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Societal, Policy and Academic ‘Visions’ for the Future of the Marine Environment and Its Management, Exemplified in the Western and Northern Isles of Scotland

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Abstract: Interactions between environmental and social change are complex and require deep insights into human perceptions, values, motivations and choices. Humanities disciplines can bring these insights to the study of marine social–ecological systems in the context of global environmental challenges. Such systems can be defined on a range of scales, but the cases most easily studied include those of small islands and their communities. This paper presents findings from three studies in the Western and Northern isles of Scotland, concentrating on some of the processes involved in social sustainability that contribute on the one hand to protecting what a community has, and on the other hand allowing a community to evolve so as to adapt to new conditions. It relates the several sorts of transformations involved, to the role and impact of external institutions such as those of governance of the natural environment, the energy market, and academic research, which together make up the environment of the transformation. By examining the world-views of different groups of actors, this paper illustrates that an understanding of the mental constructs underlying these world-views can help marine governance through integrating different ways of knowing. This paper identifies where it would be useful to employ a transdisciplinary ‘translator’ or a ‘space’ for dialogue in order to capture the diverse ‘visions’ and perceptions that these groups have in relation to management of the marine environment, where there are synergies and where more should be done to negotiate between competing values and needs. It illustrates the practical contributions to operational policy that can emerge through challenging the dominant management discourses for the marine environment.

Keywords: visions; world-views; marine management; scale; transformations; actors

1. Introduction

Renewable energy, marine conservation, aquaculture, fisheries, tourism, shipping, mining and oil and gas extraction are all human activities which make up the ‘blue economy’ and are vying for an increasing amount of space in the marine environment (Fritz and Hanus 2015). The complex character of interconnected human–environment systems (marine social–ecological systems: Berkes and Folke 1998) in the marine context calls for global and supra-national scale maritime management initiatives and strategies. However, there is growing evidence that these types of top-down management strategies and apportionments can have varying results when applied at a local scale and within complex social, cultural, political and economic contexts (Aitken 2010; Warren and McFadyen 2010; Jones 2012). In other words, marine resource management policies, set at

government level, may not match, or include, the visions and local knowledges that communities have of their marine resources at a local level.

Interactions between environmental and social change are multifaceted and require deep insights into human perceptions, values, motivations and choices. Humans are inextricably entangled with the natural world (Hall et al. 2015) and environmental problems and solutions are framed and understood through collective and individual values and culture (Schultz et al. 2005). Humanities disciplines can explore and analyse whose values and world-views drive marine environmental governance discourses and why, directing attention to who holds power and the motivations of those shaping the discussions. These insights can be brought to the study of marine social–ecological systems (SeS) and the application of mitigation strategies for global environmental challenges (such as the development of renewable energy to reduce carbon emissions, and the designation of Marine Protected Areas), which is the overall aim of this paper.

Such systems can be defined on a range of scales, but the cases most easily studied include those of small islands and their communities, due to their geographically defined characteristics and smaller populations. Such cases are particularly relevant as environmental mitigation strategies are often set at a national level but enacted on a local scale.

This paper presents findings from the SeS centred on the Western and Northern Isles of Scotland, where marine renewable energy generation is rapidly developing and Marine Protected Areas are being designated. It concentrates on some of the processes involved in social sustainability by exploring the contrasting actions involved in, on the one hand, protecting what the community has, and on the other, the community evolving so as to adapt to new conditions. Our three stories concern (1) the response of community members in the island of Barra to the designation by the Scottish Government of a Marine Protected Area; (2) the role of ‘agents for change’ in leading development in marine renewable energy (MRE) capture on the island of Lewis; and (3) the role of the academic research community in potentially helping the development of MRE. Locations are shown in Figure 1, with designated MRE sites highlighted in colour. What links these three accounts is best captured by the word ‘vision’ in our title; we aim to compare how competing visions of the world, as it is and how it might be, bear on the issues raised in each case. We argue that top-down imposition of economic or environmental strategies needs to take into account the differing visions and world-views of local actors and their communities. This pluralistic accounting creates a more inclusive process around shaping management strategies so that when they are applied, they produce more equitable transformative outcomes.

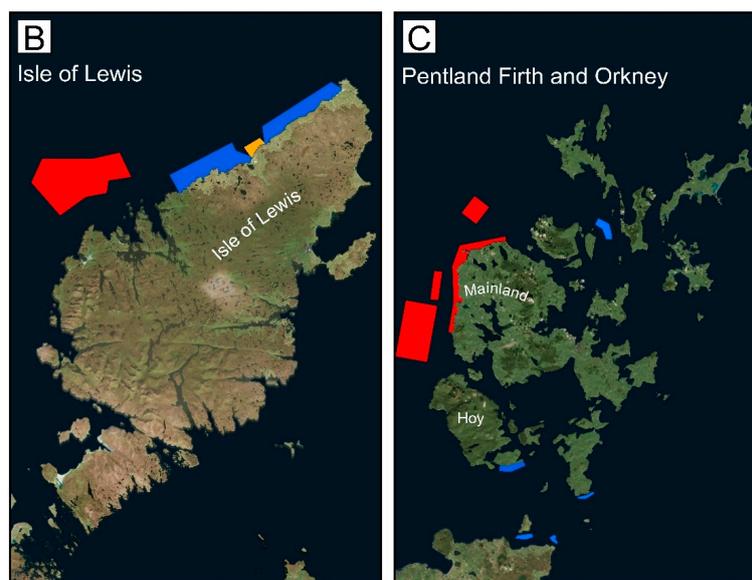


Figure 1. Cont.

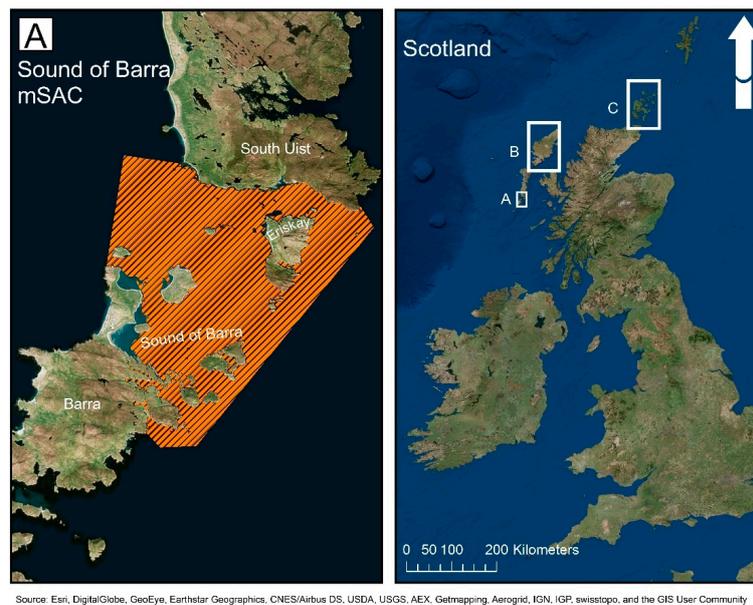


Figure 1. Case study locations with marine renewable energy (MRE) sites depicted in colour blocks.

2. Analysis Framework

This section provides a framework for comparison of the three case studies. It is loosely based on the CATWOE ‘soft systems methodology’ checklist of [Checkland \(1999\)](#). The original CATWOE framework includes customers, actors, transformation process, world-view, owner and environment¹. These elements can be defined according to the situations which are being analysed. The four components on which we focus are the actors (which include CATWOE’s ‘customers’, ‘actors’ and ‘owners’); their world-views; the change or transformation in the case study; and the external environment of the system involving the issue.

‘Actors’ are the people who have the world-views and who play roles in relation to the case-study issues that we describe. We are interested in the way actors exist and act both in relation to the biophysical world and within cultures, communities, organisations and institutions.

Adapting some of the questions asked by [Aerts et al. \(2007\)](#), a ‘world-view’ comprises a model or description of what the biophysical and social worlds are; an explanation of why they are this way; opinions about what they could be and what they should be; and, a basis for screening new information and incorporating it into an actor’s world-model. The programmatic translation of new information into meaning might be called an epistemology, an account of “the validity, scope, and methods of acquiring knowledge” ([Moon and Blackman 2014](#)). Of course, it is our own academic epistemology that presents us with these concepts as part of our world-views. Whether or not actors reflect in this way, a world-view provides values and a basis for action: for living and thriving in a social/biophysical world and for seeking to change it or to resist it being changed.

Grain and scale are important in these analyses. Communities are not homogenous; individuals can perform distinct roles, although what these are tend to be constrained by the ‘lifeworld’ ([Habermas 1984, 1987](#)) in which they are embedded. Nevertheless, the production of meaning is a dynamic process, and the lifeworld—the matrix of language, culture and unquestioned assumptions that allows communication and which both constrains and exists in each communicative act—can

¹ Customer—target of the change; Actors—those who take part in the change; Transformation process—change from one situation to another; World-View—the reasoning behind the current situation, the change process and its predicted outcomes; Owners—the people or organisations involved in the change; Environment—the limitations, boundaries and context of the change ([Checkland 1999](#)).

change. ‘Transformation’ is the most difficult of the CATWOE terms to define. It can be understood as a simple alteration in the physical domain—for example, the transformation of wave energy into electrical energy—or a more complex change in the societal domain with implications for the biophysical world; for example, the legal transformation of a sheltered bay from a learning ground for young fishers and a source of fish and shellfish into a protected reserve of bio-diversity which includes protection of an ecological nursery area for seagrass (*Zostera marina*) beds. O’Brien (2012) contrasts adaptation with transformation and imposed change with deliberate change. Recognising that there are differences in transformation types and change types is useful for understanding how and why communities adopt or react to different marine resource changes. ‘Endogenous transformation’ is deliberately engendered within a community; ‘exogenous transformation’ is change imposed on a community from outside. Bass and Steidlmeier (1999) also identify two types of social change. ‘Transactional change’ is where something is exchanged in return for the change. ‘Transformational change’ is a shift to something qualitatively different (Illeris 2017). These types of changes and transformations interact with each other are embedded in the change process (how the change is started/ created). They can also be predictors of how communities react to change, with ownership, buy-in, trust and communication already being identified as key aspects of a successful change (Kotter 1995; Lunenburg 2010; Devine-Wright 2011a; Haggett 2011; O’Brien et al. 2012; Moffat and Zhang 2014).

The final component of analysis is ‘environment’. This is not the ‘natural environment’ of the society–nature dichotomy. It is what is not local to the communities and issues in a case study. In our island cases, this environment includes what Habermas (1987) calls the ‘media-steered’ sub-systems of the larger society—especially the money-steered economic system and the power-steered administrative/governance system—which intrude into the social–ecological systems in our island case studies. They correspond to what Ostrom (2007, 2009) and McGinnis and Ostrom (2014) call ‘social, economic and political settings’ in which actions take place. In our case studies, the environment is also made up of a ‘constitutional’ level of governance, that is the European Union (with its Parliament, Councils, and executive Commission), and a ‘collective-choice’ level, which is the Scottish Government and Parliament, established in 1999 with significant devolved responsibilities within the United Kingdom (UK).

The methods used within this paper vary over the three different case studies. There are two reasons for this variation: (1) to present evidence, which has been collated from a selection of three discrete studies, that the world-views of actors within marine SeS can have competing visions of how the marine environment should be managed and the issues that this can cause and; (2) to provide examples of how humanities disciplines have been practically applied within research with the aim of furthering understanding of the societal and human aspects of marine environmental management. We explore each case study individually by describing their unique contexts and presenting the methods used, before analysing the results using the CATWOE framework of actors, world-views, transformations, and environment. We then use the same framework to compare and contrast the results of the three case studies in one general discussion. Our hope is that the CATWOE framework provides a robust structure for the analysis of each discrete case study as well as a means to discuss and compare their results in a meaningful way.

3. Case Study: Barra

Perched at the periphery of the most westerly inhabited islands in Scotland, the island of Barra is linguistically different to mainland Scotland (Scottish Gaelic is widely spoken alongside English) and religiously distinct from much of the rest of the Hebrides (80.2% of residents on are Roman Catholic (GRO 2003a) compared to less than 10% in the northern (mainly Free Presbyterian) Hebridean island groups). Barra bears the psychological legacy of nineteenth century Highland Clearances (mass evictions to make way for sheep-farms and hunting-estates). Over the years, this small-scale fisher-crofter community has garnered an array of nature conservation designations, on land and at

sea. These perceived ‘impositions’ from a distant policy environment have not been welcomed by many in the community. The most recent of these, starting in 2000, was the proposed designation of a marine Special Area of Conservation (mSAC) in the Sound of Barra, off the coast of their island. It would become one of more than 180 designated marine protected areas in Scotland, covering about 20% of Scotland’s seas (SNH 2016; Marine Scotland 2017).

The Sound of Barra mSAC had been proposed by Scottish Natural Heritage (SNH), the Scottish Government’s nature conservation agency, to meet UK obligations under the EU Habitats Directive (92/43/EEC). The Directive requires the establishment of an ecologically coherent network of special areas of conservation, both terrestrial and marine, known as the “Natura 2000” network. Under the Habitats Directive, mSAC site selection and designation must be based on scientific criteria and expert judgement (McLeod et al. 2005; European Commission 2017), and cannot include social and economic considerations. Put simply, the selection and designation process devotes an MPA completely to the interests of the species or habitat to be conserved.

The 2011 census puts the population of Barra at 1264, a slight increase from 1172 in 2001 (GRO 2013b), with population levels being maintained by adult returners or in-migrants relocating to Barra to raise their children (CBAB 2010a, 2010b). While regional statistics show a decline in the population of the Hebridean islands since 1901, examination at local level reveals a stabilisation of Barra’s population in the last decade. This emphasises the importance of widening employment opportunities on the island—if there are no opportunities for families to come back to or for people already living on the island, the population will go into decline as people leave and fail to return (CBAB 2010b; OHMS 2007). The Western Isles economy is unusual in that it is dominated by the public sector and relies on primary industry (mainly fishing). Environmental impacts (such as depletion of fish stocks) and international pressures (such as changing European legislation) particularly affect the fishing and fish farming industries (CBAB 2010b). The designation of the Western Isles (excluding Stornoway and its environs on the isle of Lewis) as economically fragile underscores the need for sustainable development opportunities which combine economic, social, cultural and environmental attributes (HIE 2010). Barra is a fisheries-dependent community, with *‘as many as a quarter of the working population . . . involved in fisheries; either directly as fishermen, or working in the fish processing sector, or indirectly in sectors such as administration, transport, equipment maintenance and marketing. This equates to around 200 people within a working population of around 800’* (Halcrow 2010, p. 19). Many people on the island have more than one job in order to generate enough income to survive. For example, fishers on Barra are often crofter-fishers (a crofter is a small-holder farmer), meaning that the fishing is supplemented by crofting (usually sheep-farming). A newcomer to the economic picture in Barra’s future is renewable energy—in recent years, two medium term options for offshore wind energy have been identified in close proximity to Barra as well as a number of proposed wave and tidal areas. The local community has not waited for regional and national developments to provide them with opportunities. Over the last 8 years, the community-owned company Coimhearsachd Bharraigh agus Bhatarsaigh Ltd (CBAB) has successfully driven forward a community-led project which resulted in the unveiling, in February 2014, of an onshore wind turbine. Indicators of the existence of a high level of social capital on Barra can be found in its multiple formal and informal social structures, including public structures (e.g., churches, schools and youth clubs), private structures (e.g., hotels, cafes and other small businesses) and public events (e.g., annual competitions in fishing, potato growing and running). This is reflected in a 2010 community survey report where 127 of the 143 respondents felt part of their community to *‘some extent’* or to a *‘great extent’*. This feeling of embeddedness within the Barra community is reflected in the significant level of local involvement in community groups. The community survey showed that over half the sample (76 of the 143 respondents) were actively involved with the community in some way (HIE 2010).

3.1. Methods Applied

A research study was carried out from 2010 to 2014 to explore the dispute (Brennan 2015; Brennan forthcoming). An emergent mixed method approach was used, including participant observation, in-depth interviews and visual participatory methods. Photographs taken by research participants and two related art-science collaborations were used to explore local understandings of the meaning of ‘conservation’ and to make visible a representation of the intangible cultural heritage (see Lenzerini 2011) in Barra’s marine environment (see Hurrell and Brennan 2013; MacKinnon and Brennan 2012). A total of 61 respondents were engaged with (49 local and 12 non-local), 59 informal conversations were documented about the mSAC conflict and life on Barra generally and 27 interviews (16 unstructured and 11 semi-structured) were conducted. A thematic analysis approach was used to analyse the data and gain a deeper understanding of the dispute by revealing more about the relationships between people and place on Barra. NVivo 10 qualitative data analysis software was used to code, sort and categorise (Bryman 2008) interview transcripts, images and fieldnote observations (Brennan forthcoming).

3.2. World-Views

While social and economic considerations can inform the development of a management plan for a site, there is no obligation to create such a plan, and so very few mSACs have one. The process of site selection and designation of SACs under the Habitats Directive effectively isolates the natural dimension of ecosystem conservation from the human dimension. This contributed to the perception, by many of the islanders, of the mSAC as a symbol of oppression.

“People here are not against looking after the environment but it’s being forced on them here.”²

“I think that many people feel that it’s an example of a form of environmental designation process that doesn’t really pay any respect to the value of the human population . . . Barra is reasonably lively as a community and the reason it’s reasonably lively and not dead, like some other places in the Highlands and Islands is because it’s got a fishing industry and . . . economic activity and I think people just feel that should be taken into account . . . ”³

Visions of space produced by maps generated by the Scottish Government during the site selection process conflicted with local visions of space rooted in different ways of knowing the marine environment on Barra (for example, through fishing). The narrative presented by those opposing the mSAC depicted the islanders as victims of distant and oppressive governmental forces and as losing control over their marine resources. Fueling the dispute was a lack of meaningful communication and co-operation, different ‘languages’ being spoken at local level and within the policy environment, different value systems and world-views coming into conflict with each other, and many local people feeling that their voices were not being heard by the Scottish Government.

Different understandings of the meaning of ‘conservation’ became evident at an early stage during the research process.

“Barra’s not a museum piece, it’s an island you live on.”⁴

Many local people perceived SNH’s understanding of conservation as ‘hands off!’ and ‘keep out!’. SNH’s world-view seemed to separate humans from nature, and, in practice, could not take into account ‘human’ considerations as part of the mSAC designation process. In contrast, the local understanding of the meaning of conservation involved a sense of ‘live with’ and ‘use/develop wisely’. The dynamism in this understanding lay in sharp contrast to the perceived stasis of conservation areas.

² RP-2.7 Excerpt from interview 21.9.11.

³ IRP-1.A (non-local) Excerpt from interview 30.9.11.

⁴ RP-2.8 Excerpt from interview 6.4.12.

“It is a working environment and totally at odds with what our governments are trying to create, a preserved environment. Conserved environment.”⁵

As fieldwork progressed, the diversity and richness in how local people experienced, knew and expressed ‘their’ marine environment became evident. The study then aimed to find ways of bringing into view these different ontologies and epistemologies of the sea. Visual participatory methods (including two art–science collaborations) were used to articulate these different ways of knowing, to understand what ‘conservation’ meant for the islanders and to find ways of connecting the world-views of decision-makers with the marine environment lived and experienced by the islanders.

“All of this is not just scenery, it’s not pretty, it’s got nothing to do with that, but it’s pleasing to the eye, some of it. But what are we about, we’re about sustaining ourselves, within the society that we’re in.”⁶

One of the outcomes was Sea Stories (www.mappingthesea.net/barra), an interactive online map of the sea, showing the **cultural** diversity of the area that was proposed to be protected by the mSAC for its **biological** diversity alone. This is exemplified in Figure 2, which shows the Sea Stories map featuring sound, image, story and naming, and articulating a version of the rich local knowledge, language and culture based on people’s relationships with the sea around Barra.

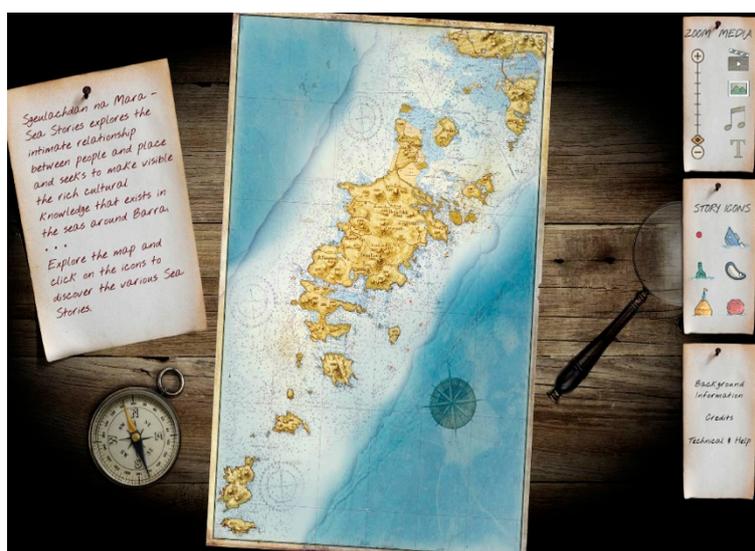


Figure 2. Sea Stories online cultural map of the sea (Hurrell and Brennan 2013).

3.3. Actors and Environment

The main actors were, on the island, key members of the local community including fishers, and, in governance, some officials of SNH and of Marine Scotland. The latter is the Scottish Government department responsible for the marine environment as a whole. The relevant feature of the biophysical Environment of the community on Barra was the sea and its resources; the relevant feature of the social Environment was the policies of the Scottish government and its agencies relevant to the use of the island’s biophysical Environment.

⁵ RP-2.4 Excerpt from interview 10.4.12

⁶ RP-2.4 Excerpt from interview 10.4.12.

3.4. Transformation

The original transformation (that involved the designation of the Sound of Barra mSAC) was from the coastal sea-bed as a source of fish and shellfish and thus of employment, to the seabed as a site of biodiversity and a contribution to the satisfaction of the UK's international obligations. (Even though the designation did not prevent the continuation of fishing or other activities in the Sound of Barra, there was nonetheless a perceived loss of local control over marine resources). However, the research study aided a different sort of transformation in the governance of the Sound of Barra mSAC. It proved possible to create a forum and a process in which the world-views of local people could be articulated and made known to the government actors, who, in turn were able to act creatively. This has led, since 2012, to the emergence of a community-led co-management process for the Sound of Barra mSAC. Since 2012, policy-makers and the people of Barra have been adjusting their conceptions of management and stewardship of the marine environment in ways which accommodate diverse understandings of, and visions for, the sea. There appears to be an emerging acknowledgement that control of marine resources in the Sound of Barra may not look like what it has looked like in the past, before the conservation area was designated. Key people on Barra have opened up a space to consider, in partnership with Marine Scotland and the two other island communities (South Uist and Eriskay) bordering the Sound of Barra, mutually acceptable ways of describing control of their marine resources.

The shift in the discourse has been reinforced in several practical ways. Following the suggestion of the local community organisation Voluntary Action Barra and Vatersay (VABV), in 2014, Marine Scotland delegated responsibility to, and funded, this organisation to facilitate a community-led process (including all three island communities) to develop a co-management structure to sustainably manage the biophysical resources of the Sound of Barra in a way that makes sense, culturally and socially, to the people who live and work that environment. At the end of March 2015, VABV sent a draft report to Marine Scotland which highlighted the issues to be addressed in deciding on the structure the local management group should take. Further work (funded by Marine Scotland) is needed in order to determine the management group structure. This work will determine details such as who will be represented on the management group, what criteria should be used to determine this, whether representatives will be elected or appointed and how to access advice from Marine Scotland without losing local control.⁷ The suggested co-management structure (which is not yet finalised) and (eventually) the management plan must also meet the needs of the policy environment (specifically, the satisfaction of statutory conservation objectives for the mSAC). This is a clear departure from the policy environment norm of appointing an external 'expert'. It suggests that policy-makers are recognising and acknowledging island epistemologies and ontologies (reflecting the intertwined relationship between people and place on Barra) together with the biocultural diversity of the Sound of Barra, rather than simply the biological diversity proposed to be protected by the mSAC. At the same time, local people are working towards making their visions visible and workable within the policy environment.

Island epistemologies and ontologies are evident in the distinctive cultural values embodied and expressed in local relationships within the marine environment on Barra (notably how people work and manage it). They are exemplified by the richness and continued importance of the sea stories intertwined with the marine environment on Barra, reflecting a world-view shared by those living on Barra, that people and the marine environment are inextricably intertwined, but not necessarily always in the same way. Take for example, the sandy-bottomed sheltered area known as the *Oitir* in the southern part of the designated Sound of Barra and the creel fishers who make their living by fishing mainly for velvet crab (*Necora puber*) there. In this ontology, the *Oitir* is a site of a series of competing *Oitir*-fisher relationships. This representation would be captured, for example, by an ecological survey

⁷ Notes from telephone conversation with Marine Scotland policy advisor, Michael McLeod, 21.4.15.

of areas of economic importance. While such a survey would be sure to represent important ecological nursery areas in the *Oitir* (such as seagrass (*Zostera marina*) beds), it would be unlikely to represent the *Oitir* as a nursery ground for creel fishermen who are learning their trade. The same *Oitir* is also a site of community presence. For example, older retired fishermen go out on their boats, '*drink tea and tell lies to each other all day!*'⁸ Heading south on the way out of the *Oitir*, towards unprotected water, the fairway known as '*caolas boga' mara*' (the narrows of the dipping sea) links the community of fishermen navigating its waters through practical navigational information provided by a name which has been handed down through the generations. Representations of the *Oitir* as a site of community presence appear to be in contrast to individual creelers competing for a fisheries resource. Yet those same individual competing fishers are regularly navigating the *caolas* and constantly communicating and sharing information—on the radio, mobile phones and, more recently, Facebook. As such, the *Oitir* fishers conceptualise fish as a commodity for which they compete in order to make a living at the same time as they embody a collective and intertwined relationship with the *Oitir* and its elements, both human and non-human.

3.5. Conclusions

Taking into account the relationship between the socio-natural environment and socio-political institutions and processes complicates conservation (see [Dove et al. 2011](#)); yet it is essential to not shy away from this complexity and to foreground human values and assumptions explicit within the conservation discourse. Conservation that is focused on a biodiversity that is framed only as other-than-human nature is not conducive to effective marine stewardship, particularly where there is local resistance to the proposed conservation measures ([Brennan forthcoming](#)). On Barra, new possibilities have opened up in relation to natural resource management and conservation through a new narrative which links cultural diversity with biodiversity, in the form of the unfolding co-management process (see Section 3.4). As part of this unfolding process. The local organization, VABV, has emphasized the need for local decision-making power so that management can be carried out 'through the eyes of the local people'. Marine Scotland have facilitated the repositioning of different kinds of knowledge so that scientific and 'expert' knowledge is less likely to be perceived as tools of oppression. Specifically, Marine Scotland have articulated their position as being 'on tap' rather than 'on top' in relation to the three island communities. This approach lies in stark contrast to mainstream conservation policy and practice which tends to treat humans and nature as separate by assuming that non-human nature is distinct from human culture. It is reflective of a more integrated understanding of conservation and natural resource management in practice which better reflects the complex and dynamic characteristics of social-ecological systems. The Barra case suggests that (1) creating a *space* for sharing world-views and (2) sharing transformation ownership, can lead to a better social-ecological outcome.

4. Case Study: Lewis

Agents for change (AfC) are key individuals who have the vision, skill and power to stimulate, coordinate and facilitate change ([Lunenburg 2010](#)). They have been identified as key to creating effective change where problems are complex and culturally imbedded because of their ability to understand the barriers and envision routes through them ([Peterson 2014](#); [Wiggins et al. 2013](#)). Much of the research on AfC is confined to subject areas including healthcare ([Weeks et al. 2009](#); [Wiggins et al. 2013](#)), education ([Hargreaves 2005](#); [Peterson 2014](#)), gender studies ([Bjørnholt 2011](#); [Peterson 2014](#); [UK Government Equalities Office 2014](#)), rural entrepreneurship ([Grodofsky and Soffer 2011](#); [Korsching and Roelfs 2005](#); [Waddock and Post 1991](#)), and organisational management ([Vermeulen et al. 2010](#); [Bucciarelli 2015](#)). However, research is emerging showing their

⁸ RP-2.3 Excerpt from interview 20.10.11.

importance to rural community development, with particular reference to facilitating renewable energy (RE) development in peripheral regions (Graziano et al. 2016; Rennie and Billing 2015).

This section presents empirical evidence that local agents for change (AfC) acted as catalysts for the development of wave energy in the Isle of Lewis in the Outer Hebrides, Scotland. It characterises the motivations behind the AfC' visions for their islands' renewable resources and the actions that they subsequently took, with varying results, from 2012–2015.

The Isle of Lewis and Harris is the largest and most northerly island in the Outer Hebrides chain. It sits 40 miles off the North West coast of the Scottish mainland. As on Barra, Lewis still bears the cultural and psychological ramifications of the Highland Clearances (Moffat 2015). The Clearances in the Western Isles went against local 'hereditary rights' to land, known as dùthchas. This notion is described as a right to land and foreshore based on generational occupancy and under a set of expectations and responsibilities which create social cohesion. It remains an important factor in current discussions about socially equitable development with particular reference to resource use as it is still culturally relevant (Mackenzie et al. 2004).

Despite life on Lewis being classed as 'good' (Comhairle nan Eilean Siar 2003), its economy is small and reliant on the public sector for jobs and UK or EU developmental funds to assist with both economic development and social improvement (HIE 2011). However, given ambitious renewable energy targets for Scotland (The Scottish Government 2011), Lewis has moved from economic periphery to limelight, due to its large and accessible renewable energy resource (both wind and wave). It also has connection to the national grid, and the Arnish Fabrication Yard has the facilities needed to build and maintain renewables devices (Burntisland Fabrications Ltd. 2012). This focus is not without issue though, as an "industrial" scale on-shore wind energy development brought contention and conflict to the island. The development, Lewis Wind Farm, was refused planning permission owing to thousands of objection letters from community members (Pasqualetti 2011). Nevertheless, local communities were (and are) taking advantage of the Land Reform (Scotland) Act 2003 and are looking to buy out their land, or those that have already done so are considering using, or are using small scale on-shore wind energy as a source of income (Rennie and Billing 2015).

From 2005–2014, Lewis attracted the attention of three different wave technology companies (see Figure 2): Aquamarine Power Ltd.; Pelamis Wave Power Ltd.; and Voith Hydro Wavegen Ltd. All three of these companies were granted leases by the Crown Estate for sites located off the west coast of Lewis (Pelamis Wave Power Ltd. 2011; Voith Hydro Wavegen Ltd. 2012; Aquamarine Power 2014). The potential of the leased sites totals 80MW of electricity generation. Although grand in ambition, the reality of the Aquamarine Power and Pelamis projects was that they were to initially be small scale—one or two devices—gradually building as the companies refined their technologies and started to make a profit by selling electricity through the national grid (Pelamis Wave Power Ltd. 2011; Aquamarine Power 2014).

4.1. Methods Applied

A grounded approach (Glaser and Strauss 1967) was taken in the Lewis case study. Data were collected using social power analysis (SPA) and semi-structured interviews. The transcripts from the interviews were qualitatively coded and categorised into emergent themes following Charmaz (2006) methods. The semi-structured interviews (Hove and Anda 2005) were conducted with a total of 8 people of which were 3 agents for change identified through the SPA process and a comparative analysis between the interview transcripts and the criteria which define an AfC (Lunenburg 2010). The 3 agents for change were interviewed twice, in order to record how their motivations, behavior and participation in wave energy development changed over time. The first interviews were conducted in 2012, the second in 2014. The SPA involved asking local people (36), local authorities (1) and the wave technology developers (3) in the case studies who they thought was influential (Harding 1996) in wave energy development in the area. When the question resulted in the same names, or organisations being produced, the researcher then contacted those on the list to request an interview. In order to ensure that

the SPA was not just based on reputation, the researcher attended relevant meetings and conferences in the local area (4) as an observer and added to the list of interviewees those who were actively involved in discussions (Bouma 1970). The emergent themes were discussed within the context of peer-reviewed, literature, up-to-date news and governmental reports, and relevant change and social power theories including Lewin (1958); Kotter (1996); Lukes (2002).

4.2. Actors

The research study described in Section 4.1 investigated AfC involved in the development of wave energy (Billing 2016). There were three local AfC on the Isle of Lewis. They were involved as individuals rather than as representatives of organisations, and were not paid for their work to facilitate the renewable industry. They had differing skills sets and interests and therefore had different approaches to capitalising on the opportunity of wave energy technology. The first AfC had expertise and local knowledge in marine engineering which allowed them to bring together a community in need of a breakwater and slipway, and a developer (Wavegen) who had wave energy converters which were housed in breakwaters. The local and technical knowledge of the AfC paired with a vision for innovative and community-based problem-solving meant that an otherwise unknown site was married to a developer, on the terms of a local community.

'They were brought together actually, by a local expert engineer [Agent 152]. They were hired by the local community to figure out a way to make a new slipway and realised that area of coastline needs protection if you are going to be launching any boats so [agent 152] brought together the community group and the company'⁹.

The second AfC was an engineer for renewables in general, and was working towards creating a local supply-chain for the wave energy industry. This AfC had a working relationship with all three of the wave energy developers and with relevant small businesses on the island. Aware of the needs that the industry would have in the long-term, the AfC identified the potential of local businesses to supply the developments and so formed a cooperative, which has been running since 2013.

'[Agent 116] has brought together the small businesses to start talking about supply chain. I think these small things will have a large impact further on down the road'¹⁰

The third AfC on Lewis was a specialist in rural development and was involved in wave energy from the perspective of their own community, rather than because of business or industry aspects. This AfC envisioned commercial developments as progressive and as shaped by the community so as to conform to their ideals and way of life (e.g., *dùthchas*). The AfC saw wave energy as one such opportunity and took the lead in contacting Aquamarine Power about their lease site to discuss working together.

'You want the financial economic benefit coming to the area. Wave energy is quite difficult because any initial developments are so expensive compared to wind . . . so actually the potential for good income to the area is possibly not great until the whole technology gets established . . . So it's very interesting to be involved right at the beginning if you like, of the technology and the development.'¹¹

4.3. Environment

The AfC on Lewis encountered external barriers that were large and complex, and which ultimately ended commercial scale interest in developing wave energy on Lewis as Aquamarine and Pelamis went into administration (BBC News Scotland 2014; Ford 2015), and Wavegen shelved its

⁹ RP-3 Excerpt from interview 12.09.12.

¹⁰ RP-2 Excerpt from interview 28.08.12.

¹¹ RP-9 Excerpt from interview 25.09.12.

plans (reNEWS 2013). These barriers can be described as a negative feedback loop of finance, policy, grid and technology issues (Billing 2016). In simplified terms, this conundrum is composed of (i) the need for grid upgrades both on Lewis and for connecting Lewis to the mainland so that the island can export its renewable electricity (Snodin 2014); (ii) UK grid upgrade policy, which is based on benefit per capita calculations, with the consequence that Lewis grid upgrades were not considered as value for money investments by Ofgem, the public electricity markets watchdog (Cowell et al. 2015); (iii) renewable energy policy in the UK being disjointed in terms of climate change mitigation strategies set at a Scottish level and actual investment in renewable energy set at a UK level (Hughes 2014); and (iv) the technology not being quite ready for commercial scale operation, but unable to attract private investment because of the lack of grid connection and energy policy uncertainty (reNEWS 2013; BBC News Scotland 2014; Ford 2015). The conundrum presents itself on a national and international scale, with power structures and interactions to match. This meant that the AfC on Lewis were not able to navigate those issues, and that the external Environment had too strong an influence on the local social-ecological system.

4.4. World-Views

Society has largely decided that the transformation to renewable energy is beneficial for mankind. However, the implementation of such a change is dictated by the people who lead it (Bass and Steidlmeier 1999). In the case of Lewis, the local AfC were motivated by a moral obligation (Werhane 2002) to their communities to create jobs and provide a long-term and sustainable solution to the social issues on the island. Their physical and psychological proximity to the communities that were going to host and adapt to the changes that commercial scale wave energy were advantageous as they increased the likelihood that any changes they facilitated would be successful by embedding into culture (Lunenburg 2010; Kotter 1996).

Although the skill of change agency can be learned to some extent, personal traits are a key factor where training is not available (Doyle 2002). The traits recorded by this study included religion, a sense of responsibility, high self-efficacy levels, and optimism. The latter three characteristics tend to be found in individuals who persevere despite set-backs or poor odds (Anderson and Galinsk 2006; Bandura and Schunk 1981; Schunk 1984; Wiggins et al. 2013). Although there are some studies relating religion to a sense of social responsibility, or pro-social behaviour (for example: Bloom (2012); Preston et al. (2010)), the web of ingredients that defines religious motivation is messy and is hard to separate from individual personality traits (Preston et al. 2010).

Understanding the traits of local AfC is of particular importance when considering the type of change that rural communities need; transformational, rather than transactional (Bass and Steidlmeier 1999; Rennie and Billing 2015). The AfC in this study were not monetarily compensated for their visions and actions, and were working outside of hierarchical organisations, where power was 'given to' them by the community and other actors (see Isaac 1987), rather than them having 'power over' the participants (see Dahl 1957), which suggests they were working towards a transformational change. Despite the Environmental constraints, when interviewed in 2014, the AfC were disappointed but undeterred and still working towards a renewable energy future for Lewis.

*'A knock back's a knock back. You've got to dust yourself off and get up and do something about it.'*¹²

4.5. Transformations

From the narrow perspective of renewable energy, the transformation sought involved in converting wave energy into electrical energy. However, the transformation desired by the AfC

¹² RP-5.2 Excerpt from interview 08.10.14.

was social and economic: they aimed to make their communities more viable by bringing in jobs and income. The strength of these AfC was in their ability to stimulate change at a local scale which was either desired or accepted by the communities that they were working with or for. However, when presented with task of marrying their visions and the actions that they had taken with national scale energy policy and grid infrastructure, the AfC did not have the power to create change further up the scale. For example, the AfC argued that the Scottish and UK governments had a rhetoric of non-action or slow-action that was juxtaposed with the targets it set for renewable energy generation. In other words, the AfC found that the governmental positions on marine renewable energy did not aid the transformations they wanted to make, despite promises that they would. Reviews of UK energy policy and markets have similar conclusions (Hughes 2014; Cowell et al. 2015). Bunn and Yusupov (2015) wrote a scathing review of UK government's decision to switch from feed-in tariffs to Contracts for Difference¹³ in 2015, concluding that the switch would be inefficient at best.

4.6. Conclusions

Change literature advises that the most effective way to ensure that top-down policy is met with bottom-up action is (i) to have AfC working in or with all levels of governance, from local and operational up to that of government and its agencies, and (ii) to be in communication with each other (Kotter 1996; Adger et al. 2009; Bucciarelli 2015). The Lewis study suggests additionally that there needs to be a *space* or *forum* specifically designated to ensure AfC can communicate their visions with each other and with decision-making institutions (such as government, investors and developers) and other interested parties (such as individuals, businesses, and higher education and research institutes). This space has the potential to create a '*coalition of power*', where actions are taken on all levels to tackle barriers and achieve more stable and morally considerate solutions. This outcome comes from the dialogue amongst the actors *before* any actions are taken, so that a shared vision for the marine environment could be agreed through a deliberative process (Fearon 1998; Billing 2016), i.e., through *communicative action* (Habermas 1984).

5. Case Study: Academia

In 2003 the Scottish Minister for Environment and Rural Development set out a decision that "Scotland should aspire to generate 40% of its electricity from renewable sources by 2020" (Scottish Executive 2003). A proportion of this was to come from wave and tidal energy. At the time, 200 MW worth of offshore wind energy projects were seeking consent for development in Scotland, but large-scale wave and tidal energy projects remained aspirational. The Ministerial strategy encouraged industry, academia, and the Energy Intermediate Technology Institute to work together with the Government (then called the 'Scottish Executive') to achieve its aim of developing a low carbon, environmentally non-intrusive industry that could revitalise Scotland's manufacturing capacity, particularly in remote and rural areas. The Government would prioritise development of planning and regulatory frameworks to set out clear guidance for the licensing and consent of marine energy developments. It wanted UK research funding councils and Scottish higher education institutions to enhance their capabilities in MRE teaching and research to meet the demands of the new industrial sector. The majority of wave and tidal energy resource and lease sites are located in the marine environments of Orkney and the Pentland Firth (Baxter et al. 2011).

This section reflects on the response of the academic community to the development of the marine renewable (wave and tide) energy (MRE) industry in Scotland. It charts shifts in the interactions between academic researchers, government regulators, and the industry from the

¹³ The inefficiency of the move to Contracts for Difference (CfD) from Feed-In Tarriffs (FiT) is described by Bunn and Yusupov (2015) through their investment risk modelling—showing higher long-term risk for investing in CfD and lower ease of access to the scheme for newcomers. They argued that the FiT scheme was working well and that the policy didn't need changing before it had run its original time allocation (to 2019).

implementation of the Scottish Government's 'Securing a Renewable Future' policy document in 2003 (Scottish Executive 2003) to 2017.

5.1. Methods Applied

This case study is based on the observations of a UK National Research Council Knowledge Exchange fellow focusing on MRE development in Scotland (an author on this paper), as well as peer-reviewed and grey literature. The observations are from MRE meetings (with academics, industry representatives, and policy-makers), workshops, and conferences attended and organised on a frequent basis between 2010 and 2014. These data were gathered at the time in the form of memoranda and notes and have been compiled and compared with literature and policy outputs for the purposes of this paper.

5.2. Actors

The actors in this case study were (1) academics from the UK research community, which is mainly sited in universities; (2) public servants from the regulatory and advisory agencies of the Scottish Government; and (3) representatives of the wave-power and tidal-energy companies that were designing developments in the Pentland Firth, and elsewhere around the Scottish coasts.

The actors were co-dependent. Regulators required environmental science research to enable decision-making for developments. Industry needed data to comply with environmental impact assessment regulation for leases and licenses, and to understand the complexities of interactions between their technologies and the high energy marine environments. The research community were reliant on partnerships and the good will of the industry and regulators in order to attract funding. At the outset of the case, however, communication amongst the actors was sparse and uncoordinated, suffered from a clash of world-views, a lack of *space* for deliberation, and the constraining effect of existing practices in marine governance (the Environment).

5.3. World-Views

As in the Lewis case, actors in this case study were, for the most part, united in recognizing that a shift towards renewable energy is imperative to mitigate climate change. Many of the researchers involved were part of national and international MRE research steering groups or committees producing research recommendations to support a developing industry¹⁴, as were the public servants they interacted with. For the environmental scientists, however, the push for rapid development of wave and tidal energy outpaced the scientific evidence base (Wright 2014), yet scientists were being asked to advise on or to guide environmental impact assessments which try to understand and mitigate potential human impacts on the marine environment and threats to the resilience of the marine ecosystem¹⁵. These assessments have been cited as an important interface between academics, the industry, and government regulators (Wright 2014).

It was clear to scientists that the 'likely significant effects' of a development outlined in an environmental impact assessment did not align with the academic description 'statistically significant'. Bonar et al. (2015) suggest that "the greatest barrier to deployment of marine renewable energy is the overwhelming lack of certainty surrounding environmental impacts". This world-view is underpinned

¹⁴ Academic interest in MRE as evidenced by participation in groups including: the ICES Working Groups on Marine Renewable Energy and Marine Benthic and Renewable Energy Development, the Marine Alliance for Science and Technology Scotland Marine Renewable Energy Forum, the Offshore Renewables Joint Industry Programme, Ocean Energy Systems Annex IV, and particularly the Scottish Offshore Renewables Research Framework (SpORRAn).

¹⁵ Marine ecosystem resilience has been defined in numerous ways (see O'Leary et al. 2017). For the purposes of this paper, 'resilience of the marine ecosystem' refers to the capacity of the system to absorb change while maintaining its function, structure, integrity, and identifying features.

by deductive scientific training and methods, and by the need to face the rigour of academic peer review when communicating findings.

Within the wave and tidal energy industry, Industry professionals were often guided by the visions for clean energy embodied by the companies they worked for, but also frequently by a desire to 'make a difference' in the face of climate change. They were faced with the urgency of development, challenged by the need to demonstrate their technologies to gain investment, and to scale up rapidly, to enable further financial backing. Despite individual perceptions within the industry that humans should be stewards of the natural environment, the reality of the market-driven energy industry meant that MRE industry viewed the natural environment as a resource to be harvested and was fueled by the excitement of innovation. Scottish Government regulators, mainly Marine Scotland, are advised by scientists in agencies including Scottish Natural Heritage and the Scottish Environment Protection Agency, as well as academics. These individuals were constrained by the need to satisfy the Government's vision to generate 100% of Scotland's annual electricity consumption from renewable sources by 2020 (Scottish Government 2015), while also complying with Scottish and UK legislation relating to biodiversity and the control of environmental pollution. What they sought was certainty in the evidence that they used in decision-making for licensing for MRE developments.

5.4. Environment

The Environment for this case study originates at the highest level, with global agreements on climate change mitigation¹⁶. These then filter down through The European Union to the UK government and are implemented through Scottish Government policy aiming to reduce Scottish carbon emissions by encouraging use of RE. A second set of international obligations include biodiversity conventions (such as the Convention on Biological Diversity), and regional seas agreements such as those of OSPAR¹⁷, made concrete in EU environmental directives¹⁸, which transposed into UK and/or Scottish law, provide the natural environmental regulatory framework for development.

The renewable energy industry operates as part of the market economy, with investors making decisions on risk and return, but initial development funding has come at least partly from public sources. However, the market is itself structured by the decisions of government concerning wholesale prices for renewable energy and public investment in grid infrastructure (including electricity transport grids: see Lewis case study). Finally, the Environment for research by academics in universities and research organisations has two key elements. First, it is largely funded through competitive bids for research projects to UK and EU public organisations. Second, academics' key outputs are largely limited to papers in peer-reviewed journals due to academic world-views and Research Assessment exercises carried out once every 7 years and which return both funding and prestige to universities with high scores.

Between 2003 and 2009, numerous academic funding programmes and the UK Energy Research Centre were established, focusing predominantly on engineering sciences. The Scottish Government invested in the European Marine Energy Centre with sites on several of the islands of Orkney. The UK allocated £50 million towards the development of marine energy prototype devices the (Marine Renewables Prototype Fund 2010). As machines moved from test tanks and into the marine environment, Marine Scotland, and other regulators, were faced with increasing pressure to make consent decisions based on sparse environmental information. In response, the Scottish Government

¹⁶ E.g., the United Nations Framework Convention on Climate Change and the Kyoto Protocol (UNFCCC 1992).

¹⁷ Oslo-Paris (OSPAR) Convention for the Protection of the Marine Environment in the North-East Atlantic http://www.ospar.org/html_documents/ospar/html/ospar_convention_e_updated_text_2007.pdf.

¹⁸ Council Directive 92/43/EEC (1992). On the Conservation of Natural Habitats and of Wild Fauna and Flora, Official Journal of the European Union 206 and Council Directive 2009/147/EC (2009). On the Conservation of Wild Birds. E. Commission, Official Journal of the European Union L 20/7.

recommended development of a ‘Survey, Deploy, and Monitor’ policy, and highlighted the need for greater environmental science research capacity to enable industry to progress (FREDS MEG 2004).

From 2010, increasing amounts of funding became available for environmental science research, including £3.9M from the UK Natural Environment Research Council. Traditionally engineering-focused funding streams also started to support environmental scientists (e.g., SuperGen UKCentre for Marine Energy Research Grand Challenges research calls). Nevertheless, most funding was awarded on the basis of peer-review and so had to satisfy academic science community paradigms relating to research excellence, hypothesis testing, and applicants’ track records. Knowledge Exchange between disciplines was encouraged, but the separation of social from natural science research continued to perpetuate traditional research methods aimed at uncovering objective truths about a biophysical ‘nature’ before such knowledge could be transferred to users. This was exacerbated by limited convergence in MRE technology, meaning the knowledge landscape was constantly shifting as the industry developed, and the industry, regulators, and academics needed to be flexible and adapt (Kerr et al. 2014; Maclean et al. 2014). Often, this was not compatible with the scientific perspective.

5.5. Transformation

The intended transformation that motivated the observations reported in this case study were simple: the conversion of marine energy into electrical energy. At the collective-choice level, the transformation sought was from a society dependent on fossil-fuel energy to one using a greater proportion of renewable energy, motivated by ethical concerns as well as practical fears about the consequences of climate change. Governance was attempting to steer this change through a mixture of economic stimulation and regulation of impact on the biophysical environment. At the operational level this required the development of technology and the application of a consenting process so that gains in the use of physical environmental services were not offset by losses in biodiversity or ecosystem function. The operational transformation required communication amongst three main groups of actors: academic scientists, regulators and developers.

However, such communication was at first ineffective, because of the actors’ differing world-views, which stifled dialogue and engendered misunderstanding and frustration at a lack of development progress from the outset. The regulators needed certainty for decision-making and staying within environmental legislation, the developers needed information ‘now’ to progress, and the academic and peer-review process for environmental scientists could take several years without providing certainty in their results.

Alongside the race to secure financial investment in projects, the requirement for ‘adequate’ assessment of environmental impacts had become a barrier to development, in part because of interpretations of ‘adequate’ by the different actors at play. The desire for more ‘research’, was often in fact the desire for more understandable ‘information’ on the part of regulatory bodies and businesses—not new science, but summaries of existing research findings, translated in such a way to be applicable to their needs. Consequentially, a need for intermediaries, or ‘transdisciplinary translators’, was identified. This was not unique to marine renewable energy, and funding bodies responded to the UK’s ‘innovation’ agenda, which encouraged the academic community to engage with the end-users of their research: government regulatory bodies and industry.

In 2013 and through strong support from the environmental science community, industry and regulatory bodies, the first commercial tidal energy development was granted consent to develop in stages, provided that they had a detailed monitoring programme (Scottish Government 2015). This represented a substantial shift, bringing environmental science into the limelight for MRE development. Environmental scientists and the industry now needed to work together, albeit within the marine environment as a purely biophysical space.

Since 2013, the role of transdisciplinary translators and their organisations has become an integral part of the marine renewable sector, across academia, industry, and the regulatory environment. Even in the wake of the failure of the exemplary companies Pelamis Wave Power and Aquamarine Power,

the environmental science community continued to work more closely within the sector, acting as intermediaries between marine regulators and the industry.

5.6. Conclusions

This case study has examined the role of academic scientists in the development and regulation of new methods of extracting energy from the sea. We have used social science methods to reflect on what natural scientists have been doing in this arena. An immediate lesson is that such methods can provide valuable insights, but are not often deployed in this way because UK funding arrangements mostly militate against such transdisciplinary approaches. Our observations suggest that there is a need to better understand the consequences of differences in world-views and subsequent communication styles (including those in our own community) between and across the actors and diverse sectors involved in marine renewable energy development.

6. General Discussion

As [Ostrom \(2007, 2009\)](#) pointed out, there are no panaceas, no universal solutions to problems of the overuse or destruction of natural resources. From our case studies, we conclude that there is no one-size fits all approach that can be taken when applying marine management strategies at a local level, especially when aiming to shape an equitable and sustainable social-ecological system. Although there are external factors which influence the success of new maritime industries and conservation and management strategies, this research shows that the resources invested in understanding the variety of world-views within and amongst communities, and being able to communicate across the variety when designing these strategies, developing new industries or conserving biodiversity can reduce conflict, create efficiencies and make reaching the goal of equitable development and management of marine space more likely.

6.1. Analytical Framework

Although there are no management panaceas, there are analytical frameworks that can be applied across diverse case studies. Our framework was influenced by [Ostrom \(2007\)](#) and [McGinnis and Ostrom \(2014\)](#), but it is better seen as a simplification of the CATWOE checklist of soft systems methodology ([Checkland 1999](#)), with the main analysis categories being 'world-view', 'actors', 'transformations' and 'environment'. The 'transformations' were those within the social-ecological systems that we studied, while the 'environment' refers to the factors, external to the SES, that constrained the transformation. Actors were persons, with their agency influenced by their world-views. Prompted by the need ([Hart and Paucar-Caceres 2014](#)) for a second-order critique of action research, we briefly reflect, here, on our adaption of CATWOE as an analytical framework for change in SES.

As conceived by Checkland, Soft Systems Theory (SST) "regards [a] system as epistemological concept which is subjectively constructed by people rather the objective entities in the world" ([Yan and Yan 2010](#)). Furthermore, the CATWOE framework, which is part of the methods provided by SST, can have many realizations for any given instance, because it is intended more as a set of questions to provoke discussion of complex and perhaps 'wicked' problems than as a constraining analytical framework.

We have used the modified framework more in the manner of the framework of [Ostrom \(2007\)](#) for analysing a social-ecological system (SES). We accept that our categories are constructs, ways of interpreting complex information about the varied behaviour of people and natural ecosystems, and that we have privileged the role of the authors, as externally placed observers as well as participants, in deciding what to include in each category. Nevertheless, the modified framework has proven fruitful applied in this way, for example in distinguishing between transformations that could be owned and steered locally with those over which external constraints (the SES environment) held too great a sway.

Our interpretation of SES starts from their definition as a 'linked systems of people and nature' (Berkes and Folke 1998), or as 'human-environment systems' (Ostrom 2007), and the ontological realistic (Moon and Blackman 2014) view that at a minimum a SES is a spatio-temporally bounded site of interaction within and between biophysical processes and information communication processes. It is tempting to refer to the biophysical processes as 'nature' and the communication processes as 'society', but, as Latour (1993, 2004) has argued, these are constructed and hegemonistic labels. In the Barra case study, for example, we have observed the clash between two different constructions of 'nature': that of the local fishermen and that of the governmental agency charged with conserving bio-diversity. We theorize these different constructions in two ways: as part of the world-views of actors, and as part of the institutional 'programme' (Luhmann 1989) of the conservation agency, which we have assigned to the environment of the SES transformation.

In the CATWOE checklist, the environment is that of the transformation. For example, in their application of CATWOE to the effects of copper mining in southern Peru, Hart and Paucar-Caceres (2014) characterise the desired transformation as "contaminated water to uncontaminated water" and the environment in which this takes place as that of "general mistrust; uninterested; ignorance/lack of information; corruption; different cultural values from different strata of society; personal/corporate interests". In our case studies we have observed that what might initially be seen as a simple transformation, for example from one form of biophysical energy (in waves) to another (in electricity), in fact required, or led to, wider changes in the SES. Therefore, what Hart and Paucar-Caceres describe as part of the transformational environment, we ascribe in part to World-Views and in part to the penetration of the local system and lifeworld by the media-steered interests of the institutional systems (Habermas 1987) of external Society; i.e., to the environment component of our analysis.

As a checklist, CATWOE suggests three categories of actors: the actors who 'do' the transformation; the owners, who can stop it; and the customers, who benefit or suffer from it. For our analysis we have combined these into the single category of Actor, on the grounds that these are roles that depend on what is identified, in the narrow sense, as the transformation, and that all these roles are linked causally or consequentially into change in the SES of which they are part (unless they are fully steered by systems in the SES Environment).

The actor-network theory (Latour 2005) presents a view of SES in which the non-human actors (for example, the scallops of St Brieuc bay in the analysis of (Callon 1986)) have as critical a role as the human actors. Our analysis differs, in that we identify as Actors only those with agency, i.e., with the conscious power of choice, because the Transformation at the heart of the analysis is in principle willed (O'Brien 2012). It is designed and desired by some Actors, perhaps opposed by others, even if what comes to pass is different from what either group wished. Scallops (in our view) cannot be said to have a world-view, because that requires the ability to explain why the world is the way it is and to envisage how it should be; it is the differences in world-views amongst actors that we have used to explain both the problem situations in each case study and the possibilities for resolving those problems through change in the linked biophysical-communicative system that is a SES.

This framework was able to hold and compare the key matters from each of our case studies, dealing with the designation of a mSAC off the coast of Barra, the role of agents for change in encouraging a wave energy capture industry on Lewis, and the exchange of knowledge between academic scientists and the renewable energy industry in Scotland. Our analysis under this framework shows that there is a disconnect, or a rift between the world-views of the entities involved in tackling global environmental challenges on a local scale. This causes conflict (Barra), missed opportunities (Lewis), and unnecessary iterative processes and delays (Academia). These are human-environmental issues (bound up in biophysical regulation and science findings), making it the responsibility and the role of the humanities to identify, describe and where possible, suggest pathways for improvement, as this paper attempts to do.

6.2. Environment

Understanding what lies outside the SeS as its ‘environment’ is helpful. In a maritime community threatened by rising sea-levels that would be the biophysical environment. In our cases the Environment has been the institutional media-steered subsystems of the larger society: the power-steered governance subsystem in the case of the Barra mSAC; the money-steered, market-oriented subsystem responsible for investment in the case of the potential exploitation of wave energy on Lewis; and the paradigms of the research funding agencies in the Academia case study. Defining the environments within each case study as social rather than biophysical allows us to see that they are a set of systems created and or designed by a group of actors with their own world-views and lifeworlds. It also allows us to see that scale and power are important factors when exploring marine resource governance, particularly at a local level. As such, taking into the account the environment of the SeS is not only essential to understanding external processes and pressures, but also for understanding how transformations are created and managed in the SeS.

In all of our case studies, the environment impacted the actions and interactions in our communities of interest. On Lewis, the wicked problem of finance, policy, grid, and technology framed the outcomes of the actions that the AfC were taking. It meant that their efforts at a local level were circumvented by the scale and impersonal character of energy policy and markets. On Barra the Environment provoked key people within the local community and key civil servants within the policy environment to action and produced changes in conduct and processes related to managing the mSAC. Although still ongoing, these changes are likely to frame the implementation of other mSACs (Brennan forthcoming). Within the academic case study, the environment imposed contradictory challenges on the academic, industry and regulatory actors, on the one hand requiring certainty and speed for industrial development and its regulation, on the other hand, imposing delays through requirements for scientific rigour.

6.3. Transformation and Actors

Transformation, within the context of marine resource management, is best understood as a total reconfiguration in the SeS under consideration rather than a simple alteration in a few components. By using our adapted CATWOE framework, we are able to reflect on the complexities of the entities involved in the attempted transformations in our three case studies, including human relationships and world views. These transformations can be described as is a shift (or attempted shift) in world-view and/or environment, purposefully designed (AfC), emergent (Barra), or a mix of both (academia), where actors are intrinsic to the change, but where the change has implications which ripple out to wider society. If fully adopted, these changes become part of the SES, and where they are successful, they are embedded in society through cultural attachment (Devine-Wright 2011b) and individual identity (Illeris 2017).

Social change was famously conceptualized and described by Lewin’s three stage model¹⁹ (Lewin 1958). However, change and transformation leadership literature has expanded on this to include the motivations of the actors involved (French and Raven 1959; Kotter 1995; Bass and Steidlmeier 1999). These issues continue to feature in today’s debate. They are becoming more prominent within climate change research as it is evident that international and national policies often ignore or even create inequitable or ineffective actions (O’Brien et al. 2012). A key component of inequality and ineffectiveness is the lack of diversity in types of knowledge caused by limited or superficial interactions with and across stakeholders (Thomas and Twyman 2005; Armitage et al. 2008).

¹⁹ Stage 1; *Unfreeze*—create uncertainty in the status quo by making a compelling message for the urgent need for change. Stage 2; *Change*—use the uncertainty to break norms/habits and provide options for new ones. Stage 3; *Re-freeze*—embed the changes in culture, making them the new norm so that they are no longer identifiable as a ‘new’, but are simply ‘how things are done.

In the Barra case, actors within governance and locally were able to recognize that they weren't progressing because of different relationships to and conceptualisations of the marine space and the mSAC. Key actors within the policy arena and local Barra community chose to take the risk of stepping out of their familiar roles and into an unknown space where a different, unscripted dialogue started to emerge. Similarly, the actors in the Academia case study were starting to address their knowledge barriers by employing knowledge exchange staff, with the aim of bridging the expectation gaps between industry, academia and government. This was not the case for Lewis, however, where the large scale and impersonal character of the system that they were trying to influence (e.g., energy markets) did not recognize their 'grassroots' efforts or the need for communication across scales. This evidence from our case studies shows that, although there has been a wider dialogue leading to a general global consensus that marine resources need more effective management, the application of such policies does not necessarily *translate* into changes which are better, acceptable or equitable on a local scale. Further, they show that it takes an understanding of the underlying world-views and implicit epistemologies of the actors involved in the change to find out *why* these measures are stalling.

6.4. World-Views

The idea of 'world-view' is the concept around which this paper turns. An individual's conscious world-view emerges from values that may rarely be reflected on, and from language and culture; i.e., they are embedded in what Habermas (1984) called the lifeworld that is continuously reproduced by acts of social communication. In modern societies, lifeworlds are impacted (Habermas 1987) by larger-scale institutions, including those of the market and of governance, and in one of our examples, by that of academia. Thus, while every person will differ in their views and priorities, so that some lead change and some lead opposition, whilst others follow these leaders, we can properly speak of community and institutional world-views which provide the framework or set of constraints within which individuals act. Mostly, their actions cause the framework to be reproduced, but sometimes they change it—as exemplified in our Barra case study. Understanding that actors, engaged with the sort of issues reported here, can differ in their world-views as collectives and as individuals, and finding mechanisms for accommodating those differences, would, we think, be a beneficial change for environmental governance. The need for such change has been recognized in the 'multi-actor approach'—where public value is created separately by communities, public authorities and industry, but would benefit from co-production of value across these actors (Bryson et al. 2016), co-production of knowledge by many actors (Nowotny et al. 2003), within the conditions needed for a development to gain 'social licence to operate' (SLO) (Prno 2013). The SLO framework advises that in order for a company/organisation to develop or use resources, particularly those in rural areas, which has a social cost (e.g., creates noise, pollution, traffic, limits public use of space etc.) they need to gain the trust and co-operation of the communities that are host to it in order for it to be considered socially acceptable. Meaningful integrating local knowledge in plans for resource use has been shown to increase the likelihood of SLO (Moffat and Zhang 2014). Keen et al. (2005) add to these arguments by demonstrating how world-views are a key aspect of local knowledge and therefore of environmental governance and change, particularly on an applied local scale.

Our case studies add to these discussions in three respects.

- (A) We have shown that unacknowledged differences in the world-views and visions that actors have for the marine environment can be a barrier to marine resource management, knowledge co-creation, innovation and progress. The governing agencies and members of the community on Barra, and the academics studying renewables, were limited in the progression of their transformations due to the difference in 'visions' between what the governance regimes and the communities imagined for marine resources/areas. On Lewis, it was a case of the visions and actions of the AfC going un-noticed by those who had the power to push through developments. These issues in all of the case studies were caused by scale, power, and world-view variation.

- (B) We argue that discussions on how to manage marine resources should acknowledge the world-views (both motivations and epistemologies) of those involved. All of the case study actors would have benefitted from, or are benefiting from, being able to communicate how they envision the most effective management of marine resources and *why*. On Lewis, the actors expressly wanted to aid wave energy on the island in order to create local social benefits, such as jobs. Combined with their specialist knowledge and skill, they were able to create relationships with developers which encompassed their ‘visions’, and may have led to social benefits had the industry been able to move into commercial operation. In the Academia case study, headway is being made because there is now a recognition that there are different world-views involved in marine renewable energy development, which makes communication easier. On Barra, the rift between the ‘visions’ of several members of the community and the governing agencies is shrinking because all parties are making an effort to accommodate their different respective needs and priorities (be that meeting policy obligations or managing local resources in a way that makes sense to local people who live and work closely with the marine environment).
- (C) We suggest that there needs to be a ‘space’ for deliberation and a ‘translator’ to help this. This would allow actors to intercommunicate the reasons for their opinions, and how they envision the use of ‘their’ marine resource. This in turn could create a change in their environment, as was the case on Barra. Key members of the Barra community and governing agencies realised that a ‘blank sheet’ approach was the ‘space’ that they needed to create an effective management structure and plan for the MPA, a discussion that continues at the time of writing. The actions of the AfC on Lewis might have been more effective had there been a forum for renewable energy development on the island which involved actors on all levels of industry, governance and local communities. The academics required specialists in knowledge exchange to effectively disseminate research, and all actors needed a network where industry and policy could communicate views about their research needs.

7. Conclusions; Practical Implications

We have argued that, within the context of increasing pressure on the marine environment through development of the blue economy, marine management measures need to be able to facilitate changes that are inclusive, equitable and socially acceptable. With this in mind, we analysed evidence from three case studies. It showed that different communities and actors have varying ‘visions’ for the biophysical marine environment. These visions differ because of the world-views and epistemologies of the actors involved, and subsequently can cause conflict, or act as barriers to innovation, progress and knowledge co-creation.

Our case study approach presented real-world situations in which different methods, drawn from the social science and humanities, were used to identify areas where management of the biophysical marine environment could be improved. Our CATWOE framework was able to capture these findings by providing a way to meaningfully compare the results of our three very different case studies. When applied to our cases it proved both flexible and robust in that the elements of the checklist were able to be successfully adapted to situations which we were analysing, but were also robust enough to hold our results.

The case studies revealed that, where there was a ‘space’ or ‘translator’ for intercommunicating actors’ reasons for their opinions and actions, there was progress towards better (more integrated) management of the marine resource in question. They also revealed where there needs to be communication between different scales of actors, from grass-roots movements to government, in order to create opportunities which meet both top-down and bottom-up objectives. In addition, we also demonstrate that the socially constructed environments surrounding our social-ecological systems impose their own world-views on the actors working within the SeS. Where the actors within the SeS were able to articulate and communicate their world-views, they were able to impact the environment, but where there was no means to access or change the Environment, opportunities were

missed. Moving towards better marine resource management will require acknowledgement that there are different world-views involved at all levels of decision-making, from top-down enforcement of management measures through to bottom-up grassroots movements. Acknowledging that people have diverse world-views and reasons for their knowledges, beliefs, and values about a marine resource, is a step towards understanding why some measures for marine resource management, monitoring and development work and why others do not. We believe, with due acceptance that we write within the context of our own world-views, that this is important for equitable and socially acceptable allocation of marine resources and space.

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