in particular a data capture programme for LIDAR, to aid strategic planning and to identify trends.
- Strategic overview of future energy requirements and of what type of technology to put where to fulfil this need. Scottish Government to lead.
- To what extent are Marine Protected Areas to provide resilience to climate change? Need more research on this and greater open-mindedness from conservation bodies.
- We do not know to what extent fisheries management measures are negated by climate change. Need more research. More adaptive management requires EU fisheries policy reform.
- Need greater understanding and modelling of biological impacts of climate change.
- Need scenarios for the near future as well as end-of-century to help make management decisions and plan for the appropriate time frames.
- Is there a relationship with groundwater abstraction? What is the relationship with agriculture / crops?

¹¹ (<http://www.meece.eu/library/erse.html>)

Monitoring

- It is critical to maintain long term (up to 30 years is useful for most uses) physical and biological monitoring to (1) detect change and (2) as a data source to study underlying processes.

Data

- Could make better use of data collected for SEA studies (make available and avoid duplication of baseline studies).
- Some models do not have enough certainty so have to use scenarios which are not as helpful.
- The basic climate forecast at the regional level needs much more effort.
- Managers needed more statistics and data than “words” in a projections report e.g. Historic Scotland required storm surge data to know if Skara Brae at threat.
- Do we need a coordinator for the knowledge base?
- A one-stop data library or comprehensive and effective inventory of data sources is required. A single body to coordinate this overview and facilitate access. Could us the SEA Gateway as a model.¹²
- There is a need for coastal erosion rates to be mapped around the whole coastline. Defra is currently doing this for England. The SEPA flood maps could serve as a model.
- Coastal flooding and erosion – are parts of Scotland better served with information than others?
- European Space Agency was undertaking a project to bring together monitoring data sets since the 1970s – Long term Data Preservation project.¹³
- European Space Agency has a climate change initiative in 2010 to merge data sets from various sensors which will produce a variety of useful products over coming years. No dedicated link available yet as project is to begin this year. Some [news links](#) provide particularly useful background information, mentioning the Global Climate Observing System and the World Meteorological Organisation which drive this requirement.¹⁴
- These paragraphs (below) from the above link highlight what make this highly relevant to our discussion:
 - “Data from ESA satellites going back three decades, combined with data from new missions, will be used to produce information on a wide range of climate variables such as greenhouse-gas concentrations, sea-ice extent and thickness, and sea-surface temperature and height.
 - The Climate Change Initiative will implement all actions necessary to generate essential climate variables, including long-term data preservation, periodic reprocessing of the long-

¹² <http://www.scotland.gov.uk/Publications/2006/09/13104943/0>

¹³ <http://earth.esa.int/gscb/lt dp/objectives.html>

¹⁴ http://www.esa.int/SPECIALS/Space_for_our_climate/SEMCGJ7JT2G_0.html

term climate archive, recalibration, algorithm development, product generation and validation, and quality assessment of climate records in the context of climate models.”¹⁵

Guidance

- Scottish Government should set specific requirements for Shoreline Management Plans in Scotland.
- Coastal managers needed to know how coastal engineering could be more adaptable for biodiversity by making defences more natural.
- Need for guidelines on incorporating climate change into Strategic Environmental Assessments (already exist for England and Wales but no equivalent in Scotland).
- Need guidance on how the projections are to be used to inform the decision makers e.g. in terms of assessing the cumulative impact?
- In terms of science, there is enough evidence, but currently there is not enough support to help people on the ground. There is a need for guidelines/tools to help people use this info. All scenarios are valid, but which one would the regulator use? The ways to answer the questions are ahead of guidance.
- Even though UK Climate Projections (UKCP09) are great, they do not provide the merged data sets that practitioners need e.g. surge figures – currently practitioners need to go elsewhere to get this info. There is a need for guidance on where to go, how to get this information, how to fast-track this process for the people that need it. There is a need for a combined assessment merging all information / projections to assess future risk.
- Need more real and practical case studies, especially along the lines of the Thames Barrier, which explored different adaptation options and investment decisions that had to be made under different future time horizons. This will help avoid incremental business as usual type decisions.

Impacts and risks

- Investigate combined effects of climate change impacts and other human pressures on marine environment, e.g. sandeel distributions in relation to fishing levels / seabird breeding success. Build on existing work to support development of appropriate policy responses.
- Implications of climate change for development of Marine Protected Areas network and on interpretation of precautionary principle.
- Investigate possible greater terrestrial run-off (increased summer rainfall) and potential changes to sedimentation and salinity in estuaries.
- Ability for different sectors to adapt to climate change, e.g. marine transport & shipping – effects of weather disruptions to ferries and effects of sea level rise on ports & harbours. Impacts on inter-island ferry services / infrastructure affect essential services to remote communities. Review past trends in relation to weather events to allow planning for disruptions (useful lessons from Scottish Government Climate Change Roads Study).

¹⁵ http://www.esa.int/SPECIALS/Space_for_our_climate/SEMDXK9KF6G_0.html

- Flood risk assessment – what is the allowance for climate change (Developers).
- More information on changes in the local landscape are required i.e. factors that will affect towns, coastal harbours etc. Do we consider moving location etc?
- Many regions / sectors do not have access to risk assessments so difficult to develop adaptation strategy without this. There is a need to link climate projections to actual impacts and translate these into societal impacts.
- Erosion and flooding should be linked – need to consider both of these together. Scottish Government and SEPA possibly doing some work on this?
- We know enough about risk – what we need now is political and societal action.
- Changes in coastal land use – economic factors for communities with high risk of being impacted. Moving communities?
- Do we have enough input to decide whether climate will have an impact on disease outbreaks both in human populations and in farmed fish and shell fish?
- Do we know enough about fish populations outside the commercial species to be confident in understanding impacts?

SECTION 3: POP UP INFORMATION SESSIONS

Marine Scotland, Scottish Government

Key points made during pop up: Noted the Scottish Government response to the Commission Green Paper on the reform of the Common Fisheries Policy. Also highlighted climate change impacts on commercial stocks and fishing.

<http://www.scotland.gov.uk/Resource/Doc/297585/0092572.pdf>

<http://www.scotland.gov.uk/Resource/Doc/276273/0082934.pdf>

MCCIP

Paul Buckley. Provided a brief overview of marine sector work particularly in relation to the UK Climate Change Risk Assessment.

The main issues raised were in relation to the UK CCRA exercise and these were as follows:

- 1) Cefas is the marine and fisheries sectoral lead and has prepared an Early Issues Report for the Core project team. This report covers key risks across UK shelf-seas to the marine fisheries sector.
- 2) Following this deliverable we have also prepared a summary narrative of the issues, which we tested at a recent workshop to assist the preparation of the Defra Adaptation Strategy (a parallel but obviously related process).
- 3) Currently the core CCRA team is developing risk assessment methodology for application across the programme (remember that a composite approach is being taken - see slides so that where 'costs' of risks are unquantifiable other more qualitative assessment methods will be used).
- 4) We have just had early sight of key elements of this methodology and will be feeding back to the core team our views on its application in the marine/fisheries sector.
- 5) Next we (Cefas) will be hosting a stakeholder workshop for c. 20 marine/coastal stakeholders at which we will collaboratively begin to explore our levels of confidence in identified impacts and their potential consequences. This workshop will be held in early May, probably in York. Katherine Kennedy will be overseeing organisation and facilitating. In response to comments regarding Regional application, we will be applying a regional spin to the event and will be inviting up to 5 Scottish Marine/Fisheries stakeholder representatives.

<http://www.defra.gov.uk/environment/climate/adaptation/ccra/index.htm>

SEPA

Alexander Downie. Provided information about SEPA's work in relation to climate change.

http://www.sepa.org.uk/climate_change.aspx

University of the West of Scotland

Alexandre Gagnon. Provided information about an EU funded research project focusing on climate change impacts on coastal communities and habitats with a pilot site in the Outer Hebrides in Scotland. The project led by Comhairle nan Eilean Siar (Western Isles Council) is titled: 'The Sea as Our Neighbour: Sustainable Adaptation to Climate Change in Coastal Communities and Habitats on Europe's Northern Periphery' (abbreviated as CoastAdapt), and involves partners from Scotland, the Republic of Ireland, Northern Ireland, Iceland, and Norway.

<http://coastadapt.org/>

<http://www.northernperiphery.eu/en/projects/show/&tid=61>

SCCIP / SEPA

Joseph Hagg. Provided background information about the Scottish UKCP09 User community coordinated by SCCIP and encouraged users (or potential users) of the marine projections to make contact and join the user community to share information and insights.

For more information about the Scottish UKCP09 User Community please email: joseph.hagg@sepa.org.uk

Scottish Natural Heritage

Alistair Rennie. Provided information about the Shorelock project. This project looks at historical changes projected forward for designated sites.

Context:

In 2006 SNH revised its policy on coastal erosion and defence (see Annex P). A key principle underpinning this policy is working with nature. This reflects an understanding that protecting the coast from the effects of climate change is not a practical or feasible option in the long term and that the focus therefore should be on management that enables geomorphological features and coastal habitats to evolve naturally with minimal human intervention. Management of the coast that follows this principle is often referred to as adaptive management.

Aims:

The aim of this project is to investigate the likely effects of and the implications for adapting to climate change for coastal habitats and geomorphological features within designated sites in Scotland over the next 100 years.

Methods:

In addition to a scientific and policy literature review, a survey and modelling exercise will be undertaken to establish the trajectory of historical physical changes to a demonstrator coastal system. These geomorphological changes will be compared with present broad habitat patterns. Using various climate scenarios (based on UKCP09, calibrated by local observations) and informed by

past changes, morphological changes are postulated. These 'possible future DTMs' are then reconsidered in the light of various sea level scenarios and broad habitat pattern changes are postulated. Areas of change are then analysed in the light of existing Natural Heritage policies and recommendations are made.

Project status:

Ongoing

Fife Council

Murray Scott. Provided background information about the development of the Fife Shoreline Management Plan and in particular emphasised the need for better, more consistent access to relevant data and information.

www.fifedirect.org/shoreline

Appendix 1 - Programme: New Climate Change Tools and information for decision makers in the marine and coastal sector



New climate change tools and information for decision makers in the marine and coastal sectors



Wednesday 17th March 2010, Royal Society of Edinburgh, 22 George Street, Edinburgh, EH2 2PQ.

Programme

- 10.00-10.30** Arrival / Refreshments
- 10.30-10.35** **Introduction**
Simon Pepper, Chair and Julian Holbrook, SCCIP Manager
- 10.35-10.45** **Facing up to Climate Change – RSE Inquiry**
Dr Andy Kerr– Member of the RSE's Inquiry, Director of the Scottish Alliance for Geosciences, Environment and Society (SAGES)

Part 1 – Essential tools and information

- 10.45-11.10** **Evidence of Marine Climate Change Impacts (from the MCCIP report cards)**
John Baxter, Scottish Natural Heritage
- 11.10-11.35** **Climate Change Projections to 2100 for Scotland – key messages**
Jonathan Tinker, Met Office
- 11.35-11.55** **Discussion**
- 11.55-12.40** **An introduction to the new UKCP09 Marine User Interface (with Q & A)**
Paul Bowyer, UKCIP
- 12.40-13.30** **Lunch** (There will be an opportunity to view on-line marine projection and information stands)

Part 2 – Adapting to a changing climate – current actions and planning

- 13.30-13.40** **Scottish Climate Change Adaptation Framework**
Jody Fleck, Scottish Government
- 13.40-13.50** **Marine planning for climate change adaptation**
Anna Donald, Scottish Government
- 13.50-14.00** **Questions**
- 14.00-14.30** **Stakeholder pop-ups (opportunities for delegates to offer information) with Q &A**
- 14.30-14.35** **MCCIP: update on the next report card and future directions**
Paul Buckley, MCCIP Manager
- 14.35-14.40** **Overview of SCCIP Adaptation Support Services**
Julian Holbrook, SCCIP Manager

Part 3 – The way ahead: Sector Action Plan for the Marine and Fisheries Sector

- 14.40-14.45** **Introduction to workshop questions**
Jody Fleck, Scottish Government
- 14.45-15.50** Workshop – Group Discussion at tables around key questions.
- 15.50-16.00** **Conclusions**
- 16.00** **Close**



Appendix 2 -List of delegates

Name	Name	Organisation	Job title / department
Alcock	Phil	Scottish Government	Information and Strategy Manager
Angus	Stewart	Scottish Natural Heritage	Policy and Advice Manager
Baxter*1	John	Scottish Natural Heritage	Head of Unit
Beswick	Anna	SCCIP	Public Sector Officer
Bowyer*1	Paul	UKCIP	Science Officer
Brown	Andrew	Scottish Government	Team leader
Buckley*1	Paul	MCCIP	MCCIP Programme Manager
Burke	Jamie	SEPA	Planning Officer
Cane	Nick	Mouchel - on behalf of Fife Council	Coastal Engineer
Counsell	Dominic	Scottish Natural Heritage	Marine and Coastal Manager
Coutts	Donald	Historic Scotland	GIS Officer
Cox*2	Martyn	Scottish Government	European, International & Research
Donald*1	Anna	Scottish Government	Head of Branch - Marine Planning
Downie*1	Alexander	SEPA	Marine Science Development Unit Manager
Esson	Graham	Perth and Kinross Council	Policy and Sustainable Development Team Leader
Ferguson	Val	Scottish Government	Policy Executive
FitzGerald*2	Lorraine	SCCIP	Private Sector Officer
Fleck	Jody	Scottish Government	Policy Officer
Gagnon	Alexandre	University of the West of Scotland	Lecturer - Faculty of Science and Technology
Gallego	Alejandro	Marine Scotland-Science	Group Leader
Hagg	Joe	SCCIP	Science Officer
Holbrook*2	Julian	SCCIP	SCCIP Manager
Kerr	Andy	Royal Society of Edinburgh	Director SAGES
Khan-Marnie	Janet	SEPA	Senior Marine Biodiversity Ecologist
Lamb	Richard	UKCIP	Training Manager
Law	Lucy	Scottish Government	Marine Science Advisor
Lonsdale	Kate	UKCIP	Science Liaison Officer
MacDougall	Johann	Scottish Resilience	Policy Executive
McIntosh	Ruth	Caledonian Maritime Assets	Civil Engineer, Harbours & Piers
Midgley	Stephen	SNIFFER	IWRM-net Project Officer
Moffat*1	Colin	Marine Scotland	Science Programme Director
Moxley	Janet	SEPA	Senior Scientist (Climate Change)
Muirhead	Ramsay	Caledonian Maritime Assets	Civil Engineer, Harbours and Piers
Mulholand	Marion	Scottish Natural Heritage	Policy Officer
Pepper	Simon	Independent Consultant	Event Chairperson
Rands	Marc	Royal Society of Edinburgh	Evidence and Advice Manager
Rennie	Alistair	Scottish Natural Heritage	Coastal Geomorphologist
Scott	Murray	Fife Council	Consultant Engineer
Smith	Sharon	Falkirk Council	Flood Prevention Officer
Spencer	Lorna	Caledonian Maritime Assets	Director of Harbours
Stewart	Bruce	Scottish Government	Policy Officer

Strachan	Stuart	Scottish Government	Offshore Wind Policy Adviser
Tilbrook*2	Cathy	Scottish Natural Heritage	Coastal & Marine Policy Manager
Tinker	Jonathan	Met Office	Climate Research Scientist
Tracey	Judith	Scottish Government	Head of Flooding Policy Team
Villegas	Ailsa	The Highland Council	Sustainable Development Officer
Walton*2	Pete	UKCIP	Training Officer
Wilcock	Chris	Scottish Government	Head of Ports and Harbours
Williams	Mark	SEPA	Marine Hydromorphologist
Wreford	Anita	Scottish Government	Science Advisor

*1 Facilitators for afternoon workshop

*2 Note takers for afternoon workshop

Appendix 3 - Note on event organising partners

New Climate Change tools and information for decision makers in the marine and coastal sectors

17th March 2010

About us: Event Partners



The Scottish Climate Change Impacts Partnership (SCCIP) brings together stakeholders in Scotland to collectively address and prepare for the impacts of climate change. SCCIP was established to “increase the resilience of organisations and infrastructure in Scotland to meet the challenges and opportunities presented by the impacts of Climate Change”. SCCIP is managed by the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER).



The UK Marine Climate Change Impacts Partnership (MCCIP) provides a co-ordinating framework to facilitate the rapid transfer of scientific understanding on marine climate change in the UK to decision makers. SEPA, Scottish Government, SNH and UKCIP are all members of the MCCIP steering group and we are keen to support the work of SCCIP and SNIFFER.



Marine Scotland was established in April 2009 as a directorate of Scottish Government to integrate core marine functions involving scientific research and monitoring, compliance monitoring, policy and management of Scotland's seas. Marine Scotland is charged with leading delivery of the SG's marine vision which has at its heart the purpose of sustainable economic growth and the marine environment. The marine vision is for "clean, healthy, safe, productive and biologically diverse marine and coastal environments, managed to meet the long term needs of nature and people."

Marine Scotland's marine planning and policy team led the development of the Marine Scotland Bill and will be overseeing the implementation of the Marine Scotland Act, including the introduction of marine planning. It also provides SG input to the Marine Climate Change Impacts Partnership and will be leading the devolvement of the marine and fisheries sector action plan under the SG Climate Change Adaptation Framework. **Marine Scotland Science**, previously Fisheries Research Services, is an integral part of Marine Scotland providing the science necessary to support the functions of Marine Scotland as well as wider national and international requirements.

Climate Change Adaptation Team is a small strategic policy team which sits within the Scottish Government's Climate Change and Greener Scotland Division. This team led on the publication of Scotland's first Climate Change Adaptation Framework and has a coordinating role in driving work forward for the 12 key adaptation sectors established in the Framework. It will also be

responsible for collating a report to Parliament on the progress of the Framework and the 12 Sector Action Plans.



The Scottish Environment Protection Agency (SEPA) is a non-departmental public body, accountable through Scottish Ministers to the Scottish Parliament and is Scotland’s environmental regulator. Our main role is to protect and improve the environment. SEPA recognises that climate change is the greatest threat to the future of the planet’s ecosystems, with significant socio-economic consequences for humankind. SEPA has, therefore, published a five year Climate Change Plan, which seeks to integrate climate change into all of SEPA’s activities; published jointly with SNH, Forestry Commission Scotland and Historic Scotland statements of intent on climate change; and is working with a wide range of partners at a local and national level to explore solutions.



Scottish Natural Heritage (SNH) is a Government body responsible to Scottish Government Ministers and through them to the Scottish Parliament. Much of our work is done in partnership with others – local authorities, Government bodies, businesses, community groups, farmers and other land managers, and representative and third sector bodies. In working for people and the natural heritage, we develop policy, provide grants, carry out research, provide advice and information, handle casework, look after designated sites, provide licenses and support interpretation. Responding to climate change is a key priority for SNH. We are implementing a 5 year Action Plan to understand the effects of climate change and to help deliver the contribution that the natural heritage can make to limiting it and adapting to it.



The UK Climate Impacts Programme (UKCIP) works at the boundary between research and society on the impacts of climate change and on adapting to those impacts. UKCIP works by promoting stakeholder-led research, and by developing tools and datasets to help organisations adapt to unavoidable climate change. UKCIP supports the users of UK Climate Projections.

The organisers would like to thank



Met Office Hadley Centre (MOHC) is the UK’s foremost climate change research centre and a key contributor to the IPCC and UKCP09 projection. The UKCP09 marine report provides projections on how the physical marine environment will change over the 21st century in terms of sea level, storms surge and wave climatology, and temperature/salinity/stratification. The aim of these projections is to provide the basis for informed decision making, within the public and private sectors. The data from the UKCP09 projections is available via a User Interface.



The Royal Society of Edinburgh (RSE) has launched a major inquiry, *Facing up to Climate Change*. Headed by renowned climate scientist Professor David Sugden, it will look into the gap between policies necessary to deal with climate change and what the public will currently accept, as well as the challenges ahead and how these can be turned into positive opportunities. For more information please visit the RSE website www.royalsoced.org.uk