A COORDINATED AGENDA FOR MARINE, ENVIRONMENT AND RURAL AFFAIRS SCIENCE (CAMERAS) (2011-2016)

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1. The Natural Environment Research Council (NERC) is one of the UK's seven Research Councils. It funds and carries out impartial scientific research in the sciences of the environment. NERC trains the next generation of independent environmental scientists.

2. Details of NERC's Research and Collaborative Centres and Major Programmes are available at www.nerc.ac.uk.

3. NERC's comments are based on input from the British Geological Survey (BGS), National Oceanography Centre, Southampton (NOCS), Proudman Oceanographic Laboratory (POL), Sea Mammal Research Unit (SMRU) and Swindon Office Staff.

Headline Themes

1. Do you agree that the two broad categories of "Local Responses to Global Change" and "Optimising the Potential of Scotland's Natural Assets" are helpful in providing an overlying structure to the Co-ordinated Agenda?

1.1 Yes.

1.2 On optimising Scotland's Natural Assets, the need to separate out the local impacts is not substantiated. Perhaps a distinction between analysing and understanding (exploration and appraisal) the national resources should be distinguished or separated from the impacts of using the resources in a particular location (impact assessment, development, production, decommissioning), which will be site specific or local.

1.3 The LWEC programme is likely to be an important delivery mechanism for Global Change issues and it is important that Scotland engages strongly with this UK initiative to ensure that its agenda becomes a part of the overall UK process and that Scotland gains added value from other UK-based participants.

2. Are the descriptions of these set out in Section 3 (and Annex 3) comprehensive?

2.1 For the most part yes, but the use of Scotland's subsurface and sub-sea resources (e.g. geothermal energy potential, coal and coal bed methane (CBM), hydrocarbons, groundwater, carbon capture and storage, quarrying, marine aggregates, waste disposal) are under-represented.

3. Do these cover the major policy challenges where science can contribute as you see them?

3.1 The generic scientific issues highlighted in Section 3 cover the key issues. The emphasis on environmental data underpinning planning and development is crucial as is the need for an integrated multidisciplinary approach.

3.2 There are gaps in data coverage, particularly in the subsurface and marine environments. More work is required to improve and maximise cooperation and integration between the Government agencies referred to in this consultation, NERC institutes such as the BGS and the Centre for Ecology and Hydrology, and universities.

3.3 A consensus is beginning to emerge that climate change mitigation will not be feasible and that the emphasis should be on adaptation. Thus, at the regional scale we should focus on "solutions" of how to live with climate change. NERC urges the Scottish Government to engage strongly with the Living With Environmental Change[1] (LWEC) programme and not duplicate efforts (see 1.3).

3.4 The state of the art climate models have no proven predictive capability at the regional scale. Science being delivered by NERC as a result of its Climate System theme action plan[2] is addressing this shortcoming.

4. Are they likely to remain broadly relevant over the longer time horizon (well beyond the 2016 focus of this Coordinated Agenda)?

4.1 Yes, the issues raised are long-standing. By 2016 it is envisaged that we would have a better idea of underlying conditions and a more refined monitoring programme in place.

5. Do you agree with the description of support for the National Capability Theme set out in Section 3 (and Annex 3)?

5.1 Yes, National Capability is a useful concept – and one developed by NERC for its core work. NERC agrees that long-term data sets form a critical part of the National Capability. NERC, with a UK-wide science remit, has made a significant investment in UK national capability at NOCS. Resources such as the National Marine Equipment Pool, British Ocean Sediment Core Research Facility (BOSCORF), the Royal Research ships RRS James Cook and RRS Discovery, the National Oceanographic Library and other assets are

[1] http://www.nerc.ac.uk/research/programmes/lwec/
[2] http://www.nerc.ac.uk/research/themes/climatesystem/

there for the whole UK marine science community, including Scottish users. There will be a need (already recognised) to collaborate with the rest of the UK regarding data and knowledge, for example, because marine phenomena cross political boundaries. We must not duplicate the work of National Centres such as British Oceanographic Data Centre (BODC), the marine centre for the UK.

5.2 There is clearly scope for the CAMERAS initiative to integrate with NERC institutes to mitigate any chance of duplication and increase efficiencies. One approach to further integration would be to consider a model similar to the Geological Survey of Northern Ireland. In Northern Ireland, BGS provides key strategic research, advice and support for policy through staff funded through the Northern Ireland Government on a rolling programme of contracts. A similar arrangement in Scotland would assist in integration, efficiency and avoidance of duplication between, for example, BGS, Fisheries Research Services (FRS), the Macaulay Institute and Scottish National Heritage (SNH).

5.3 We would also clarify that some National Capability relevant to Scotland is provided by UK science organisations. Scottish taxpayers also make a contribution to this. In other words, there is a concern that all National Capability relevant to Scotland is seen as being provided exclusively by Scottish organisations.

6. What facilities, resources and data do you think are important for Scotland to maintain?

6.1 Scotland needs to have some research ability, because Scotland has marine and environmental features distinct from the rest of the UK. Scotland must also maintain the facilities/resources that are not provided at a UK level. In the devolved structure of government, for example, fisheries research is not covered at a UK level; therefore this should be maintained by Scotland.

6.2 At the same time it is beneficial to collaborate and not try to be expert in everything; even the UK collectively is not world leading in all areas. [See also 13,17].

6.3 There are data infrastructures at the UK level that do not need to be duplicated in Scotland. There are some issues related to locations of organisations and internal management, e.g. because BGS has a Scottish office we can be seen as serving Scottish needs. The National Oceanography Centre in Southampton, although they do research in Scottish waters, is not seen as providing a local service.

6.4 The CAMERAS initiative could be widened to study how the organisations/ agencies highlighted in the document use their facilities and how they complement and work with universities, the NERC research centres and UK organisations e.g. the Maritime and Coastguard Agency, etc (see below).

7. Are there other resources that Scotland needs to acquire to support future policy development?

7.1 Scotland has a wealth of baseline scientific data but with notable gaps in the solid earth where there is a lack of comprehensive coverage of soils and shallow surface deposits (glacial and fluvial) and their role as barriers or pathways for fluids. National environmental monitoring is required to characterise and delimit these resources. Possible approaches to such a survey include:

a. **National airborne environmental surveys**, such as the Tellus[3] project funded by the Department of Enterprise Trade and Investment in Northern Ireland. This has produced new geochemical and geophysical maps that extend and expand knowledge of the geology, soils, natural resources and environmental status of Northern Ireland. This information supports the exploration for, and development of, mineral and hydrocarbon resources, informs land-use planning and provides a country-wide environmental baseline. Improved mapping by airborne magnetics and gamma-ray spectrometry has encouraged a new interest in the potential for geothermal resources. Terrestrial radiation has been mapped in detail, providing an improved means of mapping the potential distribution of the naturally occurring radioactive gas radon, a principal cause of lung cancer. Tellus also provides tools for mapping contamination from terrestrial activities. The airborne systems have mapped changes in electrical conductivity, magnetisation and radioactivity over man-made structures, landfills and industrial sites. The survey offers a rapid method of screening such sites, in conjunction with other remotely sensed data. These data are a major resource for industry, regulatory authorities and researchers. The Tellus Project is encouraging economic development by promoting investment in mineral exploration, by providing contextual, baseline geoscience information for managing development sustainably, and by stimulating research into a range of applied geological and environmental and land-use issues.

   BGS has conducted a pilot airborne environmental survey in Ayrshire with promising results, but does not have the resources to expand this to the whole of Scotland.

b. **National Seabed surveys.** In several countries in Europe it is recognised that detailed seabed maps add tremendous value to development and conservation opportunities across many industries, including fishing, aquaculture, marine renewables, oil and gas, marine aggregates, etc. A strong economic case in support of National Seabed surveys was made through a cost-benefit analysis undertaken by PriceWaterhouseCoopers for the Irish Government in Dublin. A similar case exists in Scotland and there are clear benefits through integration of efforts by FRS, SNH, BGS and the NERC funded Scottish Association of Marine Science, and the Civil Hydrography Programme to generate an integrated programme that would really assist all the marine industries and interests.

   The forthcoming requirement for enhanced integrated marine spatial planning, under the European Marine Framework Strategy Directive, will

[3] http://www.detini.gov.uk/cgi-bin/get_builder_page?page=2817&site=5&parent=156

require coordinated regional marine planning including joint planning with neighbouring Member States. As a consequence it is essential that mapping activities are jointly planned with agreed terms of reference, and baseline maps that are consistent through all component parts of the UK.

c. **Three-dimensional subsurface urban geoscience modelling**. The role of geo-environmental information is increasingly important as legislative changes have forced developers, planning authorities and regulators to consider more fully the implications and impact on the environment of large-scale development and regeneration initiatives. To comply with the principles of sustainable development, developers are increasingly required to demonstrate that proposals are based on the best possible scientific information and analysis of risk.

   Major infrastructure projects depend on site investigation studies to identify ground conditions, and to ensure that construction design is not compromised. By integrating this information across major conurbations, a unifying 3D framework for characterising the shallow subsurface can be developed in terms that are relevant to engineers, planners and developers.

   Current applied urban geological studies use state-of-the-art GIS and 3D modelling packages to develop digital geological models as a basis for geological interpretations and hydrogeological, geochemical and engineering ground assessments. By making this information more readily accessible, the planning of major developments, ground investigation and reclamation studies can be carried out on a more informed basis.

   BGS is making progress with 3D geosciences modelling in Glasgow with some co-funding from Glasgow City Council, but progress could be accelerated with additional external funding.

Policy Issues

8. Have we correctly identified the key policy issues and the associated scientific opportunities in Section 3?

8.1 The policy issues could be cut several ways but, overall, the questions set out here appear to cover most of the ground. However, this could all be boiled down in to three specific challenges: (i) how can the environment provide for the future energy needs of Scotland; (ii) how can the environment support food production; and (iii) how can we maximise (i) and (ii) without ruining the environment? Most of the questions set out in the document are “second order” questions that feed into these types of “first order” questions. A gap analysis looking at the mapping of the first- and second-order questions might reveal gaps. There is one “third order” question in the list. This relates to reduction of social inequality. I suggest that this would follow as a natural consequence of solving many of the other questions.

8.2 An issue not covered is the identification of policy trade-offs. Ideally all policies would match and be aligned but we know this will not be the case.

Tucked away within the word “sustainable” are some significant challenges that do not seem to be fully understood. For example, in fisheries this could mean a vast reduction of current fishing activity and this could run a coach and horses through ambitions for the reduction in social inequality and other economically-bases goals for the environment. There are other comparable examples in forestry, agriculture and aquaculture. We need to face up to the positives and negatives associated with particular policy approaches. Research needs to be structured to reflect this need. For example, there might be a tendency only to invest in those areas of research that purport to investigate win-wins. This could end up being highly damaging and very short-sighted.

9. Are there additional issues that should be included?

9.1 Yes, potential for geothermal energy production in Scotland.

9.2 In terms of policy issues/drivers reference could be made to food security, ageing population and the green economy.

10. What do you think will be the most important influences on Scotland’s future in the Marine, Environment, Rural Affairs and related areas?

10.1 Some of the key issues include:

a. Impact of climate change – sea level rise, flooding, fishing, agriculture, biodiversity
b. Improving the sustainability and productiveness of Scottish fisheries and aquaculture, including investment in sustainable feedstock for aquaculture
c. Competition between food supply and amenity
d. Sustaining the rural economy, especially tourism
e. Enhancing the environmental neutrality of economic activities, the “greening” of the Victorian infrastructure, etc
f. Developing Carbon Capture and Storage
g. A re-look at the potential for nuclear energy in Scotland, building on expertise already developed
h. Development of renewable energy including tidal stream, barrages, wave power and wind farms and conflicts over such developments
i. Decommissioning of oil and gas infrastructure

11. Why do you think these are important?

11.1 Decisions have to acknowledge that Scotland’s economy depends on natural resources. Rural and urban environments have differing challenges

and opportunities, achieving the right balance for the country will require tough decisions

12. Are there other scientific opportunities which should be highlighted?

12.1 See Q. 7.

12.2 The potential for integrated development of structures with multiple benefits. For example, on the east coast tidal ranges may be smaller and wave and wind energy less, but integrated coastal protection, barrage and renewable energy schemes may become economically effective when a composite scheme is assessed.

The Science

13. What existing areas of Scottish based scientific expertise should be maintained to contribute evidence to key policy issues?

13.1 As mentioned above (question 6), those that are not provided at UK level.

13.2 Marine expertise should be maintained. Because Scotland has devolved powers, England is appropriately diffident in advising Scotland; there is an expectation of Scottish scientific advice even if this calls on aspects of non-Scottish expertise; Scottish scientists are at least needed as "informed customers" to recognise any need for and make best use of external expertise. 17 asks the right question.

14. How clear is the relationship between the scientific areas and the key policy issues?

14.1 Improving for government-funded institutional research. For example, a few years ago it would have said that policy makers generally do not recognise the value of geology to decision-making, but this is changing.

14.2 BGS and its efforts to promote a national seabed survey are becoming recognised (see 7.1b). Environmental policy issues and response to national emergencies, e.g. Foot & Mouth, do need geological and sub-surface information.

14.3 Good linkage is not generally the case for University-based research which, if appropriately mentored, could be much more effective at delivering towards policy.

15. In which areas of science can we continue to make use of expertise supported elsewhere e.g. at the UK, EU and international levels?

15.1 At the UK level, the research and national capability provided by NERC, the Engineering and Physical Sciences Research Council and the Economic and Social Research Council and their component bodies.

16. In the time frame for CAMERAS (2011-2016) what new emerging areas of science are likely to mature and become available for more general use or application?

16.1 Carbon Capture and Storage, assuming continued support from government and industry

16.2 Integrated 3D subsurface geosciences modelling and application to planning, development and climate change impacts

16.3 Marine habitat mapping is improving and the benefits to fisheries management should emerge

16.4 Improved ability to model lower levels of marine ecosystems (but not necessarily up the chain to fish).

16.5 Scotland will emerge as a world-leader in the environmental trade-offs associated with renewable energy.

17. Do we have the expertise available to be able to use these new opportunities?

17.1 Generally yes, but requires collaboration at UK and international level and will only be achieved with new investment.

18. In which areas does Scotland need to be self reliant?

18.1 No comment

Delivery

19. Knowledge Exchange is essential for scientific activity to achieve impact. Do you agree that KE should be an explicit and integral aspect of the delivery of this Coordinated Agenda?

19.1 Yes. KE needs acknowledgement, thought and means of implementation; experience suggests that this will not "just happen" and needs explicit attention.

19.2 NERC would like to see a definition of knowledge exchange here as it means different things to different organisations - e.g. does it include science in society?

20. How can we continue to improve the integration of evidence from a diverse range of sources into forms that are accessible to end users?

20.1 We are on the right track, although there is much debate about sharing data between organisations with different economic models and policies – this urgently needs to be sorted out at a UK government level. We need to embrace interoperability standards (e.g. Open GeoSpatial Consortium) and the opportunities afforded by web services.

20.2 The use of advisors, analysts and interpreters are needed. Also collaborative research and multi-disciplinary research can help ensure evidence is accessible to end users especially if funders include both government and research councils or other non departmental public bodies. Perhaps an equivalent of the Marine Management Organisation (MMO)[4] would be useful for Marine Science.

20.3 It is important to rely on public sector organisations to organise this integration. This is beginning to happen on the back of the European INSPIRE directive. Universities and industry are too focussed on their own interests.

20.4 Improving the structure of research and making sure there is appropriate networking and critical mass is important. However, we need to provide training to help both end-users and research to interact more effectively. On the research side, training needs to start at the Masters and PhD level so that researchers have an improved view of how they fit in to the wider strategic objectives.

21. How can we reconcile the requirement for science to be responsive and flexible to short term demands while at the same time ensuring that longer term strategic research continues to progress our knowledge and understanding?

21.1 NERC is approaching this with its distinction between National Capability and Research Programme; it is helpful to have distinct funding streams for both types of research. However this has yet to be proven in practice. A particular concern is the sustainability of research organisations embodying National Capability when it forms only a fraction of their income and may be subject to "political" pressure in competition with calls for more "agility".

21.2 BGS is a good example of the mixed economy model of science delivery. BGS delivers both long-term national capability data, information and research funded by NERC, but also does responsive short-term commissioned research for the private and public sectors. It also supplies a rapid-response enquiry service for the private and public sectors, and also the public at large.

21.3 Scientific organisations are generally used to this way of working and deal with it effectively. The easy answer is to say that funding is the issue. Dealing with short term is relatively easy as it is a case of you can either fund it/do it or you can't. Long-term requires secure funding and commitment from many layers of government and public research organisations

[4] http://www.defra.gov.uk/marine/pdf/legislation/mmo-brochure.pdf

22. How can we ensure that the 2-way flow of knowledge from science to policy and from policy to the academic community is optimised?

22.1 Policy departments need to commission research aimed at their policy objectives. This needs to be explicit but there may be various forms for such commissioning (individual contracts or long-term support for National Capability, for example). One cannot ensure policy flow to academia but it will probably happen if there is dialogue sustained by funding opportunites (given the academic community's skill in taking up funding opportunities).

22.2 Much more needs to be done. There is a lack of knowledge amongst many policy makers of what drives and underpins the science that allows policy objectives to be achieved. Similarly there are misunderstandings amongst research about the immediacy of the needs of policy makers. Exchanging individuals from research to policy can help but, in general, this comes back to providing sufficient funding, and appropriate career recognition (see 22.3), to enable additional time on both sides to build a common understanding.

22.3 Having a reward system for scientists that recognises the value of giving scientific advice to policymakers would help.

22.4 On the marine side the proposed MMO should ensure that the policy makers have access to science and vice versa.

22.5 By ensuring mechanisms are in place to allow scientists and policy makers to work together and have ongoing dialogue from the inception of research to the delivering of outcomes.

22.6 See NERC's publication "Science into Policy: Taking Part in the Process"[5] for an in depth guide to communicating science to policy-makers.

23. Are there alternative structures/systems or new approaches/organisations that could enhance these flows?

23.1 The LWEC programme is a good example of joining up science to policy. It is important for all research activates to have a good KE plan, with resources to deliver.

23.2 The MMO may prove a useful model.

23.3 The proposal for "centres of excellence/one stop shops" seems like a good idea.

24. Are there science delivery models which could provide examples of good practice for Scotland to follow?

24.1 NERC's programmes in terms of science delivery and those of the Research Councils UK cross-Council programmes might be considered good practice models.

[5] http://www.nerc.ac.uk/publications/corporate/documents/science-into-policy.pdf

General Comments

25. We would also welcome any other general comments you may have on any of the issues raised in this document.

25.1 Generally there is a need to keep abreast of the development and application of methodologies internationally and import these as appropriate to deal with local problems.

25.2 There is a continuing need to collect data concerning the environment and environmental change, and in some cases (e.g. flooding) development of real-time data delivered over the web.