Two steps forward, two steps back: The role of innovation in transforming towards community-based marine resource management in Solomon Islands

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A B S T R A C T

In many coastal nations, community-based arrangements for marine resource management (CBRM) are promoted by government, advocated for by non-government actors, and are seen by both as one of the most promising options to achieve sustainable use and secure inshore fisheries and aquatic resources. Although there is an abundant literature on what makes CBRM effective, is it less clear how CBRM is introduced or develops as an idea in a community, and the process of how the idea leads to the adoption of a new resource management approach with supporting institutions. Here we aim to address this gap by applying an explicit process-based approach drawing on innovation history methodology by mapping and analysing the initiation and emergence of CBRM in five fishing-dependent communities in Solomon Islands. We use insights from the literatures on diffusion of innovation and transformability to define phases of the process and help guide the inductive analysis of qualitative data. We show the CBRM institutionalisation processes were non-linear, required specific strategies to move from one phase to the next, and key elements facilitated or hindered movement. Building active support for CBRM within communities depended on the types of events that happened at the beginning of the process and actions taken to sustain this. Matching CBRM to known resource management ideas or other social problems in the community, developing legitimate institutions and decision-making processes, strong continual interactions between key actors and the rest of the community (not necessarily NGO actors), and community members witnessing benefits of CBRM, all contributed to the emergence and diffusion of CBRM in the communities, and helped to overcome barriers to transformative change.

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1. Introduction

For tropical developing coastal nations, which are typically characterised by poverty and high dependence on often declining and disturbed marine resources, the need to radically transform towards more sustainable trajectories is urgent (Béné, 2009; Burke et al., 2012). This includes developing new governance regimes that support integrated approaches to the management of marine resources and ecosystems, such as ecosystem-based management which pays attention to both social and ecological dimensions of resource management, and interactions between humans and the environment (see for example, Christensen et al., 1996).

For marine systems and particularly at local and regional scales, polycentric governance and decentralised management approaches that draw on a diversity of sources of knowledge can be more appropriate for integrated resource management than conventional centralised approaches (Armitage et al., 2008). This is particularly true for nations with limited financial and human resources to enforce legislation, and with difficult-to-access remote rural communities. Decentralised approaches which embrace community-led initiatives, can be tailored to place and situation, as well as be flexible and adaptive (Armitage et al., 2008; Folke et al., 2005; Olsson et al., 2004). As a result, legislation and policy designed to empower communities to manage (or co-manage with other actors) their local marine resources are prominent in many tropical developing countries, and community-led approaches often dominate environmental non-government

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organisation's activities (Berkes, 2006; Blaikie, 2006; Evans et al., 2011).

There is a vast literature on community-based resource management (hereafter CBRM). Many studies look at what makes CBRM successful or not, and focus on institutional dimensions and adaptive capacity (Armitage, 2005; Berkes, 2006; Brown, 2002; Leach et al., 1999; Pollnac et al., 2001). However, what is less clear is how CBRM is introduced or develops as an idea in a community, and the process of how an idea leads to the adoption of a new resource management approach, with supporting institutions. This is often an emergent process that requires transformative capacity, defined here as "*the capacity to create a fundamentally new system when ecological, economic, or social, including political, conditions make the existing system untenable*" (Walker et al., 2004). Ideas around transformative capacity have emerged at the forefront of governance research to understand how transformative processes are initiated and navigated (Folke et al., 2010; Smith and Kern, 2009). Building transformative capacity is not an easy task, and often calls for *innovative* ways to "unlock" rigid and resistant institutional structures in order to pave the way for new ways of conducting business (Westley et al., 2013). However, most of the knowledge on the process of the introduction and uptake of CBRM is anecdotal. Here we aim to address this gap by applying an explicitly process-based approach, mapping out and analysing the emergence and institutionalisation of CBRM in communities. We use a comparative case study approach to gather and analyse data from five fishing-dependent communities in Solomon Islands on how CBRM in communities has emerged over time. This includes the specific activities and events that underpinned the process, and how these moved the initiation and institutionalisation processes forward and sometimes backward. We specifically seek to understand the barriers and bridges, and the strategies for moving an idea from the fringe to the mainstream in a community, and how the idea of CBRM garners support and is institutionalised.

There are three objectives to the study. First and foremost, we aim to contribute to the understanding of the *processes* of initiation and emergence of CBRM. This involves a broad focus on what kind of activities and events that take place (or not) when a community undergoes change towards CBRM. Second, in order to bring about this understanding, we have developed a method that can be readily used to analyse and compare the often 'difficult-to-pin-down' processes of innovation and transformative capacity building in communities. In doing so, we draw from the literatures on social-ecological innovation and transformation (Moore and Westley, 2011; Olsson and Galaz, 2011), and diffusion of innovation (Rogers, 1962) to provide the overall theoretical framework for the study. The diffusion of innovation lens allowed us to examine how CBRM ideas are developed and spread within and possibly also between communities. In this study we focus on innovation diffusion from the perspective of organisations – in our case, communities. An organisational perspective emphasises how organisations typically go through several stages (phases) while adopting an innovation, and that this process as such can be complex, and involves learning and adjustment for an innovation to fit within the local context (cf. Chambers et al., 1989 "Farmer first"). We also draw from innovation and learning histories methodology literature (Douthwaite and Ashby, 2005; Roth and Kleiner, 1998), and use innovation histories to understand and reflect on the process of change and learning of groups of people associated with innovation. Finally, we identify common elements across the case study sites that could be used to help guide government or non-government agency plans for supporting and engaging in processes of co-creating solutions for managing marine resources in Solomon Islands and other coastal nations.

2. Theory and background: transformative capacity and innovations for CBRM in Solomon Islands

2.1. Community-based management in the Solomon Islands context

Inshore fisheries and marine resources play a critical and unique role in the rural economy and livelihoods of Solomon Islands communities, supplying daily protein and micronutrients, and serving as one of the few sources of cash income. More than 80% of people live in rural villages across a string of 990 remote islands. Communities rely primarily on root crops (e.g. cassava, sweet potato) or imported foods (mainly rice) for their subsistence, and inshore marine resources are the most common source of animal-based food in diets (Aswani, 2002; Bell et al., 2009). In recent years in some places, the need for cash has eroded local subsistence activities, but for the most part the rural economy is dependent on producing and marketing a small number of commodities including crops and fresh fruit, coconut, cocoa, timber, as well as fish and marine products (ARDS, 2007). Wage income through direct employment accounts for approximately 26% of the household income nationally, but the majority of employment is in the urban areas (GoSI, 2006). Although few recent data exist, in 2005/2006 the incidence of basic needs poverty in Solomon Islands was estimated at 23% for the country as a whole, and 19% in rural areas. However, incidence of food poverty is lower, estimated at 10.6% nationally, and 8.7% in rural areas (UNDP, 2008), and the high dependence on fish has been described as an indication of 'subsistence affluence' (Bell et al., 2009). There are clear indications that there are limits to the capacity of the domestic fisheries sector to support the nutritional requirements, particularly with respect to animal protein and micronutrients, of the people living in Solomon Islands (Bell et al., 2009; Weeratunge et al., 2011). Thus, sustaining inshore marine resources is central to the Solomon Islands government strategy to ensure food security in the face of rapid population growth, climate change and resource degradation. The Solomon Islands National Strategy for the Management of Inshore Fisheries and Marine Resources (2010) identified community-based adaptive resource co-management as central to achieving their ambition of "sustainable and secure inshore fisheries and aquatic resources by 2020".

Solomon Islands communities have a customary tenure and governance system, where tribes and clans have ownership of the land and the sea, and communities are governed by a tribal chiefs or community leaders. Access to resources is granted to the wider community (to different degrees) by resource owners. There is widespread agreement among researchers that the tenure system and associated rules are socially motivated to reaffirm or assert power relationships and claims on resources, and did not develop as a result of resource scarcity or the need or intent to manage resources sustainably, which is recognised as a necessary pre-requisite for CBRM (Aswani, 1998; Foale, 1998; Foale et al., 2011; Ruddle, 1998). For example, customary taboo areas that temporarily close coral reef areas to fishing have long been practiced in Solomon Islands. It is common practice to declare a taboo on a clan reef as a mark of respect for the death of a prominent clan member, to protect sacred sites, or to prepare for a feast by allowing the short-term replenishment of fish. CBRM strategies in the Pacific Islands tend to advocate embracing traditional institutions, especially taboos, to implement spatial management in particular (Govan, 2009a,b; Foale et al., 2011). However, several social factors make community-based spatial management difficult, such as vague and flexible tenure boundaries, the dynamic nature of community cooperation, and cultural importance of sharing wealth (Hviding, 1998; Foale and Manele, 2004). The CBRM system that is developed is often a hybrid model, based on customary sea tenure boundaries and traditional governance

institutions which are modified using contemporary fisheries and resource management tools and ideas based on addressing future food security needs and/or meeting conservation goals. In our discussions of the CBRM 'idea' emerging in communities, we are referring to this shift in meaning: from customary rules and institutions serving a social function, to rules that are motivated by the ideas and concepts of ecosystem based management, harvest limits, and ensuring future food security for the whole community.

CBRM in Solomon Islands is often facilitated by international non-government organisations (NGOs). The NGOs may use different methods to facilitate CBRM, but to date most have used an approach requiring intensive long term collaboration with communities. There is also evidence emerging that some communities are developing rules and governance systems to manage their marine resources without input from NGOs. However, based on the current model of NGOs engaging with one community at a time, it is unlikely the ambition of the Solomon Islands national strategy will be achieved soon given limited resources and capacity in a country where transportation and communication costs are high. Hence, widespread implementation of CBRM given current limitations in terms of available resources would have to rely on some sort of diffusion process, i.e. that communities are incentivised and facilitated to take up CBRM by themselves using bottom-up approaches. This requires a much better understanding of what factors are key to enabling communities to transform towards CBRM, which is the aim of this study.

2.2. Innovations to transform towards CBRM

Transformations towards CBRM typically require substantial shifts in (1) perceptions and meanings, (2) social network configurations (patterns of interactions among actors), (3) leadership and power relations, and (4) organisational and institutional arrangements (Crona and Bodin, 2010; Folke et al., 2010; Huitema and Meijerink, 2010; Smith and Stirling, 2010; Westley et al., 2013). However, addressing these social dimensions of change is not sufficient for transforming these complex social-ecological systems towards sustainable livelihoods. Communities also need to actively learn from, respond to, and appropriately manage the dynamic ecological feedbacks in order to generate the ecosystem services to meet community needs from the marine environment (Folke et al., 2005; Olsson and Galaz, 2011).

Given that the context of communities often differs between and within countries, it is unlikely that there is an all-encompassing blue-print on how such shifts towards CBRM can be accomplished (Ostrom et al., 2007). Introduction of community-based resource management will instead require some level of reworking, and therefore innovation, at each place. We define innovation to be "any initiatives, products, processes, or programmes that change basic routines, resource and authority flows, or beliefs of any social system" (Moore and Westley, 2011). An innovation can be something entirely new that is spread throughout the community, but also can be a recombination of existing and new ideas to form something novel. In the case of CBRM in Solomon Islands, these innovations will involve finding ways to make community-based resource management fit with the current tenure system, the local seascape geography and ecology, among other factors. It also requires establishing or redefining roles and responsibilities for different actors, and finding ways to garner support among community members. Hence, the innovation(s) required for building transformative capacity for CBRM takes time to develop, need to address complex issues, and depend on the existing community context. Although it is possible that the process may begin as a consequence of a singular event or from a trigger, typically institutionalisation requires a significant number of events and actions (e.g. Lubell

et al., 2009; Sandström et al., 2014). The speed and direction of change can vary, with changes occurring incrementally or rapidly, and events can drive the process forward towards an enduring new regime of managing resources, backward towards failure, or stagnation somewhere in the middle.

It is well documented that moves towards new systems of resource management and governance likely involves conflicts and power struggles among different actors with differing interests, perceptions and incentives (Crona and Bodin, 2010; Lubell et al., 2010; Sabatier and Jenkins-Smith, 1993; Shellenberger and Nordhaus, 2004). Overcoming conflicts through collectively organising and working together to build a legitimate system that is supported by the community is considered key to the longevity of community-led governance and management of resources (Olsson et al., 2004; Ostrom, 1990, 2005). A possible alternative, where one powerful actor is solely 'in charge', or where a formally authorised institutional and jurisdictional framework is not adjusted to local conditions and/or not accompanied with the integration and participation of relevant stakeholders; can result in low compliance (Crona and Bodin, 2006; Ostrom, 1990; Scholz and Wang, 2006). Another possible alternative is unregulated open access, and this setting is often synonymous with unsustainable resource use (Hardin, 1968; Ostrom, 1990). Thus, finding innovative ways to overcome conflicts and mediating opposing coalitions could be a necessarily but challenging task in building transformative capacity for CBRM.

3. Materials and methods

3.1. Research site selection

The methodology used for this project follows a multi-case study research approach (Yin, 2009) and combines qualitative focus group data with quantitative questionnaire data. Five coastal rural communities in Western Province and Guadalcanal in Solomon Islands were used as case studies for empirical work (Fig. 1). These are located in the Jorio region of Vella Lavella Island in Western Province, and in east and west Guadalcanal Province. The communities were selected on the following criteria: (1) all have a high but varying degrees of reliance on marine resources (mainly finfish and invertebrates for subsistence and income), (2) the selected communities have implemented various types of CBRM but with different levels of success (to ensure variability in the dependent variable), (3) both communities with and without NGO involvement are part of the sample, and (4) they are all geographically close to research facilities in Western Province and Guadalcanal to accommodate as many communities as possible in the sample given a limited research budget. The fieldwork was completed between April and June 2013 by trained project staff. Research instruments were conducted in Solomon Islands Pidgin.

Three communities have had NGO involvement and assistance as part of a WorldFish programme which began in 2008, aiming to test a conceptual scheme for the diagnosis and management of small-scale fisheries (Andrew et al., 2007) and have been involved in implementing community-based adaptive management for their marine resources. Two communities have not had any NGO assistance but have worked towards implementing CBRM themselves. A description of each community is presented in Table 1.

3.2. Household surveys

Questionnaires were conducted in each community to understand whether certain preconditions for CBRM were present. These included:
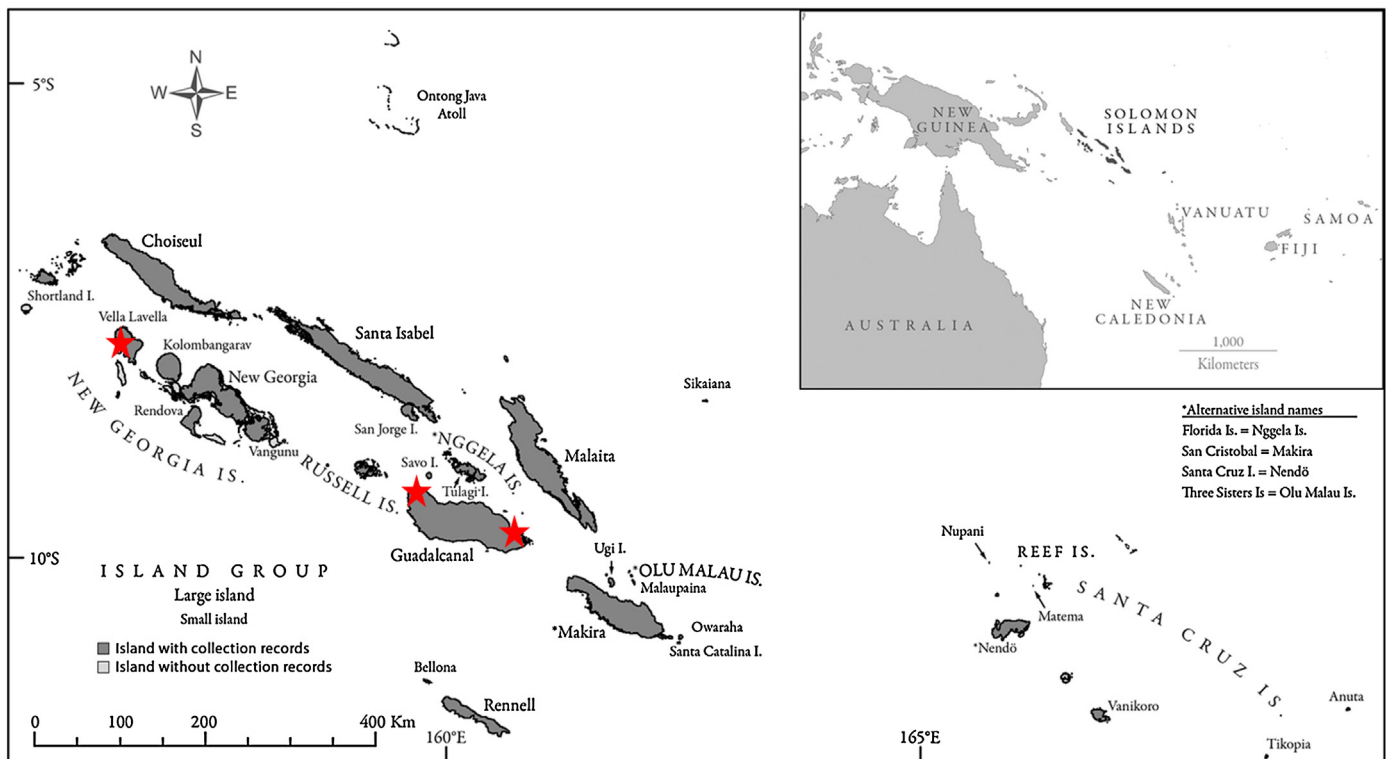
(i) Basic demographics

Fig. 1. Solomon Islands and the location of the five communities where research was undertaken denoted by stars. Three communities were on Vella Lavella Islands in Western Province, and two communities in east and west Guadalcanal.

 (ii) Whether CBRM addresses a perceived ecological need
(iii) The level of social capital (cohesion, cooperativeness, leadership) within each community
(iv) The level of community participation in CBRM activities

Questionnaire design was adapted from Krishna (2002). The questionnaires were carried out with a random sample of household heads (hhh) taken from a list available in each community, ensuring that there was an equal representation of men and women as best as possible. For larger communities, 49% (Community B: $n = 31$) 53% (Community C: $n = 46$) of household heads were interviewed, and for smaller communities, 69% (Community A: $n = 18$), 77% (Community D: $n = 20$) and 81% (Community E: $n = 21$) were surveyed. Questionnaires were conducted at different times of the day and hhh were not

interviewed if they had been in the community less than five years. Questionnaires were translated from English into Pidgin, and back-translated to ensure correct translation and meaning. The questionnaire (Supplementary Material A) and key results (Supplementary Material Table B.1.) have been used to support data and analyses from the innovation histories (see Section 3.3).

3.3. Innovation histories

In each community, an innovation history activity was designed and conducted using a focus group format. An innovation history is a participatory method for recording, discussing and reflecting on an innovation process, in this case the adoption of CBRM (based on the ideas presented in Douthwaite and Ashby, 2005). A timeline was used in each focus group as a prompt to identify and gather

Table 1

Community characteristics including size, location, tribes, churches, main occupations, NGO engagement, and CBRM governance and management type.

Characteristics	A	B	C	D	E
Size (no of households)	26	63	86	26	26
Location	Vella Lavella	Vella Lavella	Vella Lavella	East Guadalcanal	West Guadalcanal
Number of tribes	7	6	10	4	2
Number of churches	2	6	4	4	2
Top 3 occupations (in order of importance to household)	1. Fishing/gleaning 2. Garden 3. Copra	1. Garden 2. Fishing/gleaning 3. Copra	1. Fishing/gleaning 2. Garden 3. Copra	1. Fishing/gleaning 2. Garden 3. Copra	1. Garden 2. Copra Fishing/gleaning
NGO engagement	Yes (from 2007)	Yes (from 2007)	Yes (from 2007)	No	No
CBRM rules	Periodically harvested marine closure (2008–2013)	Periodically harvested marine closure (2008)	Periodically harvested marine closure (2008–2013)	Netting ban (2010–2013) Fish aggregating device (2011–2013)	Periodically harvested marine closure (2011–2013)
CBRM governance	Community CBRM representatives	Community CBRM representatives	Community CBRM leader supported by a team of youth and tribal elders and chief	Community leaders including chief, tribal and church leaders	Community youth conservation group supported by chief and elders

information on important events during the CBRM process, as well as events leading up to when the innovation idea was originally thought of or introduced in the community (either by community members or an outside actor).

The possible event types were broadly described and explained to the focus group as being one of the following: when a decision was made; when a person, group or organisation did something; when new learning occurred; when meetings occurred; when something happened (including unexpected events); and when problems were identified, arose or solved. Discussions around events included: who was involved; what influence the event had on the overall CBRM process; what the event led to; if the event was communicated to the community, by whom and how; and how events might have been responded to differently. Where relevant, discussions were held on how the community overcame barriers that prevented progression through the CBRM institutionalisation process. Additionally, the focus groups identified and discussed: key actors or groups involved within and outside the community and what their role had been in the process; what resource management rules were implemented and when, and levels of compliance; and awareness of the resource management process within the community, through time.

In summary, the innovation history method was used to describe and to provide the basis for understanding how and why the journey towards CBRM unfolded the way it did, what paths were taken and what the implications were for the uptake of resource management for each community.

The focus group participants were identified as those people who were involved and influential in the CBRM process in the community. The list of focus group participants was drawn from key informants (NGO or government personnel and community elders) and individuals identified in semi-structured interviews as being influential to the process of CBRM. Participants were included if at least two independent sources identified an actor. The field team (local researchers from Solomon Islands and lead author) spent at least one week prior to the focus group immersed in each community and conducting other research activities including semi-structured interviews with community members for the purposes of this research project. However, at least one local researcher from each field team had additionally spent extended periods of time in the community over a number of years, conducting participatory research or community-based projects, on informal visits on behalf of their organisation or to see friends and family. Detailed notes were taken during the focus group, digital recordings of the focus group were taken and later transcribed, and field team meetings to discuss key events post

focus group were held. Semi-structured individual interviews with community members, and participant observations from the prior week and other periods were used to triangulate data collected in focus groups.

3.3.1. Analysing phases of the CBRM process

The diffusion of innovation literature often distinguishes between individuals and organisations adopting an innovation (e.g. Rogers, 1962). For individuals, the internal process of adoption (when a specific individual takes up the innovation) is not usually analysed in depth because focus tends to be on how an innovation is gradually taken up by a population of individuals. For organisations, however, the implementation process *is* often problematised and scrutinised. Innovation has been widely studied and appears to have a variety of phases or stages. To identify and analyse the phases of the innovation processes in our studied communities striving to implement CBRM, Rogers (1962) definitions of the five stages in the innovation process in organisations were adapted and used as the framework for analysis (Table 2). Using the adapted definitions of each phase of innovation, every event in the community innovation histories was attributed to one of the five phases.

3.3.2. Analysing the innovation history events

Using the timeline created by participants during the focus group, a list of events with detailed descriptions were created and attributed to a point in time within a year. Times of events were cross checked with documents where available. Some inconsistencies occurred but were minor and events remained in the order the community focus groups described for analysis. Each event was then coded into one of 24 event types.

For each event, the level of active support that occurred as a result was estimated. Active support was defined as a combination of three factors: the perceived legitimacy of the resource management process, the level of community support for resource management, and the existence and the nature of rules in use. For definitions used for factors, see Table 3. These factors were chosen due to the following reasons. First, acquiring legitimacy is crucial for any institution to be effective, and this is especially relevant in cases of CBRM where communities often lack the authority to devise their own officially recognised and sanctioned legal framework. Hence, compliance with local governance and rule-making institutions is heavily dependent on community members' own perceptions and judgements of them being legitimate (Ostrom, 2005). Second, without widespread communal support, it is unlikely that CBRM will succeed as the institutionalisation and

Table 2
Phase definitions for the CBRM process, adapted from Rogers (1962) five stages in the innovation process in organisations.

	Stage (from Rogers, 1962)	Phase definition for CBRM
1	Agenda setting General firm problems that may create a perceived need for innovation	Agenda setting Community recognises a problem in the fishery that needs to be fixed, or the community recognises a problem in the wider community that needs to be fixed
2	Matching Fitting a problem from the firm's agenda with an innovations	Matching Community decides the innovation to be community-based resource management because it matches with the problem
3	Redefining/restructuring The innovation is modified and reinvented to fit the firm and firm's structures are altered	Redefining/restructuring Community decides on the community-based resource management rules and governance structures. This may be through existing structures or structures may be altered
4	Clarifying The relationship between the firm and the innovation is defined more clearly	Clarifying The community rules or governance systems are implemented or put in use (this includes at least a rudimentary level of monitoring and enforcement)
5	Routinizing The innovation becomes an on-going element in the firm's activities and loses its identify	Routinizing Community-based resource management has become normalised and stable in the community

Table 3
Definitions of the three factors that comprise active support.

Factor	Factor descriptor
Legitimacy	The level of perceived legitimacy of the resource management process is defined as the number of people in the community that perceive the governance and rule-making processes to be appropriate for their community, valid, sufficiently participatory and transparent; and that the people involved in decision-making have authority and are valid spokespersons for the wider community.
Support for idea	The level of community support for resource management or the motivation behind community-based resource management is defined as the number of people who understand what resource management is for, think it is a good idea, are voluntarily willing to support it, and change their behaviour accordingly
Rules in use	The rules in use is defined as whether there are resource management rules in use or not, and the communities ability to monitor and enforce the rules

continual enforcement is, in large, a collective action problem. Collective action requires, besides mutual trust and social capital among the involved parties, support and agreement on the task to collectively act upon (Ostrom, 2005). Third, if CBRM does not lead to fairly well-specified rules and norms in terms of what people can and cannot do, and what the consequences are if these rules are not complied with, it is unlikely that CBRM will be effective in shaping behaviours in any preferred direction (cf. North, 1990; Ostrom, 1990).

For each event, the implications for the three factors of active support were qualitatively analysed using data from the innovation history focus group data (and triangulated through participant observations, and semi structured interviews). A positive (e.g. increase in number of people perceiving the process is legitimate), negative (e.g. decrease in number of people thinking CBRM is a good idea) or zero value (no change) was attached to each event. Specifically, if the event had no effect on the factor, it was given a value of 0. If it had a positive effect, it was given a value of 1, if it had a negative effect, it was given a value of −1. If the focus group participants specifically emphasised that the event had a major effect on a factor, it was given a value of 2 or −2 depending if it was positive or negative. This scoring system facilitated the drawing of Fig. 1 for visual representation of the history of the innovation, through adding the cumulative score over time.

One potential problem with the quantification method for defining level of active support is that if a community, during a relatively short period of time, experiences many events, it may have a disproportional effect on the assessed level of active support. In reality, the actual effect of an event is continuous and could take any value. Since the method relies on qualitative data, a different quantification system for assessment is neither possible nor appropriate. However, using the method described here, many events with positive effects could rapidly and unrealistically inflate the cumulative scores of the three factors of interest.

In order to limit this undesired effect, we have developed the following scheme. First we chose a time scale that is significantly higher than the timescale at which events tend to occur. In this case, we chose the time scale of years. Then, at the end of each year, we looked at all communities' accumulated scores of support, legitimacy, and rules in use, and compared these with each other. If we found that one community had acquired a level that significantly deviated, for that year, in comparison to a relative assessment taking all the communities into account, we adjusted the score for that community. Hence, we only corrected those cases where there was an obvious deviation. We adjusted the numerical contributions of the individual events, with the same percentage, backwards until the previous point of assessment (i.e. of the previous year). In this way we limited the potential undesired effect of varying number of events, and made the actual scores comparable. However, since this approach is based on qualitative assessments, the actual levels should not be analysed using a strictly numerically basis, rather they should be interpreted relatively and should be examined with the qualitative data.

4. Results and discussion

4.1. The historical context: events leading to the CBRM process

To provide context for how the CBRM process emerged, we asked participants of the focus groups to discuss the time leading up to initiation of the CBRM idea – how fishing and gleaning practices, rules, and abundance of fish and invertebrates had changed over time.

Innovation histories for all communities were told from 1960, and the patterns in each community are very similar. All communities said that in the 1960s fish and invertebrates were large and plentiful. Catches were high with relatively low effort and fish were "*tame*". Communities used traditional methods of fishing such as bamboo pole and line and lures made from forest products. *Kastom* (Melanesian custom or tradition) in communities was strong, there was high respect for community leaders, and a strong culture of sharing (e.g. food) in the community. There were permanent customary taboos on some coral reefs and periodic taboos for certain events, such as when a chief died. In Community D, there were strict taboos against women fishing or gleaning.

By the late 1960s and throughout 1970s, harvesting and trade of marine resources became a bigger part of community life, although it had been a part of livelihoods since world war two (Allan, 1957). The communities spoke of specific foreign trading boats that would regularly come to the community to buy *bêche-de-mer* (sea cucumber) and shells (e.g. *Trochus niloticus*) for cash. Methods of fishing started to change and fishing become more commercially oriented. For example, Community D said they learned new line fishing techniques from Japanese tuna fishers, and Community E, located close to the capital, started night diving for seafood to sell at Honiara market.

By the 1980s, all communities said the human population was increasing rapidly, trade in marine products had increased, and declines in fish abundance near shore were observed. This was most acute in Community E. Imported fishing gears were introduced such as modern spear guns and torches for night diving, to meet trade demands. During this time conflicts within and between tribes in communities emerged causing tensions and loss of cohesion. The cause was mostly identified to be due to differences in opinion of whether foreign logging companies should extract timber from tribal land, or land disputes between tribes and clans more generally. The social impacts of foreign extractive industries for communities and the conflicts that have emerged have been discussed by various Solomon Islands scholars (e.g. Hviding and Bayliss Smith, 2000).

By the 1990s, trade to market centres and between communities was well-established, and fish/invertebrate declines were obvious on reflection. However, on the whole, communities did not see reduction in catches as a problem. Community's spoke both of fish being frightened and moving away, or new more efficient fishing gears masking the impact of lower catchability. In the late 1990s serious political unrest broke out across the Solomon Islands. The crisis has been described as triggered by factors linked

to rapid population growth, unemployment, limited economic opportunities and divisions over distribution of resources (Dinnen, 2002). For Vella Lavella communities (A, B, and C), violence resulted in relatives returning from Honiara to their home communities, increasing community populations and level of resource use. On Guadalcanal, communities retreated from their coastal villages to live inland.

In the 2000s, leading up to the emergence of CBRM in all communities, fishing was undertaken further from shore, and time at sea was longer. All communities spoke of increasing disrespect for community leaders and the "*old ways*" of the community. People were following more individualistic behaviour and showing "*a no care attitude*" towards their community and place.

4.2. NGO engagement in CBRM

For Vella Lavella communities (A, B and C), an earthquake and tsunami in April 2007, caused substantial destruction to villages and coastal habitats, and severely disrupted livelihoods (Prange et al., 2009; Schwarz et al., 2011). Many fishers' homes and fishing gears were destroyed. WorldFish researchers visited the Jorio region of Vella Lavella, to undertake a rapid post-tsunami assessment of fisheries livelihoods, and then began a project where five neighbouring communities (including A, B and C) worked together with WorldFish to create and implement a CBRM management plan. This included raising awareness of the problems of marine resource decline.

In contrast, the two Guadalcanal communities (D and E) did not have any direct input from NGOs for adoption of the CBRM process or in awareness-raising. However, NGOs still had influence on these two communities, through alternative mechanisms to the intensive NGO-community partnership model of CBRM institutionalisation used by Communities A, B and C. In 2011, Community D had an inshore fish aggregating device (FAD) installed as part of a Ministry of Fisheries and Marine Resources administered project. In partnership, WorldFish implemented the programme including deploying the FAD, initiating a community monitoring system and conducted interviews to evaluate effectiveness. The FAD programme began one year after Community D had implemented CBRM rules themselves. Community E is located close to Honiara, where many international and local environmental NGOs have offices. While Community E initiated and implemented a reef closure without direct NGO input, they actively sought out information on conservation and marine protected areas from the NGOs, visiting offices to find relevant literature and asking for community visits and information talks. In addition they talked to government actors and lobbied government ministries to recognise and support their initiative, including provision of tools and services. Community E's experiences reflect the trend of many coastal communities in the Asia-Pacific region independently experimenting with small temporal closures to deal with increasing marine resource scarcity (Ruddle and Satria, 2010).

4.3. CBRM innovation histories

The description of the innovation history for each community, from the point where the idea of CBRM started in the community, and in relation to community characteristics established through the questionnaire data, is presented in detail in Supplementary Material B. Fig. 2 is a visual representation of each community's level of 'active support' over time, and shows the specific events that occurred and their effect on the level of active support in each community. Community C and E have built the greatest active support since initiation of CBRM. While Community C built active support for CBRM quickly at the beginning of the process and have since plateaued, Community E spent time in a plateau at the

beginning of the process and then began to consistently build active support. Periods which plateau could be interpreted as periods of stagnation or equally as periods of stability. Community A and D show a similar pattern of building overall active support since 2010, and have achieved about half the active support of Communities C and E. Community A initiated CBRM in 2007 but failed in their first attempt. Community B has not been successful at building active support and currently does not have CBRM rules or governance systems in place.

4.4. Disaggregating active support

Overall level of active support, as depicted in Fig. 2, is useful to assess overall progress and between-case comparison. When active support is disaggregated into its three components of legitimacy, support for idea and rules in use, the proportional effect of each component on overall active support can be scrutinised qualitatively in detail and explained (Fig. 3). All three components seem important for building active support and creating an environment in which CBRM can have longevity and become normalised, and produce perceived benefits to a community. None of the communities have reached and maintained high levels of active support for CBRM without substantial contributions from all three components.

4.4.1. Rules in use

The 'rules in use' component shows whether there are resource management rules in use or not, community adaptation of rules, monitoring of resource status, rule compliance and enforcement. For all communities, the rules have been simple – a taboo on a fishing site or gear, which is temporarily lifted at particular points in the year to allow harvest. In most cases the taboo only affects a small proportion of the total fishing area or range of gears used.

4.4.1.1. Changing rules can be socially or ecologically motivated. Only one community (C) took some actions throughout the CBRM process to deliberately change rules instead of solely relying on rules crafted in the initial stages of CBRM. Rule changes occurred in response to perceived ecological or social change. The CBRM community leader, a charismatic member of the community who was appointed to the role by the chief and elders of the main land/reef owning tribe in the community, said they adapted the rules (what to harvest, and roughly how much should be harvested) to perceived changes in size and abundance of target species within the closed areas, and as support for the CBRM idea in the community shifted. The community leader for CBRM adapted techniques learned for ecological censuses for reefs from the NGO working with the community. Before each periodic harvest the leader swims the reef with a group of youth supporters he has assembled to help support the CBRM process, and then makes qualitative decisions for the community harvest.

However, management decisions were also made in response to economic or social circumstances. A recent example was associated with the lifting of the Government-led *bêche de mer* moratorium for three months in 2013. Given the high value of *bêche de mer* (see for example, Christensen, 2011), and thus a high risk of poaching on their closed reef, the CBRM leader decided to open the reef to allow community members to harvest *bêche de mer* for three days. He reasoned it was better to control the harvest (as well as benefit from it) and retain community support for CBRM than enforce the closure and lose support. The leaders in Community A said they had come under pressure to open the closed reef in response to events such as weddings. Community E opened their closed area the first time in 2013 and the youth conservation committee that governs CBRM in the community
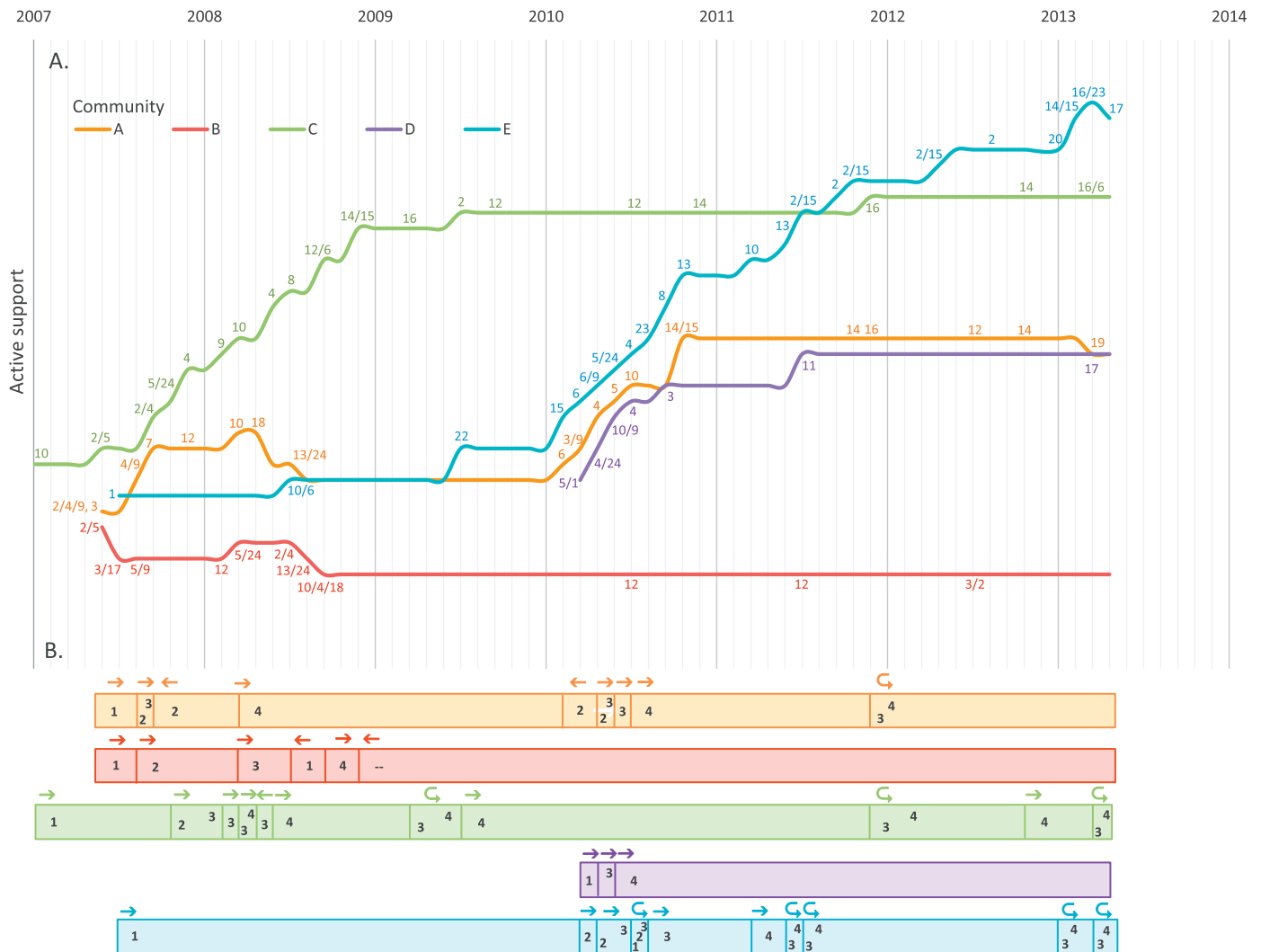
Fig. 2. The innovation histories for the process of CBRM initiation and institutionalisation in five Solomon Islands communities (A–E). Section A shows the key events that occurred in each community and whether they had a positive, negative or neutral effect on active support. The numbers on the curves corresponds to the event numbers listed in key for A of event descriptions. Section B shows the phases of the CBRM process identified. The phase number corresponds to the number and definitions identified in Table 2.

plans to only change rules once they learn to ecologically monitor the reef.

4.4.1.2. The role of tenure in rule decision-making and compliance. Agreement and support from the reef owners has been a crucial first step for CBRM to progress. For example, Community A failed in their first attempt to implement a taboo reef. It was a reef fished with a neighbouring community who were the reef owners, and located in between the two communities. As Community A were not reef owners, the community leaders were not perceived to have power to make decisions or enforce rules of the taboo. When the neighbouring community started to harvest the taboo area, fishers from Community A followed suit, and the CBRM process stalled. However, in response to this, two representatives of Community A proposed a solution – to close the reef directly in front of Community A. This reef was owned by a different community (C), who were already successfully institutionalising CBRM, and given the new close location, enforcement would be easier. Community A gained both permission and support from Community C, and the reef closure has been in place since 2010. The failure of CBRM adoption in Community B is partly due to disputes over reef ownership with a neighbouring tribe (tenure

disputes are often complex and open to multiple interpretations, see Foale and MacIntyre, 2000), but also due to failures in establishing a legitimate process and garnering support for the idea in the community (see Sections 4.4.2 and 4.4.3).

4.4.1.3. Whole community engagement in enforcement of rules. The ability to enforce rules within the community has been problematic and infringement occurs in all communities. Communities are more likely to enforce CBRM rules with people outside their community than with people they know within their communities. The communities with greatest success in enforcing CBRM rules are Communities D and E. Clear CBRM rules were made with the full community in agreement and with the whole community taking responsibility for enforcement of the rules in use. For example, Community E has developed a fine system where the money goes towards conservation and church activities. Every community member is included in enforcement (if they wish) as there is an individual incentive for community members to 'catch' infringers as they receive a proportion of the fine if they do so. The alternative is to inform the youth conservation committee (who lead CBRM governance in Community E) who then enforce the fine, and the money is kept for community church activities.
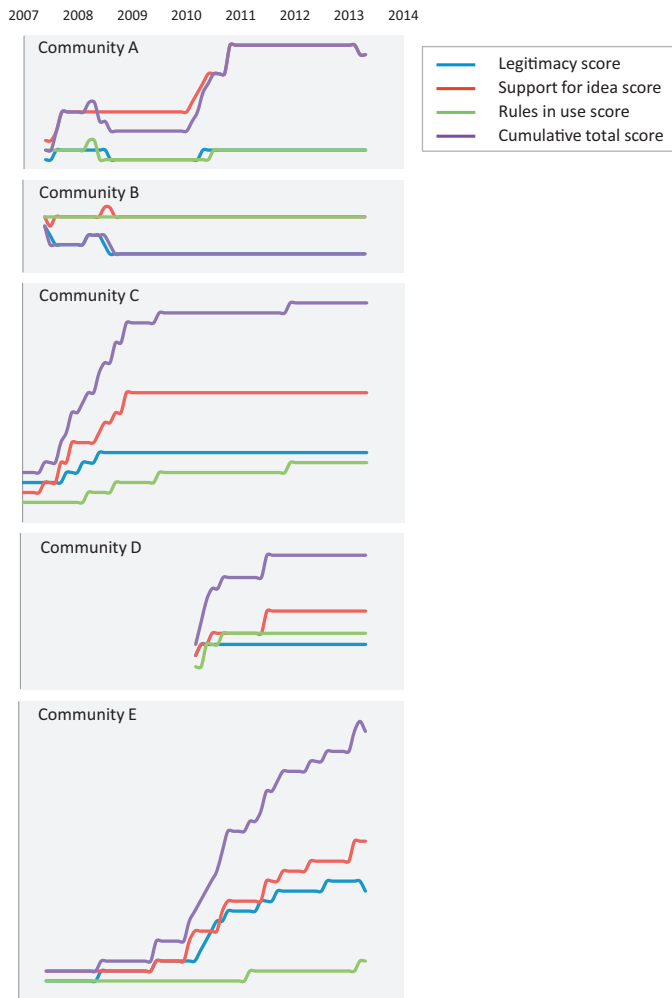
Fig. 3. Cumulative total score for active support level for innovation histories for each community, disaggregated by the three factors: legitimacy, support for idea and rules in use.

4.4.2. Support for idea

In two communities with NGO intervention (A and C), garnering support for the idea of CBRM was the focus for building active support in the communities in the initial stages of the CBRM process, and has been the primary component of active support overall. In comparison, in the communities without NGO intervention (Communities D and E), the series of events built support for the idea and legitimacy equally and simultaneously. Support for the CBRM idea has been built in two significant ways: through awareness raising and dialogue, and direct observation of the benefits of CBRM.

4.4.2.1. Knowledge brokers and the role of awareness raising and dialogue. Awareness raising and dialogue are often required as part of the preparation for community-led resource management (Chuenpagdee and Jentoft, 2007). One or two awareness sessions by the NGO kick-started the idea of CBRM in Communities A, B and C. Over time, it was only Community C and A that developed significant support for CBRM and established it as a management approach in use, whereas B failed and as of today has no CBRM in place. Thus, CBRM appears to require more than a simple transfer of ideas – follow up, facilitation and participation is of key importance. Initial enthusiasm for CBRM ideas appears to require follow-up and regular awareness sessions and dialogue discussions, with the whole community and conducted by the community. Community C conducted regular discussions over

12 months, facilitated by the appointed CBRM group leader, as part of church services. Community A initially built support, but then went through a period of stagnation that was, however, followed by an intensive period with many events that rebuilt and increased the support.

In Community E, the youth conservation committee (who lead CBRM governance, see next sub-section) conducted weekly sessions with the whole community as part of church services, for more than a year. The majority of the community worship at one church which made facilitation of these sessions, and reaching most of the community members possible. What the youth committee said, and who led the dialogue were both important in this case, and has been shown to be critical for the process to succeed by other researchers, especially when the changes are radical and may involve losses as well as gains (Chuenpagdee and Jentoft, 2007). The youth group was led by a charismatic 'champion', who talked about the ecological and food security benefits of closing their reef, based on information gathered from literature and discussions with NGOs in Honiara. They emphasised the potential economic benefits and how they may outweigh losses, such as eco-tourism and attracting attention and development aid from NGOs and government agencies through demonstrating the community can work together. Although building support for the CBRM idea required intense effort by a dedicated group of people within Communities C and E, it gave community members the opportunity to ask questions, ensured a more transparent process, spread of information throughout the community, and thus improved potential for longer term support within the community.

In both cases, the community awareness groups acted as 'knowledge brokers' or 'sense-makers' for the community (Westley et al., 2013) by making links between the marine ecological issues and broader community issues and social and economic benefits. In contrast, Community B, which currently has no rules in use, found it difficult to generate support for the idea from within the community through meetings and discussion, due to issues of legitimacy, and the process did not get the required momentum.

4.4.2.2. Seeing is believing. In all communities with marine closure rules in use (Communities A, C, and E), support for the idea of CBRM was solidified and maintained when the community saw the promised beneficial outcomes from the periodic harvest of their closed areas. All communities said that after 'seeing' the amount of resources inside the closed area after the reef had been closed, support for the idea within the community grew. In each community the periodic harvest has had direct financial benefits to individuals and the community (e.g. has paid for local church and school activities) as well as indirect benefits (e.g. visiting and paying students come to the community). There is pressure for communities to experience resource increases and harvesting benefits year to year in order to maintain active support, particularly those communities who have not built active support in other ways. There is a risk that while communities are observing benefits now, the periodically harvested closed areas have been in place for a relatively short period, and if overharvested over time, may not produce benefits in the long term (Cohen and Foale, 2013).

For Community E, direct observation helped to initiate the idea of CBRM. Observing an abundance of marine resources inside a *kastom* taboo area while visiting a neighbouring community for church activities, gave the community youth group the idea to close their community reef. This led to organising a youth conservation committee, and presenting their idea to the community leaders and the community. This exemplifies the potential of learning networks between communities to initiate CBRM ideas, a concept that is often used in NGO best practice (e.g. 'Look and learn' or exchange missions to communities engaged in

CBRM), but the effect is rarely acknowledged outside grey literature (Chuenpagdee and Jentoft, 2007; Govan et al., 2011; Lauber et al., 2008).

4.4.3. Legitimacy

The perceived legitimacy of the governance and rule-making processes as well as the people involved with making decisions were vital components for the overall level of eventual active support. In Communities A and B, legitimacy was low throughout the CBRM process. Community A appears to be relying on maintaining active support through seeing benefits from harvesting the closed area. In comparison Communities C, D and E engaged in events to build legitimacy from the start of the process. Community E has put the highest and most consistent effort into building a legitimate process for CBRM. Important elements include who participates in governance decisions, whether existing governance structures are used, and the information used to make decisions. Our data suggests that it is important to build legitimacy particularly at the beginning of the process, and if not actively sought throughout the process, can be a limiting factor in generating active support.

4.4.3.1. Participation in CBRM decision-making from the start.
When outside organisations (NGO or Government) initiate CBRM activities, they are commonly involved in decisions about who will participate in the governance of CBRM. Full participation of the community is also often postponed until later in the process to speed up initiation of CBRM (Chuenpagdee and Jentoft, 2007). This appears to be the case in Communities A and B, where community representatives for CBRM were selected through a process of NGO consultation with community leaders and elites. Community B, which suffers from weak leadership and a lack of social cohesion, had little trust in the representatives selected, which made it difficult to even initiate dialogue with the community about CBRM. In Community A, a current common complaint is that the representatives do not inform the community about CBRM developments as they happen, but are informed of decisions once they have been made.

In contrast, Communities C, D and E, have engaged in events to build legitimacy from the beginning of the process. In all three communities, meetings were held to inform the wider community of CBRM developments and to engage in dialogue and decisions in order to maintain a transparent process. In these three communities the community leaders and elders, who are mostly respected and trusted by the wider community, have given strong support to the CBRM process.

4.4.3.2. Using existing and trusted governance structures.
One of the key elements of legitimacy building has been to use existing governance structures for CBRM. Community C already had a governance structure in place for CBRM from a community-based sustainable forest resource-use programme adopted ten years prior to the introduction of the similar marine resources idea. This included a community committee with specified roles and a registered CBO. While not having as much experience, one tribe within Community E had set aside a small community terrestrial conservation area prior to CBRM, and used the existing youth committee structure to form the marine conservation committee. In addition, given their particular interest in attracting development and government support, Community E focussed efforts on building formal legitimacy. This included formally registering their marine conservation area as a community-based organisation (CBO) enabling them to apply for funding, and with the Solomon Islands LMMA (Locally Managed Marine Area network) to build resources and information networks with Asia-Pacific NGOs and communities engaged in CBRM. The conservation committee believed having formal legitimate structures has helped with lobbying government ministries and development organisations to deliver community benefits such as a sanitation project, and university student residential fieldtrips.

4.4.3.3. Information used to make decisions.
In addition to information received from other local communities, 'scientific' information from NGOs and researchers, carries legitimate weight (as well as having a role in building support for the idea of CBRM). The communities in this study placed importance on receiving information on functional ecosystem interactions and fisheries management. It may be that new and different forms of knowledge genuinely bring new and exciting ideas to communities, but it is important to be aware that the legitimacy of information can also be associated with connotations of power that outsiders may bring. Findings from research conducted on fish harvests in Community C's managed and non-managed reefs appear to have had a genuine and significant influence on the way decision-makers are thinking about the length of time to open taboo areas, what to harvest, and how they monitor the fisheries. Although the information was delivered by a researcher from outside the community, the researcher had built relationships and trust within the community, lived there, and had substantial understanding of language and culture. However, it is important to note that how CBRM information is expressed, or in some cases 'sold' to communities by any external agent (e.g. NGOs, researchers, government) can be influential and have implications for the process and adoption of CBRM. It can introduce particular hopes or expectations, and ways of thinking about CBRM and marine resource management benefits and costs. For example, others have found that over-emphasising a 'win-win' scenario and economic benefits of closing areas, can lead to lowered levels of support if expectations are not met or there are inequity in benefits within communities (Chaigneau, 2013; Christie et al., 2003).

4.5. Phases of the CBRM process

CBRM is a process as well as a product. Drawing on Roger's (1962) 'Five Stages of the Innovation Process', we interpreted the series of events in each community as different phases of the CBRM process, from idea to institutionalisation (Table 2). However, unlike the idealised model outlined by Rogers, our results show that that movement through the phases is a non-linear process. Firstly, we find in our analysis of the phases of CBRM process, communities move forwards and backwards between phases, and occasionally skip phases (see Fig. 2). We also find that a specific phase is not necessarily bound to a certain level of active support, rather a community could be at phase four while still having low levels of support. However, the results from Community B indicate that too much divergence between the level of active support and how far the CBRM process has progressed through phases, can be detrimental for the institutionalisation of CBRM. Secondly, like others (Chuenpagdee and Jentoft, 2007), we find there is no blueprint for the CBRM process, but it does appear that how a community starts a CBRM process is important for how the pathway unfolds and determines the level of support in the community for CBRM over time.

4.5.1. Preparation and matching CBRM to experience
For the two communities with greatest active support (C, E), a relatively long period was spent in Phase 1 – where the community recognised there was a problem in the community that needed to be fixed – in comparison to other communities which have built less overall active support. This first phase appeared to be an important time for the community to prepare for the changes associated with CBRM, generate support for CBRM, and build

legitimate institutions in the community, which is analogous to Olsson et al. (2006) first phase of social-ecological transformation which emphasised the time required to prepare for change to occur. For example, in the years before CBRM started, both Communities C and E had recognised a problem with their terrestrial natural resources (due to the negative impacts of logging forested land), and set up legitimised governance structures for community-based forest management. Thus, when a similar idea was proposed for the marine system (either by the NGO or members of the community), the learning that had accumulated from terrestrial management, alongside gathering information about CBRM, meant the communities were prepared for swift movement into the next phase of matching a CBRM solution to the problem, and the third phase of deciding on the new governance systems and rules.

4.5.2. Matching CBRM to ecological and/or social problems

In Phase 2, when communities decided CBRM was appropriate to address the problem identified, they did not necessarily match CBRM to an ecological or fisheries problem. In discussions during the historical context part of the innovation histories focus groups, no community had explicitly recognised an ecological problem with marine resources or necessarily attributed it directly to overharvesting. Communities spoke of there being lower fish and invertebrate catches over time and certain species disappearing from catches. However, when probed about why this was and why they did not address it at the time, it was often attributed to natural variation and a belief that marine resources would 'come back', or that fish and invertebrates were 'hiding' and 'frightened' of spearfishing or nets. This is consistent with other research in Solomon Islands where while local ecological knowledge is very high, key life history attributes that relate to resource replacement processes are largely lacking (Foale et al., 2011). It was only once CBRM events started in the community, including NGO awareness raising activities (in A, B, C), and community-led dissemination of the problems of overharvesting (in C and E), that discourses of resource decline and overharvest emerged. This is also reflected in the household surveys, which revealed most people believed there is enough fish now to meet family needs, but are less optimistic about the future, particularly in Communities B, C and D (Supplementary Material, Table B1). Future concerns about marine resources and food security were attributed to resource decline, overharvest and increasing populations in communities, which has been suggested to be, in part, a product of increasing awareness of contemporary scientific discourse on the need for better fisheries management (Foale et al., 2011).

Instead, communities tended to match CBRM to a social problem. For example, in Community E, in the ten years prior to adoption of CBRM, negative social activities such as youth drinking alcohol and causing trouble had become a concern for the community and the leaders. The leaders made a decision to address the effect youth behaviour was having on community cohesion, through encouraging youth to engage in healthy social activities. They converted an area of communal land to a sports field and engaged youth in church activities through providing instruments to start a band. When the youth group visited a neighbouring community for church activities, they dived in their kastom taboo area to harvest fish and invertebrates for the feast, and witnessed an abundance of marine resources in comparison to their own reefs. When they returned to their community and proposed to community leaders they close their community reef, the leaders actively supported the youth primarily because they felt it was a positive step for creating a socially cohesive community, with a strong youth leadership. The strength of the innovative approaches taken by leaders and youth in Community E suggests that broader integration of environmental issues with the values and problems that are meaningful to a community, can be powerful for creating change.

Similarly, Community D matched CBRM as a solution to a social problem. People from within and outside the community had started fishing using nets, while others still used pole and line methods. This was perceived as being inequitable given fish were not being shared among the community as it was in the past. The community leaders decided this inequity was a big enough problem to speak to the whole community, who then made a decision together to ban netting to everyone.

In contrast, Communities A and B, did not recognise a fisheries problem before NGO engagement. After NGO engagement and awareness raising, Community A almost immediately moved from recognising the problem and finding a matching solution, straight to making rules and decisions on the governance structure despite the level of active support being very low (Phase 3).

Although Community D also appears to follow this same trend of rapid movement through Phases 1 to 4, the problem of inequity of catch had been observed over time, and grew to a point which required action. Hence, it was comparatively easy to quickly establish a high level of support in the community, and the development of active support and forward movement through phases were better aligned. Community D is also a small close-knit community with the institutions in place to resolve problems quickly. From the first community meeting events happened quickly, decisions were made and CBRM was implemented.

4.5.3. Non-linearity in the CBRM process

All active communities (except Community D) have moved backward and forward between Phases 3 and 4, deciding on rules and governance structures, implementing and testing these, then redefining them in response to gathering more information or changing conditions. For Communities A and C, this has resulted in a plateau of active support, and a stabilisation of the CBRM process. In comparison, for Community E the switching between Phases 3 and 4 occurred alongside a continuous growth of active support. Much of this switching is related to the group of youth who lead the CBRM process. They actively sought to build on the benefits they had been receiving since implementing their closed area in 2011. For example in 2013 they successfully applied for money to build a community eco-lodge, and they are now seeking further funding for training to monitor the reef so they can adaptively manage the harvest period. Their strategy is to continuously look for opportunities to demonstrate to government and non-government actors they are a strong cohesive community, and thus hope to continue to receive benefits. The strategic opportunistic approach taken by these young entrepreneurs is an example of how strong agency can help communities navigate change and help to transform social-ecological systems (Westley et al., 2013).

5. Conclusions

This study has contributed to understand how CBRM emerges as an idea and is institutionalised in resource-dependent coastal communities. From the five case study sites in Solomon Islands we show there is no blueprint to the CBRM institutionalisation processes that occur. It clearly depends on the community context. The processes are not linear journeys and there are periods of rapid change and stability or stagnation.

The case studies revealed that sustained institutionalisation and active support of CBRM depended on the types of events that happened at the beginning of the process. Taking a social-ecological inventory rather than purely an ecological inventory, appeared to be effective for matching CBRM to the community need (Schultz et al., 2007). The subsequent series of events taken to maintain active support were also important. These events, which

can be divided into three component types, were collectively essential for building active support for CBRM within a community:

(i) Using governance structures and decision-making processes that were perceived to be legitimate through the eyes of the community were both particularly significant. Without legitimacy it was difficult to gain or hold on to support for CBRM within the community. The communities which had the most widespread active support for CBRM, had built on existing governance systems, both rules and institutions.

(ii) Spending time garnering support for the CBRM idea through community-facilitated participatory and inclusive awareness raising and dialogue was important for initiating support for CBRM. Then observing those promised improvements to community life, whether they be direct or indirectly related to CBRM, was a powerful mechanism for maintaining active support.

(iii) Selecting and adapting rules appropriate to the situation, respecting ownership of resources and involving the whole community in rule enforcement improved compliance and the acceptance of rules in the community.

In examining the role of NGOs we unveiled some interesting findings. First, communities generated effective and active support for CBRM ideas without direct NGO input. Agency was important here as building support for the idea required intensive engagement with the whole community and facilitation by an enthusiastic and determined group from within the community. A supportive leadership with an active youth appeared to be a successful combination in these cases. Nevertheless NGOs had an important role to play in the co-production of CBRM, particularly in supporting and providing access to information on resource problem recognition, marine ecosystem function, management options, and long term monitoring of CBRM and fisheries. However, delivery of this information, the type of information, and potential power asymmetries need to be considered carefully.

It seems reasonable to conclude that building transformative capacity for CBRM management systems requires innovation in both governance and management. Such innovations are a *bricolage* of existing ideas that are recombined for a specific context. In the case of Solomon Islands the innovations in governance used the existing governance system of traditional tenure, leadership and community committees, but hybridised it with new governance approaches, such as seeking formal and legal recognition, building partnerships with conservation NGOs and government, and initiating socio-political change through youth empowerment. The innovation in management comes from the rules that were used to manage the resources, such as the hybrid of *kastom taboo* with marine spatial planning. However, the taboos adopted (e.g. periodically harvested reefs) represented only a fraction of the total fishery accessed by communities. While these rules may produce short term gains, the long term fisheries benefits are questionable (Cohen and Alexander, 2013). In the case studies presented here, most innovations took place in governance rather than management (Community C's qualitative assessment of the ecological status before deciding on what to harvest and how many to harvest being an exception). This may be due to the underlying tipping point for transforming to CBRM being to address social problems rather than ecological ones. Therefore, along with others we can speculate that addressing the ecological need of fisheries has been under-emphasised in CBRM in these cases (Cohen and Foale, 2013; Cohen et al., 2013), and that communities may need to invest in innovations in management approaches drawing on a suite of rules, especially to be resilient in the long run.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.gloenvcha.2014.07.008.

References

Allan, C.H., 1957. Customary Land Tenure in the British Solomon Islands Protectorate. Western Pacific High Commission, Honiara.

Andrew, N.L., Bene, C., Hall, S.J., Allison, E.H., Heck, S., Ratner, B.D., 2007. Diagnosis and management of small-scale fisheries in developing countries. Fish Fisheries 8, 227–240.

ARDS, 2007. Solomon Islands Agricultural Rural Development Strategy. Solomon Islands Government, Ministry of Development Planning and Aid Coordination, pp. 73.

Armitage, D., 2005. Adaptive capacity and community-based natural resource management. Environ. Manage. 35, 703–715.

Armitage, D.R., Plummer, R., Berkes, F., Arthur, R.I., Charles, A.T., Davidson-Hunt, I.J., Diduck, A.P., Doubleday, N.C., Johnson, D.S., Marschke, M., 2008. Adaptive co-management for social-ecological complexity. Front. Ecol. Environ. 7, 95–102.

Aswani, S., 1998. Patterns of marine harvest effort in southwestern New Georgia, Solomon Islands: resource management or optimal foraging? Ocean Coast. Manage. 40, 207–235.

Aswani, S., 2002. Assessing the effects of changing demographic and consumption patterns on sea tenure regimes in the Roviana Lagoon, Solomon Islands. Ambio 31, 272–284.

Bell, J., Kronen, M., Vunisea, A., Nash, W.J., Keeble, G., Demmke, A., Pontifex, S., Andréfouët, S., 2009. Planning the use of fish for food security in the Pacific. Mar. Policy 33, 64–76.

Béné, C., 2009. Are fishers poor or vulnerable? Assessing economic vulnerability in small-scale fishing communities. J. Dev. Stud. 45, 911–933.

Berkes, F., 2006. From community-based resource management to complex systems: the scale issue and marine commons. Ecol. Soc. 11, 45.

Blaikie, P., 2006. Is small really beautiful? Community-based natural resource management in Malawi and Botswana. World Dev. 34, 1942–1957.

Brown, K., 2002. Innovations for conservation and development. Geograph. J. 168, 6–17.

Burke, L., Reytar, K., Spalding, M., Perry, A., 2012. Reefs at Risk Revisted in the Coral Triangle. World Resource Institute.

Chaigneau, T., 2013. Understanding community support towards three marine protected areas in the Visayas Region of the Philippines. School of International Development, University of East Anglia, UK, pp. 327.

Chambers, R., Pacey, A., Thrupp, I.A., 1989. Farmer First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications, London.

Christensen, A.E., 2011. Marine GOLD and Atoll Livelihoods: The Rise and Fall of the Bêche-de-mer trade on Ontong Java, Solomon Islands, Natural Resources Forum. Wiley Online Library, , pp. 9–20.

Christensen, N.L., Bartuska, A.M., Brown, J.H., Carpenter, S., D'Antonio, C., Francis, R., Franklin, J.F., MacMahon, J.A., Noss, R.F., Parsons, D.J., 1996. The report of the Ecological Society of America committee on the scientific basis for ecosystem management. Ecol. Appl. 6, 665–691.

Christie, P., McCay, B.J., Miller, M.L., Lowe, C., White, A.T., Stoffle, R., Fluharty, D.L., McManus, L.T., Chuenpagdee, R., Pomeroy, C., 2003. Toward developing a complete understanding: a social science research agenda for marine protected areas. Fisheries 28, 22–25.

Chuenpagdee, R., Jentoft, S., 2007. Step zero for fisheries co-management: what precedes implementation. Mar. Policy 31, 657–668.

Cohen, P.J., Alexander, T.J., 2013. Catch rates, composition and fish size from reefs managed with periodically-harvested closures. PLOS ONE 8, e73383.

Cohen, P.J., Cinner, J.E., Foale, S., 2013. Fishing dynamics associated with periodically harvested marine closures. Global Environ. Change 23, 1702–1713.

Cohen, P.J., Foale, S.J., 2013. Sustaining small-scale fisheries with periodically harvested marine reserves. Mar. Policy 37, 278–287.

Crona, B., Bodin, O., 2006. What you know is who you know? Communication patterns among resource users as a prerequisite for co-management. Ecol. Soc. 11, 7–27.

Crona, B.I., Bodin, Ö., 2010. Power asymmetries in small-scale fisheries: a barrier to governance transformability? Ecol. Soc. 15, 32.

Dinnen, S., 2002. Winners and losers: politics and disorder in the Solomon Islands 2000–2002. J. Pacif. Hist. 37, 285–298.

Douthwaite, B., Ashby, J., 2005. Innovation Histories: A Method for Learning from Experience, ILAC Brief 5. Institutional Learning and Change Initiative, Rome.

Evans, L., Cherrett, N., Pemsl, D., 2011. Assessing the impact of fisheries co-management interventions in developing countries: a meta-analysis. J. Environ. Manage. 92, 1938–1949.

Foale, S., 1998. Assessment and management of the trochus fishery at West Nggela, Solomon Islands: an interdisciplinary approach. Ocean Coast. Manage. 40, 187–205.

Foale, S., MacIntyre, M., 2000. Dynamic and flexible aspects of land and marine tenure at West Nggela: implications for marine resource management. Oceania 30–45.

Foale, S., Manele, B., 2004. Social and political barriers to the use of marine protected areas for conservation and fishery management in Melanesia. Asia Pacif. Viewpoint 45, 373–386.

Foale, S., Cohen, P., Januchowski-Hartley, S., Wenger, A., Macintyre, M., 2011. Tenure and taboos: origins and implications for fisheries in the Pacific. Fish Fisheries 12, 357–369.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T., Rockström, J., 2010. Resilience thinking: integrating resilience, adaptability and transformability. Ecol. Soc. 15, 20.

Folke, C., Hahn, T., Olsson, P., Norberg, J., 2005. Adaptive governance of social-ecological systems. Annu. Rev. Environ. Resour. 30, 441–473.

Govan, H., 2009a. Achieving the potential of locally managed marine areas in the South Pacific. SPC Tradit. Mar. Resour. Manage. Knowl. Inform. Bull. 25, 16–25.

Govan, H., 2009b. Status and Potential of Locally-Managed Marine Areas in the South Pacific: Meeting Nature Conservation and Sustainable Livelihood Targets Through Wide-Spread Implementation of LMMAs. REP/WWF/WorldFish-Reefbase/CRISP, Apia/Suva/Noumea.

Govan, H., Schwarz, A., Boso, D., 2011. Towards integrated island management: lessons from Lau, Malaita, for the implementation of a national approach to resource management in Solomon Islands: Final report. WorldFish Center Report to SPREP.

GoSI (Government of Solomon Islands), 2006. Household Income and Expenditure Survey 2005/6 National Report (Part One). Solomon Islands Statistics Office, Department of Finance and Treasury, Honiara.

Hardin, G., 1968. The tragedy of the commons. Science 162, 1243–1248.

Huitema, D., Meijerink, S., 2010. Realizing water transitions: the role of policy entrepreneurs in water policy change. Ecol. Soc. 15, 26.

Hviding, E., 1998. Contextual flexibility: present status and future of customary marine tenure in Solomon Islands. Ocean Coast. Manage. 40, 253–269.

Hviding, E., Bayliss Smith, T., 2000. Islands of Rainforest: Agroforestry, Logging and Eco-tourism in Solomon Islands. Ashgate, London.

Krishna, A., 2002. Active Social Capital: Tracing the Roots of Development and Democracy. Columbia University Press, New York.

Lauber, T.B., Decker, D.J., Knuth, B.A., 2008. Social networks and community-based natural resource management. Environ. Manage. 42, 677–687.

Leach, M., Mearns, R., Scoones, I., 1999. Environmental entitlements: dynamics and institutions in community-based natural resource management. World Dev. 27, 225–247.

Lubell, M., Henry, A.D., McCoy, M., 2010. Collaborative institutions in an ecology of games. Am. J. Polit. Sci. 54, 287–300.

Lubell, M., Leach, W.D., Sabatier, P.A., 2009. Collaborative watershed partnerships in the epoch of sustainability. In: Mazmanian, D.A., Kraft, M.E. (Eds.), Toward sustainable communities: Transition and transformations in environmental policy. MIT Press, Cambridge, MA, pp. 255–288.

Moore, M.L., Westley, F., 2011. Surmountable chasms: networks and social innovation for resilient systems. Ecol. Soc. 16 (1), 5.

North, D.C., 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.

Olsson, P., Folke, C., Berkes, F., 2004. Adaptive comanagement for building resilience in social-ecological systems. Environ. Manage. 34, 75–90.

Olsson, P., Galaz, V., 2011. Social-ecological innovation and transformation. In: Nicholls, A., Murdock, A. (Eds.), Social Innovation: Blurring Boundaries to Reconfigure Markets, vol. 223. Palgrave Macmillan, London, pp. 223–247.

Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C., Holling, C.S., 2006. Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. Ecol. Soc. 11, 18.

Ostrom, E., 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge.

Ostrom, E., 2005. Understanding Institutional Diversity. Princeton University Press, Princeton.

Ostrom, E., Janssen, M.A., Anderies, J.M., 2007. Going beyond panaceas. Proc. Natl. Acad. Sci. U.S.A. 104, 15176–15178.

Prange, J.A., Schwarz, A., Tewfik, A., 2009. Assessing needs and management options for improved resilience of fisheries-dependent communities in the earthquake/tsunami impacted Western Solomon Islands. WorldFish Center Report.

Rogers, E., 1962. Diffusion of Innovations. Simon and Schuster, New York.

Roth, G., Kleiner, A., 1998. Developing organizational memory through learning histories. Organ. Dyn. 27 (2), 43–60.

Ruddle, K., Satria, A., 2010. Managing Coastal and Inland Waters: Pre-existing Aquatic Management Systems in Southeast Asia. Springer, Heidelberg, Germany.

Sandström, A., Crona, B., Bodin, Ö, 2014. Legitimacy in co-management: the impact of preexisting structures, social networks and governance strategies. Environ. Pol. Govern. 24, 60–76.

Scholz, J.T., Wang, C.L., 2006. Cooptation or transformation? Local policy networks and federal regulatory enforcement. Am. J. Polit. Sci. 50, 81–97.

Schultz, L., Folke, C., Olsson, P., 2007. Enhancing ecosystem management through social-ecological inventories: lessons from Kristianstads Vattenrike, Sweden. Environ. Conserv. 34, 140–152.

Shellenberger, M., Nordhaus, T., 2004. The Death of Environmentalism. Global Warming Politics in a Post-environmental World. Breakthrough Institute.

Smith, A., Kern, F., 2009. The transitions storyline in Dutch environmental policy. Environ. Polit. 18, 78–98.

Smith, A., Stirling, A., 2010. The politics of social-ecological resilience and sustainable socio-technical transitions. Ecol. Soc. 15, 11.

UNDP [United Nations Development Program], 2008. Analysis of the 2005/06 Household Income and Expenditure Survey. Final report on the estimation of basic needs poverty lines, and the incidence and characteristics of poverty in Solomon Islands. SINSO and UNDP Pacific Center, Suva, Fiji.

Weeratunge, N., Pemsl, D., Rodriguez, P., Chen, O.L., Badjeck, M.C., Schwarz, A.M., Paul, C., Prange, J., Kelling, I., 2011. Planning the use of fish for food security in Solomon Islands. Coral Triangle Supp. Partner. 51.

Westley, F.R., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B., Bodin, Ö, 2013. A theory of transformative agency in linked social-ecological systems. Ecol. Soc. 18, 18.

Yin, R.K., 2009. Case Study Research: Design and Methods. Sage, Thousand Oaks.