

An innovation and agency perspective on the emergence and spread of Marine Spatial Planning



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ABSTRACT

The roles of governance and technological innovation have been widely recognized as important parts of sustainability transitions. However, less attention has been paid to understanding the mechanisms of the emergence and spread of innovative ideas for stewardship of social–ecological systems. This study considers how theories of innovation and agency are able to provide explanatory power regarding the spread and impact of such ideas. This includes how innovations may contribute to resolving the mismatches between the scale of ecological processes and the scale of governance of ecosystems. The emergence and spread of Marine Spatial Planning (MSP) is used as an illustrative case study. The study shows that individuals embedded in informal networks have played a key role in driving the emergence of MSP across scales and in constantly re-framing the tool in order to overcome obstacles to adoption and implementation. In a number of cases, MSP has been decoupled from the ecosystem despite being framed as a tool for ecosystem-based management. Finally, this study is important to understand the process of emergence of new integrated tools for ecosystem stewardship at the global level.

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1. Introduction

Multiple and interacting anthropogenic drivers of change are influencing the structure and function of marine ecosystems [1]. At the same time, there is an increasing demand for use of marine ecosystem services [2,3] and cumulative human pressure on coastal and marine areas [1,4]. These pressures and the rapid degradation of marine ecosystems points to an urgent need for the shift to new forms of governance and management of these areas, such as ecosystem stewardship [5]. This entails transformations that can help humanity embark on more sustainable trajectories that both increase human well-being and development and increase the capacity of ecosystems to generate services. Many of the ideas and innovations for reversing current global trends of marine resource degradation already exist in various parts of the world. However, there is a need to understand how these can have an impact at scales that match the problems. More specifically, it is crucial to understand how ideas and innovations for ecosystem stewardship emerge and spread and the role of different organizations and individuals in these processes.

This article uses an innovation perspective to explore the emergence and spread of Marine Spatial Planning (MSP), a tool that could contribute to ecosystem stewardship. The focus of much of the work on innovation has been on the development of new

knowledge within society which goes beyond a simplistic focus on new technologies as they enter societies [6]. However, in order for new innovations to actually contribute to sustainability and to solving the challenges facing linked social–ecological systems it is important to understand how and where ecological knowledge enters the process of emergence and how this impacts the framing and the packaging of ideas [7].

This is important because in the past many technologies that have led to disruptive and rapid changes in economies and societies have occurred at the expense of ecosystems, which have been degraded in part due to technological innovation and transformation [8]. An example here is the green revolution in agriculture which has drastically increased food production but has also been a cause of soil erosion, nutrient loading and the reduced provision of a wide range of ecosystem services within intensively farmed landscapes [9]. Innovation therefore involves trade-offs. Future ‘sustainability’ innovations must incorporate the ecosystem dimension if the intention is to move towards sustainable stewardship of the oceans.

1.1. Why is MSP a good case study?

Marine Spatial Planning (MSP) is regularly acknowledged to have potential as a new and integrated “solutions tool” with a capacity to balance conservation with sustainable use and economic development [10]. Furthermore, further study is merited given that MSP is being developed and implemented in many

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parts of the world and is a key component of government policy to move towards integrated management of the sea. These similar sets of policy processes have seemingly emerged both recently and relatively simultaneously [11].

As it has been defined in the literature, MSP is an attempt to couple human and environmental dynamics at the outset of a planning process [12]. It is by design, an approach that explicitly offers an integrated way of managing the ocean at relatively large spatial scales. It has the potential to meet the challenge of simultaneously increasing human wellbeing and the delivery of ecosystem services. An innovation lens that accounts for the roles of individuals and organizations as change makers (agency) [13] has been applied to look more closely at the spread of MSP as a tool for ecosystem stewardship that supports integrated governance of marine systems.

The paper is outlined as follows. Section 2 focuses on relevant literature on different conceptualisations of innovation, the connection between social innovation, ecosystem stewardship and agency using the concept of institutional entrepreneurship. Section 3 outlines the methodological framework. This is followed by a presentation of the results. The paper concludes with a discussion on some key features of the emergence and spread of MSP in the context of the roles of individuals and organizations interacting in networks and the degree to which MSP is coupled to ecosystem-based management and stewardship.

2. Analytical approach

The innovation perspective allows the empirical analysis of the emergence and spread of new ideas in society [14]. The term innovation can be traced back to Joseph Schumpeter who identified innovation as being at the heart of economic change [15]. His original conception of innovation and that of many studies that followed is of a technological innovation [6]. However other studies have focused on innovations that are not defined as technologies but ideas. Examples of these types of innovations include; models of democracy [16]. Wejnert identifies these types of innovations as having 'public consequences' and being primarily focused on 'issues of societal well-being [16].' Another example of these 'social innovations' that Wejnert [16] puts forward draws on the work of Soule [17] that studied the involvement of students in anti-apartheid protests around the world.

However, much of innovation theory using linear models of change does not explain very well how ideas move and develop that are focused on solving complex problems. This point is

articulated by Moore and Westley [18] who state: "Complex problems demand that knowledge and ideas will need to cross scales, whether the scales are spatial, temporal, hierarchical, or even cognitive." Scale here is defined as "The spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon, and 'levels' as the unit of analysis that are located at different positions on a scale [19]." In the context of this study, it is important to consider how MSP might move across scales over time. The levels of analysis in this case are geographic.

The work of Olsson and Galaz [7] draws attention to the fact that when dealing with complex social-ecological systems; 'Innovation is crucial to steer away from potential critical thresholds in the earth system and open up new trajectories of sustainability.' However, the theoretical perspectives available for understanding the spread of ideas and tools for addressing challenges facing interlinked social-ecological systems are limited. In summary, there is an emerging field that uses a complexity perspective on innovation which is good at tracking the emergence and spread of new ideas in society but does not help us understand how they can fundamentally change human-environmental interactions [7]. Resilience scholars have for a long time been interested in shifts in social-ecological systems', including the novelty, renewal, and transformations that are part of such systems' dynamics. However, they have rarely used an innovation perspective to understand these dynamics (one exception is the work of Westley [20] and onwards). This study aims to bridge this gap and improve our understanding by using MSP as an empirical case study.

The case study provides an opportunity for considering innovation as part of transitions towards sustainability and looking at innovations that do not only consider social dynamics [21] or socio-technical change [22,23] but address linked social and ecological systems and the implications for the ongoing delivery of ecosystem services [5,7,24]. In order to clarify the distinction between these different approaches to innovation, the following table has been constructed. This shows that a classic theory of innovation would address a certain component of MSP (i.e. the geospatial technical component that enables the planning) but social and ecological components need to be considered to fully understand why MSP can be seen as being innovative in the context of transitions towards sustainability. Table 1

In understanding the emergence and spread of innovation understanding the role of agency is crucial. This includes the role of individuals and organizations and the strategies they use to achieve change. It is appropriate to turn to the work of Moore and Westley [18] and Westley et al [13] who explore the role of institutional entrepreneurs [13,18]. In this work, institutional

Table 1

A comparison table that shows three different conceptualisations of innovation.

Distinguishing variable	Classical theory of innovation [6]	Social innovation [25]	Social-ecological innovation [7]
Core definition	An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption. It matters little, as far as human behavior is concerned, whether an idea is objectively new as measured by the lapse of time since its first use or discovery	Social innovation is an initiative, product or process or program that profoundly changes the basic routines, resource and authority flows or beliefs of any social system	Social innovation that is ecologically literate and embedded in being able to deliver ongoing provision of a bundle of desirable ecosystem services while maintaining ecosystem structure and function
Consequences of innovation	Deliberate private consequences, unintentional or unknown social consequences	Focus is on hoped for social consequences with less of a focus on private consequences	Focus is on public consequences connected directly to sustainability and the ongoing functioning of ecosystems as important for human wellbeing.
Connection to MSP	Marxan and related Geospatial tools for spatial planning	Geospatial tools combined with an application of adaptive cross, sectoral planning process with a high degree of stakeholder engagement	Geospatial tools, a cross-sectoral, adaptive planning process with stakeholder engagement explicitly focused on maintaining ecosystem structure and function.

entrepreneurs are distinguished from social entrepreneurs who are characterized as the inventors of a 'novel norm, idea or product.' In the case being studied here, it is not the aim to focus on individual organizations or individuals as 'inventors' but an institutional entrepreneurship conceptualization of agency, which offers more explanatory power.

Institutional entrepreneurs (IEs) are focused on; 'managing the context in such a way that the innovation has a chance to flourish, widening the circle of its impact' [13]. Indeed, institutional entrepreneurship recognizes that individuals can be champions for an idea or an innovation while also being an agent of change in managing the context and moving an idea across scales and be seen by others as an opinion leader on a given set of ideas. This perspective then moves beyond the individuals as 'champions' characterization of agency, where single individuals are given almost all credit for the success of an idea or organization and instead recognizes that institutional entrepreneurs are often embedded as part of informal networks of several change makers [13,25,26]. Furthermore, these informal networks exist in a broader system that represents an opportunity landscape that allows for the impact of crisis, serendipity and timeliness [13] as impacting the spread of innovation.

A final component for the analysis is the importance of framing. As this study focuses on the emergence and spread of a tool for ecosystem-based management and stewardship that is important as a normative idea as much as a physical tool, an understanding of how the 'idea' of MSP evolves and is actively modified by agents over time is necessary. A frame is defined by Reese [27] as 'socially shared organizing principles that meaningfully structure the social world.' The point as articulated by Matthes [28] is that ideas, issues, events and politics are subject to different interpretations and these interpretations are 'negotiated, contested and modified' over time. Therefore, it is not possible to consider the emergence of MSP without actively considering the possible importance of framing and reframing processes by key individuals and organizations.

3. Methods

3.1. Research questions

This study explores the emergence and spread dynamics of MSP between 2000 and 2010 through a case study approach. Marine Spatial Planning has emerged as a tool for understanding and managing the multiple use demands put on the oceans, resolving conflicts while following a trajectory of sustainable development through the articulation and implementation of an ecosystem approach [12] that incorporates but moves beyond networks of Marine Protected Areas [29]. The study set out to answer the following broad questions:

- How can using analytical tools from innovation studies contribute to understanding novelty and renewal as processes of transformation within the field of social–ecological systems?
- What is the role of agency in driving the spread of new ideas and the emergence of novelty for addressing challenges facing social–ecological systems?
- What is the role of ecological knowledge in the framing of Marine Spatial Planning and where does it enter the process?

3.2. Literature review

In order to build this comprehensive understanding of MSP, a literature review was undertaken of academic articles, policy documents, marine spatial plans, working papers and other gray literature on MSP and related subjects that were necessary

for understanding and orienting MSP such as Ocean Zoning, integrated coastal zone management and integrated ocean governance. During this process a total of 90 academic papers and 50 policy documents were reviewed. It was clear at this stage that the vast majority of the literature and the developments related to the literature had occurred after the year 2000 and that developments and the literature that reflected them had increased steadily from 2006 onwards.

3.3. Interviews and analysis

Data collection included 45 qualitative interviews in total [30,31]. A number were conducted in Australia (Townsville) between November and February 2011 ($n=15$). For interviewees based in the US, Europe and Australia (outside Townsville), the interviews were conducted using Skype ($n=30$). An initial group of respondents ($n=9$) for exploratory interviews were selected based on expert recommendation (using a snowball technique) and from well-cited publications on spatial planning [32,33].

Interviews were conducted with persons representing: International Governmental Organizations ($n=6$), National Government Agencies ($n=9$), European Government Agencies ($n=4$) Non-Governmental Organizations ($n=7$), Research Institutes ($n=6$), Academics ($n=10$) and Consultants ($n=3$). All interviews, which were semi-structured and informed by an interview guide, were conducted in English, recorded when respondents gave his/her consent, and transcribed. Interviews lasted 60–90 min and were conducted in the respondent's place of work (or via skype). Interviews were designed to elicit information on the following four thematic areas: (i) what was the role of individuals and organizations in the emergence and spread of MSP; (ii) what key events and places were important for the emergence and spread of MSP; (iii) enabling factors that may have contributed to the emergence of MSP, and (iv) strategies used to spread MSP (v) Ecological knowledge that supports MSP.

The intention here was to be able to balance the gathering of data directly connected to the research questions with allowing new, potentially interesting subjects to emerge. The interviews were transcribed and analyzed using open coding and qualitative data analysis that organized the interview information according to the preliminary analytical framework that was adapted from Rogers' [6] work on the stages of diffusion of innovations [16]. Responses were grouped by combining them together based on initial categories from the literature. The analysis combined deductive and inductive approaches [33], which built on existing theory and allowed new categories and understandings of the emergence and spread process to occur during the analytical process [33]. For example, during the analysis process responses were grouped together which indicated that the presence of pre-conditions as being important to how MSP emerged and the trajectories of its spread. Also, the phases of emergence and spread which are presented in the results arose out of the analytical process. Representative quotes from the final groupings are included in the results section. The quotes represent a particular idea, process or concept and act as a way to illustrate the findings.

Transcripts were examined to discover if individuals and organizations use specific strategies, key events and enabling conditions to facilitate the emergence and spread of MSP [31]. The identified regularities were used to create a condensed and coherent description of the emergence and spread of MSP. This process is illustrated in Fig. 1 and the phases of emergence and spread structure the results section. At the requests of some interviewees, the identities of the interviewees will not be revealed. Interviewees are kept anonymous throughout. Individual quotes are, however, used to identify key features of the process of emergence and spread of MSP [32]. Due to the focus on the

Emergence and Spread of MSP

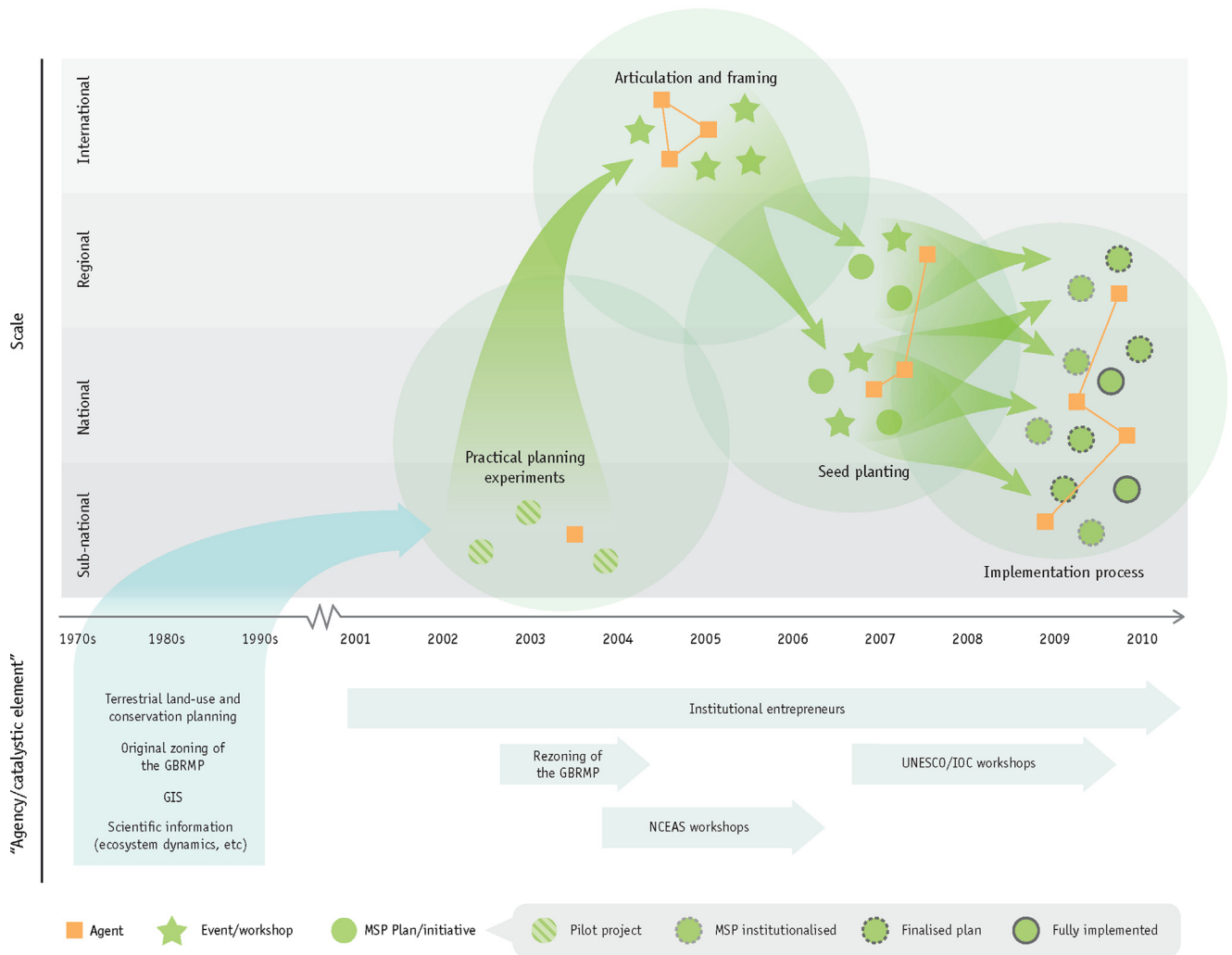


Fig. 1. Emergence and spread of MSP.

emergence and spread of Marine Spatial Planning, the study does not focus on the details of implementation in different places around the world.

4. Results

4.1. Preconditions for the emergence of MSP

The respondents identified a number of pre-conditions as important for the emergence of MSP. The key precondition that has led to the emergence of MSP was identified by the majority of respondents as terrestrial land-use and conservation planning. This is supported by a number of studies which refer to terrestrial land-use planning as being a key input into MSP [34,35]. The following quote by a senior official from an international NGO provides clear evidence of the connection between terrestrial land-use conservation planning and its use in first zoning and then becoming a core component of MSP:

“It is worth noting that a lot of the thinking that feed into the GBR was based on terrestrial thinking of the Regional Forest Process which was taken on board by marine;[...]. This is a worldwide thing too though. I don’t think this idea from terrestrial systems was actually exported from Australia to the rest of the world.”

A number of respondents indicated another key precondition for MSP as being the original zoning of the Great Barrier Reef Marine Park. Both Australian and International respondents saw the existence of the GBR zoning scheme as it was originally conceived as an important ‘demonstration site’ of how spatial separation of the ocean could occur in practice. The rezoning of the GBR which was completed in 2004 will be discussed at a later point as it occurred during the MSP emergence process and cannot be characterized as a precondition. None of the respondents identified the GBR as the sole source of innovation that led to the emergence of MSP but there was strong agreement by a number of respondents that the GBR zoning and its strong international outreach program was highly influential to future developments relating to the emergence of MSP. This precursor also points to the role of specific individuals who helped to build the early stage of the network through which MSP as an innovation could be diffused.

Ex-senior management officials from the Great Barrier Reef Marine Park were particularly influential in the 1980s and 1990s in communicating the benefits of Multiple Use Marine Planning which is an antecedent of Marine Spatial Planning. A quote is useful here to illustrate the GBR’s importance and the sharing of its early zoning experiences internationally as a prior-condition for the emergence of MSP:

“The movement towards large areas, spatial planning of large areas is heartening and I think a product of debate around the GBRMP”. In terms of individuals, I don’t have any doubt that the work in the 80s and 90s and continuing now by ex-senior officials from GBRMPA was absolutely crucial. They were tireless in their proselytizing.”

This quote by an ex-executive in the park management section of the GBRMP is illustrative of the fact that the build-up to the emergence of MSP took a long time and required a lot of groundwork to be laid over a period of time. In the case of MSP, the early pioneers in the GBR were highly influential in creating an informal international network that would be amenable to spread over the course of the emergence of MSP. The quote below by a leading expert on MSP for IOC-UNESCO strengthens the evidence that the GBR was involved in entrepreneurial ‘innovative’ behavior even in its early days.

“The GBR were pioneers in the business...we recognise the contribution that these guys made when no-one was even thinking about these issues and no-one certainly was putting them into practice.”

Another key prior-condition identified by respondents for the emergence of MSP is the development of Geographical Information Systems [36]. This is a key ‘hardware’ component of MSP, it acts as an enabler and provides the ability to synthesize and draw meaning from large amounts of spatial data in a cost-effective way [36]. Respondents did not indicate that MSP is impossible without GIS but they did point to the fact that it is much more difficult and expensive. GIS is therefore a key prior-condition but MSP is more than simply a GIS tool. A quote by a leading expert on MSP for IOC-UNESCO illustrates the role of GIS as a prior-condition:

“We could certainly do MSP without GIS and other tools, other computerised tools but I think that these tools are so powerful for quantifying and visualising information and its similarities and differences that I think the tool has been instrumental in the way we think about the oceans”.

The final prior-condition that was identified as being important by a number of respondents was the development of science useful in marine planning processes. Respondents identified that MSP as a tool relies on an excellent scientific underpinning both in terms of understanding the impacts of multiple uses and the underlying ecosystem dynamics in a given marine area [37]. Without the development of such science it is unlikely that MSP would be able to be regarded as a tool for ecosystem-based management [38]. A quote from a senior ex-official from the GBRMPA clearly illustrates this point and is representative of the centrality of high-quality scientific information as a key prior-condition for the development of MSP as a tool for ecosystem-based management:

“The crucial thing with MSP though, is that it actually has to be underpinned by a halfway decent knowledge base in terms of your biophysical resources so that you know what you are spatially planning and you also have to know about the socioeconomic factors.”

In summary, the key preconditions identified by respondents for the emergence of MSP were; terrestrial land-use and conservation planning, the original zoning of the GBRMP, the development of GIS and science that can be applied in a marine planning process.

4.2. The phases of spread and emergence of MSP

4.2.1. Practical Planning Experiments in marine spatial planning

The first phase that is distinguishable is one of ‘Practical Planning Experiments.’ In this phase the focus is on testing out ideas. This phase can be approximately identified as beginning around the year 2000. In this phase, informal networks around marine conservation and governance began to exchange ideas related to a new approach to marine planning that was, at its core, ecosystem based. It became clear from the respondents that some of the central components and indeed the terminology of ‘marine spatial planning’ came out of initial exploratory work in the United Kingdom in the early 2000s as indicated by two respondents and in various publications [39,40].

During this early phase three planning experiments at the local level can be identified from respondents that together were identified as being important for the emergence and spread of MSP. The first is the Irish Sea Pilot Project which was set up in 2002 by the UK government ‘Review of Marine Nature Conservation.’ This project was one of the first attempts to do integrated, cross-sectoral and ecosystem-based planning [41] and its explicit purpose was to ‘Test the potential for an ecosystem approach to managing the marine environment at a regional sea scale’ (JNCC/DEFRA 2010). The second key area of experimentation of MSP as a tool for ecosystem based management occurred in Belgium as part of the ‘flood of space’ project [42]. This experiment in moving ‘towards a spatial structure of the North Sea’ [43] was identified by a number of respondents as being very important in the early stages for the emergence of MSP internationally and its spread.

The third key local scale demonstration site that was particularly focused on spatial management of the oceans on the basis of consideration of a linked social–ecological system was the Rezoning of the GBR through the ‘Representative Areas Program’ which was completed in 2004 [44]. A number of respondents identified this process as providing energy, inspiration and impetus to new approaches to marine governance and a willingness to explore ecosystem-based tools for marine management and planning. Therefore, this site of experimentation was very important for creating a workable model of ecosystem based management through marine planning. A quote by the director of ecosystem conservation and sustainable use at the GBRMPA illustrates the importance of the GBRMP Authority rezoning process and its connection to MSP:

“It is like all these things [...] nothing succeeds like success. If you have a success to point to, a working model you can show to those who doubt it or don’t want to engage. You say well, it works here for the following reasons...”

A number of respondents recognized that MSP is about making connections to the ecosystem. The GBRMP was influential in impacting the spread of MSP at the international level because, it was the earliest and, one of the few working examples of Ecosystem-Based Management at a large scale that addressed the human and ecosystem dimensions of impacts on inter-linked social–ecological systems. This quote by an Australian regional government official picks up on the concept of marine connectivity as an important component of spatial resilience (introduced earlier in the results) as being at the core of the GBR following the implementation of the representative areas program:

“There is no doubt in my mind that the GBRMP approach was the most sensible, logical way, if you wanted to manage human impacts on valued ecosystems. Because the alternative approach, which was to have highly protected enclaves, as some people say, in a sea of mismanagement given the nature of connectivity between systems seems foolish.”

4.2.2. Articulation and framing of MSP at the international level

In the second phase, connections between developments that had occurred locally and the international context began to take place. There were a number of key events identified by respondents that occurred at the beginning of this phase which precipitated the emergence and created momentum for the spread of MSP. A set of key developments that aided the emergence of MSP and its spread internationally was a series of workshops held in California and organized by the National Centre for Ecological Analysis and Synthesis [10]. Four workshops were held between late 2004 and late 2006. These workshops were identified by some respondents as a 'turning point' in terms of altering the marine governance paradigm and advancing a cross-sectoral, integrated and ecosystem based approach to marine management and planning. The following quote by the head scientist of the marine conservation biology institute illustrates the importance of this series of workshops and their context:

"We assembled a group of people [...] and our purpose was to figure out what the problem is and how can we address that problem [...] we realized that the problem was the mismatches between how the ocean works as a natural system and how human governance works...that was catalytic for me and it opened up everything"

This quote not only provides support for this series of workshops as a turning point but it shows that these NCEAS workshops were important for clearly articulating what the problem was facing the oceans and what a solution needed to look like to address that problem. The work on MSP up until that point that had been emerging in different parts of the world had begun to be framed as a potential solution for this identified mismatch [45]. During the workshops the use of the term ocean zoning was replaced with Marine Spatial Planning as evidenced by the following quote by a senior official from the UNESCO-IOC MSP initiative:

"If we had 20 people in the audience, 20 of them would stand up and say this is not going to work in the US! So it was a U.S. specific set of issues that eventually convinced the working group, they first started using marine spatial planning and zoning and after four meetings they more or less dropped the zoning idea or at least it subsumed it under marine spatial planning."

This is crucial with respect to the role of framing that has allowed MSP to have an impact and spread in a way that ocean zoning has not i.e. a number of respondents made the point that zoning is a politically difficult concept particularly in the U.S. So using this term could have stopped the idea from spreading both internationally and as applied in individual countries.

A final quote with reference to this series of workshops by a senior official from the UK Marine Management Organisation identifies where the ecological component became truly part of MSP and where the concept moved away from being a facsimile of terrestrial planning on land [34]. This is because the NCEAS mediated workshops brought a strong ecological perspective which infused discussions on integrated marine planning.

"I think what NCEAS came up with was crucial [...] this wasn't something in the mind of a planner anymore. It was something where people from very different backgrounds could say, I have looked at this and from my perspective, this works. So I think it gave the intellectual support that went beyond the priesthood of planners."

At the same time as these meetings were underway a number of MSP processes were occurring at the national level such as in Norway [46] and Germany [11].

4.2.3. The seed planting phase

The next phase can be identified in light of the findings as the 'seed planting' phase. This is where MSP as an innovation is clarified and then its adoption accelerates as countries around the world draw on the internationally framed and articulated concept and it begins to be incorporated in policy. In addition, respondents highlight some key milestones. The starting point for the spread of MSP internationally begins with the origins of the UNESCO/IOC MSP initiative [47]. In November 2006, the first international workshop on MSP was held. This workshop picked up on the challenge laid out during the NCEAS workshops to push forward and operationalize MSP. This Workshop was funded by a combination of IOC and 10 National Governments (UNESCO/IOC MSP Initiative Website).

"So they pulled together a group of people [...] to look at how this might be done and we met four times in Paris over the course of two years and that was the basis of the step-by-step approach."

This quote illustrates the fact that these UNESCO/IOC workshops were important for connecting scientists to practitioners and planners to marine conservationists who operated at the local and regional scales and then became involved in moving MSP forward internationally. More importantly, this focused activity at the international level helped to coordinate the parallel, disparate processes that were occurring at the time. This initiative acted as a catalyst to bring together the different strings of marine planning and bundle them together to create a globally coherent MSP process with particular constituent elements. In September 2008, a special issue on MSP was published in the Marine Policy Journal [37] 11 articles were published by workshop participants who were a mix of practitioners and scientists from around the world. Finally the culmination of this activity was the publication of a 'Marine Spatial Planning "how to" guide' which was released in June 2009 [47].

4.2.4. The implementation process phase

This phase then draws evidence from the respondents about the impact that the move towards MSP is having in terms of actually altering marine governance. A number of respondents highlighted the fact that MSP has now become fairly widespread and ubiquitous and that it has 'broken through into the mainstream' [34]. This is important because at least at the international level, there is evidence that MSP has now become an innovative approach that is embraced by the marine planning and marine conservation communities [48]. This point was echoed by the majority of respondents and further illustrated by the following quote by a senior official from the UK marine management organisation:

"The concept has broken through and become widespread and respected.... the ideas have spread around...The point is that next week the people that are coming are the actual planners and those that are responsible for taking action and making recommendations to government on MSP and actually doing the planning. So the level has changed and those conversations are now taking place."

The claim that MSP has reached acceptance at the international level, as well as being implemented at the national and regional levels is not to claim that there is not skepticism towards MSP as an effective, innovative tool for ecosystem-based management and the degree to which it has as yet had an impact. As noted by this quote by a senior director of an international marine NGO:

"So the challenge is, in a sense, that you end up with concepts in place... the more challenging thing is how you nurture it and move

it forward in a way in which it gains shape and depth as opposed to being another label.”

It is clear that MSP is having a notable impact on the governance of marine ecosystems around the world, and that it offers a framework for change. UNESCO's Intergovernmental Oceanographic Commission (IOC) estimates that between 2000 and 2013, MSP plans have been put in place in nine countries covering an area totaling about 9% (almost 13 million km²) of global exclusive economic zones. IOC predicts that between 2013 and 2025 (based on MSP processes currently underway) MSP plans could be implemented in over 25 countries covering almost a quarter (over 31 million km²) of the world's EEZs. The cumulative total by 2025 would then be an area amounting to almost one-third of the world's EEZs (over 44 million km²) (Charles Ehler, UNESCO/IOC, pers comm 2013). These figures indicate that the emergence and spread process of MSP across scales has had a tangible impact. Fig. 1 summarizes the emergence and spread process described.

5. Discussion

5.1. Marine Spatial Planning and agency

This study of the emergence and spread MSP shows that the group of institutional entrepreneurs promoting MSP is the 'agency element' and this agency cannot simply be seen as individual champions or opinion leaders [6]. This group of multinational, interdisciplinary individuals as a network were involved in knowledge exchange of MSP principles and components and over time they collaborated in a sense-making process [25]. This process drew on a number of sub-national MSP experiments around the world (as in Belgium, the GBR and the Irish Sea) and came to a shared understanding that fed into the articulation and framing of MSP at the international level and then the further adoption of MSP into policy frameworks at local and regional levels through a seed planting and eventually an implementation process. Hence, the influence and ability to spread knowledge of MSP cannot be attributed to a few 'heroes' [26] but a strong informal network with key individuals taking on roles as institutional entrepreneurs [13,18,26]. These individuals actively spread ideas that have led to the building of a common understanding of MSP and its recognition as a tool for managing cumulative impacts, conflicting human uses and as a tool for integrated ecosystem-based management [12,35,39,49].

The results show that institutional entrepreneurs do not try to deliberately control how MSP spreads but are deeply involved creating many connections over time and their main role is in 'managing the context' rather than inventing MSP per se. A clear example from the results was the series of NCEAS workshops organized by individuals to bring together a core group of people focused on ocean zoning, which then evolved into MSP. Earlier than this, the efforts of early stage institutional entrepreneurs from GBRMPA were indicated by respondents as mobilizing knowledge and were instrumental in building some of the initial network architecture around multiple-use marine planning systems that was subsequently used and built upon during the spread of MSP. Moore and Westley [20] posit that these individual 'entrepreneurs' exist within a constantly shifting network that must be built, maintained and recharged over time. Organizations, including NOAA, GBRMPA, UNESCO/IOC, IUCN Marine division (including the World Commission on Protected Areas), NCEAS, MCBI and WWF were connected to each other via a set of individuals. IUCN was particularly important as supporting institutional entrepreneurs as three individuals influential in

either determining the prior conditions or the emergence, development and spread of MSP served as vice-chairs of the IUCN marine division. The significance of this informal network in contributing to the spread and on-going influence of MSP should be highlighted. Expanding on the notion of institutional entrepreneurs embedded in informal networks is important.

Social-ecological systems scholars that focus on transformation [13,44,50,51] posit the existence of a 'shadow network' defined as; "Informal networks that emphasize political independence outside the fray of regulation and implementation..../...and act as incubators for new ideas and approaches for governing social-ecological systems" [50]. This study on the emergence of MSP indicates similar dynamics where a small group of people from both inside and outside of the marine policy making community were part of an informal network for building and spreading MSP as a new idea. As such, members were able to offer a solution when the opportunity presented itself. One of the clearest examples of such timeliness from the results was the fact that when the Obama administration in the USA made the political decision to move forward with a new ocean governance policy, MSP as a worked-through innovative solution was available to be incorporated. The ability for this to occur was enhanced by a number of the institutional entrepreneurs and members of the 'shadow network' having had previous strong connections to NOAA.

This study also confirms earlier studies about the importance of experimentation and 'Beta Testing'. The results show how three initial experiments in different aspects of what would become MSP were crucial in providing the core ideas, impetus and energy for the on-going spread of MSP: firstly, the Belgian experiment provided an innovative approach to cross-sectoral, integrated planning and the creation of scenarios [52,53]. Secondly, the GBR experiment focused on extending the possibilities of ecosystem-based marine conservation employing concepts of spatial resilience as well as innovation around stakeholder involvement and assessment and monitoring of social-ecological systems [54]. Thirdly, the Irish Sea pilot projects were valuable in working out complex regulatory, jurisdictional and usage conflict issues. Different members of the informal network brought the knowledge, learning and experiences from these 'beta tests' or in the parlance of diffusion theory 'lead-users' [6], which was then scaled up via these agents and incorporated into the international development of MSP. It is clear then that when considering innovation in the context of social-ecological systems, institutional entrepreneurship and the shadow network provide valuable insight.

5.2. Marine Spatial Planning and ecosystems

The results of the emergence of MSP illustrate that the GBR was one of the most forward-thinking areas in terms of its use of the place-based approach and concepts of spatial resilience to provide protection for the various habitats, species and ecosystem services provided by the GBR [44,49,50]. However as MSP spread, the focus on ecosystem-based management and stewardship became diluted. Although the GBR can clearly be identified as one source of practices that fed into the framing of MSP at the international level, the process was highly context dependent. In the case of the GBR there is a clear path dependency based on the long history of the marine park which has led to the primacy of biodiversity conservation over other goals and due to the iconic status of the GBR, the interweaving of ecological knowledge and the implementation of ecosystem-based management through spatial planning was more likely to be achieved [44]. A true challenge is how to achieve effective, ecosystem-based MSP in the absence of such an 'iconic' social-ecological system.

More broadly, in some places where MSP has been adopted, the only concession to ecosystems is to create small, unconnected

networks of marine reserves [45]. There is a clear implementation gap between the 'idea' of MSP that has been developed internationally and how it is implemented in individual country contexts. This makes MSP highly adaptable to different socio-political contexts but this adaptability comes at a cost with respect to ensuring the sustainability of marine social–ecological systems. Further studies should address the process of how MSP and other similar tools spread and what is lost and added along the way and how that affects sustainability outcomes.

6. Conclusions

MSP has clear elements that delineate it as an important social–ecological innovation [7] in that it has the potential to change human–environmental interactions and feedbacks in a way that simultaneously increases human well-being and the capacity of ecosystems to generate bundles of services. It has been constructed and framed using a number of pre-existing ideas combined in a compelling way. In such a form, MSP has emerged as a tool for operationalizing ecosystem-based management and stewardship [45,55,56]. In order for MSP to be a social–ecological innovation it must pay equal attention to social and ecological dimensions [34]. The case of MSP also shows that technology (such as GIS) was a critical component in the emergence of MSP [36]. This underlines the need to address the intersection between technological, social, and ecological systems when studying the spread of innovations that can benefit both people and the planet.

MSP is only one tool for oceans governance, a tool that has been framed as a way forward in being able to implement ecosystem-based management and stewardship in an ever more complex and crowded ocean [57,58]. There was a degree of inevitability identified by respondents in the oft-repeated concept that the international push and prominence of thought around MSP is very much due to timeliness. Indeed, many of the core ideas that make up MSP have been around for 20 years but only recently have they come together as an effectively framed and newly-packaged social–ecological innovation that has impact. In the view of the authors, MSP is innovative because it enables the recognition that the oceans are no longer being a free-for-all commons and rather a space where human interests and responsibilities (established and emerging) and ecosystems interact. Further, it offers an implementable framework for addressing the challenges inherent in this recognition. MSP is indeed an idea whose time has come. MSP may be approaching a 'transformative' moment in terms of its prominence and spread but in the longer term there is nothing to guarantee that MSP will be able to fulfill its potential as a tool for ecosystem stewardship. It is important that it continues to build on the idea that humans and nature as an integral whole within which a healthy planet is the premise for economic and social development. It is these innovations that can help to reverse negative global trends of marine degradation and create the conditions for good lives for people today and in the future, while strengthening Earth's marine systems.

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