

Climate Change Adaptation and Local Knowledge: A case study from the Developed World.

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Abstract: This paper examines what role 'local knowledge' can play in strategies for adaptation to climate change. Using a small and vulnerable group of Scottish Islands, an ethnological approach is taken here in the developed world to see if 'local knowledge' exists in a community still mostly engaged in primary production. Local knowledge is defined and compared to citizen science. Its viability in Climate Change Adaptation and Disaster Risk Reduction (CCA/DRR) processes are explored drawing on the academic literature and practical case studies from the developing world. Trends in the composition of CCA/DRR processes are traced showing the increasing importance of local knowledge and its suitability for inclusion in policy. Issues of scale and the way local knowledge is held are discussed, together with ways of re-constructing a more valuable body of knowledge from the experience and pieces found. Areas for further research are highlighted. Keywords: Climate change, adaptation, local knowledge, scale, developed world.

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Abstract

This paper examines what role 'local knowledge' can play in strategies for adaptation to climate change. Using a small and vulnerable group of Scottish Islands, an ethnological approach is taken here in the developed world to see if 'local knowledge' exists in a community still mostly engaged in primary production. Local knowledge is defined and compared to citizen science. Its viability in Climate Change Adaptation and Disaster Risk Reduction (CCA/DRR) processes are explored drawing on the academic literature and practical case studies from the developing world. Trends in the composition of CCA/DRR processes are traced showing the increasing importance of local knowledge and its suitability for inclusion in policy. Issues of scale and the way local knowledge is held are discussed, together with ways of re-constructing a more valuable body of knowledge from the experience and pieces found. Areas for further research are highlighted.

Keywords: Climate change, adaptation, local knowledge, scale, developed world.

1 INTRODUCTION

The purpose of this investigation is to see whether 'local knowledge' can supplement science in increasing resilience and reducing vulnerability to hazards in the environment, including climate change in the developed world. Do people working in primary production, in a closer, and different relationship to their environment than most city dwellers, notice changes? How is such knowledge conceptualized? What meaning, if any, is made out of it? Is it of any use or value, and can this data feed into policy? In order to test these questions here within the British Isles, a context needed to be found where most people in a community are either directly or indirectly connected with primary production. For this study, a group of islands off the North West coast of Scotland were chosen. People there are engaged in crofting¹, other forms of agriculture, fishing, and aquaculture.

Although studies of this nature have been undertaken in the developing world (Mertz et al 2009, Nyong et al 2007), and with indigenous peoples in the North American Arctic (Krupnik and Jolly, 2002, Ford, Smit and Wandel, 2006, Berkes and Jolly, 2002 for example), few have been made with mainstream communities in the developed economies of the Economic North.

¹ Crofting is discussed in part 3.

The Research Questions

The focus of the project evolved from the original questions. These are formalized into the four research questions:

1. To what extent are the islanders sensitively aware of any changes that there may be in the environment? What 'adaptation processes' have they adopted or created?
2. How do they ascribe 'meaning' to this? How are such changes conceptualised and understood?
3. Are the epistemological differences so vast that they cannot be bridged? Or put another way, how difficult is it to turn 'local knowledge' into usable, credible, scientific data that can be used by influential agencies such as the EEA²?
4. What if any general conclusions can be drawn from a single case study?

Format

Section two examines the central concepts, analyses the relevant definitions and offers a conceptual framework for this research. Part three introduces the study location, and then, in part four the methodology is explained. The key findings are shown in the section five, and they are discussed and evaluated in part six.

Limitations of this study

Resources limited this study. With more money, more time could have been spent on the islands, extending the discussions with existing respondents, finding more contributors, and in observing how they interact with the local organisations concerned with the environment. More time would have allowed for greater immersion in the culture, so that some of the subtleties might have been captured earlier.

A qualitative study was chosen and undertaken as it offered more depth. It could have been augmented with a survey, which may have added a quantitative perspective, but I was warned that the Islanders 'are faced with surveys every week' (Stewart Angus, Scottish Natural Heritage, personal communication). Time and expense militated against this in any event.

Although it was envisaged that the interviews would centre on changes in the *environment*, the article announcing the research³ did mention '*Climate Change*', thus potentially leading the study in a particular way. However, only one interviewee responded directly from the paper. Given the nature of this particular meeting, (with 'A') the integrity of the research holds.

The sense arises that more literature could have been reviewed. Given the time constraints, it is thought that an extensive rather than complete review of the literature has been undertaken. That said, there is little of it that relates directly to local knowledge and environmental changes in Scotland, let alone the study area in the Hebrides.

² European Environment Agency, which already uses citizen science, see McGlade, 2009

³ See appendix 2

2 THE REVIEW OF THE LITERATURE

An extensive review of the literature concerning 'local knowledge', 'indigenous knowledge', 'traditional knowledge' and 'Citizen Science' was undertaken in the context of 'Climate Change Adaptation'. It became apparent that the context needed to be widened to include the emergence of the terms 'adaptation' and 'mitigation', and their roles in attempting to manage 'Global Warming' in the Developed and Developing world. Further, Climate Change is not the threat upper most in the minds of many people in the developing world. Other, more pressing hazards are faced and managed (Mercer, 2010, Kelman and West, 2009, Gero et al, 2011). The review is further extended into the Disaster Risk Reduction literature, from the perspective of both scholarship (Mitchell and van Aalst, 2010, Wisner, 2004 for example), and The Red Cross (IFRCC) whose case studies, using 'local knowledge' reflect successful deployment and community involvement, in a process that is something other than the 'top down' approach⁴. This gave the initial intellectual framework to form and sharpen the research questions. An examination of what similar studies have been done where and why began to show where some of the gaps in the research might be.

Context

'Local' or 'Indigenous' knowledge, sometimes referred to as Tradition Environmental Knowledge or TEK, has become increasingly important in the debate around how communities adapt to climate change (for example Mercer, 2010, Gero et al 2011, Smit and Wandel, 2006, Mercer et al, 2007, Pearce, et al, 2009, Huntington, 2000, Berkes et al, 2000) To fully understand this debate, a quick recourse to the history of 'Adaptation' is necessary.

Adaptation emerged as one of the two responses to climate change from the Rio Earth Summit (Burton et al 2002:377). Mitigation was the other. The developed world would 'mitigate' the worst impacts of changes in the climate, and the developing world would adapt. Although Article 2 of UNFCCC does define 'mitigation', no definition of 'adaptation' is offered. Mitigation meant that carbon emissions would be reduced by the developed world, whereas the developing world would adapt to the changes in the environment. Initially, the idea of adaptation in the economic 'North' took on a negative nuance (Pielke jnr, 1998, Prins and Rayner, 2007, Pittock and Jones 2000). It was thought that to adapt, was to admit the failure of mitigation, and the political will behind it. Mitigation has not worked. Emissions are still rising (IPCC, 2007, Anderson and Bows, 2008, Houghton, 2009, New, 2011, Stafford-Smith et al, 2011, Anderson and Bows, 2011). The importance of adaptation has increased, as have those processes that make up 'Climate Change Adaptation' (CCA). Adaptation is seen as the ways in which communities reduce their vulnerability and enhance resilience (Adger and Brown, 2009, Berkes, 2007). 'Local Knowledge' was once seen as peripheral, or even irrelevant because the response to climate change was primarily a scientific one (Brace and Geoghegan, 2010:285, Mansfield, 2009:44, Mercer et al 2007:246, for example). Local knowledge is now increasingly seen as one of the important ingredients of CCA (Backstrand, 2003, Drew, 2005, Brace and Geoghegan, 2009, Button and Peterson, 2009, IPCC, 2007:864.).

⁴ Case study brochures are set out in Appendix 2

In the developing world, the concept of 'Adaptation' has a history in the Hazards Management literature through Disaster Risk Reduction (DRR) (Smit and Wandel, 2006:282ff). DRR seems to offer processes that are the same as or very similar to CCA. Closer inspection of both DRR and CCA allows us to see how close in form and function these two processes are, and what role there may be for 'local' traditional or indigenous knowledge.

One of the many definitions of DRR is offered by the UN as 'the systematic development and application of policies, strategies and practices to minimise vulnerabilities, hazards and the unfolding of disaster impacts throughout a society, in the broad context of sustainable development' (UNISDR, 2004:3). Here, explicitly, DRR is seen as a component of sustainable development.

CCA has been defined as "Adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits benefit opportunities" (IPCC, 2007:869). Resilience is the ability to encounter the stimuli mentioned, and for the socio-ecological system to bounce back to a recognizable equilibrium. There are problems with this description, especially the idea of equilibrium, but they lie outside of the scope of this paper.

Both the CCA and the DRR process offer hard solutions, such as building infrastructure (sea defences, planting mangroves, for example), and soft solutions like educating and raising the awareness in the community. Both measure the effectiveness of their solutions in terms of enhancing resilience and reducing vulnerability. DRR looks to reduce vulnerability and increase resilience to all hazards, whilst CCA is concerned about Climate hazards alone. Studies have shown that although there are differences between these two processes, the common ground is greater (Thomalla et al., 2006; Mitchell and van Aalst, 2008; Venton and La Trobe, 2008; Mercer, 2010). Indeed, there is a body of scholarship arguing for their integration (Glantz, 2003; O'Brien et al., 2006, Gero et al 2011). A key component in this developing debate is community involvement from the bottom up, as well as top-down expertise. Mercer tells us that DRR processes are 'often at community level' (2010:247) and that 'those directly impacted by hazards are best placed to identify solutions for risk reduction' (ibid: 249). Here indigenous and scientific knowledge can work together to reduce vulnerability.

In view of this research, and the practical success of processes using local knowledge as exemplified by the Red Cross as shown in the case studies, efforts are now being made to mainstream CCA and DRR together through the Sustainable Development discourse (Smit and Wandel, 2006, Mercer, 2010, Kelman and West, 2009, Gero et al 2011). This merges the energy, finance and other resources needed for these activities into one combined and focused discussion (Gero et al,2010:102). Efforts are not duplicated. Some donor organizations, like AusAid, are favouring this approach (Gero et al 2010:109).

Further examination reveals that the inclusion of the community in helping to increase resilience whether in terms of CCA or DRR is a recent development. Indeed as Weichselgartner and Oberstein point out "disaster schemes and programs still treat people as 'clients' in disaster management processes where science and technology do things to them and for them, rather than together

with them”(2002:76). This depicts a narrow ‘top down’ process driven by science and technology, with little or no room for any other type of knowledge.

This is not the place to offer a full history of the ‘resilience’ concept, but a few points must be made. ‘Resilience’ was originally a scientific concept, arising in ecology (Brand and Jax, 2007), and only later being applied to ‘socio-ecological systems’ (Adger, 2000). It is no wonder then, those employing the concept at the beginning looked for scientific, or at least technological solutions (Mansfield, 2009:47). Indeed, resilience literature shows a deep debate between those who argued for a technical solution (Kates et al 2001, for example), and those arguing for a more holistic approach (Adger, 2000, Adger et al 2005, Adger and Brown, 2009, Mansfield, 2009). The ‘grey’ literature from the Red Cross, together with some in the DRR community (Mitchell and van Aalst, 2008, Kelman and West, 2009, Mercer, 2010, Gero et al, 2011) suggests that there has been a move away from the technical, towards the holistic solution in the last five years. Technical answers alone were necessary, but not sufficient in addressing the issues equitably. Three new strands join with the rejection of the purely ‘scientific’ response to resilience and CCA/DDR that ignores the community. The new approach starts with a holistic view that sees relationships as more important than types, or ‘things’ (Adger and Brown, 2009). Brace and Geoghegan concur by putting ‘landscape’ in the foreground as an organizing concept (2010:285). This can then include local knowledge (see Button and Peterson, 2009, for example), which in turn challenges the top down approach. Writers and practitioners report that with these changes, there has been a move from a focus on the hazard, to a focus on the vulnerability (Mercer, 2010, Kelman and West, 2009, John Gwynn⁵, personal communication, August 2011).

It has been argued that it is the hegemony of scientific knowledge, valued over all other types, that not only limited the concept of resilience, but constrained the developed world’s response to climate change generally. Climate change has been treated as ‘something imminent which yields itself only to science’ (Brace and Geoghegan, 2010:285). Perhaps then, it is not surprising that the main output from the developed world are the Global Circulation Models (GCM). GCMs are great achievements. But their best outputs are on a global scale. The application of this knowledge cannot be localized, thus there are ‘serious limitations’ at the local scale. (Houghton, 2009:130). Sanderson, Hemming and Betts (2011:97), talk in terms of regions, like ‘North Africa’ and ‘Central Asia’. Issues of scale, both spatial and temporal are crucial (Adger and Brown, 2009). Climate predictions on regional scales cannot be accurately applied to areas such as the Scottish Islands forming the study area for this research (Houghton, 2009:130 & 149ff).

From this, two conclusions can be drawn. The first is that the dominant paradigm for contextualizing and addressing climate change is the scientific one. This in itself creates problems for the inclusion of ‘local knowledge’, which is based on a different epistemology. Levi-Strauss reminds us that local knowledge, drawn from the physical world is ‘supremely concrete’, whereas scientific

⁵ John Gwynn, a Red Cross executive, based in Kuala Lumpur with 20 years practical experience.

knowledge is 'supremely abstract' (1962:269). This is the origin of the thinking behind the third research question in this study. The second issue, inextricably linked to the first, is one of scale. The developed world started addressing the climate change problem on a global scale. The 'IPCC and other national and international scientific bodies have tended to see atmospheric emissions as a universal and global scale problem affecting the climate system of the whole planet' (Brace and Geoghegan, 2010: 286). In one sense, this is correct, but it is not a problem that natural sciences will solve alone. Adaptation does not, and cannot be addressed on this spatial scale.

Science, working from the abstract, is then being applied to the particular. Local Knowledge can be that information that allows the better application of science. The two epistemologies can be complimentary. They are not mutually exclusive. People living in a close relationship with their environment often notice changes before scientists (Button 2002, Mary Simon⁶, Angus, 2001). Local knowledge can be used with technology and science to create DRR and CCA processes (Drew, 2005, Button and Peterson, 2009). Brace and Geoghegan argue that this approach has caused a split between science and the social and political contexts for the understanding of climate change, which they conclude, needs 'to be understood on a local scale' with local knowledge.

From the above, it can be concluded that 'local knowledge' could now be a necessary ingredient in processes (DRR or CCA) for reducing vulnerability and enhancing resilience. In addressing issues that are local and relevant to a community they become meaningful and comprehensible in a way that global scale issues cannot. This relevance and understanding leads to engagement (Button and Peterson, The Red Cross case studies, John Gwynn per com).

Although experience of adaptation has been gained in the developing world, it seems appropriate for the developed world too. Practical lessons can, and are being learnt here. The international CoastAdapt project (www.coastadapt.org) is looking to bring together CCA and DRR processes for some vulnerable areas of Europe's North Atlantic coast, including our research area. This research seeks to design projects and processes that are practical, that are not necessarily 'top down' and include local knowledge. This is a good example of the collaboration of Science and practical knowledge

Defining 'Local Knowledge'.

Is it clear what is meant by 'local, indigenous or traditional knowledge'? These terms are now examined, and then compared with 'Citizen Science'. Which of the terms is most appropriate for the Uists, and why does this matter? An attempt is then made to define 'Local Knowledge'.

Studies in Indigenous Knowledge or Traditional Ecological Knowledge (TEK) are not new (Berkes et al, 2000, Kelly and Adger, 2000). There are many cases of Indigenous Knowledge from the Arctic alone (Berkes and Jolly 2001, Pearce et al 2009, Ford Smit and Wandel, 2006). Others are from the developing world (Valdiva et al, 2010, Nyong et al 2007, Mertz et al, 2009, Lefale, 2010, for

⁶ Mary Simon, Prime Minister of the Inuit People, talking at a meeting in London, 2010,

example). But few can be found where an ethnographic approach has been taken with small mainstream communities in the developed world. Possible reasons for this have been touched on. It may be because the local knowledge has been lost here. Or is it no longer valued? Or is it that CCA processes are not deemed necessary in the developing world, and on such a small spatial scale? These questions will be addressed again in later sections. But, it is contended that the 'West' has been pre-occupied by the idea of mitigation, and the GCM's. They add significantly to the understanding of how the climate and weather systems work. The sensitivity is not yet fine enough for a community such as the Uists, the study area, with its unique environment and its vulnerability to the Atlantic. Houghton, (2009:131) concludes that a 'great deal remains to be done to narrow the uncertainty of model predictions'. Therefore, local knowledge of the weather, and indeed, local weather records are important, but this is not the only type of local knowledge that can be used in CCA/DRR processes.

How is TEK different from local knowledge? And is 'Indigenous Knowledge' different again? Berkes et al (2000) offer a working definition of TEK as:

'a cumulative body of knowledge, practice and belief evolving by adaptive processes, and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another, and with their environment' (2000:1252).

They go on to say that this 'is an attribute of societies with historical continuity in resource use practice' and that it applies to 'nonindustrial', technically 'less advanced' societies. Berkes et al (2000), say that this does not necessarily mean that such knowledge would only be found in Indigenous or Tribal communities. But would this exclude the Uist Islanders? Continuity of practice can still be observed (especially in crofting and seafaring activities) and, as is shown below, there is an historical spatial continuity seen through language and place names. But these isles are as technically advanced as the rest of the British Isles.

Pearce et al (2009) offer a different, and, with the Uists in mind, wider definition of 'traditional' knowledge. It is, they say, 'knowledge and values which have been acquired through experience, observation from the land or from spiritual teachings and handed down from one generation to another' (2009:14). They continue " 'Traditional Ecological Knowledge', is that part of 'Traditional Knowledge' that relates to ecosystems and human interactions with the environment" (Pearce et al 2009:14). They equate Indigenous knowledge with Traditional Knowledge. For them 'Local Knowledge' is simply knowledge from the community, regardless of culture or inter-generational history. Practical as this may be, it does not help to separate and designate that specialized, place based body of knowledge, experience and understanding that is evident in many communities, such as the Uists, upon which livelihood decisions are made. It is too broad. This view of 'local knowledge' could equally refer to knowing where to find the island bakery, and a century of local weather records.

Berkes et al, despite defining TEK, then use the term in an interchangeable manner with 'Indigenous Knowledge' and 'Local knowledge'. Although their emphasis is on the practical applications of this knowledge, whatever it is called, they then confuse matters further with the following:

'Whether a practice is traditional or contemporary is not the key issue. The important aspect is whether or not there exists local knowledge that helps monitor, interpret, and respond to dynamic changes in ecosystems and the resources and services that they generate' (2000:1252).

So, what are they looking for? If the contemporary is part of the local, and the local equates to the traditional, we get no closer in defining exactly what it is that we are seeking. Perhaps there is no form of knowledge that is purely 'traditional', or 'Indigenous', however well defined.

Agrawal, (1995 & 2009), takes a different view, and rather than try to be clearer on the definitions, notes that 'The qualifiers indigenous and scientific, when used in conjunction with knowledge, represent conceptual formations that are internally fractured and categorically indistinct—even if they represent social issues and political concerns that are coherent, well bounded and durable (2009:157). All knowledge is culturally constructed. What does matter is whether it works or not. Although this seems clear enough, in the formation of policy, advisors look for 'evidence'. Science is privileged because, so it is argued, offers a more reliable form of evidence. Huntington (2000:1273) notes 'inertia' is a key inhibitor to using other types of knowledge because it is easier to work in the existing paradigm. It was noted above that the climate change discourse, with its focus in the developed world on the GCMs is rooted in the natural sciences. The problem with Agrawal's approach then, is that although these categories may be 'fractured' and 'incomplete' they are not treated as similar, or even equal to local knowledge by policymakers (Backstrand, 2003). Thus, the search for definitions is not an empty one. Evidence offered for policy, must be qualified, supported and point towards a defined body of practical experience. A practical, proximate and corrigible definition of 'Local Knowledge' is offered as those pieces of place based information and experience gained through a close, practical and historical continuity in understanding the subtle nature of interactions and relationships in the environment, and upon which people make livelihood decisions, such as when to plant and when and where to fish. Local Knowledge is the result of understanding a unique set of relationships between a community, and its environment. Here, 'environment' includes climate and weather patterns, tides and currents, soils and ecosystems, and the way to survive, or even thrive physically and economically therein. The coming together of these factors is unique in each case. Therefore, the solutions to the set of threats arising in a given locale, with its specific culture and environment, whether through DRR or CCA will also be unique. One size does not fit all. Smit and Wandel, (2006:283), put it this way: 'Practical initiatives that tangibly address and improve adaptive capacity thereby reducing vulnerability are commonly expected to be evident at the community scale'. This points towards a partnership whereby local knowledge shapes the application of abstract science and technology. But, as argued below, the 'technical' side of the solution is just the beginning.

There are difficulties with the definition offered as there are with all definitions of local, indigenous and traditional knowledge. The word 'environment' was chosen ahead of landscape, even though it has been devalued by over use and by incorporation into the neo-liberal right's ecosystem services discourse.

'Landscape' was rejected because of its tendency to be seen as lifeless, unchanging, inert, (Sauer, 1925, cf Jones, 2009, Ingold, 2000, & 2010) and exploitable in a way that does not reflect the relationships between the human and non-human elements

Huntington (2000) points out that it is not easy to 'collect' local knowledge, as it is often unwritten. It is embedded in culture: Local Knowledge is not an easily identifiable body of work. Sometimes, its individual holders are reluctant to 'give it away' for reasons explored below. Knowledge is not always held in the brain, it can be embodied or held in the 'social memory'. These concepts are explored below, for now suffice it to say that this too causes problems in collecting and understanding it.

Wiig, 2007 (quoted by Santha et al, 2010:51ff) reminds us that knowledge has various applications, including creating awareness, sense making, problem solving, implementing decisions, and good governance. It also has different levels of significance. Knowing the whereabouts of the harbour has some value. Knowing *why* it is there starts to prevail on the body of knowledge that is sought here, and its value in usage. The aggregation or absence of 'local knowledge' in this context is important, if not essential to the livelihood and well being of the community concerned. Following Levi Strauss, it is 'supremely concrete'. The working definition offered here overcomes the limitations of the 'Indigenous' and 'Traditional' trappings that look redundant in the Hebrides. It is narrow enough to define the research, here and in similar locations, and yet avoids being too broad, as per Pearce et al. Wiig's (ibid) list of applications is a starting point in evaluating the practicality of any given piece of local knowledge in the context of DRR and CCA. Strangely, although there has been a debate on the concept of TEK, a similar debate on how a particular piece of knowledge is evaluated, is noticeable by its absence.

Berkes et al's idea of 'the continuity of resource use practice' is useful, but it is ignored here because 'resource use' could be construed as part of the Neo-Liberal 'Ecosystems services' discourse that is better avoided. The view that it offers is narrow, and reductionist. Communities are not only aware of their environment in terms of the uses that can be derived from them. It is lived in, valued and enjoyed, not merely exploited and seen in terms of the 'services' they generate (Adger et al, 2005b, Ingold, 2010, Adger and Brown, 2009). This is another discourse that attempts to 'deaden' the non-human world and describe it in terms of economic 'science'.

Citizen Science and Local Knowledge

Now that there is a clearer idea as to what is meant by 'Local' Knowledge', questions arise. Why is it important? Why should we be interested in it now, and where has its application been valuable? First though, it needs to be distinguished from citizen science. There has been an increase in interest in engaging the public, through 'Citizen Science' (Bonney et al, 2009). According to Bonney et al (2009:977) 'Citizen science projects have been remarkably successful in advancing scientific knowledge.' Both local knowledge and citizen science engage the public, and are becoming increasingly important to researchers (Bonney et al, 2009, Mercer, 2010, Smit and Wandel, 2006). These

projects could impact on policy. But on closer observation, Local Knowledge and citizen science are very different. The difference needs to be understood, for, although the developed world has been involved with Citizen Science in various ways and for a number of decades, the 'local knowledge' approach appears to be new to the developed world. No study similar to this, seeking 'local knowledge' as a way to enhance CCA/DRR in the economic north could be traced. Citizen Science is 'a research technique that enlists the public in gathering scientific information' (Bonney et al, 2009:977). It has been widely used for collecting data on bird numbers and behaviour for over a hundred years (Bonney et al: ibid). It follows a scientific protocol, driven by a specific research question. Citizen Science is different, because although it involves the public and its results can lead into policy in a more direct manner than local knowledge, that which is sought is rarely practical in the same every day sense of livelihood that is seen in local knowledge. Citizen Science is narrower in scope. There is a difference in understanding the migration patterns of swallows, and knowing the flows of tides and currents that have immediate implications on livelihoods. Often Citizen Science is part of an on-going or long-term research project. Local Knowledge comes from a more holistic relationship with the environment, and does not seek to answer single research questions. Citizen Science is supervised and directed. Thus, whereas 'Local Knowledge' could be seen as a 'bottom up' process that is lived, Citizen Science is top-down. 'Science' gives it the credibility necessary to be included in policy in a more direct manner than Local Knowledge. It has been validated in a way that Local Knowledge cannot be (Backstrand 2003:36ff). Backstrand suggests that another key difference between Local, or in her case indigenous or traditional knowledge and Citizen Science, is that the former has local applications, whilst the latter is universal (2003:37).

Local Knowledge: some practical applications

So far in this literature review the Red Cross case studies have been referred to without showing close examination. Twelve documents were made available. Each comes from South East Asia. They are variously described as 'case studies' and 'climate change' awareness leaflets. The majority of these are dated, but on reading, the two that are not, must date from 2007 (RC11) and 2005 (RC12) respectively. These reports come from vulnerable locations across the region, from Tuvalu to Bangladesh, Indonesia to Viet Nam. An exhaustive analysis was not undertaken. The point was to see what approaches and processes are being undertaken, whether or not there is a match with any part of the critique above, and whether or not the practical experience of those working the field was ahead of the academic research. In all twelve of the publications scale was seen as crucial to adaptation efforts. One case study (RC3) mentions that 'each community needs to understand their own risk and lead the process to reduce it'. This puts community involvement at the centre. This point is echoed in all of the twelve documents. Involvement is in both the hard solutions like clearing dykes, building traditional bridges and planting mangroves and the soft ones for raising awareness and education. The Bangladesh case study (RC3) shows how local knowledge is the basis of the efforts to build adaptation processes. They state that 'studying existing community based coping mechanisms is fundamental in order to design appropriate capacity building operations that mitigate the effects of climate change'. From these studies it can be shown that the process followed

by the Red Cross at least listens to the concerns of the community, and at best takes local knowledge on board. Not all of the communities reported were engaged in primary production, and as urban poor, disconnected from the environment, they may not have access to the type of local knowledge sought in this study. Finally, all but one of the papers explicitly link DRR with CCA.

Although the study location is literally half a world away from South East Asia, there was a value in analyzing the Red Cross data, and comparing it with the academic literature review. The conclusions would seem to support the arguments above regarding the merging of DRR and CCA processes (Mercer, 2010, Kelman and West 2009, Gero et al, 2011), the importance of scale (Brace and Geoghegan, 2010, Adger et al 2005, Smit and Wandel, 2006, Adger and Brown, 2009) the movement away from the top down 'do it to them' approach (Weichselgartner and Oberstein, above), and towards the involvement of the community and an understanding of its unique relationship to its environment and culture. Perhaps the most important shift seen in these recent developments from DRR and CCA is that from the focus on the hazard, to the focus on the vulnerability (Mercer et al, 2007, Kelman and West, 2009, Button and Peterson, 2009:334, John Gwynn personal communication). It can be argued that this is an outcome of the move away from the technical response, to the more holistic one that includes social aspects. The Red Cross literature is simple, and is not peer reviewed. However, with close ties to governments, communities and business throughout the world Red Cross publications cannot afford to be inaccurate.

The academic literature and the Red Cross papers illustrate that there is a wide range of uses for local knowledge. The Solomon Islands (RC1) document clearly shows traditional weather records supplementing information for the recent meteorological station. Button and Peterson offer Alaskan examples of local knowledge providing an 'early warning system' ahead of environmental problems. Local knowledge gleaned from communities still in close relationship with their environments can help fill the gaps in the science (Drew, 2005), see and report changes before scientists, and offer explanations of what is happening. The review of the literature has shown local knowledge to be a valuable resource that perhaps has not received the attention it is due in communities of the developed world that are still involved with primary production.

Storing Local Knowledge

Local knowledge of the type sought here is rarely written. This being the case, knowing where and how it may be stored is crucial. Thus two final concepts are deemed necessary targets for enquiry: 'Social Memory' and 'Embodiment'.

Often the issue of what constitutes local knowledge, and how it is held in a community is overlooked. Some scholars refer to 'Social Memory' or something similar, but without attempting a definition. Berkes and Davidson Hunt (2006:37) write about the 'social memory of traditional practices'. Button and Peterson mention a 'shared memory bank' (2009:333). Those who do offer a definition (Olsson et al, 2003, Adger et al, 2005, Folke et al 2005,) have built

upon McIntosh's (2000: 141ff) work with the Mande. The most extensive discussion is found in Folke et al who following McIntosh state that "Social memory" has been defined as the arena in which captured experience with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision-making processes into appropriate strategies for dealing with ongoing change' (2005:453). Holding and storing local knowledge seem to be a community enterprise. However, further insight is gained from Olick and Robbins who state that 'Social Memory studies is a non-paradigmatic transdisciplinary centerless enterprise' (1998:106). Historians, sociologists, anthropologists, geographers and others who do not point to a common definition have used the term, or variations of it such as 'collective memory'. 'Social Memory' is used as a boundary object⁷, rather than a specific concept. It is a concept that we can point towards without agreeing on a specific definition. Olick and Robbins make an important distinction between 'history' and 'collective memory'. The former is 'the remembered past to which we no longer have an organic relationship', whilst for them 'collective memory is the past that forms our identities' (1998:111). Presumably the organic connection to the past remains in the case of collective memories.

'Embodiment', is a concept of interest as it 'situates experience within the body' (Carolan, 2009:2). 'Consciousness' is distributed throughout the body. So is knowledge. This approach stems from the phenomenology of Merleau-Ponty (1968, 1969, 1992), who argues that "the world is not what I think, but what I live through" (1992:xviii). Knowledge comes from experience. That knowing experience is not restricted to the mind or brain. Following Merleau-Ponty, Lorimer asserts that humans engage with, and come to know the world in a 'multisensual' mode (2005:86). Gardeners, for example may know the condition of the soil through their fingers. The continual practice of this embodied knowledge keeps it alive and vibrant, even if the tradition is ancient. The converse is also true: that when traditional practices are stopped, the unique relationship between the practitioners and the environment which gives rise to and reinforces the experience, the knowledge, is also lost. Carolan puts it this way: 'a failure in doings leads to a loss of knowledge' (2009:10). Harrison, (2000:507) echoes this: 'our belief is in our acts.....and acting (we) can quite literally *make sense*' of the world' (*italics original*). When a particular set of actions stop, we lose 'touch' with that aspect of the world. Referring back to the section on the nature of 'collective memory' perhaps it is the quality and depth of this embodied relationship that keeps it organic, and stops it from falling into 'history' (Olick and Robbins, 1998:11). Put another way, we may expect to find a

⁷ 'Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds.' Starr and Griesemer, 1989

strong collective memory in a community with a set of livelihood 'doings' based on traditional methods that shows historical continuity.

Although there are ethnographic studies that report on embodied knowledge, (Carolan, 2009, offers examples), this is not an approach that has been used with local knowledge in the DRR/CCA debate, either by the academic community, or, by the Red Cross. The literature, although rarely specific on this point, suggests that information is mainly gained by interview, or by working along side local informants. Often there are details of actual methods, such as 'semi structured interviews were carried out' but information on the questions guiding those interviews, and details of how the responses were treated and then analysed are omitted (see Ford et al, 2006, Pearce et al, 2009 for example).

The outcomes of this literature review confirm that any vulnerable community in the developed world, rooted in their local culture, and still substantially engaged in primary production is worthy of study. One of the gaps noticed is a lack of small-scale studies into local knowledge and the adaptation needs of such communities in the developed world. The examples and case studies from the developing world show that DRR and CCA processes can be strengthening by good use of local knowledge, but there can be epistemological issues in translating it into policy. In order to 'make sense' of such data, the context needs to be understood. With all of the above in mind, the following research questions were designed:

1. To what extent are those Island dwellers sensitively aware of such changes that there may be? What adaptation processes have they adopted or created?
2. How do they ascribe 'meaning' to this? How are such changes conceptualised and understood?
3. Are the epistemological differences so vast that they cannot be bridged? Or put another way, how difficult is it to turn 'local knowledge' into usable, credible, scientific data that can be used by influential agencies such as the EEA?
4. What if any general conclusions can be drawn from a single case study?

3 STUDY LOCATION



Figure 1, showing the Uists from Berneray to Eriskay

The Uists, the southern part of the chain of islands forming the Outer Hebrides, or Western Isles were chosen as the study area (Figure 1). This area stretches from Berneray in the north, and includes North Uist, Grimsay and Baleshare, plus the small islands in the chain to Benbecula and then further south to South Uist. It was envisaged that Eriskay and Barra would be a natural part of the study area, but these islands were not visited, and no one from them was interviewed.

Geographically, these islands fall between 57 and 57° 42 minutes north. This puts them on the same latitude as the Central Siberian Plateau, The Alaskan Peninsular and Kamchatka. They are further north than Moscow and the majority of British Columbia. Whilst global warming will affect the whole planet, Northern latitudes are predicted to see higher rises than planetary average (IPCC, 2007, Houghton, 2009, Sanderson et al, 2011). Putting this into context, the Uists are further north than Hartley Bay, British Columbia, (53° 25 minutes north) which is 'at considerable risk' (Turner and Clifton, 2009:180).

In choosing to work on 'The Uists', the latitude together with the following were taken into consideration:

Crofting, and other forms of agriculture and aquaculture are important culturally and economically. Knowledge of the winds and currents is essential. In addition to their use for fishing and aquaculture, boats are used for leisure and tourism. Ferries connect this remote island chain to the mainland (5 hours), the Isle of Skye (2 hours) and Harris and Lewis to the north (45mins). Most people are connected either directly or indirectly with primary production and the environment. The sea is rarely out of sight. The economy is such that most Islanders derive their income from more than one source.

The geographical area is easily defined, and the boundaries are clear. There are fragile and unique aspects to the landscape such as the machair that are vulnerable in terms of any changes either in the environment, or in the ways it is managed and farmed. According to the local council, (Comhairle nan Eilean Siar, Balivanich) the community is relatively small and the population is declining. The 2001 census shows 6075 people living between Berneray and Barra. The Uists are relatively remote, yet traveling between the islands, across the causeways, is easy.

Being on the North West Atlantic 'fringe' of Europe, the Uists have always been affected by storms. The west, Atlantic facing coast is low lying, open to the elements, with nothing to mitigate the Westerly, or South Westerly winds for at least two thousand miles. There are low-lying lochs of both fresh and seawater. The area is vulnerable to coastal flooding, massive on going coastal erosion and is open to the Atlantic gales. The beaches are mainly sandy, inland from which the machair system is located. In view of the close relationship between the machair, crofting and the Gaelic culture, this deserves particular attention. The east of the islands is generally more protected from the Atlantic winds. The main harbours of Loch Boisdale, Lochmaddy, and Kallin, are all on the east coast. The east contains moorland, and is more mountainous. The beaches are made up of rocks and pebbles. Apart from sheep farming, there is less agriculture here. East to West, the widest part of the Islands, across North Uist, measures

approximately 15 miles. From Berneray in the North, to the southern tip of South Uist is approximately 40 miles.

Machair is found only in northwestern Ireland and northern Scotland (Angus, 2001:178). The vast majority of it, some 70% of the total area 19,000ha, is found in Scotland, (Angus, 2001b, Owen et al, 2000, Machair Life⁸). The best-preserved and largest continuity of machair is found on the Uists. It is 'generated by an exceptional blend of physical factors, including climate, substrate and topography, combined with longstanding human influences. It forms when sand with very high shell content blows landwards by prevailing westerly winds, creating a fertile, low-lying plain⁹' (see also Owen et al, 2000, Angus, 1996, 2001b, 2004). As Angus (2001b:178ff) points out, 'Machair' not only refers to 'a coastal grassland plain established on shell sand' but it is 'is almost invariably an integral part of a wider machair system incorporating marsh, dune, saltmarsh, loch and even brackish waters, all of which are affected, to varying extents, by the blown sand which is an essential feature of this dynamic formation'. The mention of 'long standing human influences' on the formation of the machair points to the strong and intimate link between it and the local community.

Although all of the islanders interviewed are fluent in English, Gaelic is in many cases, their first language. Even a basic grasp of Gaelic may have provided additional and pertinent lines of questioning. People on the islands were aware of and some were engaged in citizen science, but the approach taken by this study was new to them

Crofting, an activity unique to the Highlands and Islands of northern Scotland is based on a complex series of individual and collective land tenure. It is important for both cultural and environmental reasons. Crofting is a low intensity and traditional method of using the land that can be traced back for at least 600 years (Angus, 1997, Owen et al 2000:156). If it is left unmanaged, machair deteriorates to an environment that is difficult to sustain any agriculture, and results in a substantial fall in biodiversity. If farming methods change becoming more intensive, then again biodiversity falls, and this essential cultural landscape, with its profusion of wading birds and summer flowers is lost (Owen et al, 2000, Angus, 1996, 2001b, 2009). The machair system, to remain as it is, needs to be maintained through this balance of natural processes and human activity, more or less as it has done for six centuries, and probably much longer. Archeologists are re-appraising the precise amount of time for the duration of the relationship between the machair and crofting. (Angus, personal communication). Put succinctly 'habitat quality is directly dependent upon traditional land management (Angus, 2001b:179). In order to examine the cultural connection between the crofters and the machair further, this quote from Angus is instructive: 'the agriculture of the machair areas appears to involve methods and machinery which have long been abandoned elsewhere,' he continues "The light soils are stabilized and fertilized using a readily available organic medium, and

⁸ <http://www.machairlife.org.uk/index.php?/home/what>

⁹ Machair Life web site accessed 4th August. 2011

the methods support a rich flora and fauna, as well as a dense rural human population. Though the benefits are evident, the pressures on these islands are many, and their economy is fragile' (Angus, 2001b:187). The 'organic medium' mentioned is storm washed seaweed, which adds humus to the soil in a way that agrochemicals cannot. It binds the light sandy soil. The 'benefits' are cultural and aesthetic. Crofting work could be easier, less time consuming, and perhaps in the sort term, more economically viable if these practices were 'modernised'. But the islanders know that in doing this, the essence of their landscape would be lost, together with the wildlife that it supports. No anthropological study could be found addressing the machair, and its unique relationship with the culture and Gaelic language.

4 METHOD

Prior to visiting the islands contact was made with the editor of Am Paipear, the local monthly 'Highland and Island community newspaper'. After outlining the nature and purpose of the research, and offering to publish the results in his paper first, he agreed to publish a short article announcing the research, and requesting interested people to contact the author. That article was published in the April 2011 edition (see appendix 1). It was thought that interest would be aroused and people may come forward, offering to be interviewed. Their 'credentials' could be easily checked (how long have they lived on the islands? what activities are they engaged in? was what they were offering of value?). As noted below, in every case the respondents were genuine, credible, interested and engaging. One meeting arose from this: the other initial meetings were set up from referrals, either from 'A', this first interviewee, or from the paper's editor. After that, the majority of people interviewed were happy to offer referrals.

As a result of the initial research, contact had also been made with Stewart Angus, author of many papers on the machair and the policy and advice manager for coastal ecology at Scottish Natural Heritage in Inverness. From there, an introduction was made to David Muir of the local council (Comhairle nan Eilean Siar), based in Balivanich on Benbecula. David is head of technical services, the CoastAdapt¹⁰ liaison officer for the Uists, and a crofter.

This study is primarily a search for meaning in relation to local knowledge. It was approached with a combination of qualitative methods. Focusing on this defined community and its relationship to the changing environment, a mixture of interviews with the minimum of structure, participant observation and photography were planned in order to gain a 'thick', interpretative, descriptive account of local knowledge (Geertz, 1973). The resulting description was to be limited to answering the research questions. Interviews would be unstructured, and on a one-to-one basis where possible. It was thought that this would allow the participants to raise themes and issues with the minimum of prompting or leading. As far as possible, open-ended questions would be asked. Themes and threads could be taken during the conversation and developed naturally. A second preference was prepared and piloted: that of talking to small groups of

¹⁰ CoastAdapt, see above.

people in the event of not finding enough genuine one to one candidates. However, group work was not necessary.

Table of Respondents (Figure 2)

Respondent	Date	Place	Interest	Mode	Code
Bill	18/04	South Uist	Artist and Ornithologist	In person	A
David Muir	19/04 29/06	Benbecula	Crofter, CoastAdapt co-ordinator, Local Authority	Both	B
Archie A	20/04	South Uist	Crofter, forester, fisherman	In person	C
Archie B	19/04	Benbecula	Media	In person	D
Jean	19/04	Benbecula	Media and charity worker	both	E
Kenny	19/04	Benbecula	Retired, from a crofting family	In person	F
Rona	20/04	Benbecula	Area manager, crofter	In person	G
Mr & Mrs M	21/04	Grimsay	Guest house owners, crofters, and retired builder	In person	H
Joanna	28/06	Benbecula	Sustainability manager	In person	I
Marion	28/06	North Uist	RSPB volunteer, crofter	In person	J
Ian	28/06	Berneray	Crofter, handyman	In person	K
Gordon	29/06	Benbecula	Gaelic Scholar	both	L
Gloria	29/06	Berneray	Crofter, guest house owner	In person	M
Donald	30/06	Berneray	Ferryman, fisherman	In person	N
Roddy	30/06	Benbecula	Crofter	In person	O
Matt	29/06	North Uist	Environment Officer	In person	P
Julia	29/06	Benbecula	Co-ordinator, Machair Life,	In person	Q
Johanne	30/06	South Uist	Manager, SNH, crofting family	In person	R
Jane	04/08	South Uist	Retired fish farmer	Phone	S
Eric	04/08	South Uist	Retired fish farmer	Phone	T
Stewart	20/12/10	Inverness	Coastal Ecologist, SNH,	3 phone	U

Angus			Machair scholar	calls	
Alison	20/04 & 27/06	Berneray	Educator	Both	V
Rita	27/06	Berneray	Retired teacher	In person	W
Callum	28, 30/06	North Uist	Fisherman, musician	Phone	X
Mark	28/06	Berneray	Handyman/community worker	In person	Y
Nico	30/06	Berneray	Eco tourism	In person	Z

The table (figure 2), shows the profile of the respondents, how, where and when the interview took place, and ‘interest’ refers to their particular experience or expertise.

A further series of conversations took place, not on the islands but in the author’s home between 20th and 22nd July, and 14th -17th August with John Gwynn, a Red Cross executive based in Kuala Lumpur, who works with DRR/CCA issues across South East Asia.

As shown in the Table (fig 2) interviews, where face-to-face, were mainly undertaken in the respondents’ own ‘territory’, either in their home or office, so that they were at ease. The tone of the interviews was conversational, and apart from a couple of opening questions, the interviews were unstructured. This method was chosen, with just the opening questions in mind, to allow the informants to give the information that they thought was most pertinent. Occasionally, questions needed to be asked for clarification. The intent was to remove as many barriers and to give the respondents every opportunity to be in control of the conversation and resulting knowledge flow. It was obvious that the majority of the informants did not see themselves as experts, a topic that is returned to below.

The following opening questions guided the interviews:

How long have you lived here?

Have you noticed any changes?

The latter was designed to be as open as possible. In practice, perhaps because a friend had set up the meeting, people needed little encouragement once introductions had been made and pleasantries exchanged. The less ‘official’ the interview seemed, with little or no note taking¹¹, an informal introduction (this is Des, give him an hour about crofting, or fishing) rather than a formal one (Des Gould is a researcher from the University of London etc.) then the barriers or

¹¹ Notes were written up immediately after, and informants emailed for clarity and accuracy. The major contributors were offered the draft ‘findings’. All comments were incorporated in the final draft.

inhibitions were lessened. Getting people to engage and share was not an issue. As most interviews were undertaken in the respondent's home, much of the initial information was obvious: that they lived on a croft, were of a certain age. The longest interview took two hours whilst the average was 60 minutes. There was only one conversation that lasted for less than an hour, that with K and Y.

The Islands were visited on two separate occasions, both of which lasted a week. The first visit was in mid April 2011, and the second at the end of June. For the first week, the base was the central location of Kallin, on Grimsay. The base for the second trip was a croft house in Borve on the island of Berneray, at the northern end of the research area.

This combination of approaches would provide the parameters and processes for the overall, descriptive, 'Interpretist' (Geertz, 1973) and essentially ethnographical study.

Ethical Statement:

All participants were adults, consented to being interviewed, and to the contents of such interviews to be used in this specific research project. They all participated in the interviews freely, and knowing that this was academic research on local knowledge and changes in the environment. At the beginning of each interview, it was explained that it was the views and experience of the respondent that was being sought. All interviewees were aware that the research was to be written up, and that the results were to be offered to the local community newspaper for publication at the end of 2011. This was in line with the article published in *Am Paipear*, (appendix 1) in advance of the first week of fieldwork.

5 FINDINGS

Economic life on these islands is sustained through three main types of activity: primary production in the form of crofting, fishing and aquaculture, then public sector employment and tourism. Further, all the crofters interviewed had more than one source of income (see B, C and H in the table for example). Indeed, Angus, (2001b, and personal communication) suggests that crofting was never designed to be a full-time occupation. This engenders more opportunities to network across the community and provides multiple perspectives on local issues.

There is a high level of awareness regarding environmental issues in the study location. This is evidenced in what appears to be good take-up in voluntary activities. Through working with organisations like the RSPB, BTO, or helping out on post mortem of cetaceans, many respondents are familiar with the term 'citizen science'. Occasionally there was a need to explain the difference in approach between 'local knowledge' and 'citizen science', and to show that what was being sought here was the level of local knowledge that was existent.

The three events

At the planning stage, engaging with local institutions, apart from the council, and there only for facts and figures on demographics, was not part of the plan.

However, it soon became clear that there was already a deep concern on the islands regarding changes to, and stressors on the environment. There was a range of issues from the climate to agricultural practices. Three events, locally regarded as stressors, particularly stand out, and were mentioned in the majority of interviews that took place. They were:

The Storm of 2005: The Storm of 2005 was devastating in its power and the resulting loss of life. A family of 5 was swept to their death during that event which is etched into the memory of this small community. This powerful storm, which hit Uist and Barra particularly hard, 'stunned' the community, reinforcing their vulnerability to the Atlantic.

The Causeways: The following causeways connect island-to-island forming the main (and in some areas only) road across the study area (see figure 3):

The South Ford Causeway, completed in 1983, connects Benbecula to South Uist. This replaced a single-track deck bridge supported by legs. It is approximately one kilometre long, and forms part of the main A865 road.

The original causeway between Benbecula and North Uist was built around 1960. It was substantially damaged by the storm of 2005, and subsequently greatly improved. This too is a kilometre long and is part of the A865.

The causeway between North Uist and Berneray was completed in 1999 (approx. .75km). Previously, there had been a small ferry.

The Eriskay causeway was started in 2000, and joins Eriskay to South Uist. It runs for almost 2 km, and completes the road link from Berneray across the Uists to Eriskay.

These mainly solid structures have few vents that allow the passage of strong tidal flows, and predominantly run north-south across the prevailing west to east wind direction. It is strongly argued that this has changed the local currents, created additional coastal erosion, and forced substantial changes in the distribution of sea life, especially velvet crabs and seals.

Geese: Numbers of Greylag Geese tripled between 1993 and 2007. Barnacle geese numbers have also tripled in the same period. (Respondent A and BTO¹²). Flocks of these geese can, and do devastate the crops of the crofters. The growth in the geese population can be traced back the creation of a reserve at Loch Druidibeg in 1950¹³.

Responses

In one way or another, these events, especially the storm, touch all of this island community, and have shaped or reshaped the discourse on 'environmental changes' 'vulnerability' and climate change'. Although it occurred six years ago, the storm of 2005 underlined the community's vulnerability. The damage was widespread; to houses, to the primary school at Balivanich that needed to be

¹² British Trust for Ornithology

¹³ SNH web site accessed 29th August, 2011 (www.snh.gov.uk)

rebuilt, and the loss of life mentioned. Roads and causeways had to be rebuilt. Estimates of the total economic costs range between £15 and £20 million. Islanders have daily reminders of the event. Confidence has been 'badly shaken' (respondent B), and every approaching storm is now viewed with 'some apprehension' (respondent I). Local projects and special interest groups have arisen in the light of these, and other more general community wide concerns regarding the environment, and are valuable sources of information and networking. Thus useful contact was made with CoastAdapt, 'Sustainable Uist'¹⁴ 'Machair Life'¹⁵, the local offices of Community Energy Scotland¹⁶ and Scottish Natural Heritage¹⁷, and Am Paipear¹⁸.

A specific response to the storm was for the Islands, through its local authority (Comhairle nan Eilean Siar) to join the international 'CoastAdapt' (www.CoastAdapt.Org) project. This three-year project links vulnerable communities in Iceland, Norway, Scotland and Ireland, with the following aims:

1. To reduce the risks brought by climate change
2. The development of adaptation tools
3. The implementation of these tools¹⁹

The remaining threads of 'local knowledge' are arranged thematically. They are in no particular order of importance, as issues of high importance to fishermen do not necessarily rank the same for crofters or other members of the community. Further, this study intends to uncover 'local knowledge'. Classifying and corroborating it thoroughly is outside of the scope.

Causeways, currents and erosion

Informant 'O' has been a ferryman, working the link between Berneray and Harris for more than twenty-five years. He has lived on Berneray all of his life. In the past he would catch and sell velvet crabs, for sale in Spanish markets. His catch was often 50 kilos. He said that velvet crabs (not eaten by the islanders), live in waters with strong currents, and eat that which is swept past them. Once the North Uist–Berneray causeway was completed, numbers of this species dropped to the extent that he stopped fishing for them. In his work on the ferries, 'O' has built up a vast amount of knowledge regarding the currents. In the short (9 mile) trip from Berneray to Harris, the ferry has to change direction 22 times. He has copies of the charts for these waters in his home, and pointed out where the currents used to run, and where they run now. This he says accounts for the demise of the velvet crab, and the reason behind the change in currents is the causeway, which prevents the tidal flow between North Uist and Berneray. Similar views are held elsewhere on the islands regarding the other three main causeways. For example, respondent S could see up to 'sixty seals from her

¹⁴ www.sustainableuist.org

¹⁵ www.machairlife.org.uk

¹⁶ www.communityenergyscotland.org.uk

¹⁷ www.snh.gov.uk

¹⁸ www.ampaipear.org.uk

¹⁹ www.coastadapt.org/whatiscoastadapt.html/Objectives

kitchen window'. This represents a significant rise in Loch Eynort, and a corresponding fall in the Sound of Barra. This has occurred since the Eriskay causeway was built²⁰. There are three underlying concerns: First that the changes in the flow of the tides and currents created by the causeways is adding to the speed of the natural process of coastal erosion. An example quoted is of an island, Gualan, on the west side of the South Ford Causeway. At the moment it measures less than 3 km on the Ordnance Survey map (sheet 453, 2007 edition). Gualan, stretches in a roughly north – south direction, and at places is just a few metres wide. When the causeway was built (1982), it had high sand dunes with a covering of various grasses. Now, it is a low-lying shingle bank. The continual over-washing of the sea has taken the organic material required by the grasses, and increased the salinity. Second, O's evidence at Berneray, and S's regarding Eriskay strongly suggests a significant redistribution of sealife.

Third, there is good local knowledge regarding the dynamic nature of the western coastal areas in particular. This fragmented landmass is cut here and there by both freshwater and sea lochs. The fear is, and was expressed by informants, that the islands will split further. Loch Paible²¹, on North Uist was specifically mentioned. It was a freshwater loch, and now it is a sea loch. This change occurred in living memory.

The majority of islanders speak Gaelic²². Baleshare is an island and small community to the west of North Uist. The Monarch Islands are found some fifteen kilometres across the sea from there. Stories were reported that cattle were 'walked across a natural, narrow, sand causeway' at crucial tide times for summer grazing. These reports were checked and double-checked, regarding both the 'walking of the cattle', and the existence of the causeway. They are almost certainly true. One respondent, (respondent X) a fisherman with family weather records since 1906, mentioned that it is still there. Baleshare, (*Baile Sear in Gaelic*) literally means 'East Township'²³. On further investigation details of a community west of Baleshare was found. Hussabost, so the western township was called, disappeared a few hundred years ago^{24,25}. The concern regarding the further splitting of the islands, and loss of more land to erosion is not unfounded. The lochs and lochans remain in their current state of either seawater or freshwater because of a complex drainage system. Angus, who has a unique combination of scholarly and practical knowledge of the Uists writes: 'the stability of the present loch network of the Uists is dependent on the maintenance of the artificial drains. Evidence of this is provided by the island of

²⁰ This is now the subject of a research project by the Sea Mammals Research Unit at St. Andrews University.

²¹ Another view suggests that Paible's change to a sea loch was the unintended consequence of a badly implemented drainage attempt.

²² 68% according to the last census, figures from Comhairle nan Eilean Siar

²³ Confirmed by Gaelic scholar Gordon Wells

²⁴ I was warned that when someone says that his or her father used a rock to fish from which is now inaccessible, it may equally have been a forefather.

²⁵ Hussabost probably disappeared in the fifteenth century. Archeological remains have been found at very low tides. Personal Communication from Stewart Angus, but see also Angus, S (1997) *The Outer Hebrides*.

Boreray off North Uist, where lack of drain maintenance has permitted the saline lagoon to recover some of its former area' (Angus and Hansom, 2006:31).

Berneray's coast is also changing. The north beach is now accessed through dunes and sand cliffs reaching over 12 feet in height. Respondent V has been coming to this beach for over 50 years. She recalls the dunes being there, but at half the height.

There is real dynamism in the changing landscape. Coastal erosion and deposition is not measured in decades; it is measured by the storm. A single gale can, and has reshaped parts of the fragile coastline. Respondent E from South Uist, reported that the topography of the Howmore estuary changes after each storm. Her interest has been such that she has been taking photos to record this (fig 4 & 5). Most respondents had stories of this nature. It is an urgent and important issue because all of the erosion is taking place on the west of the islands, and it is the productive machair that is being lost.



Figure 3, *Howmore Estuary, taken in January 2011, but in **Figure 4**, taken in September, the rocks are covered and the river is forced to a new course. Photos Jean Newman*



Birds

Many of the respondents talked about sightings of new species of birds on the Uists. 'A' is a professional wildlife artist, with an excellent eye for detail. He has lived on the west side of South Uist, close to the machair, for 31 years. That eye is reflected in the way that he collects data for bird watching and his involvement in bumblebee conservation. He is also a reporter for the BTO. He has kept records of sightings during most of that time. He has noticed the arrival of Greenfinches during his time on the islands. Good data based evidence supports this. There has been an increase in the number of swallows, despite their numbers dropping in the rest of the British Isles. Sand Martins have visited, and now nested during the last 3 summers. Other respondents mentioned an increase in finch numbers particularly. Sparrow Hawks are another recent arrival. One respondent ('C') mentioned that a sparrow hawk ate all of his young chickens last year.

A was careful as to what he would and would not attribute the changes to. More trees have been planted, offering nest sites. This could account for the increase in Sparrow Hawks. However, for him there may be a correlation between the increase in finches and hirondelles, and a warming climate. A also mentioned that bumblebee numbers are 'good', but that not enough research had been gathered to start suggesting why this should be the case. Numbers are falling rapidly on the mainland. Other informants challenge the connection between finches and climate, citing an increase in the number of islanders taking up gardening over the past fifteen years or so, offering the finches shelter and potential nest sites in the bushes and shrubs that have been planted. Although this take up in gardening could account for the increase in finches, it cannot be used to support the increase in hirondelles.

New species visiting and then breeding in an area can be a sign of changes in the environment. However, care is taken here to distinguish the signals from the noise.

The Weather

All informants had a view on the weather. Anecdotally, more storms are said to occur, and the most violent ones can happen anytime. One respondent mentioned that the worst storm that she could recall 'happened in July, on the day we moved into our house' (Respondent Z). 'S' also recalls 'that horrendous day' recounting that the Barra lifeboat was launched, and the rescue so difficult that the coxswain was awarded a bravery medal.

It may be that the west side of the Uists does experience more rain, and the eastern side, away from the prevailing winds has become dryer. Initial research undertaken for SNH suggests that the west coast of South Uist records more rainfall than the northeast of the chain. 'C', living on the east side of South Uist, reported that for the last two summers, (2009 & 2010), he had to 'take water to the potatoes' for the first time in his life.

Many respondents mentioned that the weather 'is never stable', indicating that no two days are the same, and that even within a given day 'many forms of weather' can be experienced. This is a change. 'C' mentioned that, from a very young age, it was a challenge to get daffodils as a Mother's Day present. Now, he says that they flower earlier, and that by Mother's Day, daffodils are plentiful. 'S' who nowadays regularly has daffodils in bloom in late February confirmed this. Further, for about seven years from 1981, S ran wildlife holidays on South Uist. When she started, she said that it was 'hard work' searching for any wild flowers in bloom on the machair at the end of May. It is not the same today. The machair regularly flowers from mid May onwards.

Westerly and southwesterly winds were so prevalent on the islands that it was traditional for the front door of a croft to be on the east side of the house. Cyclists come to take a few days to ride from Loch Boisdale in the south, 'down' to Lochmaddy in the North. The general direction is northwest. The usual advice was to make the trip in that direction, taking advantage of a little help from a following wind. Many informants pointed out that this might no longer be the case. More winds are coming from the southeast. In late April and May, in recent years north easterlies have been prevalent, making it difficult for some islanders on the east side, to launch their boats (S & T). The advantage of the tail wind for the cyclists cannot now be guaranteed.

One islander, ('X'), who has been fishing all of his life, reported that the main weather change that he had noticed was an increase in wave activity by approximately 30per cent. Waves, he said, were on average a third higher than in the past, and even on a calm day, the waters would not be still. When questioned more on the weather, and its effects on the sea, this respondent mentioned that he, and his family before him had kept weather records since 1906.

Given the vagaries of the weather, a question was put regarding how the crofters knew when the time was right to plant the crops. The response (from 'R') was 'we knew it through our fingers'. It was explained that the weight, texture,

consistency and temperature of the soil was determined in this manner. The answer generated further questions that were put to some of the respondents at a later date by email. Their responses suggest that this way of holding knowledge bodily (embodied knowledge) is not uncommon and indicates the unique relationship between the crofters and the machair (G & O). It is worth noting that this information started to come to light towards the end of the second week on the islands, when the rapport between the islanders and the researcher was at its best.

Fishing and Aquaculture

Fishing has been an important activity for this community for generations. Donald was the first to mention that historically, sea birds, including cormorants, occasionally used to find their way to the dinner table. Now, there are very few cormorants on Berneray, as there are few fish for them to feed on.

The fisherman with the weather records (above) reported that his catch is now mainly shellfish. Even though boats put to sea on fewer days, cod and haddock are a rarity. There are pollock, and mackerel during the summer, but prawns, lobster and scallops make up the main catch.

'T' and 'S' owned and ran a salmon farm from 1983 until recently. Although the summer sea temperatures do not seem to be on a rising trend, (the summer average has remained at close to 14 degrees Centigrade), Sea Bass have recently been caught off of the east coast of South Uist. This is new, the species seem to be 'coming further north', extending their distribution.

'M' has lived on the islands for 49 years. She recalls days in the past when she had been out fishing, and the catch was so large that much of it was given away to relatives.

'R' who manages the local Scottish Natural Heritage office, tells a story of when she was a young girl. On a summer's day, when the tides were right, the family would go to a very shallow part of a sea loch. There they would 'spear' large flounders that had come into the warm waters. Large specimens of these flat fish are never seen now. This was explained in the following story, told by 'O' an older crofter, and corroborated by many others.

'If you look out there (he pointed at the open sea, to the west of the islands), what do you see? Nothing except water and sky. But you would be wrong. A local boat got into difficulties recently, around St. Kilda, and within thirty minutes there were 15 other boats there offering help. They were Spanish fishing vessels and Russian factory ships'. The absence of cod, haddock, and large flounders is put down to over fishing in the deeper waters off the islands.

Ticks

The welfare of domestic animals is obviously important. Ticks, which are found on sheep, were the subject of many of the conversations. It was mooted that the increase (something there was full agreement on), was due to damper, warmer weather ('C'). The contrary view was that as sheep are no longer 'dipped' annually (they are injected instead), the population of ticks would grow ('R', J). However, there is an increase in the number of ticks on red deer. This could be

due to the changes in sheep husbandry, or, the deer picking up the ticks from the sheep may cause it. A different view altogether is also offered. Over recent years, the long-standing practice of burning the heather on the moors has ceased. Ticks live and breed in the vegetation and their breeding places are burnt ('S'). No burning means more ticks. This was complicated further when it was reported ('G' & 'S') that finding ticks was normal for the east side of the islands, but their number is increasing on the west, in the machair.

Changes on the machair

Many changes in the way the machair was traditionally managed were reported. The last couple of years have seen a return to the traditional mode of fertilizing the Machair; using storm cast seaweed. Living weed is never cut. The annual supply of storm cast weed is more than sufficient to cover the crofters' needs. This change has been due mostly because of the huge rise in the costs of agrochemicals that are based on fossil fuels. The methods of collection and distribution are still remembered, although the local research project, Machair Life, has helped and encouraged this.



Figure 5: *The Machair, between sea loch and open sea.*

Stock kept on the machair has changed. This helpful quote from an email received from 'I' is offered. 'In years gone by the cattle would mostly have been short horn, kept for meat and milk. Now the emphasis is on weight for sale (no-one is milking now) so the large continental breeds are favoured. The main ones are Limousin and Simental. The huge increase in size of the cows is in evidence when you take a different breed of cow into an old byre and try to stand it in a stall.' These larger cattle are high input animals requiring more feed than the machair can produce, leading to crofters buying in feedstuffs from elsewhere.

Limousin and Simental are 'two feet longer' than short horn and weigh much more. Outside market forces are shaping changes to the machair.

In recent years many respondents reported that the water table on the machair has risen. The majority suggested that this is due to higher rainfall, resulting in soil so wet that it cannot be ploughed in places where 'fathers and grandfathers once did' ('A'). An opposing view is that in places the water table has risen, but poor drainage practices are in place, which accounts for at least some of the land remaining unploughed. What is certain is that there are recommended shallow plough sizes, and that ploughing is restricted to certain times of the year.

The real underlying concern is that slowly, the machair is vanishing. The anxiety is that with the power of the Atlantic, if a little machair is allowed to be lost in a few strategic places, rather than protecting the rest, the remaining machair will be more vulnerable. Year on year, all respondents perceive that this valuable and unique landscape is disappearing. When the destructive forces of the weather and coastal erosion are at work on the Uists, it is the machair that takes the brunt of it. The loss of the machair would be a threat to the culture that it is inextricably linked to, as well as irreplaceable land loss. It was emphasized that this unique environment, forged through the power of the sea and wind, combining with particular soil conditions, and influenced over many years by low intensity crofting, cannot be replaced or rebuilt elsewhere.

Social Memory

Old knowledge is retained in songs and in place names (C, R & L), but an aging population holds this, and the key is the Gaelic Language. No 'elder' or chieftain' no 'bards' in the old sense, act as a 'social repository for knowledge'. Changing social patterns are also militating against the socialization of local practical knowledge. 'F' was clear that one of the underlying issues is that nowadays people only visit friends and neighbours when invited, and that is usually 'to watch a sporting event on the television'. In the past, visiting neighbours and relatives was very informal. Perhaps the fall of this informal 'Ceilidh' system not only stopped the conversations which debated then aggregated the knowledge, but now, such knowledge is refocused to 'my' interest or my croft. Local knowledge is fragmented. This is not done in a selfish way, but from a point of view that no one else would be interested, and the forum to find out if they are (the house ceilidh) has disappeared. Thus it is devalued. The point is made in the next section, that local knowledge increases in value as it becomes less fragmented, and more accessible.

6. DISCUSSION

The objective of this study is to address the four research questions. This section attempts to describe those answers in terms of plausibility. It does not seek to 'prove' anything. Given the short time in the field, no conclusions can be drawn. The islanders here, like those in the Pacific described by Lefale (2010), and those in Indonesia mentioned by Mercer et al, (2007) and Kelman and West (2009) are concerned about their vulnerability, be it from the power of the weather, or the dynamics of coastal erosion. The economically and culturally important part of their land, the machair, is shrinking and cannot be replaced. Whether this is due to normal changes in the weather patterns, or driven by climate change is

academic to them. They, like their counterparts elsewhere, rarely make that distinction. What is at stake here is the question of the value of their local knowledge, and how that may give those at the effects of the threats more of a say in policy building. The contention here is that more and valuable local knowledge opens the way for a more balanced process, bottom up and top down. SEPA (Scottish Environment Protection Agency), are, it was said, trying to enforce a policy regarding flooding which is very 'top down' (respondent B). One wonders whether they would do that in the face of strong local knowledge that could be corroborated and supported?

From the above, whether it is the Machair, or the sea, the birds or the dynamic relationship between the tides and the islands, there can be no doubt, that even this study, which has barely scratched the surface, shows that there is a wealth of local knowledge. This knowledge is not just confined to what is happening. It often offers some ideas as to why it may be occurring too.

Some comments are now made about the nature of that knowledge and how it is held. The concepts of 'social memory' and 'embodied knowledge' are re-examined in relation to this. The natural disposition of the island community is also reviewed, as is the 'deferral' to so-called 'experts'. Case studies from across the world are offered, where the participative, bottom up and top down process has been mobilized successfully. There is a move away from the 'do it to them' approach highlighted by Weichselgartner and Oberstein (above). Huntington's (2000) assertion that collecting local knowledge is difficult is addressed. This may be especially so in this study area as the population is both declining and aging²⁶.

It was noticeable how 'atomised' the local knowledge on the islands was. Informants might be very knowledgeable about, say birds, and the changes that they have noticed in particular locations; areas where they work, or walk, or pass everyday. However the social fabric is not in place for this information to be shared, evaluated, and 'joined up'. Kenny, from Torlun, first mentioned this. A '*ceilidh*', he said was a meeting. It might turn out to be a musical event too, but first and foremost it was an informal meeting where people got together and shared news. The Gaelic (*Gaidhig*) scholar, Gordon Wells, described *ceilidhs* thus:

'My mother would drop in on old friends and relations "just for a wee *ceilidh*", an informal visit and a chat in other words. To call that a meeting, even an informal one, is still suggestive to me of a level of planning /organization when my sense was that these gatherings could be quite spontaneous'²⁷.

News, especially that relating to their livelihood was essential, as was information regarding changes in the environment. The informal *ceilidh* was the natural place for a discussion such as that regarding the ticks. As noted earlier, the advent of television changed this. Although many islanders are holding valuable pieces of the 'jig saw puzzle', there is no forum to meet and put these pieces together. New knowledge is fragmented, and old knowledge is in danger

²⁶ Figures from Comhairle nan Eilean Siar

²⁷ Personal Communication from Gordon Wells, dated 6th August 2011

of being lost. The population is aging and fewer people speak Gaelic²⁸. It is contended that 'the body of local knowledge' thrives when it is valued, used and added to regularly and collectively. It then lives in the 'Social Memory'. For this to work, there needs to be a mechanism, either formal or informal to facilitate this. If this study shows contradictions in pieces of local knowledge, it is perhaps because it has not been debated and aggregated. There are studies where this has happened: Items of local knowledge have been 'rediscovered' put back together, and then joined with science to produce a more comprehensive adaptation plan. A good example comes from the Grand Bayou, Louisiana, after the devastation of Hurricane Katrina (Button and Peterson 2009:327ff). A scheme was created in which scientists, social scientists and the local community worked together in enhancing a coastal community's resilience to natural disasters, namely tropical storms and hurricanes' (2009:333). The methodology had a 'strong ethnographic focus' (2009:333). A method used was to encourage members of the community to tell stories. This is 'to make objective and public that which formerly was informal and private' (ibid:333). This helped the community to create a shared memory bank. It revived the social memory. The authors reported that it enhanced the community's resilience and increased confidence. This joint work contributed to science.

Contributors often reported that the inhabitants of the Uists are not naturally outgoing people. This was brought to light during the fieldwork. As mentioned above, how introductions were made mattered. The more formal the introduction, the more wary the respondent. In business, the common practice is to establish credentials first, showing that it is worth investing time for a meeting. On the islands that mode sets one apart, almost in the role of expert. There seems to be a reluctance to talk to experts, especially scientists or researchers, as local knowledge is often devalued in the face expert, or scientific knowledge. A clear example can be recounted. Many islanders suggested that 'C' would be a good and knowledgeable person to meet. He had lived by a certain loch for all but four of his almost seventy years. 'C' is a crofter and fisherman who planted almost 100,000 trees over the last 20 years. On the telephone call to him, his initial reaction was 'I don't know anything about the environment'. Plainly, this was not so.

With the globalization of economies, cultures and knowledge, is local knowledge losing its currency? Button and Peterson refer to this as 'our highly professionalized culture' where the voice of 'the expert' is 'privileged' (2009:334). Brace and Geoghegan take this further in saying that 'science is at the top of a hierarchy of ways of knowing' (2010:294). Wisner (2004) argues that the 'devaluation of local knowledge' is in fact an aspect of vulnerability, and that communities should be encouraged to 'rediscover' their local knowledge, thus arguing for the local and specific over the global and general. These, along with the demise of the *ceilidh*, are barriers militating against local knowledge.

Appendix 2 holds a collection of Red Cross brochures from South East Asia. Granted, this is not peer-reviewed literature. But they attest the success of small

²⁸ Census figures from Comhairle nan Eilean Siar

and localized projects that have enhanced resilience. They have been implemented across the region. The Red Cross has been successful, as they have engaged with communities, and using facilitation techniques, teased out local knowledge for bolstering adaptation and coping strategies. Their interventions, much like Button and Peterson's story telling techniques, have enhanced the social memory, in terms of content and value by using a combination of local knowledge and science in a bottom up and top down process. A step away from the 'do it to them' approach is noted (Weichselgartner and Oberstein, above).

The first of these leaflets (RC1) is entitled 'Integrating climate change and disaster risk reduction'. It champions local knowledge, community involvement, and the 'mainstreaming' of CCA and DRR into the Sustainable Development framework. For them, using local knowledge is obvious, as this quote show:

"While scientific information is important for measuring changes in rainfall, temperature and the frequency of extreme events, using it in conjunction with local knowledge on trends can enhance decision-making and the development of appropriate responses."²⁹

The practical nature of the work of the aid agencies, especially those with experience in disaster management, like the Red Cross show them to be running ahead of the academic literature. It shows that local knowledge can, and is being used in policy making in the developing world. This simple material, also used to educate and build awareness, has lifted the confidence of the communities concerned and their faith in their local knowledge³⁰. This theme of merging CCA and DRR efforts, and including local knowledge is seen in all this written material. Bangladesh is a country threatened by rising sea levels and devastating flooding. In the Bangladesh case study, the Red Cross states that 'studying existing community based coping mechanisms is fundamental in order to design appropriate capacity building operations that mitigate the effects of climate change.' The Bangladeshi Red Cross Red Crescent Society is working with Kyoto University to see how 'community based DRR programmes can meet the current and future needs of climate change' (RC3, appendix 2). Local knowledge is at the core, and cannot work with the top-down approach. Vulnerable people in South East Asia, like those on the Uists, rarely recognize the difference between CCA and DRR. But they are, along with some of the aid agencies, leading the integration of DRR and CCA.

The Uists, like the Grand Bayou, are situated in a particularly dynamic part of the world, where the speed of the changing environment is such that traditional coping strategies may be inadequate in the near future. The argument is not 'anti-science', but it is for the emergence of more processes that allow the best science to work alongside the best of a 're-invigorated' local knowledge in a manner that is both top down and bottom up, that generates knowledge and promotes local action and engagement.

²⁹ RC1 in appendix 2.

³⁰ John Gwynn, personal communications July and August 2011. See also documents numbered x, xx, etc

Thus stated, there have been examples where science has been less accurate than local knowledge. Concurring with Button and Peterson (2009:335) local knowledge 'can often provide an early warning system for environmental problems not perceived by scientists'. Some local knowledge has been fragmented, but as Button and Peterson (2009:333) have shown, much of it can be restored to the 'social memory'. Angus gives examples from the Hebrides: 'Crofters and others in the community possess a formidable body of knowledge about the history and ecology of machair and some of the more important species. Occasionally expensive scientific studies are mounted which reach conclusions long known to the local population.' (Angus 2001:188)

Local knowledge has been overlooked, but there has been a significant reassessment, especially in the DRR literature. Academics have highlighted this, and it has been shown that successful processes have been created for DRR/CCA schemes with local knowledge being a central component. Here it is shown that not only are CCA/DRR processes necessary in the developed world, but that the evolving processes from the developing world, which has moved away from the top down approach and incorporated local knowledge is a better model to build on.

Evaluating the Research Questions

A reminder of the research questions is now pertinent. Can plausible answers be offered to them?

1. To what extent are those Island dwellers sensitively aware of such changes that there may be? What adaptation processes have they adopted or created?
2. How do they ascribe 'meaning' to this? How are such changes conceptualised and understood?
3. Are the epistemological differences so vast that they cannot be bridged? Or put another way, how difficult is it to turn 'local knowledge' into usable, credible, scientific data that can be used by influential agencies such as the EEA?
4. What if any general conclusions can be drawn from a single case study?

Taking these questions one by one, the first part of question one can be answered positively. It is contended that the islanders are well aware of the changes occurring in their environment. There is a large degree of sensitivity. That is not to say that every islander is aware of every change. What has been highlighted is the specific nature of the knowledge; specific to a location, or an activity.

It could be argued that the new groups on the Uists, such as 'Sustainable Uists', 'Machair Life' and indeed island involvement in CoastAdapt are adaptation processes, insofar as they are all responses to changes in the environment. The re-distribution of knowledge and awareness are examples of 'soft solutions', and changes like those in crofting practices espoused by Machair Life are 'hard solutions' in line with the CCA/DRR definitions offered above. These have strong possibilities for affecting policy. And, given the nature of the crofters and the dynamic environment, adaptation is on going.

Turning now to question two, the big issues are those relating to the community's vulnerability to the Atlantic: the threats from storms, and the continuing coastal erosion. This threatens the machair and their way of life, directly for many, indirectly for the majority. Major changes are seen, conceptualized and understood in terms of livelihood. Local knowledge is valued for its practical applications, even though the resulting livelihood decisions may be taken over varying time scales. The influence of climate change is a minority view. There is growing awareness amongst those interviewed that weather changes need to be taken seriously. Perhaps one of the reasons why climate change is not seen as central to the differences in wave size, phenology, bird sighting, and the other changes mentioned, is because the knowledge has been 'atomised' in the absence of the *ceilidh* tradition. No one sees the whole picture.

The third question is to do with finding a way of turning this knowledge into data, usable in policy by the local authority, and perhaps the likes of the EEA. Here, Huntington's (2000) comments are recalled. This knowledge is difficult to collect, especially in its present localized, specialized and almost individualized form. This is especially true where geographers, biologists and others, trained in particular research techniques, try doing ethnographic studies (Huntington, 2000, Drew, 2005). It is difficult to judge whether or not single pieces of individual knowledge would affect local policy. However, if they were collected, and then collectively presented through the likes of 'Sustainable Uists' or 'Island Voices', or 'Machair Life', local groups that already have credibility, then its value would increase. It could be argued that these groups, in following their chosen purposes are already beginning to reconstitute the social memory. Island Voices offers this by collecting stories. Machair Life could be construed as 'reminding' younger crofters of traditional techniques, Sustainable Uists is engaging in the wider question: how to make the islands sustainable, in crofting, and in general. Local knowledge would be much more valuable if it were collected actively and *explicitly*. It is hard to disagree with Brace and Geoghegan's (2010) conclusion that local knowledge should be seen in its own right, and no attempt to justify it in scientific terms should be made. In practice, it is the hegemony of scientific knowledge upon which politicians rely (Mansfield, 2009).

Many different factors make up the environment on and around the Uists, and the special relationships that the community has with it. The answer to the fourth question is that the pieces of knowledge, the individual pieces of the jig saw, will never be exactly the same from one place to another. However, some conclusions are transferable. Where this close relationship exists, the likelihood of finding local knowledge is high. It is then, the process of rediscovery, and the way it is presented that will determine its value in terms of policy. The ethnographic methodology for uncovering the knowledge is suitable for the developed world and can be replicated. Those on the Uists can learn from the South-East Asian experience, and other similar studies. The inclusion of local knowledge has broadened the concept of CCA/DRR activities by making it more than a purely technical response to a scientific problem and placing it in a wider context. Moreover, the process of mobilization has itself changed. Top-down no longer works when community input is needed.

Areas for further study

Knowledge exists at various levels. The 'embodied' strata was noted late in the study rather than fully explored. How local knowledge is held, and how it may be understood and 'mined' more efficiently are questions requiring more research. If Carolan (2009:10) is right, the Islanders could be 'physically tuned' to their environment. If this is the case, local knowledge is very valuable indeed. It is surprising that in view of the vulnerability of the Uists, and indeed other island communities around Europe, a search of the literature shows a dearth of studies looking at the relationship between islanders, their environment and climate change. The whole subject regarding how this environmentally sensitive local knowledge is held, either through the social memory or embodied seems relatively un-researched. A more focused study on the machair, going beyond this one, and looking at ways the knowledge is held and embodied would be timely. A comparative study across all the Scottish Islands might also reveal significant results that could reduce vulnerabilities. The growth of a perspective showing the acceptance of and need for local knowledge, would on its own suggest the need for more qualitative studies with a strong ethnographic approach in the developed world.

Appendix 1: Press Release, published in the April edition of Am Paipear

Local Knowledge and Citizen Science

Context

One of the issues in our quest for a greater understanding of our environment is that there is a lack of scientists. It's a big planet. One of the consequences of this is that the application of our knowledge is not localized enough. Climate Change models are great achievements. But the outputs are regional, and these regions may be as big as Western Europe. How can that data be accurately applied, through policy, to you here on the Uists?

Approach

In some approaches there was a conflict between local knowledge and science. Recently, there has been a realization that science *plus* local knowledge yields more understanding for everyone.

My research asks the question of how local or traditional knowledge can inform scientific data on the local scale and feed into policy?

What some of you know about your environment, and your community's relationship to it is invaluable. Seeing and understanding trends in your local habitats, like changes in the machair, in fish behaviour, in crops and birds, and in weather patterns, is vital in understanding and preserving the health of the whole ecosystem.

With this understanding, there is a much higher likelihood of building a more resilient community, in the event of further environmental changes.

I am interested in talking and listening to your experience here in the Uists. So, whether you are a crofter, a fisherman, retired, or just interested, I would like to meet you. I won't take more than an hour of your time. But I would like to know what changes and trends you have spotted, and what thoughts you may have about them.

No research quite like this has been undertaken in the United Kingdom. Local knowledge has been important in Climate Change adaptation in many parts of the world, especially vulnerable areas such as the Arctic and New Orleans. I have been encouraged and helped by Stewart Angus at Scottish National Heritage, David Muir in your local council, Alison Dix, and a pleasant response from those at Sustainable Uist.

I will share my results with you, in an article for *Am Paipear* this autumn.

Contact

My next visit to the Uists will be in April, and I will be available to meet with interested people from 18th to 23rd. I can be contacted by email at des@desgould.com or on my mobile: 07703 547 470

Des Gould, Birkbeck College, University of London & Landscape photographer

This research is self-funded and poses no potential conflicts of interest.

Appendix 2: The Red Cross Literature

RC1: Case Study: Bridging the Gap: Integrating climate change and disaster risk reduction (2008)

RC2: Case Study: Tuvalu: joining forces to tackle climate change (2008)

RC3: Climate Change: Awareness, Adaptation and Disaster Risk Reduction, a Bangladesh case study' (2007)

RC4: Case Study: Preparing for climate change in Viet Nam, (2007)

RC5: Case Study, Bangladesh: Empowering the community to adapt to climate change, (Jan, 2008)

RC6: Preparing for climate change in Vietnam (2007) Vietnam Red Cross Society

RC7: Climate change Adaptation: Livelihoods (2009, Indonesia)

RC8: Climate change Adaptation: Multi-Hazards (2009, Indonesia)

RC9: Climate change Adaptation: Gender (2009, Indonesia)

RC10: Climate change Adaptation: Volunteer Community Participation (2009, Indonesia)

RC11: From debate to action on climate change in Indonesia (nd, but post 2007)

RC12: Community Participation: Small plants offer protection from raging white elephant (nd, but post 2005, Vietnam)

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