Please complete and send back to a.dalton@uea.ac.uk by 15th November 2012. Thank you!

Principal Investigator

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Discipline	Economics and environmental management		
Role in team	PI		

Project team

Total number of people involved	Academics	23
	Non-academics	13
Of these, how many are	Natural scientists	18
	Social scientists	5
	Economists	13

Project title (<120 Characters)

Coastal ecosystem services: from science to values and decision-making

Project objectives

To apply the NEA/VNN conceptual framework to the coastal zone context and inter alia aim to provide evidence to help meet the four VNN challenges.
To support and enhance coastal zone management principles and practice in the UK and Europe. Using an interdisciplinary and systems based approach, to investigate the stock and flow of ecosystem services provided in coastal zones; and the associated management and governance problems that are posed in this especially dynamic environment.

Summary

Please provide a **one page** plain language summary of your project, aimed at a non-specialist audience. Please address the following:

- what is your project about?
- briefly state your key findings
- why are these important?
- what have you produced that other people or organisations might find useful: tools/models etc?
- who (what type of organisations) should be interested in your tools etc?

The project highlights why coastal zones are important in terms of the role they play in terms of environmental life support and quality, as well as their contribution to economic, social and cultural aspects of human society and its well being. The management of coastal areas poses a difficult challenge because of the constant environmental changes (driven by marine and land-based pressures and drivers) that these areas are subject to. Recent thinking has emphasized the need to manage our coastal in a more comprehensive ('holistic') and flexible way, with due regard to the need to better conserve natural habitats in their own right, while also seeking to maximize the socio-economic and cultural benefits that humans derive from them. Coastal areas supply a wide range of so-called 'ecosystem services' from food supply to flood protection and recreation/amenity opportunities. In total these services provide significant human well-being benefits, only some of which can be expressed in monetary terms. This project aims to better define, quantify and value coastal ecosystem services and benefits; and to distinguish between the 'stock' position i.e. the available amount of coastal ecosystem services at a given point in time and the 'flow' position i.e. the incremental changes in the supply of services over time. The policy context for coastal management options is currently dominated by legislation such as ,for example, the EU Marine Strategy Framework Directive (MSFD), with its central objective of the maintenance of 'Good Environmental Quality Status' within coastal and marine waters. The findings of this research project will contribute to the more detailed implementation of the MSFD and related policies based on spatial planning and marine protected areas

Your project and the Valuing Nature Network

Please provide up to **four pages** of detail regarding the following:

1. Your insights into which of the four VNN Key Challenges (Appendix A) you addressed, according to your proposal
2. How you have evolved the overall VNN conceptual framework (content of boxes and flows between) (see Appendix B)
3. Your thoughts on the future agenda for VNN research (following on from initial ideas in April's meeting)
4. Your recommendations regarding mechanisms to maintain and grow the network

1. The key challenges

The research whose core aim is to integrate the ecosystem services framework into a more adaptive coastal management approach in the UK and Europe, has to some extent addressed all four of the VNN challenges. It has incorporated complexity into the ecosystem services framework for coastal contexts; it has distinguished between stock and flow concepts in data compilation and valuation analysis; it has taken due regard of scale and scale mismatch problems; and it has combined data from different disciplinary perspectives into policy relevant environmental knowledge and know how in order to provide 'better' decision making support.
This coastal zone research has confirmed that the NEA/VNN conceptual framework is both necessary and sufficient to provide for more detailed analysis of the coastal ecosystem services concept and its policy significance. The research is also further refining the NEA futures scenarios with explicit reference to the coastal/marine context.

The findings of this project aim to be relevant to the following bodies and their policy processes:
DEFRA) National Environment Ministry; other Ministries with environmental impacts concerns/duties; Environment Agency, Natural England, local government, NGOs, National Farmers Union and other industry groups.

KEY FINDINGS

- Based on an extended and adapted NEA conceptual framework, this project has shown that coastal zones supply many valuable ecosystem services but that this supply is under threat from a combination of socio-economic and environmental/climate change drivers. A more adaptive and flexible policy response is required in future (one that goes beyond just the construction of engineered flood defence structures) to meet these challenges and to maintain as far as is feasible existing coastal environments and human communities. The ecosystem services framework can help to highlight the need to 'work with nature' as much as possible in order to respond efficiently and effectively, especially given the prevailing national and global financial recession.
- Given the NEA conceptual framework, this project has proposed a particular interpretation of the ecosystem services stock and flow concepts in order to distinguish between the monetary accounting value of the ecosystem services stock (at a given point in time, and analogous to the economic activity measure Gross Domestic Product GDP); and the economic (marginal) value of incremental changes in flows of ecosystem services over time. These monetary estimates can serve to emphasise the 'significance' of ecosystem services to the economy and human welfare; and may carry further traction with Finance Ministries and their thinking because they are explicitly couched in monetary terms.
- The wide (systems-based) approach adopted has served to re-emphasise that the basic ecosystem processes and structure that underpins the stock and flow of ecosystem services is fundamentally 'valuable' in its own right. Thus it is always the case that the total monetary economic value (related to the sum of the flow of ecosystem services) is less than total system value. This has important implications for policy options appraisal and trade off decision making. It requires, among other things, that economic cost-benefit decision support analysis must be constrained by 'regulations' that reflect precautionary thinking if it is suspected that environmental 'limits' i.e. thresholds and irreversibilities (changes that cannot be reversed either because it is too costly to do so or technologically not feasible), may be approaching.
- Coastal zones are subject to relatively rapid and complex environmental changes and policy responses should therefore be guided by principles such as pluralism (i.e. get knowledge from a number of different disciplines, natural, social sciences and arts/humanities); pragmatism and conditional rationality (i.e. do what you can to 'improve' matters now and do not delay to search for optimal solutions which probably require much more evidence collected over long

periods of time). In other words deploy interdisciplinary research to inform real world adaptive and timely decision making, accepting that there is always uncertainty and that in many cases decisions create 'winners' and 'losers'. In simple terms this is a 'learning by doing' approach. In this context, the project has proposed the use and development of a decision support tool, the 'balance sheets ' method/approach, which seeks to provide a more comprehensive set of information to the policy process.

- The research has begun the process of indentifying indicators of changes in ecosystem services provision in coastal areas. The indicators set is being linked more closely to ecosystem functions and consequent services and represents a reduced form of the large (over70) number of indicators originally identified in order to begin the MSFD implementation and make progress towards 'Good Ecological Status' conditions for coastal/marine waters. It is not yet clear whether the indicator set will prove to be sufficient to construct a part of an ecosystem services (non monetary)'account' which could sit alongside National Income Accounts (traditional GDP and/or modified GDP welfare accounts).
- The research has quantified and evaluated a set of significant ecosystem services (carbon storage, fish nursery provision and recreation and amenity) for some large North Sea estuaries. The estimates of 'blue carbon' derived from saltmarshes and seagrass beds are highly policy relevant in the climate policy arena.
- In the context of marine spatial planning, a number of marine protected areas (MPAs) have been established/proposed. This research has identified the ecosystem services most likely to be conserved/provided under this spatial designation process. Matrices for the provision of ecosystem services provided by key designated features (habitats and species) have been constructed.

KEY CHALLENGES

- THE COMPLEXITY PROBLEM

  This has been investigated in terms of both ecosystem services stock (i.e. the configuration of ecosystem structure and processes present at a given place and time) and the aggregate valuation of ecosystem services flows. For example, in the stock context, complexity was analysed in terms of particular coastal ecosystem services – organic carbon cycling, burial and storage in the estuarine mudflat-saltmarsh system. Organic carbon input and cycling within the estuarine water column is itself complex and this characteristic is maintained as organic carbon is deposited in estuarine sediments. The carbon burial and decay mechanisms that operate (intermediate ecosystem services) also release other greenhouse gases e.g. nitrous oxide. So only the net organic carbon storage (final ecosystem service) can be assigned a monetary value based on the CO2 equivalent which has been prevented from entering the atmosphere. So this monetary benefit estimate has to be adjusted in line with the net carbon burial/other gases (nitrous oxide and in some places methane) release process, as carbon storage takes place. There are then two benefit valuation methods available, the social cost of carbon (damage costs avoided) method and the marginal abatement (clean-up cost) approach based on DECC prices. The results from these two approach are significantly different. Further complexity is introduced when it is realised that the carbon storage service operates over decades to centuries of time. So the monetary estimates of its annual value will need to be discounted. The discounting controversy has long troubled economists and others and now involves choices between: no discounting; discounting at a particular 'appropriate' rate i.e. based on market data or other ethical premises ; declining discount rates.

  STOCKS AND FLOWS

  We have proposed that the stock of coastal ecosystem services can be assigned an 'accounting' price value, at a given point in time, which is analogous to a national income account estimation such as Gross Domestic Product (GDP) with a constant set of weights. On the other hand, the flow value i.e. of marginal (incremental) changes in ecosystem services provision over time, can be addressed via more conventional economic benefit valuation methods. these range from production function approaches through to survey – based contingent valuation and choice experiments methods.
  When the ecosystem services value relates only to non- market services it can be combined with GDP to yield a more 'green' GDP or Net DP measure. This moves the GDP indicator away from being a measure of 'economic activity' towards a more 'welfare' related measure. But a separate and complementary ecosystem services account/index could also be a

worthwhile goal. Such an account/index will require an agreed and measurable set of ecosystem services indicators.
In order to take this last suggestion further it will be necessary to refine, shorten and quantify the long list (>70) of proposed MSFD indicators which combine to define 'Good Ecological Status'. A restricted set of indicators, more closely related to and reflective of ecosystem functioning and services provision is required in order to realise a usable ecosystem services account/index.
The stock concept should also serve to remind us that a 'healthy' functioning ecosystem is reliant on a minimum provision of basic processes and structure. This provision is significant in itself in terms of its inherent 'infrastructure' or 'glue' or 'primary' value that it guarantees. Without this provision there would be no sustainable flow of ecosystem services and valued benefits. It is therefore always the case that total system value (TSE) is > total economic value (TEV).

DECISION – SUPPORT SYSTEMS.

The management of coastal systems is complicated by , among others, the so-called scaling mismatch problem. The dynamic changes that occur in these zones are driven by forces and pressures originating in nearby terrestrial catchments and by marine sourced influences. Some of the latter operate at the global scale – sea temperature rise, acidification, sea level rise – and are linked with economic activity such as trade and shipping to induce a wide variety of environmental impacts including the spread of non-native invasive species. The coastal zone administrative and governance boundaries are therefore far from coincident.

A more 'adaptive' and 'integrated' management approach is therefore required for future coastal management.

This work package has developed a decision-support tool, the balance sheets method/approach, which is aimed at providing decision-makers with a more comprehensive but coordinated set of policy relevant data than that currently provided via methods such as economic cost benefit analysis (CBA) used in isolation as a meta tool.

The balance sheet approach encompasses three separate but complementary information displays, only one of which is focused on extended CBA (i.e. with distributional weights included). The other two displays, balance sheets, contain data at a local to regional scale which may ,for example, highlight 'local' losers in employment or other terms, from a given policy option choice. These local impacts may not register as significant net impacts in the national efficiency CBA, but nevertheless carry significant political traction e.g. local coastal communities faced with erosion/flooding risks or suffering employment losses due to fishing restrictions, etc. The third balance sheet sets out impact information through a multi-criteria lense(s) and can serve to highlight different ethical perspectives and their implications e.g. arguments in favour of more extensive 'regulation' to safeguard key ecosystems.

Future directions
Work to establish the feasibility of an ecosystem services change account/index at the national scale, and supported by a suitable indicators set;
Valuation studies to increase the values database for coastal/marine ecosystem services benefits which is currently sparsely populated;
Further development of the 'balance sheets' decision support tool;
Practical 'coupling' of currently separate process models for land use change in catchments, estuarine ecosystem changes and coastal waters environmental changes – to support more holistic environmental management.

Specific project details

Please provide brief details (**100 words** for each question) to address the following:

Progress

Did the research proceed as expected and on time?
If NO give details. yes

Was there any significant change in the research compared with the original proposal?
If YES give reasons for changes.
No

Were there any circumstances that aided or impeded research progress?
If YES explain how the work was affected and how any problems were overcome or opportunities exploited.
Openness within the marine science community to embrace interdisciplinary research

Publications

Dissemination of results.
List the following types of output: papers (both published and in press) and reports directly arising from the research; conference proceedings; book chapters; etc.
Four papers:
Conceptual framework paper;
Estuarine – based case studies paper highlighting complexity;
Valuation meta data bases paper; and
MPA and governance in relation to ecosystem services paper.
The aim will be to turn some of these papers into journal articles and to combine all of the material into a published volume.

Results and outputs

Have any significant datasets been generated from this research?
If YES give details.

Were there any circumstances that aided or impeded research progress?
If YES explain how the work was affected and how any problems were overcome or opportunities exploited.

Results exploitation and knowledge transfer

Who do you think are the main users of this research?
Include any that apply: industry (please specify which sector); policymakers and regulators (e.g. Defra, Environment Agency), NGOs (e.g. RSPB, conservation bodies; other academics).
All of the above

Have any potential beneficiaries and/or users of the research outputs (in particular non-academic research users, such as private or public sector organisations) been involved at any stage in the research activity and/or been informed of the research outputs and achievements?
If YES give details.
WP members included representatives from regulatory agencies and government and NGOs.

Has the research led to any further collaborations with potential users or other academics?
If YES give details.
Led to NEA 2 WP3b

Science in society

Has an opportunity arisen to promote the public understanding of the scientific results from this research?
Give details of work/activity undertaken

Interdisciplinary working

To what extent did the project enable new working relationships a) between different academic disciplines and b) with non-academics?
Please give details
Closer cooperation between natural and social scientists in the network.

What were the main challenges of working as a team consisting of people from different disciplines/sectors?
Please give details
Different terminology; the role of normative research and how it can be handled in research aimed at policy makers; the scale at which some natural science and some social science is inevitable conducted and the more extensive scales required to inform policy making e.g. the lack of joined up process models to link catchments to coastal waters; or the site specific characteristics of some economic valuation studies which limits transferability of results.

What methods did you use to successfully address these challenges?
Please give details and also include any recommendations for future VNN research.
Specific information exchanges/dialogues within the whole group at the outset of the work; all specific groups working on the four papers were interdisciplinary

Anything else?

If there are any other outcomes from your project that have not been captured above, or if you have any further comments, please add them here

Appendix A

The four Key Challenges

1. How can the **complexity of socio-ecological systems** be incorporated into valuations of biodiversity, ecosystem services and natural resource use?
2. How can **stock sustainability** be incorporated within valuations of biodiversity, ecosystem services and natural resource use?
3. How can issues of **scale** be incorporated within valuations of biodiversity, ecosystem services and natural resource use?
4. How do we integrate natural and social science information on values for biodiversity, ecosystem services and natural resources into governance and so improve **decision-making** and implementation?

Appendix B

The conceptual framework