Master‘s thesis

Opportunities for Greater Public Participation in the Natural Sciences

A Case Study of the Alde and Ore Futures ICZM Project, Suffolk, UK

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Declaration

I hereby confirm that I am the sole author of this thesis and it is a product of my own academic research.

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Acronyms

Note: each acronym is given in its full form at its first appearance in the text; abbreviated forms are used thereafter.

ACAP = Atlantic Coastal Action Plan

AOF = Alde and Ore Futures

AONB = Area of Outstanding Natural Beauty

BAP = Biodiversity Action Plan

CAPE = Community Adaptation Planning and Engagement

CEFAS = Centre for Environment, Fisheries & Aquaculture Science

DEFRA = Department for Environment, Food and Rural Affairs

EA = Environment Agency

EPP = Estuary Planning Partnership

ESJFC = Eastern Sea Joint Fisheries Committee

EU = European Union

FC = Forestry Commission

FWAG = Farming and Wildlife Advisory Group

GPPNS = Greater Public Participation in the Natural Sciences

ICZM = Integrated Coastal Zone Management

MCS = Marine Conservation Society

NE = Natural England

NGO = Non-Governmental Organisation

NT = National Trust

PPNS = Public Participation in Natural Sciences

RSPB = Royal Society for Protection of Birds

SBRC = Suffolk Biological Records Centre

SC&H = Suffolk Coast and Heaths

SCDC = Suffolk Coastal District Council

SSSI = Special Site of Scientific Interest

SWT = Suffolk Wildlife Trust

Contents

"While there are barriers to the generation of knowledge, the larger bottlenecks lie in knowledge dissemination and utilization. By enabling the end user to help identify needs for scientific information and participate in the scientific project or monitoring required to produce the information, local communities now have greater confidence in government data and are more likely to act upon the information provided" [Environment Canada 2001]

Abstract

The discipline of Integrated Coastal Zone Management has the public's participation in the management process at its core, as a way of achieving sustainable management of coastal and marine environment. The UK, has to date, neglected this fact which has been to the detriment of Suffolk coastline communities and management organisations alike, with disagreements and distrust rife between the two societal sectors. The Alde and Futures Project is a new ICZM initiative aiming to put right the situation; however, it noticeably lacks participation from the wider public. Research was therefore conducted to identify routes for greater public participation through the natural sciences. Stakeholders, i.e. management organisations conducting research grounded in the natural sciences, are mapped and subsequently interviewed using a semi-structured interview format in order to identify their current activities, and opportunities and constraints to involving the public in their scientific activities. Current efforts to involve the public are identified as pseudo science and opportunities to develop genuine public science projects subsequently discussed. It is suggested such projects will allow: the public to share the responsibility and privilege of managing the coastal and marine environment; allow management organisations to work together towards common research goals and hence gain an ecosystem perspective; and familiarise local people with the principles of sustainability which are currently known, yet not fully endorsed.

Introduction

Integrated Coastal Zone Management (ICZM) has, at its core, a commitment to improving the governance process and indeed this is one of the main drivers behind the Alde and Ore Future's (AOF) ICZM project [Parker 2009]. Governance in an ICZM context can be understood as the process by which decisions about the use of coastal marine areas and resources are made. To improve governance, one first has to identify where current modes of practice are falling short. Due to past failings, this information is readily available at the location chosen for study; shortcomings include: a lack of integration between management organisations and a general public distrust and dislike of management decisions. The current study picks up on both of these points, by attempting to find ways to promote an integrated approach between management organisations and the public they serve. This is done through identification of opportunities to create government - public science projects, as this is recognised as a useful tool to get people working together towards and thus sharing the responsibility for coastal zone management. Having introduced the AOF more extensively, the paper then places the research in its theoretical setting before presenting the research methods, results and discussion.

Setting

The recently conceived Alde and Ore Future's (AOF) Integrated Coastal Zone Management (ICZM) project is a pilot project that aims to create a working model that can then be applied to the whole Suffolk coastline. It has been created following recognition that the existing coastal protection and planning management structure suffers from centuries of uncoordinated decisions and actions at both the national and local levels, as is the case across the whole of the United Kingdom (UK) [Edwards, Jones & Nowell 1997]. In this situation, the management structure can appear fragmented into sectoral, resource-specific systems

from the community's point of view [Jentoft 2000]; this has been found to be applicable to the Suffolk coastline where findings from a European Regional Development Fund Interreg IIC project identified a common vision lacking for the Suffolk coastline, attributing it to absent co-ordination between different plans and amongst the plethora of coastal management interests and organisations [NORCOAST 1999].

The AOF pilot project takes its name from the Alde and Ore estuary, which meanders through 18 parishes and has been used as the focal landscape feature, though management boundaries have been delineated from data indicating the area that is at risk from a1 in 200 year flood event *[personal communication, Bill Parker, 18/01/2010]* on which to base (see Figure 1). It falls under an area designated as an Area of Outstanding Natural Beauty (AONB) [Suffolk Coast and Heaths 2008]; a landscape designation equal to that of a National Park in the UK. This designation hints at the relatively undeveloped infrastructure in the project area, with the coastline being characterized by small towns and villages, interspersed with substantial areas designated for wildlife protection and non-designated sites that have high biodiversity value as well. Biodiversity and landscape tourism is a key economic sector, with conservation bodies adopting a positive approach to visitors [NORCOAST 1999]. Intensively farmed arable land is also commonly found; characteristically abutting the estuary's many river walls that protect the land from flooding.

The management structure of the coastal zone is typical of developed countries, with multiple jurisdictions and responsible agencies, resultant bureaucracies, specialisation of knowledge and increasing sophistication and spatial extent of human activities [Stojanovic & Ballinger 2009]. It also has a long political history of command-and-rule approach to coastal management [Edwards et al. 1997], which has been employed to control environmental factors as much as human activity. This approach has met with severe challenges due to

Suffolk's coastline being geologically soft and low lying, making erosion and flooding key management concerns throughout the last century. The contemporary situation is being made worse by a combination of factors including a growing population, rising sea-levels and isostatic sinking. There are therefore major issues for the sustainable safe-guarding of towns and settlements, farmland and international wildlife habitats [NORCOAST 1999].

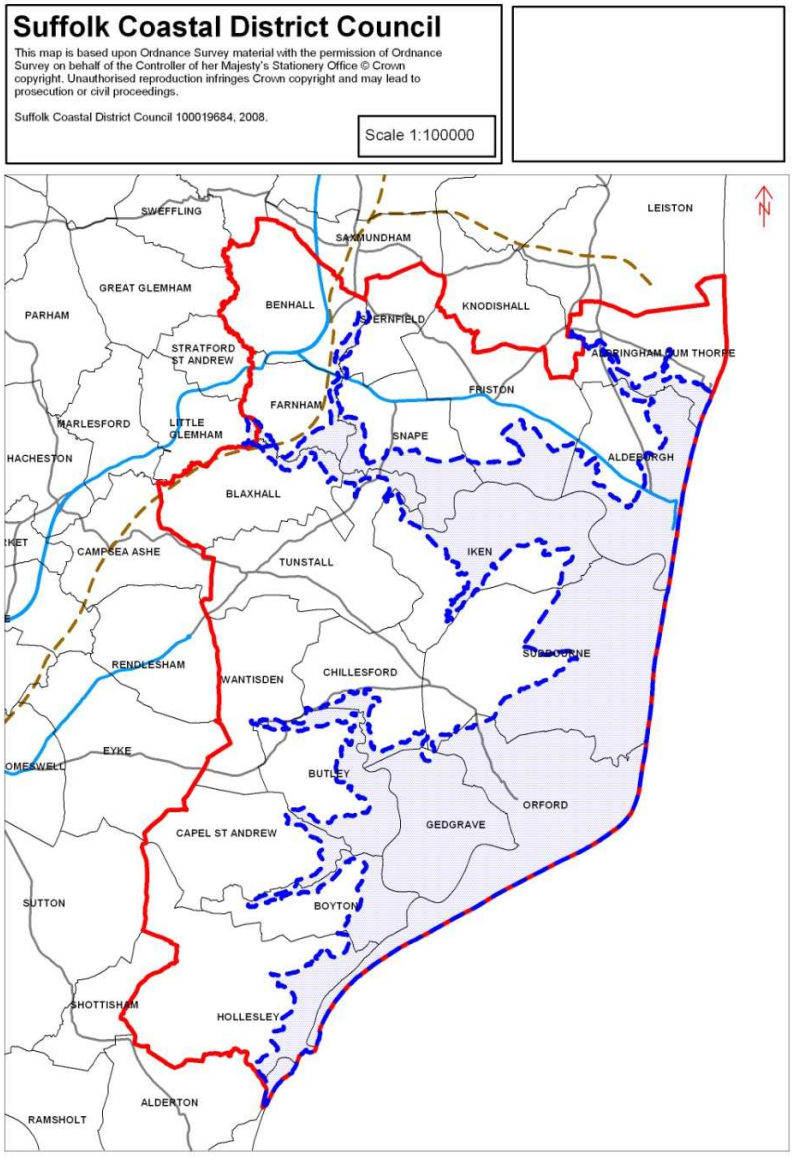

Figure 1: Red Line – Area covered by the project [replicated from Parker 2009].

The rise of ICZM

Coastal planning in the UK has traditionally been based on planning principles set forth in the 1947 Town and Country Act. This system covers the landward part of the coastal zone down to the low-water mark. Two tiers of government are involved: county councils decide on policy for development, with regional or district councils drawing up more detailed local plans [Cicin-Sain & Knecht1998]. This management structure was refreshed in reaction to growing problems in the coastal zone during the 1970's-80's. An inquiry was conducted in 1992 by the House of Commons Select Committee on the Environment [House of Common s Report 1997], which recommended an integrated coastal management strategy. The British government supported their findings and published *Planning Policy Guidance on Coastal Planning for England and Wales*, and a number of other documents; these resulted in an interdepartmental group on coastal policy and a coastal forum, designed to link up government departments working on coastal issues [Cicin-Sain et al. 1998; Edwards et al. 1997]. These developments favoured an approach to coastal management that built on existing institutional structures and statutory responsibilities, at the same time providing an environment conducive to working together.

Following on from these developments, English Nature, now Natural England (NE) - the government's adviser on nature conservation, implemented a 'Strategy for the Sustainable Use of England's Estuaries' to *"achieve the sustainable use of England's estuaries..... through the preparation and implementation of integrated management plans that have been developed, and are supported, by those users and authorities themselves"* [Morris 2008]. This strategy resulted in a number of coastal partnerships being developed; one of the first being the Stour and Orwell Estuary Management Group in Suffolk. This approach was commended for being able to tackle specific issues but was found to have flaws when widely applied [NORCOAST 1999]. It was therefore suggested a strategic approach be

adopted, with local authorities acting as lead agencies, working in conjunction with the statutory agencies with their various sectoral powers, other organisations and the local communities [Edwards et al. 1997]. This is the structure that the AOF project has adopted with an ambitious goal 'to manage the coast sustainably through taking into account the wider social, economic and environmental aspects of life in the communities' [Suffolk Coast and Heaths 2009 & Coastline 2009]. The project hopes to do this by delivering the following objectives:

- An overall framework plan developed with the community
- Creation of a joint approach to resolving future funding needs
- Identification of governance and policy issues that act as barriers to the development of a sustainable development plan [Parker 2009].

To realise this, the project will attempt to dovetail together existing management activities including: shoreline management plan, local development plan, regional spatial plan, habitat management plans, parish plans biodiversity action plans and local transport strategy [Morris 2008].

Support for ICZM is founded on the belief that it can provide a useful framework in which decisions are taken for the sustainable use, development, and protection of coastal and marine areas and resources [Cicin-Sain, Knecht & Vallega 2000]. This is a concept that has the backing of the European Union (EU) following their demonstration programme and subsequent recommendations [EU 2002]; and more recently it has met with approval from Department for Environment, Food and Rural Affairs (DEFRA), the UK government's environmental arm, who published a 'Strategy for Promoting an Integrated Approach to the Management of Coastal Resources in England' in early 2009. This 'ICZM strategy for England' sets out the initiatives being taken forward across Government which will

contribute towards integration in coastal areas and contains the objective to embed all EU recommended ICZM principles into all coastal planning and management processes. This is complementary to the newly legislated Marine and Coastal Access Act (November 2009) which focuses on the marine licensing system, coastal access and inshore fisheries. The management of inshore fisheries have been explicitly placed in an ICZM context through formation of integrated management authorities made up of representatives from the Marine Management Organisation, the Environment Agency (EA), NE and other public bodies dealing with coastal defence, flood management, cultural heritage protection, and members of the fishing community [DEFRA 2009].

Public participation in ICZM

A central theme of ICZM, as evidenced by inclusion in the EU's ICZM recommended principles, is public participation [EU 2002]. Indeed, one of the main goals of any ICZM initiative is to raise the awareness of local communities in order to foster the potential for collective participation in management initiatives [Edwards et al. 1997]. It is also based on the understanding that sustainable management of the coast will require stakeholders to sacrifice part of their interests to other stakeholders or to future generations. Treby & Clark [2004] suggest that this sacrifice will be made more willingly if those concerned have been involved in the decision making process, and so have a greater appreciation of the issues and associated tradeoffs. As an extension from this, public participation may also increase public trust in decisions and civil society, especially if participatory processes are perceived to be transparent and consider conflicting claims and views [Reed 2008]. Other arguments commonly put forward in favour of public participation include: an increased sense of ownership over the processes and outcomes [Roe 2000, as cited in Treby & Clark 2004; Stojanovic & Ballinger 2009] research becomes more robust through having higher quality

information inputs [Reed 2008]; and it facilitates a re-distribution of power that enables the citizens who are commonly excluded from political and economic processes, through for example having poor access to education, to be deliberately included in the future [Arnstein 1969].

At the international level, the importance of public participation in ICZM has long been recognised as a benefit in coastal initiatives However history relates a very different picture in the UK where community participation in coastal management has been traditionally elicited through consultation exercises based upon the Town and Country planning system. In this process, strategies, policies, and development plans are prepared following initial discussions with key interested parties and only then are they widely publicised and circulated for comment [Edwards et al. 1997]. This top-down approach to natural resource management is characteristic of many European countries, but has been criticised for giving public no responsibility or ownership of the proposed plan, making implementation totally out of their hands [Ellsworth, Hildebrand & Glover 1997]. Resultantly, it has met with considerable resistance in recent years due to a lack of trust between people and their governments [Arhus Convention 1996]. Encouraging participation in the decision making process is an obvious way to try and combat this; thus it has lead to a plethora of legislation that has provided impetus for public involvement in ICZM [e.g. Local Agenda 21 following the Earth Summit in Rio de Janeiro 1992; Water Framework Directive 2001] as well as strengthening the democratic rights of citizens in the decision making process [Arhus Convention 1996; Reed 2008].

Public participation: a research requirement for the Alde and Ore Futures Project

The impetus for the AOF project is attributed to a controversial estuary strategy for flood risk management, drawn up by the EA – the government's flood and erosion

management arm, for an estuary lying adjacent to the AOF project area – The Blyth Estuary. The plan was first communicated to the public through the consultation process but was met with widespread criticism, and resulted in the public asserting their political and economic rights in the form of administrative and legal redress mechanisms. Ellsworth et al. [1997] suggest these resource-wasting relationships are avoidable through bringing the public into the decision making process more inclusively. The authorities in the area echoed this through widespread acceptance for the need of a more holistic, locality specific approach to coastal management *[personal communication, Bill Parker, 09/10/2009]*. ICZM was therefore inaugurated into local government to manage the Suffolk coastline more coherently and sustainably. The AOF pilot project is an attempt to identify what works, and what doesn't, so as to be able to apply an ICZM model to the whole Suffolk coastline: there is therefore considerable scope and relevance for research.

Public participation is currently being elicited through topic groups that come together, identify issues and work together to find solutions. The groups are made up of selectively invited local community leaders and known individuals. Out of 250 invitees around 50 have agreed to take part. The groups are split into five categories:

1. Community sustainability
2. Physical infrastructure and the economy
3. Farming, agriculture and aquaculture
4. Wildlife, landscape, historic environment, navigation and access
5. The arts

The groups are coordinated by a community leader (chair) and a lead officer from an ICZM member organisation (all members are from government) [Parker 2009]. Their activity feeds into a separate governance subgroup who themselves have a remit to address wider issues of governance and policy conflict. They, in turn, report to ICZM Steering and Executive Groups

whose members are senior officials from government organisations who fund the project (See Figure 2).Together, they will all come together to decide conclusions for the AOF project. The conclusions themselves will be sounded against the Estuary Planning Partnership, a community group set up prior to AOF project to improve communication amongst the general public and management organisations in the area. The project can be labelled a form of joint planning [Ellsworth & Hildebrand 1997] wherein multi-stakeholder groups are invited to help identify the needs of the local community, thus allowing a broader range of information to be brought forward and acted upon through formal and informal partnerships between all levels of government and invited community members. This approach reflects recognition from staff leading the ICZM initiative that it must operate within existing statutory responsibilities and so must remain a top-down approach to ICZM, albeit one that has taken significant steps to involve some members of the community in the planning process. This approach has limited potential to deliver the many benefits associated with comprehensive public participation. These limitations result from a lack of opportunity for the wider public to be involved whilst those that are have little, to no, say in the final, final decision making process. As Hildebrand [1997] points out, genuine participation is only achieved when power is shared; and power sharing is only recognisable when user-group organisations have the option to make autonomous decisions [Jentoft 2000].

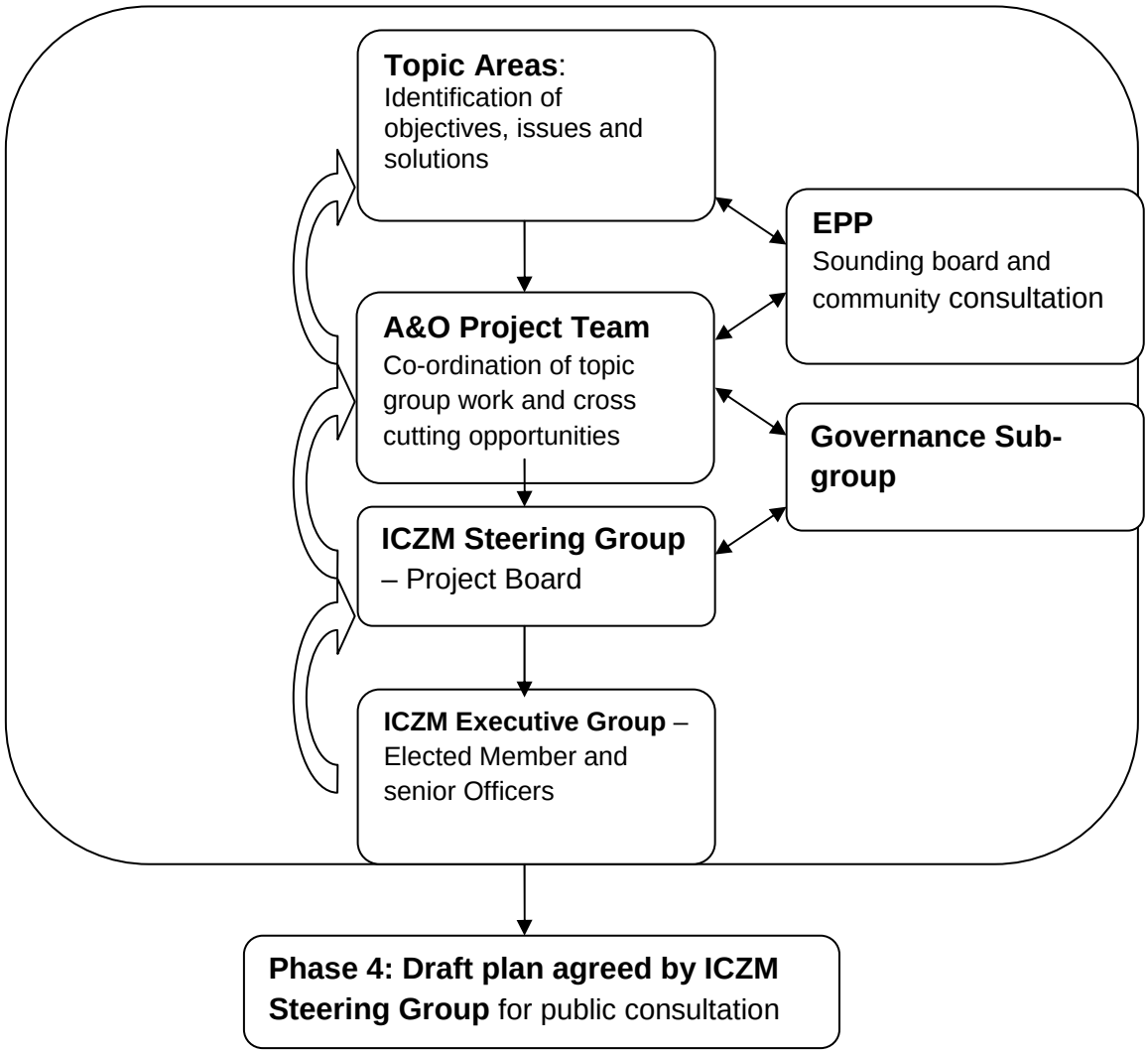

Figure 2: Structure of the AOF ICZM project being used to formulate a draft plan [adapted from Parker 2009]

In the face of these shortcomings there was a research need to identify opportunities for greater public participation. Due to many of the issues facing the Suffolk coast being parameterised by the natural sciences and hence their predominance in the decision making process, the natural sciences represent an opportunity to increase the wider public's involvement in the decision making process through their direct involvement in the research process. Research into this opportunity acts upon recommendations for Suffolk, as set out in NORCOAST Report [1999]: 'Develop a greater coastal processes research, information and

monitoring base; provide support for voluntary organisations and local communities involvement in coastal wildlife conservation; establish better coordination and access to the biological database and future monitoring of the resource ’. Such research would also address the ICZM strategy for England’s requirements, which states: *“It is important to promote awareness and understanding of coastal areas and the issues facing them to encourage the public to participate in management processes. Many people living on or visiting the coast may not be fully aware of the complex issues operating within the coastal zone* [DEFRA 2008].

Research into these opportunities was made possible by joining the AOF ICZM pilot project for a period of 4 months in a professional capacity. This also fulfilled research requirements for the Masters of Natural Resource Management degree programme, as run by University of Akureyri, Iceland. Bill Parker, ICZM project officer, required additional support for the duration of research, this entailed helping with administration, attending stakeholder meetings, sitting in on committee meetings and helping organise events. As a researcher, opportunities for wider public participation in the natural sciences were sought. By doing this, it set out to go beyond current project objectives to *‘encourage input from those who live or work there’* [Coastline 2009] to facilitate direct heuristic involvement in the ICZM process. It is also a direct response to the initiative’s first community conference, September 2009, where invitees were asked to voice their concerns about the future of the area, many of which have potential to be addressed through greater public participation in the natural sciences (GPPNS) (Table 1).

Table 1: Details of concerns raised at the community conference that public involvement in the natural sciences has the potential to help tackle and assuage [Alde and Ore 2009].

Issue classification	Detailed concern
Governance and legislation	• Confusion over who makes the final decisions that impact the area
Knowledge and involvement	• There is a lack of public involvement and wider communication • Science and its implications are poorly understood • Local knowledge is not collected and used enough
Sustainable communities and education	• Access to education needs to be improved
Landscape and historic assets	• Change of landscape characteristics e.g. saltmarsh
Agriculture and water quality	• Intensification of agriculture – the impact on landscape, decline of farmland birds and soil erosion
Imbalance in management activities	• Wildlife vs. people • Tourism vs. environmental qualities • Allowing vs. restricting access

The reader is now familiarised with background setting of the AOF ICZM pilot project. Following on from this introduction, the report sets out a theoretical framework on which the subsequent action-orientated research is grounded. The *Theory and Application* section reports on examples of public science in coastal management and other resource management sectors from around the world. This includes an investigation of the benefits accrued and challenges faced by these projects. The *Methods* used for the action-orientated research are then described, with resulting outputs and summarised findings displayed for the reader in Figure 3 and Table 4, under *Results*. These findings are discussed in the context of theory and the AOF project requirements, under *Discussion.* The sections *Recommendations* and *Conclusions* consider the likely parameters of future public science developments, as well as identifying further research needs and limitations to the current research reported here.

Theory and application

Public involvement in science is a growing trend in resource management that is driven by increasing public scepticism about science, increasing interest in environmental decisions and ongoing policy trends that emphasise partnership working and sustainable development [Reed 2008]. Involvement is characterised by a mutual learning process between the public and scientists, and so tries to overcome scepticism about science that typically results from one-way transmission of knowledge from experts to the public. The model of mutual learning is based on the premise that both the public and scientists have valuable expertise, perspectives and knowledge to contribute to the development of science and its application in society [McCallie et al. 2009]. It therefore empowers the management process by increasing recognition of needs and opportunities, and developing capacity for action to produce more relevant and effective environmental policy and practice [Reed 2008]. This is a pertinent point that contributed, in part, to the formation of the AOF project: science was disbelieved by the adjacent Blyth estuarine community, who subsequently carried out their own research with different results; thus fuelling the disagreement further.

Science projects involving the public are a form of partnership whereby scientists are provided with a platform to become involved in outreach programmes, enabling them to deliver their research findings to effectively overcome the chasm of understanding prevalent between scientists and the public. On the other side of the coin, local communities provide large-scale temporal and geographical data that could not be gathered in any other way [Donhong, Mecalfe & Schiele 2006]. In return, the community receives interesting and enjoyable activities; a self-reinforcing paradigm is the result. Jacoby et al. [1997] identify that these partnerships can be particularly fruitful when implemented in an educated and committed community, as the communities within the AOF project area definitively are. In

this situation, individuals and community groups use their detailed knowledge of specific environmental issues to continuously observe and speculate upon conditions and changes in the environment. Such partnerships also succeed in bringing management and science closer together by achieving a better synthesis between goals and bodies of knowledge [Milligan, Hills, Smith & Tissier 2004], which includes valuable local knowledge [Stojanovic & Ballinger 2009]. Substantial benefits are therefore provided to all participants, both professional and non-professional [Brossard, Lewenstein & Bonney 2005].

In terms of sustainability, it is argued that public involvement in coastal management is inherently good practice which has lead to it being enshrined in international legislation [e.g. Rio de Janerio 1992; EU Recommendations, 2002]. Central to this concept is giving local communities responsibility for their immediate environment, thereby investing in a belief that people don't like to foul their own nest. But employment of this principle does not always result in sustainable coastal management decisions. As McKenna et al. [2009] point out, employment of this principle on a eroding coastline, as Suffolk's is, will only ever result in empowering property owners who normally only have one objective: to protect their property or obtain compensation for its loss to the sea. Neither is a sustainable strategy, especially as sea levels rise and the line of protection or compensation is continually moved inland. In short, this will result in continuation of conflict as individuals, groups and organisations pursue their own ideologies at the expense of others'. Before this principle is ubiquitously applied to the Suffolk coastline there needs to be an embracement of sustainability by all participants [Treby & Clark 2004]. Grounded as they are in natural sciences, the principles of sustainability have the potential to be furthered through public participation in the natural sciences. Such involvement would provide an opportunity for all stakeholders to move towards an appreciation of the complexity of environmental coastal issues and share, with government, the burden and privilege of tackling these challenges

[Jacoby, Manning, Fritz & Rose 1997]. This may well lead to more empathetically minded citizens. A greater understanding of the environmental issues may also enable people to look past the worst case scenario (i.e. being irrevocably flooded) to the opportunities and alternative management strategies that might be successfully employed.

At the project level, sustainability is recognised by a monitoring framework that provides the information needed to assess management actions and adjust those that are not fulfilling objectives. Without monitoring the project is liable to fail or do undetected harm. This forms an essential component of adaptive management (Recommendation 3 in the EU list of ICZM recommendations [as cited in McKenna et al. 2009] and yet is often seen as an unnecessary component to management [Jacoby et al. 1997], largely due to a lack of resources and the time-limited project funding structure in place. One way to overcome this lack of resources is to involve the community. Involving volunteers has been shown to dramatically expand the available resource base and cut costs [Jacoby et al. 1997; Cowper 1999] and by designing the project to local requirements and interests, it is possible to maintain a much longer term interest in the project than would otherwise be possible. As NORCOAST Recommendations [1999] summarise: '*A good process of involvement can be as valuable as the outcome. It determines the quality of information inputs, the degree of co-operation and trust built up between stakeholders, and the level of commitment to implement the plan over the long term*'.

Of central importance to all ICZM practitioners looking to employ or create public science projects is a realisation that they are adaptable and flexible, and can vary in several dimensions. These dimensions are detailed by Donghong et al. [2006] (see Table 2 for a useful guide on the many faces public involvement in science can take).

Table 2: Public participation in science can vary in many dimensaions [adapted from Donhong et al. 2006].

Dimension	**Flexibility**
Geographic scope	Local → regional → national → continential → global
Temporal scope	Snapshot (days) → seasonal (months) → ongoing, continuous
Skill Level of participant	Basic skills → amateur → professional
Audience	Children → adults; individuals → families → groups
Protocols and methods	Simple (e.g. single variable) → complex (e.g. multiple variables)
Financial	Free → monetary contribution required to participate
Participation time commitment	Opportunistic → regimented, one period → repeated short periods → repeated long periods
Technology	Paper forms → electronic data forms →online data submission
Educational objective	Environmental awareness; science literacy → conservation action

It is also necessary to decide in which of the many stages in the scientific process to include the public. The possiblities include: choosing or defining questions for study; gathering information and resources; developing explanations (hypotheses) about possible answers to questions; designing data collection methodologies (both experimental and observational); collecting data; analyzing data; interpreting data and drawing conclusions; disseminating conclusions; discussing results and asking new questions. The choice on when to include the public will determine whether the project is:

1. Contributory, where project is designed by scientists and members of the public contribute data [Bonney et al. 2009]
2. Collaborative, where project is designed by scientists and members of the public help analyse data, disseminate findings and refine experimental design [Bonney et al. 2009]
3. Co-created , where scientists and members of the public working together in most of the steps in the scientific process [Bonney et al. 2009]

A working example of public science – Atlantic Coastal Action Plan (ACAP)

On a global scale, harnessing the power of public science both outside and within ICZM has only just begun. Australia, USA, Canada and UK all have examples of citizen involvement in the scientific process; with Australia and Canada both able to showcase examples explicitly linked to coastal management. In Australia, community concerns about coastal management lead to the development of monitoring programs to support managers. Under the banner *Listening to the Land,* activities included monitoring estuarine and coastal water quality, flora, fauna (birds, fish, dolphins, whales, and terrestrial species), land use, beach and ocean-based litter, and human impacts on beaches. In addition meteorological parameters and change in sandy beach and dune systems were monitored by community members in several Australian states [Jacoby et al. 1997].

But a far more comprehensive and impressive example comes from Canada where the national government's environmental arm, Environment Canada, took heed of advice emanating from an ICZM conference in 1994: "*to build cooperative management processes from the ground up, so that coastal communities become partners with resource users and others in the management of the resource"* [Ricketts & Harrison 2007]. The initiative was pursued under a multi-billion dollar green plan that saw the government break from the political malaise of *'NIMTO' (Not in my Term of Office)* to transcend the limitations embedded in a sectored based approach. Start-up funding was provided by Environment Canada for the formation of 14 community organisations, in four Canadian Atlantic provinces, which were then provided with an operational framework to facilitate recognition/identification of environmental issues and to aid community groups in their management practices. Emphasised from the beginning of the process was the need to provide all partners in the coastal zone with the knowledge skill, information and other resources needed to play their full part in cooperative management processes [Ricketts &

Harrison 2007]. This priority was advanced through the ACAP's *Science Linkages* initiative whereby Environment Canada's scientists work in partnership with ACAP communities and their partners to carry out and communicate science [Environment Canada 2001]. One of the most unique and important aspects of the *Science Linkages* initiative is its *Windows* approach wherein each ACAP organization was paired up with a government scientist (whether a biologist, engineer, habitat manager, chemist etc) to build a working relationship, thus gaining access to each other's knowledge base, contacts, resources and expertise [Dech 2003]. The *Windows* provide a human face to the government department and serve as effective conduits for information flow and the pursuit of common priorities [Environment Canada 2001]. It also offers a heuristic learning process wherein the learners can directly affect the learning process, content, and /or outcomes of the experience. Research shows this type of learning results in strong motivation to engage and learn in the subject matter because it is directly relevant to the individual's life [McCallie et al. 2009].

The type of issues successfully tackled by co-created community-government science projects include: pollution (e.g. one community group in Nova Scotia identified sources of fecal coliform pollution in the Annapolis River through DNA analysis); solving problems related to sewage treatment and household hazardous wastes; restoring shellfish growing areas; building local capacity and educating communities on sustainability. Community research is also ongoing in the fields of climate change; sea-level rise; air quality; and smog. The benefits to this project are manifold (Table 3) although significant obstacles had to be overcome first, including scepticism on whether communities and volunteers could do good science. Similarly, the communities were concerned that the federal government was downloading their environmental responsibilities onto them. Once overcome though, the projects have produced a wealth of credible scientific data at a fraction of the cost that it would have cost the government alone. On average the ACAP organisations leverage $4.25

to every 1 provided by the government, most of which is in the form of in-kind services [Dech 2003]. This is possible as stakeholders and resources-are aligned behind actions that are scientifically defensible, economically feasible and publicly supported [Ellsworth et al. 1997]. The empowered communities have responsibility for developing and implementing innovative solutions to local and/or regional environmental, economic and social issues and at the same time have a better understanding of the constraints and opportunities available at the government levels, within industry and businesses and the community at large [Environment Canada 2001]. The result is a practical demonstration of joint management approach to ICZM which offers lessons to governments and coastal communities looking to establish lasting partnerships for the advancement of sustainable coastal ecosystems.

Table 3: Benefits accrued from the Canadian government's *Science Linkages* program [adapted from Dech 2003].

Environment Canada	ACAP organisations	EC & ACAP
▪ Builds support and raises awareness within the ACAP communities for EC's science and priorities ▪ Communicates departmental goals, objectives and priorities which are built into community programs ▪ Ensures that science is valued and utilized by decision makers at all levels ▪ Delivers departmental programs and initiatives in a cost effective manner ▪ Provides access to established community contacts ▪ Allows EC scientists to collaborate with and provide advice and analytical support to the ACAP organizations	▪ Builds scientific capacity within communities ▪ Promotes holistic research: natural, social and economic sciences ▪ Ensures effective communication of science: by community to the community ▪ Provides training for staff on proper sampling and research techniques ▪ Creates an awareness of EC science and priorities and who is doing what within the Department ▪ Ensures publication, documentation and promotion of the benefits derived and the results achieved through Science Linkages	▪ Fills in knowledge gaps on science and local issues/concerns ▪ Allows for leverage of resources and builds partnerships on many levels ▪ Enlists others in validating and communicating science ▪ Builds credibility and respect among peers – community members, fellow scientists, industry and business partners ▪ Provides training for local volunteers and students at all levels of education ▪ Provides mutual access to project and program summaries and data ▪ Allows for continuous improvement of criteria and administrative process ▪ Results in good, credible science

Methods

Data gathering and analysis

The research had three separate, but complimentary, components. The first was a comprehensive literature review with the objective of finding examples of public science in ICZM, and resource management in general. The literature review was carried out to form the theoretical basis of the study and to aid interpretation of results. It was completed through a process of literature linkage, i.e. articles were searched through science journal databases, read and assessed on their respective merits and subsequently used as points of departure to access studies aligned to the parameters being studied.

The second component was placing the research in its background setting through a context investigation. This allowed those organisations that use natural science in their decision making process to be identified and their respective mandates understood. This was achieved through investigation of relevant documents, including: minutes of meetings, descriptions of funding priorities, announcements, formal policy statements and mandates. From this step a Stakeholder Influence/Impact Matrix was created. The Matrix depicts the level of influence each stakeholder has over greater public participation in natural science, the criteria being: power held in the coastal management framework (i.e. level of government, amount of land ownership etc). The second variable is the potential positive impact on each stakeholder of public participation in science; the criteria for this variable being: degree to which the idea dovetails with their respective operating philosophies and the potential for theoretical benefits (identified above) complement existing activity. The basis for plotting both variables was the context investigation. From the Matrix, those stakeholders ranked highly were prioritised for further investigation via semi-structured interviews.

The third component of research was *semi-structured* in-depth interviews, conducted

with staff in organisations in the area. This was done in order to identify the current structure of scientific activity, level of public involvement and barriers and opportunities for greater public involvement in science. A *semi-structured* interview format was used . This requires the interviewer having a series of specific topics to be raised during a conversation with the interviewee [Leech 2002], but to keep an opportunistic and flexible structure to the conversation. All interviews were voice recorded and transcribed for further analysis. The following organisations took part in the interview process: Eastern Sea Joint Fisheries Committee, Environment Agency, Forestry Commission, National Trust, Natural England, Royal Society for Protection of Birds, Suffolk Biological Records Centre, Suffolk Coastal District Council and Suffolk Wildlife Trust. The following topic list was used as a guide when conducting semi-structured interviews:

- What scientific activities are your organisation involved in i.e. who does the science and what is its focus?
- Is it the sole basis for management decisions?
- How are results communicated to the public?
- Do you perceive a gap in the public's understanding of your science and hence management decisions?

- What mandates do you have, if any, for involving the public in your scientific and management activities?
- What outreach programmes involving science do you currently run for the public?

- Do you have research requirements that are currently not met?
- What is the constraining factor?
- What level of expertise is needed to carry out this research?
- Openness to the idea of citizen science – likely opportunities and hurdles to overcome

From these three research strands, a qualitative analysis was conducted. As Marshall and Rossman [2006] point out: *'the most fundamental operation in the analysis of qualitative data is that of discovering significant classes of things, persons and events and the properties*

which characterise them'. For this study, the common threads of thought on the idea of greater public participation in science, as well as their respective barriers and opportunities were identified. Having identified recurrent themes in the data gathered a Stakeholder Analysis Grid was compiled. The grid shows the conditions in which any future public science initiatives have to operate, i.e. what individual stakeholder requirements are. It also can be used to anticipate what the different stakeholders' reactions might be to management proposals for greater public participation in science projects. These summarised results are subsequently placed in their background and theoretical context to make recommendations for implementation routes and, more generally, the appropriateness of public science for this ICZM initiative.

Results

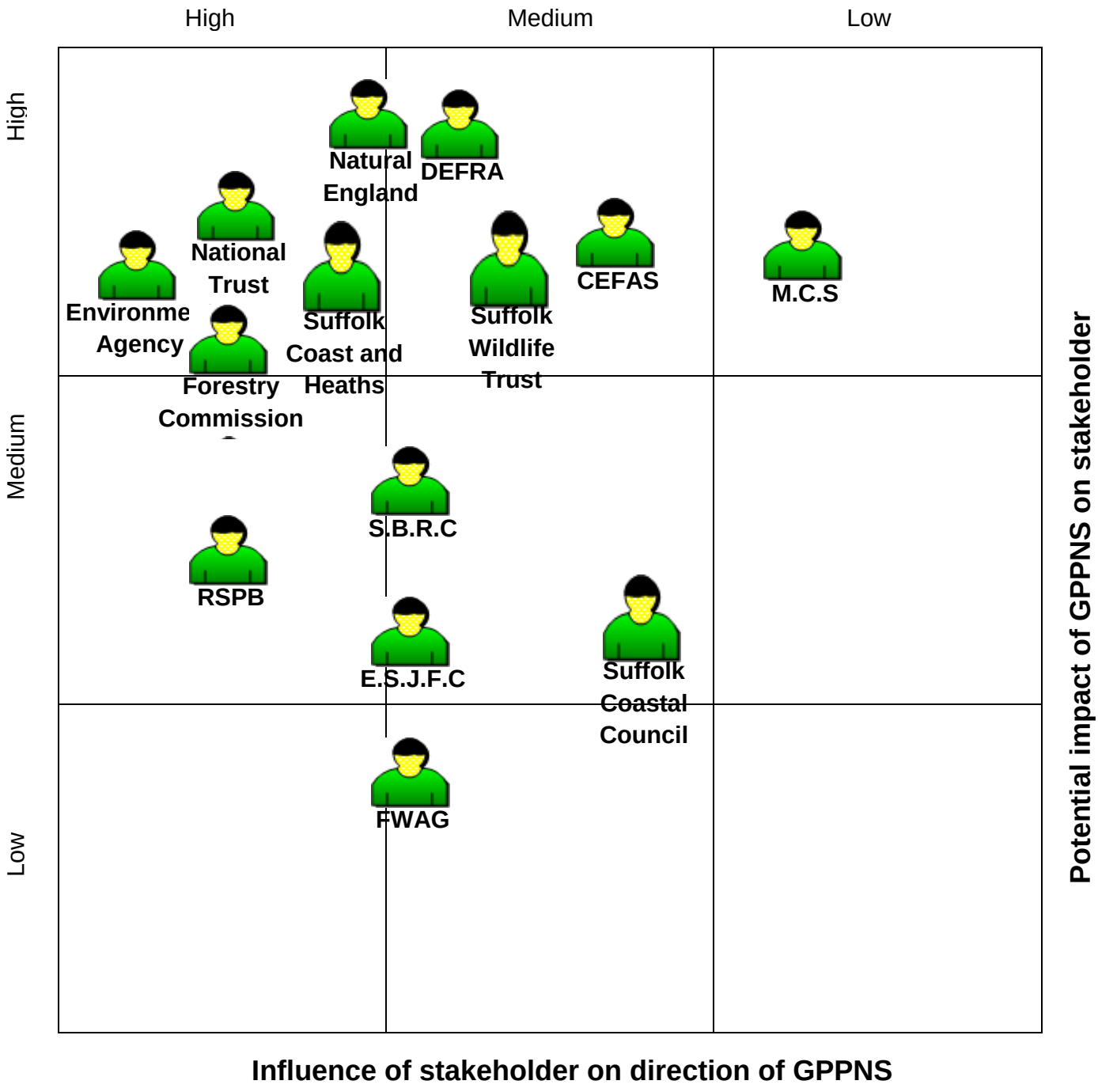

Figure 3: Stakeholder Influence/Impact Matrix

Stakeholder Information			**Factors affecting potential for greater public participation in science**					**Specific opportunities**	
Stakeholder name	***Overall level of interest for GPPNS***	***Current level of existing PPNS***	***Strategic direction towards GPPNS***	***Human resources***	***Financial resources***	***In-house technical expertise***	***Specific research requirements***	***Project opportunity***	***Opportunity to address specific community concerns***
Natural England	Strong	Consult & pseudo	Aligned	Limitation	Limitation	Yes, but for pseudo science only	Continuous monitoring of SSSIs	Shingle Street & Orfordness: Monitoring of SSSIs	Lack of public involvement; imbalance in management activities
Royal Society for Protection of Birds	Weak	Contributory e.g. monitoring of management actions	Aligned	A lot of resources available e.g. volunteers	Limitation	Yes	Continuous monitoring	Havergate Island, but contract likely to be outsourced	Imbalance of management activities
Environment Agency	Strong	Consult & contributory (though pseudo)	Aligned: strong focus on building trust with communities	Not a limitation	Available	No – use consultants	No	No immediate; but potential to develop monitoring of chosen SEA strategies.	Change of landscape characteristics; Local knowledge not used enough
Eastern Sea Joint Fisheries Committee	Medium	Consult	Unaligned – due to a mandate of enforcement only	Limitation	?	Yes	no	Marine BAPs; Research boat for Suffolk	Local knowledge not used enough

Table 4: Stakeholder Analysis Grid showing conditions in which any future public science initiatives have to operate

Stakeholder Information			**Factors affecting potential for greater public participation in science**					**Specific opportunities**	
Stakeholder name	***Overall level of interest for GPPNS***	***Current level of existing PPNS***	***Strategic direction towards GPPNS***	***Human resources***	***Financial resources***	***In-house technical expertise***	***Specific research requirements***	***Project opportunity***	***Opportunity to address specific community concerns***
Suffolk Biological Records Centre	Medium – strong	Co-created	Aligned well	Limitation	Limitation	Some – advice on project structure and data interpretation	Natural history records for farmland species; coastal and marine & insect species	Monitoring of farmland species (if grant available); Marine BAPs	Access to education; science poorly understood
National Trust	Medium – strong	Contributory (pseudo e.g. surveys for shingle and salt marsh species)	Aligned	Limitation	Limitation	No, only 6 in house researchers for whole country	Yes. Fill gaps in biological records for Orfordness area	Access control for spit at orfordness LIFE project	Imbalance in management activities;
Suffolk Coastal District Council	Weak	Consult & contributory (pseudo)	?	Limitation	Limitation	No	Ongoing Suffolk hedgerow survey	Yes, if further heathland restoration work done	Confusion over who makes final decisions
Forestry Commission	Strong	Consult & contributory (pseudo e.g. forest design plans)	Nationally aligned but not recognised locally	Limited capacity to analyse data	Limitation	Yes, for bat surveys	Yes, Bats, mushrooms, slime moulds, moth trapping water voles	Impact of new housing development study	Lack of public involvement

Table 4: Stakeholder Analysis Grid *continued*

Stakeholder Information			**Factors affecting potential for greater public participation in science**					**Specific opportunities**	
Stakeholder name	***Overall level of interest for GPPNS***	***Current level of existing PPNS***	***Strategic direction towards GPPNS***	***Human resources***	***Financial resources***	***In-house technical expertise***	***Specific research requirements***	***Project opportunity***	***Opportunity to address specific community concerns***
Suffolk Coast and Heaths	Strong	Collaborative (pseudo)	Aligned	Access to Volunteers good	?Grants available	Yes, for pseudo	Warden Scheme	Development of warden scheme	Lack of public involvement; imbalance in management activities
Suffolk Wildlife Trust	Undeter-mined	collaborative (pseudo e.g. monitoring)	Aligned	Strong volunteer network	Limitations	Yes but time is a limitation	Species adaptation to climate change; BAP invertebrates	Marine BAPs?	Science poorly understood; lack of public involvement; access to education
Marine Conservation Society	Did Not Interview	?	Aligned	Volunteer based	n/a	yes	Litter surveys	MSC's BeachWatch: Thorpeness – Aldeburgh; Aldeburgh –- Bawdsey	Tourism vs. environmental qualities
Farming and Wildlife Advisory Group	Did Not Interview	?	Aligned	Volunteer based	?	Yes	Working with farmers to implement conservation measures	Opportunities to create local projects	Agricultural + water quality: intensification of farming

Table 4: Stakeholder Analysis Grid *continued*

Stakeholder Influence/Impact Matrix

The ‘Stakeholder Influence/Impact Matrix’ was used to prioritise stakeholders for interview and so gain a greater understanding of their current activity, opportunities and constraints. Those positioned in the top left corner were contacted firs i.e. those with high values for both the X and Y axis. As is to be expected, some stakeholders did not reply immediately and some not at all. When this happened the next highest scoring stakeholder was contacted. Eventually all stakeholders, bar 2, were contacted; these two, Marine Conservation Society and Farming and Wildlife Advisory Group, both scored lowly on the matrix.

Stakeholder Analysis Grid

A plethora of different initiatives for public involvement in scientific activities currently exist within the project area; their many guises and parameters are explored below to offer the reader a greater understanding of the ostensible working conditions within which future public science projects have to operate. Following this presentation of results, specific opportunities are discussed in their theoretical context under ‘Discussion’.

With its mandate to draw up management strategies for low lying land at risk of flooding, the EA is the stakeholder with most pertinence to the discussion of sustainability and coastal defence work. Their approach has traditionally been to consult the public on management plans that were already completed. This arrangement worked fine due to a bounty of resources being available to carry out the necessary defence work, but that changed when their budget was cut and they had to prioritise defence works. The estuary adjacent to the Alde and Ore, the Blyth estuary, was one of the first to be earmarked for withdrawal of sea wall maintenance funding. News of this travelled to the public through the traditional consultation process, which resulted in, still continuing, legal battles. Early public

involvement is seen as paramount to prevent a re-enactment of this happening on the Alde and Ore, which is the Alde and Ore Association, a river defence committee made up of community and private organisations are currently feeding into EA's decision framework for wall maintenance by collecting sea-wall condition data and subsequently making suggestions on where to focus limited resources. And whilst not science, it is a form of pseudo-science involving the public. Other efforts to draw in the public include guided walks to increase understanding of coastal processes and incorporation of knowledge from estuary users to validate estuary dynamic models, which again is not science but recognition of the value of local knowledge nonetheless. But the main issue for concern, that being how to make less defence work more palatable to the public is not fully addressed by these efforts. To gain widespread acceptance for less defence work the public must first embrace the principles of sustainability. This point is picked up again in the section *'Opportunities'* under Discussion below.

The following stakeholders work predominantly to conserve nature: Royal Society for Protection of Birds (RSPB), Suffolk Wildlife Trust (SWT), Suffolk Coast and Heaths (SC&H), National Trust (NT), FWAG, and NE. With their mandates to protect and enhance the natural environment, they are all working closely with natural process and therefore have potential to educate and involve the public in research relevant to the local environment's long term sustainability. Current levels of public involvement vary widely: the RSPB and SWT both regularly coordinate and incorporate local groups in to their activity. The RSPB involve volunteers in their scientific framework through organising monitoring activities. Their monitoring step is designed to assess the effectiveness of management activities and so has direct relevance for decisions. With over 1000 active volunteers in Suffolk alone *[personal communication, Dorothy Casey, 07/10/2009]*, SWT is strongly focused on

volunteer involvement to provide an enriched experience of and successful management of their nature reserves; science underpins their work and volunteers are brought in at the surveying and monitoring step. These two stakeholders have considerable existing access to local communities and volunteers and are therefore a useful resource when initiating a public science initiative.

SC&H, the body responsible for management of the AONB, have an interesting new Coastal and Estuary warden scheme wherein they've asked for anyone on the Suffolk coast and estuaries to do monitoring on erosion of footpaths, erosion of salt marshes, litter, pollution, bait digging, anti-social behaviour on a bit of local coast. At the moment this is not science *per se,* rather a form of community policing, albeit one with no legal power; but potential science developments do exist – see *'Opportunities'* section below. The NT is a major stakeholder, owning a large property within the project area that has an interesting military and political history attached to it. The history means very little environmental data exists for this area making baseline surveying a priority, some of which is done by experts, some by the public and some by existing naturalist groups who are also asked to make management recommendations on the back of their finds. FWAG was established in 1969 by a group of farmers who were concerned about the dramatic decline of habitat and wildlife as a result of the ever increasing intensification of farming methods. In partnership with volunteers and other organisations, FWAG operates to reverse this decline and a particularly successful project has been their Farmer and Volunteer Alliance, run in conjunction with the RSPB. Nationwide, the scheme was developed with the help of nearly 2000 volunteers to help reverse the decline of farmland bird populations through undertaking 3,350 surveys to date and feeding this information into agricultural-environmental schemes, which are coordinated and funded by DEFRA [Farming and Wildlife Advisory Group].

NE collects evidence and undertakes research relating to the places that provide opportunities for enjoying the natural environment. They have made significant steps to involve the public in recent years, primarily through a more extensive consultation process which enables local people to influence the details in decisions. Evidence is highlighted as a central management tool but as yet there is no direct involvement of the public in their research.

Stakeholders with partial focus on nature conservation include the Forestry Commission (FC) and Suffolk Coastal District Council (SCDC), both of whom are actively involved in creating biodiversity rich heathland habitat. In both projects public involvement takes the form of post project formation consultation which, it has been demonstrated, can be an unpopular and project derailing process when the value of existing habitat to local people is underestimated [Fisher 2008]. SCDC do also have a better example of public involvement in science through their hedgerow survey which has been running for 15 years**.** Volunteers are elicited through Parish councils and asked to survey hedgerow species to create a baseline of this valuable wildlife habitat for planners and developers to work with. The survey does not test hypotheses and therefore remains a form of pseudo science, albeit one that has generated a lot of support and data; the results are fed into Suffolk Biological Records Centre (SBRC) where they can be accessed by environmental decision makers. SBRC is a stakeholder itself through acting as a depository for all data coming from biological recording activity in Suffolk to provide an impartial information portal for planners and conservation bodies to use in decision making processes. It is user led and based on partnership between many user organisations and also between professionals and a strong voluntary recording community. The centre's responsibilities to provide impartial information gives it an apolitical structure: setting it apart from the other stakeholders. It can therefore be viewed and used as an objective authority with considerable expertise when designing public science

projects.

Thus far, all stakeholders discussed have had a terrestrial focus. The marine environment is underrepresented in the existing natural science framework within the project area for the following reasons: the inshore fishing industry is weak following collapse of fish stocks during the 1970s; it therefore plays second fiddle to the neighbouring county, Norfolk, where shellfish stocks are prospering. The Eastern Sea Joint Fisheries Committee (ESJFC) is responsible for managing the inshore fisheries resource through acting as an enforcement, protection and fisheries development agency. In neighbouring county Norfolk, they currently work closely with county council, DEFRA and recreational and commercial fishermen to find the most appropriate management solution based on the available data, this is made possible through the existence of a statutory instrument The Wash Fishery Order 1992. Fishermen do not contribute to data past reporting their landings data; instead stock data is primarily collected by Centre for Environment, Fisheries & Aquaculture Science (CEFAS) who are an executive agency of the UK government that carry out scientific research for fisheries management, environmental protection and aquaculture. CEFAS are a potential stakeholder for this study but have not responded to date and so must be recognised as a research gap. A relevant project they are involved in is an initiative to build relationships between UK offshore fishermen and scientists and to involve these fishermen in the co-commissioning of science. The project has been running for six years with a fund of £1 million/yr and has been assured another four years of funding. The project may not have direct relevance for the AOF project, with its small contingent of inshore fishermen, but it is the only stakeholder currently involved in a co-created public science project and should therefore be approached for advice when considering public science projects for the wider Suffolk coastline.

Another reason for lack of focus on the marine environment is that the local authority's jurisdiction stops at the low water mark, a theme common to the whole of the UK; this has prevented a more holistic, ecosystem based, approach to coastal management in the past. This is a fact picked up by the new Marine and Coastal Access Act, which aims to rebalance conservation efforts in favour of the marine environment through the creation of marine conservation zones [DEFRA 2009]. A network of protected areas will be formed and managed under the newly passed legislation; however the AOF project area falls outside these planned conservation zones that are positioned to protect specific habitat types that are threatened or especially diverse. The lack of these habitat conditions in the project area also helps explain the bias towards terrestrial natural science.

Overall, there are several existing opportunities for the public to be involved in the natural sciences in the project area. Some of these are contributory public science projects where the project is designed by scientists and members of the public contribute data, as in the case of the RSPB and SWT. Some opportunities take the form of pseudo science which typically takes the form of creating a baseline of existing conditions through surveys, as demonstrated by EA, SC&H, FWAG, SCDC and SBRC. Finally, consultation is used to elicit public input by the flowing stakeholders: FC, SCDC and ESJFC. The terrestrial bias results from a very strong nature conservation sector that has traditionally found conservation priorities on land [NORCOAST 1999]; this reflects the area's historical land use patterns.

Discussion

There are clear shortcomings to the existing network of opportunities: there seems to be an underestimation of the public in terms of the level of interest people might have in the scientific side of it. This means there are no actual science projects in the sense of starting out

with a hypothesis and testing it through data collection. As one interviewee commented: *'they tend to treat them like idiots and say just send me all the records of the number of hedgehogs you've seen; not 'we think hedgehogs are being eaten by Badgers – let's go and get some data on it'*. Better still would be to get researchers and communities working together from the proposal and hypothesis stage through to fieldwork, analysis and completion [Reed 2008]. Not doing so can lead to a waning of interest and a high turnover of volunteers, which typically results in high operation costs from having to continuously train people; it also leads to flimsy data through collection of incomplete data sets that vary considerably in their level of expertise, as people come and go. Data is also unnecessarily replicated as volunteer efforts remain uncoordinated *[personal communication, Martin Sanford, 04/11/2009]*. The limited development of public science projects is ubiquitous in the UK, where awareness and empowerment activities are more likely to manifest as guided tours and walks, events, conferences and interactive websites [DEFRA 2008]. On a national scale, one organisation bucking the trend is Open Air Laboratories who received a £11.75 million grant from the Big Lottery Fund to develop a wide range of local and national public science programmes. By bringing scientists, amateur-experts, local interest groups and the public closer together, they hope to form lasting relationships that can help tackle and explore environmental issues of local and global relevance explored [Opal Explore Nature].

Opportunities for greater public participation in natural sciences

The following section reports on research findings that offer specific opportunities for greater public involvement in science, with emphasis placed on those opportunities that have potential to address key community concerns, as elicited at the community conference in September 2009. The EA, with its highly sensitive mandate to provide flood defence under a tightened budget, stands to gain significantly if they are able to bring the public from a fixed

hold-the-line mindset to one where land use change is an acceptable inevitability that promises opportunity; and not solely disaster. A good starting place, to gain an understanding of what the future might offer, is to understand estuary dynamics. This is a task the EA currently outsources to consultants who do a one off study and subsequently make recommendations on the back of cost-benefit calculations. At the Blyth there were few attempts to help communities adapt to the changing conditions and equally few attempts to adapt by the community to the rising sea-level prognosis put forward by the EA. To enable adaptation, it is necessary to put local people on level footing in terms of knowledge which can then be used to envisage and create alternative solutions to challenges faced. An important first step has been taken on the Alde and Ore by the EA who have developed new ways of working that allow the sharing of information, with farmers, on salt marsh dynamics. This information is distributed in conjunction with an offer of an £10,000/hectare payment to farmers allowing their seawalls to breach to enable saltmarsh creation. This initiative has the aim of creating natural buffers against flooding that also double up as important wildlife habitat. Although a step in the right direction, this is prescribed action that allows little room for creativity and relies on the incentive of funding. A better and coordinated understanding of the environmental processes through public science would lead landowners and user groups to realisation of opportunities should water levels be allowed to rise in a controlled manner. Opportunities that might present themselves include: salt marsh lamb farming, water-based sports or shellfish farming [Coastal Farm Business Diversification 2006]. Public science of this nature would also address the raised community concern: ‘changing landscape characteristics’ and ‘science and its implications are poorly understood’ [Alde and Ore 2009].

On exploring the potential for public science with the EA, it became clear that significant barriers exist. The first of these is the fact that the science being studied is of a long term nature and not short-term water quality type changes. High powered modelling is

involved and the scientists involved have built their whole career on understanding the data analysis and methodology procedure. This is viewed as a major obstacle to getting people involved in the scientific process, but should not be. Given the training, it is not beyond the public to collect the data, and, so long as the data collected is used transparently, it would lead to benefits e.g. a more reliable model, wider-spread agreement, realisation of economic opportunities etc. A far bigger obstacle is their practice of outsourcing research to consultants in place of having in-house expertise. It is not, however, unfathomable for private-public partnerships to be engendered under EA's auspices, though this would require an alteration to the current research framework which is delineated by time-restricted projects. Though EA were unaware, there is scope for public involvement in science through monitoring chosen management actions as required under their own Strategic Environmental Assessment report. In order for this to be a worthwhile endeavour, the chosen management action would first need to have public backing, which is unlikely if they are not involved in its formation from the outset. The fact that they were unaware suggests monitoring receives low priority meaning adaptive management cannot exist; it should be noted however that willingness to change this is forthcoming. Finally, as with all public science projects, it is necessary to ask '*what is in it for them (the public)?'* This is particularly true for flood risk science where the public have strong vested interests and will demand an answer to this question more vehemently than might be the case with nature conservation science projects. If the EA is to take this idea forward, there needs to be cross collaboration with public and private sectors to allow the focus to expand past EA's remit to provide flood defence to identification and visioning of new possibilities through which to live by. Building a base of widely supported credible science is an important first step to this process [Dech 2003].

Shingle access management

Suffolk is home to one of the World's largest expanses of shingle. The noise of shingle owned at the beach on a stormy day, rattles, reverberates and soothes your form, and directly reminds you of the shifting dynamism of the Suffolk coastline. It is typically inhabited by salt-tolerant plant species and nesting ground birds which, due to the relative scarcity of habitat and fragility of the plants, are afforded a high level of conservation priority through national and international designations. This often means the public have restricted access to certain areas, which can lead to public resentment at wildlife being given more attention than people [Alde and Ore 2009]. Also, the effectiveness of restriction is limited by individuals' lack of appreciation of the resource under protection. Upon inspection, two examples of this happening were found in the project area, one at the appropriately named location Shingle Street, and the other at NT reserve Orfordness. Both sites are under Special Sites of Scientific Interest (SSSI) legislation, making NE responsible for assessing their condition. They have traditionally achieved this through their Condition Assessment Framework, which is a survey used to assess condition and inform management action, done on a six year cycle; but local social dynamics have prevented successful employment of this tool in both places.

Shingle Street is a popular destination for recreational fishermen, holiday makers and walkers all of whom combine to produce significant disturbance to the protected habitat. A similar situation exists on a remote corner of the NT reserve where fishermen and dog walkers regularly use the area as recreational space. Having interviewed both stakeholders responsible for the management of these areas, they realise a top-down regulatory approach is only likely to lead to resentment and conflict as people would be forced to change without any explanation. Instead, both are exploring the possibilities for involving the public more meaningfully. At Shingle Street, NE are willing to devolve the Condition Assessment

Framework's as a tool to the local community who will be able to use it to identify priority areas, and, more importantly, to decide what type and level of access to restrict. The community themselves have expressed support for the idea and can easily be put into action being both well organised and educated *[personal communication, Trazar Astley-Reid, 20/10/2009]*. Placing it in the hands of local residents will result in the formation of: a continuous monitoring system, commitment to management decisions and will provide a response to concerns raised at the community conference. These include: 'confusion over who makes the final decisions that impact the area; there is a lack of public involvement and wider communication; and balancing wildlife vs. people, tourism vs. environmental qualities and allowing vs. restricting access' [Alde and Ore 2009]. At Orfordness, the lack of a residential community means the issue has to be approached differently; it would be conducive to a public art-science collaboration wherein art could be made functional to provide a lasting visual component to complement management decisions, where a watchful community are lacking. Local stakeholders could still be involved in the monitoring and evaluation of outcomes and empowered to make alterations where necessary.

Marine environments

Scientific activity in the marine and inter-tidal zone environment is under development in the project area, this will complement existing initiatives that aim to maintain the aesthetics of the coastal zone e.g. the Marine Conservation's Society's (MCS) Adopt-a-Beach campaign, which takes litter off beaches and uses it to identify sources of pollution; The following stretches of coastline, within the project area, still need to be adopted under the MSC's Adopt-a-Beach campaign: Thorpeness – Aldeburgh; Aldeburgh – Shingle Street; and Shingle Street – Bawdsey. The new warden scheme, being run by SC&H, is currently a form of community policing (i.e. reporting litter dropping, bait digging etc) but also has potential

to make the transition to a more inclusive, intelligent form of public involvement through scientific activities. This could be a logical next development in SC&H management framework, one that would go a long way to achieving their management goal, which is to create a high quality network of habitat in those areas that are currently not managed by NGOs. As the self-proclaimed 'eyes and ears on the coast' *[personal communication, Trazar Astley-Reid, 20/10/2009]*, the warden scheme will identify transgressions which could then be used to form hypothesis and points of departure into understanding the dynamics and solutions to the perceived problems. For example, if bait digging is identified as being too commonplace, then there exists an opportunity to investigate whether wading birds numbers are being affected (which may have implications for ornithologists visiting the area) and if so to identify which areas are more suitable, if any. This would also move the warden project past its current focus of getting one interested individual to police the area to one where it would be possible to involve many participants increasing their ability to identify organisms, to use measurement instruments, to collect field data and increase their understanding of the scientific process. The latter point is easily furthered by holding data analysis workshops where participants could be invited to draw conclusions from evidence and raise new questions as a basis for new study designs. This level of involvement will also act as an effective conduit for wider public appreciation of management goals and activities [Bonney et al. 2009]. In interview, a call for a better understanding of the coastal zone's ecological processes was also made by the SBRC. The potential for public involvement to investigate these ecological processes is huge *[personal communication, Martin Sanford, 04/11/2009]*. SWT is a well positioned stakeholder to use for development of this strand of research due to their strong background of working with volunteers. However, they have not done a lot of work in the coastal zone and would therefore need funding to employ experts to guide the research process. Having experts involved would mean a far greater range of data could be

collected from teaching a group of volunteers 25 species, instead of the 5 that would be possible with a guide sheet. This would more than justify the cost by making decisions more reliable and justifiable. It would also go some way to addressing concerns over access to education and public involvement that were put forward at the community conference [Alde and Ore 2009].

Finally, there exists, in the marine environment, an exciting new initiative for three East of England marine Biodiversity Action Plans (BAPs), for marine fish species, cetaceans and seagrass beds. These will cover the coastlines of Essex, Suffolk and Norfolk The BAPs are enshrined in UK law under the Convention on Biological Diversity [1992] and are intended to drive actions to halt the loss of biodiversity, both for identified species and habitats.. The initiative is being led by a consortium of local organisations that join ranks under the banner Suffolk Biodiversity Partnership which is an informal partnership of 16 organisations committed to protecting and enhancing biodiversity in Suffolk. The marine fish plan is in formative stages but is likely to have a multipronged approach through policy and legislation, site specific management, communications and publicity and research and monitoring. Public involvement is likely to be sought through educational activities promoting the importance of biodiversity and through practical management projects on the ground. There are plans to involve the public in these research activities, e.g. the fishing industry are going to be brought into the process to contribute vital data on key spawning and nursery grounds of BAP species. They are directly responsible for fishing effort and hence are responsible for putting pressure on these species; so their buy-in is essential if the BAP are to have any impact. This will prove challenging because to really gain their buy-in it will require demonstration that their findings are altering the way the fish stocks are allocated and managed. This is a hard task given quotas are currently being set by the EU. However, the

ESJFC enforcement agency has shown that they are willing to adapt their enforcement activities to current data and knowledge. The most advanced example of this is The Wash Fishery Order 1992, in neighbouring county Norfolk, which enables a committee of local organisations and individuals to make management decisions for shellfish resource themselves, though data gathering remains in the hands of CEFAS and ESJFC. Involving resource users in the BAP research process should be straightforward at this location. In Suffolk, the situation is likely to be more challenging due to a lack of existing community management structure; however a new research boat has been commissioned by ESJFC for Suffolk which could be used to create a symbiotic relationship between the conservation focused Suffolk Biodiversity Partnership and fishermen. This may take the form of using the research boat to increase quality of catch or reduce over fishing expenditure for the fishermen who, in turn, can tailor their activities to suit the conservation requirements. This idea to help solve fishermen concerns with the new research boat was put forward by ESJFC themselves and so holds real potential *[personal communication Judith Stout 05/11/2009*]. Delivery of BAPs depends on collaborative integration which makes BAPs an important driver of ICZM and hence improved management in the project area and beyond.

Reversion to heathland

Throughout the centuries, the Suffolk landscape has been shaped by farming. For the majority of that time the impact on biodiversity was, in fact, positive [Suffolk Coast and Heaths 2008]. Species richness thrived under a constantly shifting grazing and growing regime. It is only in the last 100 years that intensification of farming changed the quilt-work of diverse habitats into swathes of monoculture that have little space for wildlife. Within Suffolk there are ongoing efforts to re-diversify the agricultural landscape through schemes such as the one being run by FC at Dunwich, which is removing pine plantations to restore

heathland – a traditional grazing landscape. The SCDC is also planning to run a similar programme on one of its properties, having been awarded a grant by NE. At both locations, the work is being contracted out to consultants who have helped formulate a strategy and who will then carry out the physical work at one location and are making preparations at the other. Works having started at FC's site, the public have been up in arms at plans to remove red oaks, leading to a local politician becoming involved to further the community's opinion. This is typical of the FC's tendency to deal with the public on a reactive basis *[personal communication, Simon Leatherdale, 19/11/2009]*. SCDC is anticipating a similar reaction to their plans and are having to spend time considering how to circumvent, what they see as likely public opposition *[personal communication, Peter Grimes, 08/12/2009]*. In both cases, the public could have been brought to the table at plan formation stage and helped design the projects. This would have generated support and agreement for the initiatives. At both sites there seems to have been a disregard for the existing landscape value, both in terms of how people relate to it, and the existing biodiversity value – which did not factor into NE's decision to grant funds for SCDC to carry out the project. It is clear to see that the public could have been involved to elucidate this information and help determine the most appropriate decisions for these projects. New projects attempting healthland restoration would do well to take note of these examples, projects that will undoubtedly be forthcoming given the consistently strong focus on conservation in the AOF area.

Another initiative working to reverse the damage done by agriculture on wildlife is the work being done by FWAG, as already detailed in *Stakeholder Discussion*. There exists a local FWAG group in Suffolk who keenly involve volunteers to work, with farmers, towards environmentally friendly farming methods. FWAG therefore offers real opportunities for involvement to those people who raised intensification of farming as a concern at the

community conference [Alde and Ore 2009]. These opportunities should be relayed to the relevant people. That the government are providing financial support for agri-environment schemes makes this option an attractive proposition to farmers and concerned members of the public alike.

Logistical recommendations for public science projects

Opportunities for greater public involvement in science exist within the project area and, if developed bearing in mind the theory presented herein, they could begin to contribute to a more sustainable management framework for the Suffolk coastline through affiliating local resource users with the underlying ecological processes of the area. To maximise their impact, any new projects should follow tried and tested design principles and considerations. The most commonly overlooked design consideration is who, in the public, stands to gain by the project. If this is clearly understood then it should be straightforward to indentify the most appropriate participants. As a general rule, people are more content to commit time if they feel that what they are doing has implications for their patch of land. Reed [2008] reported a steep fall off in volunteer time commitment with distances extending past 10km of their homesteads. This implies that the research loop must be closed for participants, by demonstrating participants' effort is directly benefiting their respective immediate environment. The amount of time that participants are likely able to give up also varies between cultures; with its well educated, middle income, retired community, the project area should fare well on this basis. This is supported by the discussion surrounding Shingle Street where the local resident community has been identified as strongly organised, well educated and willing *[personal communication, Trazar Astley-Reid, 20/10/2009]* and hence ready for quick involvement. This is likely to be the case with many communities within the project area; it is important to get people to embrace the opportunity that exists to take responsibility

rather than allowing them to make the assumption that outside authorities will implement management strategies as and when necessary, as has traditionally been the case.

A second, akin, design consideration is an understanding of *how* people stand to gain by becoming involved. Public science projects will benefit from the identification and involvement of core groups that make their contribution as part of their ongoing activities and so have vested interest in the results [Jacoby et al. 1997] (e.g. recreational fishing clubs). Within the project area, there is a well established societal network with many different interest and volunteer groups; these can be invited to participate on the basis of their stakeholder position in relation to the management framework and science project. The community conference also yielded several individualised concerns that could be used as a departing point for involving people in projects that have direct relevance for their lives e.g. the local FWAG could be supported to create a project that involved those individuals that raised concerns at the first community conference.

Once these parameters have been understood, the project can move to the more detailed planning stage. The first principle to take note of is: ensure the project is small enough to succeed given the available resources rather than a large-scale effort that exceeds the community's capacity and fails [Reed 2008]. When deciding the scale of the project to be undertaken, the level of organisation necessary should be a consideration; organisational aspects require greater time commitments as the level of public involvement increases. Therefore, a co-created project will take more planning and organisation than a contributory project. Successful organisation will depend on one or more coordinators responsible for key parts of each project step e.g. volunteer identification, scientific design, analysis, and interpretation. There also needs to be randomised quality control data checks, by experts, at

all stages of the process; this ensures the project's proper design, interpretation and analysis and so guarantees the project's outputs are usable and credible [Jacoby et al. 1997].

From the early planning stages right through to the implementation of the project, the public must feel they own at least part of the process and the outputs if their involvement is to be sustained past the initial novelty level of interest [Brossarda et al. 2005]. One way this must be achieved is through managers responding to a project's outputs transparently and with validity. This feedback must be explicit and valid [Jacoby et al. 1997]. From participants' point of view, studies [Reed 2008] have shown the most important components of any public science projects to be: having a genuine influence on decisions, promoting communication and learning, and treating all citizens equally. On the flip side, Fritsch and Newig 2007 [as cited in Reed 2008], conducted a meta-analysis of 35 cases of local or regional participatory environmental decision-making in North America and Western Europe to evaluate the effectiveness of different participatory processes on environmental outcomes. They determined the most important determinants of environmental effectiveness were the interests and goals of the participants, and how strongly they favoured sustainable environmental outcomes. If followed, the recommendations put forward thus far offer ways to involve those that care strongly about environmental sustainability. In addition, public science itself can increase understanding of the science surrounding sustainability (e.g. carrying capacity) and hence appreciation for the need to immediately adopt its principles.

Future directions

The Suffolk coast is managed through very distinct managerial sectors, each with their own priorities. Some of these priorities complement each other, others sit at odds. By involving the public in distinct projects it is, to some extent, perpetrating existing managerial divisions into the public sphere. This does not nullify the worth of creating a public science

project as the benefits will still be realised locally. However, appreciation of complete ecosystem processes will remain underdeveloped in both the public and management sphere; the latter because it does little to encourage collaboration amongst the management bodies who instead remain tied to their own sources of information and knowledge. This heterogeneity makes collective action more difficult to organise in the public sphere [Jentoft 2000]. To overcome this management inefficiency, common management goals must be sought and pursued through partnerships involving the public, private and government sectors. Underlying these partnerships should be a commitment from managerial stakeholders to abandon the *'we own the data'* stance so that existing bodies of knowledge can be combined to enable effective working partnerships. This is a difficult process because managerial stakeholders guard their missions, responsibilities and resources that accompany them, in order to survive [Cicin-Sain et al. 1998]. Co-created public science projects potentially offer a way around this catch-22 situation through releasing managers from their prescribed mandates to tackle broader concerns identified under the partnerships. This would allow coastal research activities to move past their current focus on particular issues in local environments to an understanding and interpretation of change in broader-scale, complex, and interacting systems [Jacoby et al 1997].

There is continuing widespread distrust of the notion of managed realignment as evidenced by: the legal wrangles surrounding its attempt at the Blyth; the fact the whole AOF ICZM process is, at least in part, an attempt to influence the EA's Estuarine Strategy for the Alde and Ore, in the strategic direction of a hold-the-line approach *[personal communication with participants at 'Topic Group Meeting', 24/11/2009]*; and the fact a Green Flag Sustainability Award was given to Suffolk Coastal District Council ("Green Flags Awarded," 2009) for the part it played in getting sea defences built, for a cluster of four buildings (one

historic) situated at Bawdsey, even though the rock used to construct the hard defence was imported from Norway at vast expense and was placed with little consideration of the coastal processes at work on the wider coastline. These examples reflect a situation in which non-professional and professional stakeholders remain uninformed on and unconvinced by the technical scientific arguments in favour of managed retreat or abandoning the line [Treby & Clark 2004]. Other reasons for not embracing sustainability more fully include political pressure from local user groups with vested interests and an inability to see past the immediate flood risk issue to the opportunities that present themselves with a changing environment. This leads to situations where management actions are recognised as being unsustainable yet accepted as a matter of course e.g. moving 80,000 tonnes/yr of shingle from NT property Orfordness to Slaughden – where the sea is threatening to breach into the estuary at a point that would cause significant alteration to the area's characteristics. Science integration and science based partnership between the public, private and government could deliver wider spread understanding of the area's ecological requirements which could then be used to frame the area's sustainable management options, which will be many and varied if a diverse body of stakeholders are brought onto a level footing to share responsibility for the area's future. Underlying any partnership or integration of science should be a philosophy of playfulness, because it leads to experimentation and thus learning and flexibility, which are essential management ingredients under conditions of uncertainty and complexity [Treby & Clark 2004].

Conclusions

Coastal management in Suffolk and across many locations in the UK is being pursued under the guise of ICZM. Integration is a key objective for all of these projects, as the ICZM name details. This is to be expected from recognition that integration is essential if co-

ordinated, effective and holistic decisions are to be made on complex coastlines, as the UK's is. For this reason, integration is a key objective put forward by DEFRA's ICZM strategy for England [2009], a strategy that also endorses all 8 EU ICZM recommendations [Morris 2008]. Within the EU ICZM recommendations one finds guidelines to integrate at all levels of management and society. This means integrating existing bodies of knowledge and responsibilities amongst management authorities and the wider public in order to create complimentary management activities and a shared responsibility for the coastal zone. Failure to do this results in a management structure that is characterised by competition between the management authorities, because each protects their own mandate in order to remain distinguishable for funding. Decisions that result from this arrangement appear fragmented and conflicting to the public, who subsequently feel distant to and subjugated by the system, which can lead to embittered relations between government bodies and their citizens. Through integration, the AOF project is attempting to find a model of coastal management that will prevent this from happening on the wider Suffolk coastline. The type of integration being pursued most is between existing management authorities, rather than the wider public who are being integrated into the process through five topic groups that help identify issues and subsequently work together to try find solutions. They do not however have any say in the final decisions made by the various management organisations. Topic group membership is by invitation only which ensures numbers remains manageable. This arrangement was identified, in theory, as a likely constraint on the ICZM process delivering effective and widely supported management decisions because the potential for collective action remains underdeveloped [Hidebrand 1997], as does understanding of the need to make management decisions that pursue environmental sustainability.

Given the area's historical focus on natural sciences and the potential to use this existing knowledge base to affiliate members of the public with the principles of sustainability, the natural sciences were posited as a way to bring the wider public into the ICZM process; one that has potential to bring the public onto a more level footing with management organisations (as in the case of a co-created science project). The research carried out to investigate opportunities for greater public involvement through the natural sciences yielded several opportunities for the public to be more directly involved, though these opportunities mostly rest with one, or at most two, management stakeholders, and therefore run the risk of perpetuating existing management divides, albeit in a form that breaks down the expert – non-expert divide. For integration to occur at all levels, it will be necessary to form partnerships that extend beyond the individual stakeholder's own focus, which is derived from funding priorities, to a situation where common goals and research priorities are sought in full collaboration amongst the various stakeholders and the public. Only then will the coastal ecosystem be understood and managed as a whole by management stakeholders, whilst the public can begin to appreciate the drivers of change i.e. the need for more sustainable approaches to environmental management [Treby & Clark 2004]. Research into the marine and coastal zone environments offers one route into this type of research collaboration because there is a huge gap in the biological records for these environments and an urgent need to understand these systems in the face of climate change and increasing pressure from resource users. The Suffolk Biodiversity Partnership's BAP process for marine fish species is one example where common research goals and objectives are being pursued, in the marine environment, across both sectoral and hierarchal boundaries. More transboundary research goals and objectives could and should be sought through SC&H's new warden scheme, the EA's Alde and Ore Estuary strategy and through innovative visioning for different research activities.

Those opportunities that rest with individual management stakeholders are derived from projects being undertaken under specific mandates. There is often focus on a single resource issue which has been shown to often stand to gain by increasing the level of public involvement in the project. Failure to bring the public into the research and management process has and will continue to create problems for management bodies, as exemplified by the activity surrounding heathland restoration. The advantage of individual stakeholders involving the public in research, as opposed to the aforementioned transboundary approach, is that the projects are likely to be complementing existing management activities and so will require less financial and human resource input to run and sustain themselves [McKenna & Cooper 2006]. The most conspicuous requirement for these single stakeholder run projects is to develop the public's involvement from contributory pseudo science to a collaborative or even co-created science project. People enjoy feeling connected to their environment and yet are often faced with top-down, heavy handed management activities that have consultation as the central mechanism for public involvement. This leaves them understandably disquieted and disconnected. To meaningfully connect communities to the science and policy surrounding natural resource issues it is necessary to help them understand the interlinked nature of the many resource issues and help them to apply technical information in a larger context of shared understanding [Kapoor 2001] where all participants are able to influence or alter the management questions that are asked and the outputs that are produced [Reed 2008]. If attended to, such action would be appreciated and worthwhile, as is evidenced by the examples reported on from Canada and Australia in this report.

The report presented here has shortcomings, most of which could have been circumvented if time availability has been greater. Shortcomings include the absence of two stakeholders, both of whom scored highly on the Stakeholder Influence/Impact Matrix

(Figure 3): CEFAS and DEFRA. Drawn from the literature review, both are involving the public innovatively; CEFAS through their public science project with fisherman, the only true public science project found near the project area, and DEFRA through their Community Pathfinder project on the coast. The Pathfinder project awards funds in the region of £500,000- £3million to various local authorities who are required to work in partnership with local communities in order to adapt to climate change. Guidelines were being put together for the application process at the time of research. This process included deliberations on whether to provide funding for communities to do their own research. Further investigation into this potentially relevant development yielded no offer of meeting or further insights, though significant opportunities obviously exist for communities and management bodies to work together on research projects. Although it applied, Suffolk was not awarded a grant and so will have to find alternative sources of funding should public science projects be brought to actualisation within the project area. Future research into public science developments should contact these two stakeholders as a matter of priority. Other research shortcomings that could have been addressed if more time was available would be a wider evaluation of pilot public science projects that span a variety of ecosystems and organisations. This would increase understanding of what makes public science projects a success within different contexts. For instance, whereas a local organisation might find volunteer monitoring useful for informing small-scale water quality management decisions, a protected area might determine that the same monitoring protocol does not meet its need for data that can withstand scientific scrutiny in a peer-reviewed journal or court of law [Penrose and Call 1995]. From a management perspective, it would be beneficial to better understand and prioritise the factors that make stakeholder participation lead to stronger and more durable decisions in different contexts [Reed 2008]. One potential shortcoming to the study is the researchers own stance in relation to environmental management. He has a great deal of

enjoyable experience in nature conservation and therefore has a bias towards strong sustainability over weak, as exemplified in this report, by the discussion surrounding the hold-the-line approach being favoured by local people. However, the author feels this bias justified given the EU's ICZM recommendations include: 'work with natural processes, not against' [EU 2002].

The depth of support for nature conservation within the project area made the natural sciences an appropriate sector to target for developing opportunities for greater public participation in the AOF project. There is, however, a plenitude of other disciplines, some scientific, others not, that many people will feel more closely akin to when interpreting the coastal zone. This means understanding and responses to management decisions are deeply informed by knowledge and perspectives from non-natural science domains, such as senses of ethics and morality, visions for society and future generations and drives to explore and explain the unknown [McCallie et al. 2009]. ICZM must therefore create opportunities for an exchange of knowledge, ideas, and perspectives that involves the participation of all aspects of society in a collaborative and integrated fashion. Unlocking human ingenuity and creativity from all sectors is essential to solving complex coastal management challenges.

References

Alde and Ore Community Conference *Community Concerns Summarized* November 2009

Arhus Convention *Postnote* Parliamentary Office of Science and Technology 1996

Arnstein S R. A Ladder of Citizen Participation *JAIP,* Vol. 35, pp. 216-224, 1969

Bonney R., Ballard H., Jordan R., McCallie E., Phillips T., Shirk J., and Wilderman C. C. Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. *A CAISE Inquiry Group Report.* Washington, D.C.: Center for Advancement of Informal Science Education (CAISE) 2009

Brossarda D., Lewenstein B., Bonney R. Scientific knowledge and attitude change: The impact of a citizen science project *International Journal of Science Education* Vol. 27, pp. 1099–1121, 2005

Cicin-Sain B., Knecht R W. *Integrated Coastal and Ocean Management Concepts and Practices* Island Press 1998

Cicin-Sain B., Knecht R W., Vallega A.. Harakunarak A. Education and training in integrated coastal Management: lessons from the international arena. *Ocean & Coastal Management* Vol. 43, pp. 291–330, 2000

Coastal Farm Business Diversification *ComCoast project*, co-financed by the EU-Interreg IIIb North Sea Programme 2006

Coastline *The Newsletter from Suffolk Coastal District Council* Issue 40 Summer 2009

Cowper D. Community and Science: A Critical Interface in Co-Management *MARA 5012* 1999

Dech S. ACAP's Science Linkages Initiative: A Sound Investment in Science & Community 1997-2002 Sustainable Communities and Ecosystems Division Corporate Affairs Branch *Environment Canada* 2003 *Retrieved from:* http://atlantic-web1.ns.ec.gc.ca/community/acap/default.asp?lang=En&n=085FF7FC-1

Department for Environment, Food and Rural Affairs (DEFRA) Marine and Coastal Access Bill Policy Paper 2009 *Retrieved from:* http://www.defra.gov.uk/environment/marine/documents/legislation/mab-policy.pdf

Department for Environment, Food and Rural Affairs (DEFRA). A strategy for promoting an integrated approach to the management of coastal areas in England 2008

Donhong. C., Mecalfe J., Schiele B. (Eds.) At the human scale: international practices in science communication *PCST network Science Press Beijng,* 2006

Edwards S D., Jones P J S., Nowell D E. Participation in coastal zone management initiatives: a review and analysis of examples from the UK *Ocean & Coastal Management,* Vol. 36, pp. 143-165, 1997

Ellsworth J E., Hildebrand L E., Glover A E. Canada's Atlantic Coastal Action Program: A community-based approach to collective governance *Ocean & Coastal Management,* Vol. 36, pp. 121-142, 1997

Environment Canada A Summary Report of The Atlantic Coastal Action Plan 2001 *retrieved from:* http://www.unep.org/gc/gc23/documents/Canada-ACAP-AF8-REV.pdf

EU recommendations concerning the implementation of Integrated Coastal Zone Management in Europe *Official Journal of the European Communities* 2002/413/EC

Farming and Wildlife Advisory Group *Accessed* 10 November 2009 www.fwag.org

Fisher M. Heathland MADNESS - the juggernaut of nature conservation *Retrieved from* http://www.self-willed-land.org.uk/heath_madness.htm

Green Flags Awarded *East Anglian Daily Times* p.23, 9th December 2009

Hildebrand LP. Introduction to the special issue on community-based coastal management. *Ocean & Coastal Management* Vol. 36, 1997

House of Commons Environment Committee, *Coastal Zone Protection and*

Jacoby C., Manning C., Fritz S., Rose L. Three recent initiatives for monitoring of Australian coasts by the community *Ocean & Coastal Management,* Vol. 36, pp. 205-226, 1997

Jentoft S. Co-managing the coastal zone: is the task too complex? *Ocean & Coastal Management* Vol. 43, pp. 527-535, 2000

Kapoor I.Towards participatory environmental management? *Journal of Environmental Management* Vol. 63, pp. 269-279, 2001

Leech B L. Asking questions: Techniques for semi-structured interviews *Political Science and Politics* Vol. 35, pp. 665-668, 2002

Marshall C., Rossman G B. Designing qualitative research *Sage Publications 4th Edition* 2006

McCallie E., Bell L., Lohwater T., Falk J H., Lehr J L., Lewenstein B V., Needham C., and Wiehe B. Many Experts, Many Audiences: Public Engagement with Science and Informal Science Education. *A CAISE Inquiry Group Report*. Washington, D.C.: Center for Advancement of Informal Science Education (CAISE) 2009. *Retrieved from:* http://caise.insci.org/uploads/docs/public_engagement_with_science.pdf

McKenna J., Andrew J G., Marie O'Hagan C. Coastal erosion management and the European principles of ICZM: local versus strategic perspectives Journal of Coastal Conservation Vol. 13, pp.165–173 2009

McKenna J., Cooper A. Sacred cows in coastal management: the need for a ‘cheap and transitory’ model *Area* Vol. 38, pp. 421–431, 2006

Milligan J., Hills J., Smith T., Tissier M. A typology of coastal researchers’ modes of interactions with stakeholders International School for Advanced Studies *Journal of Science Communication* Vol.3 2004

Morris K A. English nature’s Estuaries Initiative: A review of its contribution to ICZM *Ocean and Coastal Management* Vol.51, pp. 25-42, 2008

NORCOAST Report from European Regional Development Fund Interreg IIC, North Sea Region: Community Initiative Concerning Transnational Coperation on Spatial Planning 1997-1999

Opal Explore Nature *Accessed* 20 November 2009 www.opalexplorenature.org

Parker B. Alde and Ore Futures: an integrated coastal zone management pilot project summary report June 2009 (contact author for report)

Penrose D., Call S M. Volunteer Monitoring of Benthic Macroinvertebrates: Regulatory Biologists' Perspectives *Journal of the North American Benthological Society*, Vol. 14, pp. 203-209, 1995

Recommendations on improved Integrated Coastal Zone Management in the North Sea Region European Regional Development Fund Interreg IIC, North Sea Region NORCOAST 1997-1999

Reed M S. Stakeholder participation for environmental management A literature review *Biological Conservation* Vol. 141, pp. 2417-2431, 2008

Ricketts P., Harrison P. Coastal and Ocean Management in Canada: Moving into the 21st Century *Coastal Management,* Vol. 35, pp. 5-22 2007

Stojanovic T A., Ballinger R C. Integrated Coastal Management: A comparative analysis of four UK initiatives *Applied Geography* Vol. 29, pp.46-62, 2009

Suffolk Coast and Heaths – An Area of Outstanding Natural Beauty *Discover magazine* 2008

Suffolk Coast and Heaths *The Free newspaper of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB)* Summer edition 2009

Treby E J., Clark M J. Refining a Practical Approach to Participatory Decision Making: An Example from Coastal Zone Management *Coastal Management,* Vol. 32, pp. 353–372, 2004