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Exploring the prospects for adaptive governance in marine transboundary conservation in East Africa

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ABSTRACT

This article explores the prospects for adaptive governance in a proposed marine transboundary conservation initiative in East Africa. Adaptive governance that involves interdependent state and non-state actors learning and taking action on joint environmental problems is suggested for effective transboundary resource governance. Using the concept of adaptive co-management, the current multi-stakeholder marine governance systems in southern Kenya and northern Tanzania are compared to illuminate opportunities and constraints for adaptive marine transboundary conservation governance between Kenya and Tanzania. The concept of networks and the formal method of social network analysis (SNA) are applied as the main methodological device. Using questionnaire and semi-structured interviews, social network data of 70 organizations (local resources users, government agencies and NGOs) was generated from Kenya (n = 33) and Tanzania (n = 37). Results show the existence of strong collaboration networks for marine resource governance in both Kenya and Tanzania. Social proximity is the common driver of network formation. Collaboration networks in Kenya and Tanzania have contributed to enhanced learning among marine resource managers. Conclusions point to the need to focus on common challenges relating to low levels of rule-compliance, limited access to information on the state of resources and poor integration of science into marine management decisions. Finally, differences in views regarding the state of marine ecosystems need to be addressed to improve prospects for joint problem-solving in marine transboundary conservation.

1. Introduction

Marine ecosystems span man-made borders and are inherently transboundary in character, therefore their management cannot be dealt with merely at the local level. Transboundary governance is essential for marine socio-ecological systems (SESs) that span international borders [1,2]. However, transboundary marine resource management often faces many challenges, because transboundary ecosystems are complex socio-ecological systems with multiple problems. The concept of SESs indicates the interconnectedness of humans and their environment [3,4]. In such systems, challenges occur at many different scales. Thus, the challenge of managing transboundary marine socio-ecological systems is to devise governance mechanisms for maintaining ecosystem function while allowing for sustainable use at appropriate scales [5–7].

The notion of adaptive governance is put forward as a practical means for societies to deal with the complex issues that socio-ecological systems are confronted with [8,9]. Adaptive governance can be understood as a flexible, learning-based, collaborative, decision-making process, involving both state and non-state actors, often at multiple levels, with the aim to adaptively negotiate and coordinate management of socio-ecological systems across landscapes and seascapes [9,10]. Adaptive governance calls for new governance systems that are "*flexible, less prescriptive and less hierarchical, and promise a more innovative but effective way of dealing with complex environmental problems*" [9,11], including transboundary marine SESs. Flexibility is important for adaptive capacity during periods of change. Adaptive governance is particularly emphasized by scholars studying transboundary SESs facing uncertainty and change [12,14]. This is because its learning-focused approach fosters conditions that help to deal with complexities

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and uncertainties inherent in complex SESs [11,15]. Experiences from elsewhere indicate that systems of adaptive governance can improve the adaptive capacity and resilience of SESs [16,17]. However, where transboundary SESs are involved, difference between national institutional, socio-cultural and political systems can present challenges for operationalizing adaptive governance [12,18,19]. For example, difficulties in coordinating different resource governance systems and lack of political will are obstacles for operationalization of adaptive governance [20]. Thus, a deeper understanding of institutions, socio-cultural and political factors is needed to overcome barriers to adaptive governance in transboundary marine SESs.

The aim of this paper is to assess the potential for making adaptive governance operational in a transboundary, marine, socio-ecological context in East Africa. Specifically, this paper intends to assist marine governance actors in the Kenya-Tanzania border region to find ways of coordinating more effectively to implement adaptive, marine, transboundary, conservation governance. An analysis of governance in practice is used, comparing multi-stakeholder structures for marine resource governance in two adjacent regions - southern Kenya and northern Tanzania. These two regions represent the two sides of the Kenya-Tanzania border, which is an area that has been proposed for marine transboundary conservation [21]. The overriding goal of the proposed marine transboundary conservation initiative is to conserve the shared, transboundary, marine ecosystem, ensuring effective and equitable governance of its use, and deploying sustainable solutions to the common challenges, including climate and the growing demand for food and development. An adaptive governance approach that promotes collaboration between multiple stakeholders at different levels has been proposed. However, adaptive governance will require some degree of congruence in marine governance practices and their coordination between countries. Moreover, it will not be easy to formulate and implement an adaptive approach, especially when differences exist in institutional frameworks for marine governance between the two countries. This article, therefore, provides a comparative perspective of Kenya and Tanzania, examining how the characteristics of the current marine governance systems in two adjacent regions - southern Kenya and northern Tanzania - might facilitate or constrain transition to adaptive transboundary marine resource governance.

2. Conceptual and analytical framework

Adaptive governance of socio-ecological systems (SESs) has been under increased scrutiny in recent decades. Adaptive governance focuses on the broader social context within which sustainable ecosystem management occurs [9,11,13]. It builds upon linkages between actors at multiple levels and scales for sustainable ecosystem management [9,22]. Adaptive governance is usually correlated with resilience, or capacity to cope with stresses or disturbances [23]. One approach, aimed at improving adaptive governance of complex SESs, is adaptive co-management, defined by Olsson et al. (2004) [24] as "… *flexible, community-based systems of resource management tailored to specific places and situations, and supported by and working with various organizations at different scales*". Adaptive co-management is frequently described as an approach or strategy for the governance of SESs in the face of complexity and uncertainty [25,26]. There are numerous examples of how an adaptive co-management approach has been applied to address a variety of environmental and resource challenges [27,28]. Different frameworks have also been proposed for evaluating adaptive co-management interventions at different stages of implementation, based on different parameters [29,32].

So far, there have been few efforts towards evaluating the process of adaptive co-management as a way of improving the prospects of adaptive governance, despite several conceptual frameworks, a growing research field in adaptive co-management and many published case-studies. This study focuses on this gap by conducting an in-depth analysis of ongoing, multi-stakeholder, marine governance initiatives in Kenya and Tanzania, drawing on the adaptive co-management perspective. The aim is to provide feedback to improve the processes and associated outcomes, as well as to foster the capacity of stakeholders to engage in adaptive transboundary marine conservation governance. Adaptive co-management is diagnosed using the framework proposed by Plummer et al. (2014; 2017) [31,33] (Fig. 1). This framework builds on previous frameworks for analyzing adaptive co-management that only considered the processes and outcomes attributes [29,30,34]. It captures the antecedents or pre-conditions or the factors that catalyse the early phase of the adaptive co-management process. Thus it gives a holistic view of adaptive co-management from its inception to the outcomes.

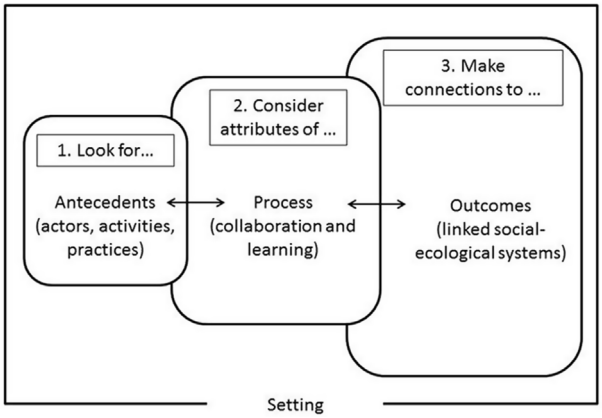

Fig. 1. Framework for diagnosing adaptive co-management. Adapted from Ref. [33].

In this study, the analysis of adaptive co-management begins with the antecedents, where actors engage to begin interacting and deliberating (Fig. 1). This focuses attention on circumstances where adaptive co-management may be present. For example, interactions among multiple types of actors, across decision-making levels with some degree of power-sharing, are essential elements of adaptive co-management [9,35]. These interactions lead to collaboration that can then be conceptualized as social networks of actors, as co-management networks or governance networks that consist of numerous authorities and agencies [36,37]. Such networks facilitate adaptive co-management processes, (learning and coordination of administration and planning), by linking the people and institutions involved in resource management into a coordinated and holistic system. The social networks provide mechanisms for individual stakeholders or communities to coordinate their activities and share experiences [38,39].

The collaborations and learning that are facilitated by social networks result in numerous outcomes (Fig. 1). Outcomes include the results/products from the adaptive co-management initiative, as well as their consequences/effects (recognizing these are not mutually exclusive) [31]. '*Results*' are products arising from the adaptive co-management process and these include many tangible products, e.g. resource management plans and codified statements of action. This study focused on building knowledge and understanding of ecosystem dynamics by resource managers, which is an important aspect of adaptive governance [9]. '*Effects*' are the consequences that are usually considered in terms of ecological or livelihoods contributions [33]. Contributions from adaptive co-management in this study were appraised in the context of learning and adaptive capacity [31,33]. If learning is to be meaningful, a change in understanding should lead to adaptive management practices [40,41].

The components of the framework are interconnected (Fig. 1). For instance, the antecedents influence the process, which will lead to specific outcomes that will, in turn, reshape the process. Effective, adaptive co-management should be locally adapted to specific places and situations [42,43]. The setting encompasses the scale of the

adaptive co-management system, the history and goals, existing enabling legislation, biophysical conditions and socio-ecological connections and other locally important aspects, [31,32]. The diagnostic framework applied in this study (Fig. 1) clarifies how the setting, the antecedents, and processes of adaptive co-management relate to each other and to the social and ecological outcomes. This diagnostic framework may be operationalized in several ways. In this study, the concept of networks and the formal method of social network analysis (SNA) is the main methodological device. SNA builds on the growing consensus that social networks are important for adaptive co-management [44,45]. The particular advantage of applying SNA in the empirical study of adaptive co-management of natural resources has been proposed by several scholars [46–48]. Using SNA, the structural properties of resource governance networks in natural resource management can be empirically analyzed and the relationship of these properties to adaptive co-management can be explored.

3. Case setting: cross border ecology, socio-economics and governance

3.1. Ecology and socio-economics

The transboundary marine area chosen for this study is situated in southern Kenya and northern Tanzania. The two regions represent the two sides of the Kenya-Tanzania border (Fig. 2). Ecologically, this region is an important seascape within the Tanga-Msambweni East African Marine Eco-region [49]. It includes coral reefs, important turtle and dugong feeding areas, as well as extensive mangrove forests [49]. The rich biodiversity of the Kenya-Tanzania transboundary marine area is important as a source of subsistence for the coastal communities [50,51]. The majority of households depend primarily on artisanal fishing for their livelihoods. The artisanal fishery is based on gear such as seine nets, different types of gillnets, spear-guns, hand-lines and traps, to a lesser extent, [52]. Fishing communities have a long tradition of migration across Kenya and Tanzania, exploiting resources in both countries [53]. Migration is an integral part of fishing in East Africa, often as an adaptive response to seasonal fluctuations of resources at varying temporal and spatial scales [54]. Therefore, cross-border interactions at local resource management levels and spatial scales is a common feature in the Kenya-Tanzania transboundary marine area.

Despite the importance of the Kenya-Tanzania transboundary marine area to supporting local coastal livelihoods, there is increased degradation and loss of species that is endangering livelihoods of coastal communities in both Kenya and Tanzania [55]. Uncontrolled, unsustainable fishing is one of the greatest threats to marine biodiversity and the continued sustainability of the transboundary marine resources [56]. Uncontrolled fishing threatens not only biodiversity levels and ocean habitats, but also ecosystem structures, and impacts human welfare and future food security. The Kenya-Tanzania transboundary marine area also continues to be threatened by climate-related factors that could degrade key habitats and cause species loss. Change in Sea Surface Temperature have been observed throughout the Kenya-Tanzania transboundary marine area, with mass coral bleaching events in 1987 and 1998 resulting in between 50% and 90% coral mortality across Kenya and Tanzania [57]. Managing these problems requires integrated and coordinated adaptive approaches and between-country collaboration in transboundary marine resource management. Thus, recently Kenya and Tanzania have increased contacts and are considering further cooperation in transboundary, marine conservation to preserve their shared coastal-marine waters, as well as to address the impacts of climate change. The two countries are proposing the establishment of a transboundary, marine conservation area that extends from the northern boundary of the Diani-Chale Marine Reserve in Kenya to the northern boundary of Tanga Coelacanth Marine Park (TCMP) in Tanzania, with a seaward boundary corresponding to the 200 m depth contour (Fig. 2). The 200 m contour is about 5 nautical miles offshore [21].

3.2. Current marine resource governance in Kenya and Tanzania

Kenya and Tanzania have autonomous marine governance regimes that operate under different constitutional rules [51]. This provides a matched pair to explore the characteristics of regimes and how they can foster or hinder cooperation in marine conservation and adaptive governance. Historically, marine management approaches in both Kenya and Tanzania have mainly been centralized and top-down [58]. For example, the governance of fisheries and marine protected areas did not allow greater participation, power sharing and decision making by non-governmental stakeholders, including the private sector [59–61]. Centralized systems have been criticized as a primary reason for over-exploitation of fisheries and other coastal resources in the region, although resource users have contributed little to monitor and regulate their activities [62]. However, recent trends in marine governance in both Kenya and Tanzania show a shift towards more collaborative approaches, although this shift came much earlier in Tanzania [63,64].

In both Kenya and Tanzania, multi-stakeholder approaches have emerged, signaling a shift from government to governance through co-management [65]. In both countries, legal reforms in fisheries management provide for the establishment of participatory marine resource management (co-management) arrangements where the government and the fisher communities now share responsibilities and authority in the management of the fisheries resource. Transition towards marine resource co-management in both Kenya and Tanzania can be seen in the increasing number of beach management units (BMUs) and the proliferation of BMU fisheries management areas, commonly referred to as locally managed marine areas (LMMAs) or community fisheries management areas (CFMAs) [66,67]. BMUs are institutions for fisheries management that incorporate resources users and state actors to share responsibilities in resource management and conservation, as an imperative to improve livelihoods of people dependent on these resources. BMUs are considered to be the backbone of fisheries co-management in both Kenya and Tanzania [68]. In Kenya, the enactment of BMU Regulations has provided the necessary legal framework for the BMUs to operate. Likewise, in Tanzania, the Fisheries Act provides for the establishment of participatory resource management (co-management) approaches and the establishment of fisher group associations including BMUs. In both Kenya and Tanzania, contemporary marine and coastal governance is a mixture of hierarchical, collaborative, and somewhat integrated management at varying levels [61,69].

4. Methods

4.1. Data collection

The diagnostic framework for adaptive co-management proposed by Plummer et al. (2014; 2017) [31,33] (Fig. 1) was used in this study to compare the characteristics of marine governance arrangements in southern Kenya and northern Tanzania. Semi-structured face-to-face and online surveys were used to consult representatives of the organizations involved in marine resource management in the two case regions. The organizations that took part in the survey were identified from information provided by marine resource managers (fisheries officers, marine protected area managers, and beach management unit (BMU) leaders). They were initially asked to provide a list of names of the organizations involved in marine and coastal management in the two case regions. The list provided included government agencies, non-governmental organization, community-based organizations, and private entities. A total of 81 organizations were identified (42 from Kenya and 39 from Tanzania). Informants who were surveyed were organizational leaders expected to have first-hand knowledge about their organizations, who were able to influence the organization and also sanction interactions with other organizations [70]. It is important to

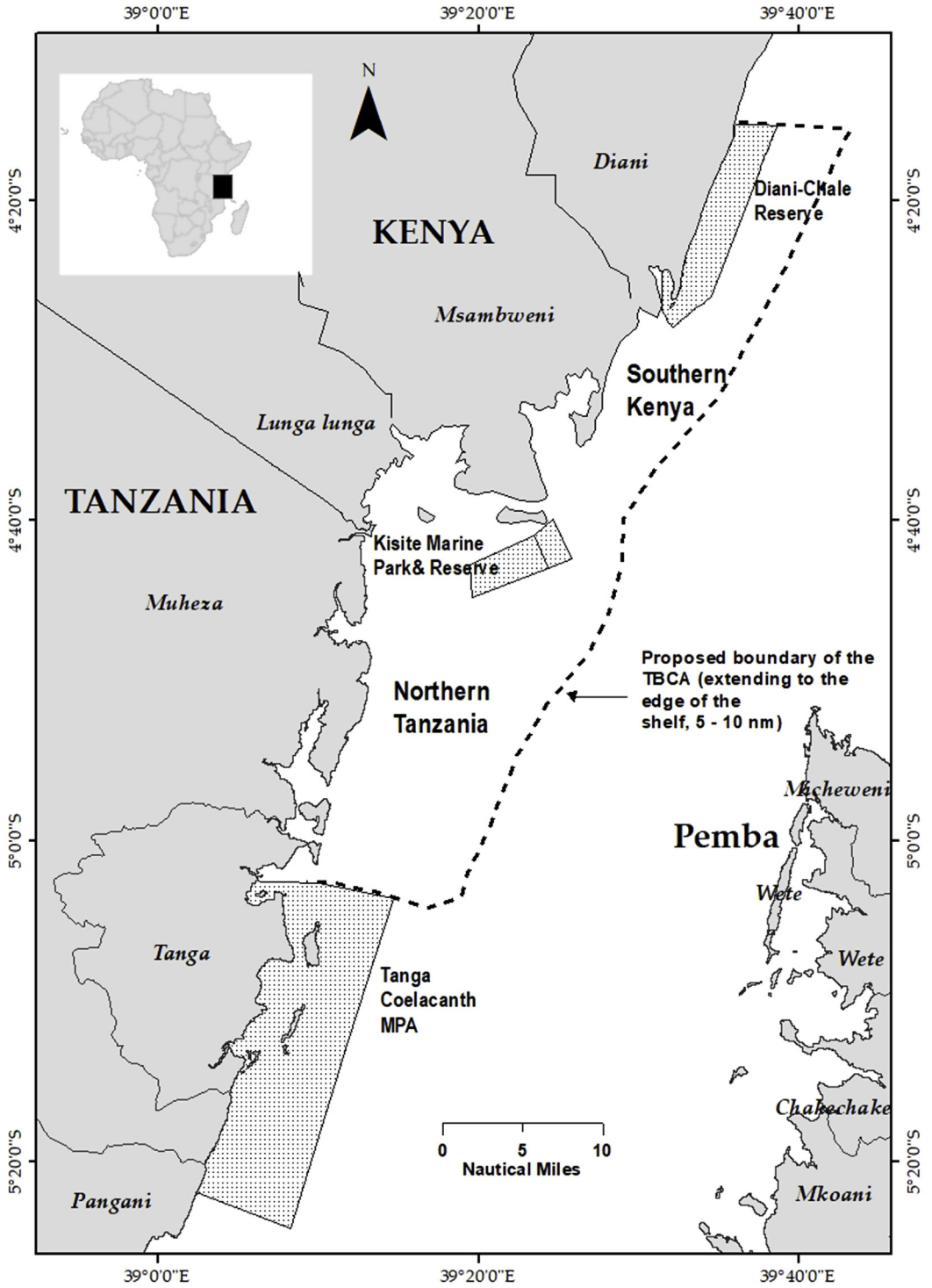

Fig. 2. Map showing the two case study areas (southern Kenya and northen Tanzania) and the proposed transboundary marine conservation area. (adopted from Ref. [21])

note that informants were responding on behalf of the organizations and not personally. The surveys were conducted between April and August 2016.

Survey questions focused on the antecedents of current multi-stakeholder marine governance systems, the management processes (collaboration and learning) and the outcomes of these management processes (see Supplemental data, Table S1; for questions used in the interviews). The questions included sociometric questions about inter-organizational relations and closed Likert-type questions about the processes (learning) and outcomes (adaptive capacity) (Table S1). Sociometric questions applied a recall list that enabled informants to identify those organizations that they collaborated with in marine resource management (names not provided here for reasons of confidentiality). For each case region, informants were asked to mark the organizations they regularly talked to about routines of marine resource management and those they interacted with in resource planning and monitoring.

Survey question on learning focused on changes in understanding

by individuals, their access to and use of information for adaptive management [31] (Table S1). Two 'dimensions' of learning were considered: 1) cognitive (factual knowledge) and 2) relational (building of trust, appreciation of others' worldviews, etc.) [71]. These dimensions of learning were also measured at the individual unit of analysis with the use of a questionnaire instrument (Table S1). The instrument posed multiple questions (Likert scale where 1 = strongly disagree; 5 = strongly agree) that correspond to each dimension of learning. Cognitive learning was assessed by looking for changes in actors understanding of the social and ecological processes that maintain the current status of their socio-ecological systems and their values, testing the assumption that adaptive co-management leads to a more complex as well as a shared understanding of the resource under management. With regards to relational learning, the focus was on changes in individuals perception of others and their learning to work together [31]. Learning is expected to lead to outcomes that include changes in practice, institutions or systems and taking adaptive action. A set of governance-related adaptive capacity indicators that relate to rule formulation and adaptive management were operationalized and used to explore adaptive actions [72]. The questions focused on how rules at the local scale provide guidance for preparing for or responding to environmental problems and on adaptive management practices (Table S1).

Individual respondents from 70 of the 81 organizations were interviewed on both sides of the Kenya-Tanzania border (Kenya n = 33 and Tanzania n = 37). All 70 respondents answered the questions on the antecedents (i.e. sociometric questions about inter-organizational relations). However, interviews that examined learning (processes) and adaptive capacity (outcomes) were carried out only with individuals from organizations with a formal mandate to manage sites (the Beach Management Units (BMUs) and Marine Protected Area (MPA) managers). From Kenya, 15 BMU leaders and 1 MPA manager were interviewed while from Tanzania 10 BMU leaders and 4 MPA managers were interviewed. Informants from these organizations were also asked about their cross-border linkages by asking to also mark from the recall list of the other country those organizations that they have interacted with in the last year on issues relating to marine resource management. This questions focused specifically on organizations involved in site management, because they are expected to work collaboratively and synergistically in the management of the network of MPAs and LMMAs in the Kenya-Tanzania transboundary marine conservation area.

Information about organizational attributes was also gathered. This included the economic sector affiliations (e.g. fisheries, tourism etc), organization type (e.g. government, NGO etc), their roles in marine resource management (e.g. maritime operations, culture, and historic, fisheries resource management etc) and their political-administrative areas of operation. It is important to note that some organizations operated beyond the defined study area (Fig. 2). However, in this study, informants were restricted to only chose one answer to represent their political-administrative unit where their activities were concentrated. Thus, informants were asked to select one of the three political administrative units in Kenya and Tanzania. For Kenya, three sub-counties were provided (Diani, Msambweni and Lunga Lunga), while for Tanzania three districts were considered (Muheza, Tanga, and Pangani) (Fig. 2).

4.2. Data analysis

The antecedents of the current collaborative governance structures and the extent of collaboration were examined by analyzing the sociometric data using social network analysis (SNA), which is the process of investigating social structures through the use of networks [73]. A network is simply a number of points (or 'nodes') that are connected by network ties or links. Generally, in social network analysis, the nodes are people and the links are any social connection between them – for example, friendship, family ties, or financial. In this study, nodes were organizations involved in marine resource management and the ties were the informal interactions in the context of marine resource management. Inter-organizational network data was analyzed using various network techniques including statistical models and mathematical graph theory [74]. To apply SNA, data from the sociometric survey was converted into adjacency matrices (network matrices) of links for each of the participating organizations. In an adjacency matrix, the organizations constitute both the rows and the columns, and the cells specify if social interaction exists between the organizations in the row and the column. A value of "1" was given to represent an existing social interaction between two corresponding organizations and "0" to represent the absence of such interactions. The direction of the interactions between organizations was either reciprocal or not. In a reciprocal interaction organization, A and B interacted and shared a "bonded tie", in which case the entry in the x_{ij} cell was given a value of "1" and then the same entry was given in the x_{ji} cell. Where interactions were not reciprocal, the cell x_{ij} was scored "1", while the cell x_{ji} was score "0". In such a case, the values in the matrix represent a directed relationship between A and B, and the adjacency matrix is asymmetric in its structure [75].

4.2.1. Antecedents of multi-sakeholder governance structures

The emergence of current, multi-stakeholder governance structures for marine resource governance was explored using the concept of proximity [76,77]. The proximity perspective accounts for the tendency for entities to form interpersonal relations with those who are close to them [76]. The Multiple Regression Quadratic Assignment Procedure (MR-QAP) [78, 93–95] was applied to assess how organizations selected their partners according to their geographical, organizational, institutional and social proximity [79,91,92] (see supplementary material for MR-QAP calculations).

4.2.2. Processes (collaboration and learning) and outcomes

The extent of collaboration in the multi-stakeholder marine governance systems was examined using different social network analysis (SNA) metrics. The path length, (average number of steps between any two organizations), and network diameter, (the longest geodesic distance in a connected network), were used to measure the ease with which organizations were able to reach one another [80]. The easier organizations could reach each other, the higher the potential for collaboration. The extent to which collaboration between organizations relied on a few actors was examined using network centralization, (the variation in the number of times that actors in the network lie on paths between other actors), and in/out degree centralization, (the extent to which one actor is holding all the links in the network) [44]. SNA was conducted using UCINET 6 for Windows, [81]. Learning and adaptive capacity were analyzed by coding the interview questions and assessing the evidence.

4.3. Methodological limitations

While the diagnostic framework for adaptive co-management applied in this study (Fig. 1) is appropriate for assessing adaptive governance across cases and at different levels, the methodological approach used here still has some limitations. The approach taken only gives a snapshot of marine resource governance at a given moment and fails to account for the inherent problem of dynamic governance systems. Empirical information concerning the longitudinal evolution of the marine governance structures would have added knowledge of their dynamics and how they transition to adaptive systems. Longitudinal social network analysis represents approaches that could be applied to examine the evolution of governance systems over time [82]. There are also limitations in terms of the factors that have been considered as enabling or hindering adaptive governance i.e. institutional structures. As earlier described in transboundary marine governance context, additional factors stemming from the economic, cultural and socio-

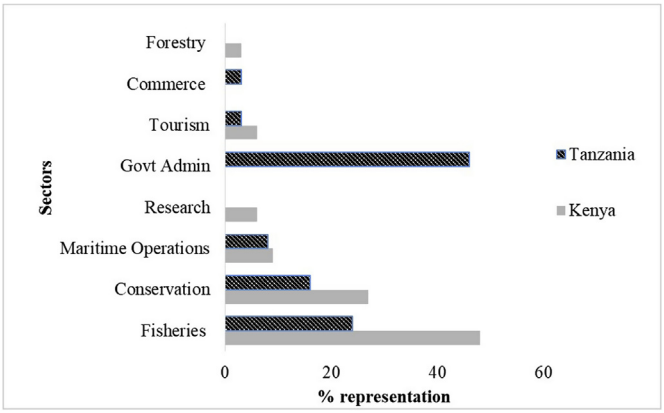

Fig. 3. Representation of organizations in collaboration networks for marine resource governance in southern Kenya and northern categorized by sector.

political differences may limit transboundary adaptive marine resource governance. Adaptive governance at transboundary scales may also require polycentric structures, building trust and long-term relationships [83,84]. These additional requirements if examined could also increase understanding of the prospects for cross-border collaboration and adaptive governance.

5. Results

5.1. Composition of marine governance systems

The summary statistics of organizations that constituted the two multi-stakeholder marine governance networks in southern Kenya and northern Tanzania grouped by sector (Fig. 3) and organization type (Fig. 4). There are differences in the composition of organizations in the two networks with Kenya's network dominated by organizations that are affiliated with the fisheries sector while Tanzania's network is dominated by organizations affiliated to government administration. The majority of organizations in Kenya's network are the community-based organizations, while in Tanzania's network the majority are local authority organizations.

5.2. The antecedents of collaboration networks

The results of the Multiple Regression Quadratic Assignment Procedure (MR-QAP) to assess the influence of proximity on the formation of multi-stakeholder collaboration networks of marine resource governance in southern Kenya and northern Tanzania is presented in

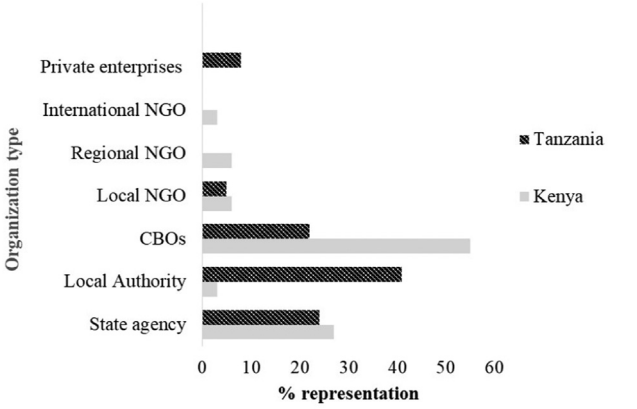

Fig. 4. Representation of organizations in collaboration networks for marine resource governance in southern Kenya and northern Tanzania categorized by organization types.

Table 1
MR-QAP estimating factors associated with the propensity of organization to collaborate (Significant factors in parenthesis).

Dimension of proximity	Kenya		Tanzania	
	Standardized coefficient	p-value	Standardized coefficient	p-value
Geographical	(0.05974)	(0.02449)	−0.00581	0.39980
Organizational				
Sector	0.18860	(0.00050)	0.12786	(0.00050)
Organization type	−0.00089	0.49525	(0.07066)	(0.00750)
Institutional	0.04521	0.11894	−0.00913	0.39830
Social				
Monitoring	(0.64122)	(0.00050)	(0.51607)	(0.00050)
Planning	(0.20820)	(0.00050)	(0.38414)	(0.00050)

Table 1. Geographical proximity marginally explains the formation of collaborative ties between organizations in Kenya. Thus, the idea that organizations that are geographically proximate will form collaborative ties is only supported for Kenya and not Tanzania. Even though the relationship between geographical proximity and forming ties is not significant in the case of Tanzania (negative values), these are very low. This indicates that organizations that are geographically apart from each other tend (slightly) to have ties, suggesting the presence of cross-boundary interactions.

The formation of ties in both Kenya and Tanzania networks (Table 1) is influenced by belonging to the same sector. Organizations belonging to the same sector are more likely to associate with each other and collaboration among them in both Kenya and Tanzania is strongly influenced by sectoral affiliations. In Tanzania, there is a high tendency of organizations that are of the same type to collaborate. For example, it is more likely that government agencies will form ties with other government agencies and not with NGOs or CBOs. In Kenya, however, organization type has a negative but not significant effect on collaborative tie formation. In both Kenya and Tanzania, institutional proximity (being affected by the same rules) does not influence the formation of inter-organizational ties. Instead, social proximity predicts tie formation in both networks. Having previous relations e.g. in this case, in resource planning and monitoring, increases the possibilities for organizations forming collaborative ties. The result of MR-QAP shows that social proximity is statistically the most significant, with the involvement of organizations in resource monitoring having the largest effect in the formation of marine collaboration networks in both Kenya and Tanzania.

5.3. Strength of collaboration ties

The results on the extent of collaboration in the two marine governance networks in southern Kenya and northern Tanzania are presented in Table 2. The results are quite similar between the Kenya and Tanzania networks, although the number of links is greater for the Tanzanian network. The average path distance (Kenya = 1.681 and Tanzania = 1.718) indicates that, to reach any other contact in the

Table 2
Network measures on strength of collaboration networks.

Measures	Kenya	Tanzania	Cross-border
Number of ties	363	470	144
Diameter	3	3	6
Average Distance	1.681	1.718	2.365
Density	0.344	0.353	0.190
Average degree	11	12.703	5.143
Out-degree centralization	0.612	0.551	0.302
Degree centralization	0.632	0.567	0.187

network, a member of each of the networks requires a mean of only one to two contacts. Both networks have a short average path length, so it seems every organization is connected to the others through short paths. Both networks have network diameter scores of 3, meaning that it takes three steps to move from one side of the network to the other i.e. the maximum number of relations that an organization in the networks needs to reach another organization is three. These two measures indicate that both networks are highly connected and there is quick transfer of information. The proportions of possible collaborations in the networks that actually exist are 34% for Kenya and 35% for Tanzania. Despite both networks showing strong collaboration, Tanzania has stronger interactions between organizations, as shown by the average degree statistics. On average, an organization in Tanzania interacts with 12 organizations of the 37 organizations in the network. In comparison, in Kenya one organization interacts with 11 organizations of the 33 organizations in the network. Hence Tanzania's network shows a possibility of a higher degree of collaboration and information exchange. Out-degree and degree centralization are greater for the Kenya network (Table 2) indicating that knowledge flow is centralized in fewer stakeholders than in the Tanzania network.

The results of the extent of interactions between MPA managers and BMU leaders on issues relating to marine resource use and management across the Kenya-Tanzania border is displayed in Fig. 3. Managers associated with MPA management and BMU leaders responsible for community managed fisheries areas are connected via some patterns of communication, through which they exchange information. The results show the presence of weak collaborative ties across the Kenya-Tanzania border, with a network density being 0.190, i.e., only 19% of all the potential relationships between MPA and BMU leaders across the border have been actualized. In the cross-border network, connecting two organizations requires at least two intermediates (path distance = 2). This cross-border network has a low degree of centralization, that is, no single BMU or MPA organizations is the most important of most central in the network. It also means that there is a low degree of inequality among members.

5.4. Learning capacity of marine resource managers

Comparison of learning processes by beach management units (BMUs) and marine protected area (MPA) managers in the Kenya and Tanzania networks show only slight variations. In both Kenyan and Tanzanian networks, the majority of respondents (over 60%, n = 16, Kenya and n = 14) agree that their *'knowledge of marine resources and their management'* has increased due to their involvement in multi-stakeholder management processes. However, in Kenya, most respondents did not agree (63%) that they have similar or closely matched views about the current marine resource problems and management solutions. In contrast, in Tanzania, 50% of respondents agree that they have almost similar views on the current problems and management solutions. In both Kenya and Tanzania, significant challenges remain in accessing information about the state of the resources being managed. Overall, 75% of respondents in Kenya said they lacked information about the state of the resource, whereas, in Tanzania, more than 35% of respondents did not agree that they have information about the state of the resource. Nearly all respondents (more than 80%) in both cases perceive scientific information as relevant to or useful for managing current resource conditions. In both cases, over 70% of respondents indicate that members/staff of their organizations (BMU and MPAs) participate actively in resource management. However, participatory approaches vary between organizations in both Kenya and Tanzania, ranging from obtaining limited input to obtaining extensive involvement in the decision-making process.

5.5. Analysis of adaptive action by resource managers

Most of the site managers (BMU leaders and MPA managers) interviewed indicated that their sites are governed by an institutional framework of national and local rules that stipulates how resources are to be managed at the local site level. However, in Kenya, most of the BMUs (60% of respondents) do not have formal rules that specify how their sites should be managed. For those with rules, these do not specify the roles of different actors in the management of their sites. In contrast, in Tanzania, 71% of marine resource managers agree that there are rules that also specify management structures. The general perception in both Kenya and Tanzania is that more than half of resource users do not respect the rules (53% in Kenya and 57% in Tanzania). Current rules in Kenya only weakly address current resource management problems (40% of respondents), compared to Tanzania (60%). In both Kenya and Tanzania, significant challenges remain in accessing adequate data to guide the formulation of plans and adjustment of rules. More respondents in Tanzania (70%) than in Kenya (40%) agree that the prevailing knowledge about their resource was insufficient. While there is a strong awareness among BMU leaders and MPA managers that the marine environment is changing (Kenya 70%, 63 Tanzania percent), this has not been translated into enhanced monitoring or integration of uncertainty into management and planning of marine resources in both study areas (Kenya 40%, 34 Tanzania percent).

6. Discussion

The existence of transboundary, marine biological connections and threats that are common to most countries, (e.g. overfishing, inadequate coastal development and climate change), show the need for governance approaches that can respond to uncertainty and change in transboundary, marine socio-ecological systems. Adaptive governance an approach capable of supporting transboundary, ecosystem management to address highly contextualized social-ecological issues and respond to complex, unpredictable feedbacks between social and ecological components [9,14]. This study investigated how marine resource governance regimes in Kenya and Tanzania could improve their prospects for implementing adaptive governance in a proposed conservation initiative in the Kenya-Tanzania transboundary marine area. The concept of adaptive co-management provided the analytical framework for comparing existing marine governance structures in southern Kenya and northern Tanzania focusing on their antecedents, processes, and outcomes. Across the highly contrasted marine governance contexts in Kenya and Tanzania, the analysis reveals both similar and distinct institutional opportunities and challenges for developing adaptive governance in relation to transboundary conservation.

6.1. Similarities

The comparative analysis suggests that marine resource governance in southern Kenya and northern Tanzania are progressing towards collaborative forms of governance. This is confirmed by the presence of multi-stakeholder collaboration networks that support marine resource management in the two regions. Looking into how these collaboration networks emerge, the analysis reveals that social proximity has a higher positive influence on the network tie formation in both Kenya and Tanzania. It appears the organizations in both networks prefer to collaborate with other organizations with whom they have had previous relations. Thus, strategies aimed at building cross-boundary collaboration to foster adaptive governance across the Kenya-Tanzania national border should recognize the crucial role of social proximity in influencing collaboration. Both collaboration networks show strong cohesion, indicating the existence of a high flow of exchange relations among different stakeholders. The existence of strong collaborative ties may be the reason for improved knowledge of resource managers (MPA managers and BMU leaders) in southern Kenya and northern Tanzania. Strong network ties that facilitate transmission of information between stakeholders are often a precursor to learning and adaptive governance

[85,86]. There are similarities in Kenya and Tanzania on how stakeholders cohere to form networks, the strong connections between stakeholders, and the improved knowledge of resource managers. These common factors can improve the prospect of adaptive governance of the Kenya-Tanzania transboundary marine socio-ecological system.

There are also similarities between the two regimes that could constrain adaptive governance of the Kenya-Tanzania transboundary marine socio-ecological system. The high degree of centralization in both Kenya and Tanzania marine collaboration networks means that only a few actors are central to the transmission of information, despite facilitating information flow between actors. Centrality may facilitate coordination and control, but it can also reduce the diversity of knowledge, because all the actors are closely connected to the few central actors and all of them receive similar information [87]. Strong, sectoral tendencies observed in both Kenya and Tanzania are likely to undermine effective collaboration and transition towards adaptive governance. Successful, adaptive governance requires integration among different sectors to address cross-sectoral issues [17,84]. In both Kenya and Tanzania, access to information and data for decision-making seems to be a challenge. However, the problem may not necessarily be lack of access to the data, since there are many mechanisms applied in southern Kenya and northern Tanzania where research data is disseminated to stakeholders [64,69]. It is highly likely that the main problem is how to use existing data to support decision-making. Adaptive governance requires environmental stakeholders to not only register and interpret ecological feedback, but also to integrate this information into updated governance institutions and, where necessary, to modify behaviour [9]. On both sides, existing rules seldom address local resource management problems and there are also problems with rule-compliance. For a management process to be interpreted as truly adaptive, rules should be implemented, followed and enforced [45], which is not the case in Kenya and Tanzania.

6.2. Differences

Comparing the Kenyan and Tanzanian marine governance systems, some clear differences that can constrain adaptive governance are notable. In Kenya, the formation of collaboration networks is also influenced by the geographical proximity of actors. The majority of organizations in Kenya's network, particularly community-based organizations (CBOs), tend to limit their interactions to those spatially close to them, possibly due to limited resources to engage in activities beyond their localities. In Tanzania, there are high tendencies of organizations of the same organization type associating and linking with similar others. These differences in how organizations choose their partners may hinder the emergence and evolution of cross-border networks. Differences in views regarding problems, solutions and related marine resource status and management interventions that are observed, mainly in Kenya, could also affect joint problem solving with Tanzania. When stakeholders lack a common view on the status of socio-ecological systems, finding common solutions, deciding on joint approaches, and taking adaptive actions becomes difficult [88]. Other notable differences that may hinder adaptive actions across the Kenya-Tanzania transboundary marine system relate to rules governing marine resource use at the local site level. In Tanzania, rules specify how resources are to be managed at the local site level while in Kenya they do not. It should be noted that these differences are not by definition merely constraining. On the contrary, they could even stimulate cross-border learning and knowledge sharing. Both sides can learn from each other's approaches, strategies, and plans. Kenya, for example, can learn from Tanzania about the formulation of site-level rules. On the other hand, Tanzania can learn from Kenya has enhanced organizational interactions, that is between different organizations types.

6.3. Issues to address

As Kenya and Tanzania seek to address the key, transboundary, marine resource issues facing the two countries, they may need to strengthen their institutional arrangements to support adaptive governance of their shared, transboundary, marine area. In both Kenya and Tanzania, there is a need to address issues relating to the use of scientific information in decision-making processes, the continued revision of rules, improving compliance with rules and creating a shared vision for the management of the transboundary marine socio-ecological system. Improving participation of all levels in rule formulation is one way to ensure that rules are aligned to local situations and compliance with rules improved [89]. Since learning by marine resource managers in both Kenya and Tanzania seems to have been improved by inter-organizational interactions, strengthening the existing but weak cross-border interactions between MPA managers and BMU leaders may be one way of enhancing the prospects for adaptive governance. The presence of MPA and BMU linkages across the border highlights the multiple situations where adaptive marine transboundary conservation is envisaged. The experiences already acquired in MPA and LMMA co-management can be harnessed to achieve the goal of strengthening the transboundary MPA and LMMA network. The general knowledge-base to foster adaptive governance can be improved if MPA managers and BMU leaders on both sides of the Kenya-Tanzania border interacted more and exchanged ideas. Strategies aiming to improve cross-boundary collaboration need to recognize the crucial roles of geographical, organizational and social proximity in influencing collaboration. In particular, such strategies need to address the important role of social proximity in shaping collaboration networks in both Kenya and Tanzania. We cannot, however, conclude that social proximity alone will directly influence how organizations choose their partners across country boundaries to establish collaboration networks. When borders are crossed, additional factors come into play including cultural differences (language, education, and knowledge bases) which may limit such cross-country collaboration in border regions [2,90].

7. Conclusion

Adaptive governance holds wide appeal conceptually, although there is still relatively little insight into how adaptive governance might play out in transboundary socio-ecological systems, particularly in the developing country contexts. This study has applied an analysis of governance in practice in two case studies in Kenya and Tanzania to examine the prospects for adaptive governance of marine transboundary conservation. The case studies point to a number of issues that should be addressed in governance reform, toward more adaptive management of the Kenya-Tanzania, transboundary, marine socio-ecological system. Despite the contrast in marine governance approaches between the two cases, they share similar governance features that may be conducive for adaptive co-management and moving towards adaptive governance. However, shortfalls in capacity for adaptive action in both cases presents particular challenges for transitioning towards adaptive governance. Addressing these challenges is paramount for making existing, marine resource governance institutions more adaptive and improving the prospects of cross-border adaptive governance.

Declarations of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.marpol.2019.02.051.

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