

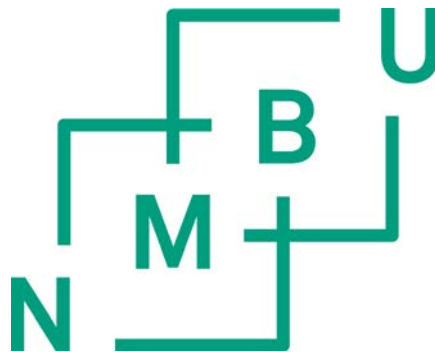
Changing seascapes: local adaptation processes in Belizean fishing communities

Seascapes i endring: lokale tilpasningsprosesser i Beliziske fiskerisamfunn

Philosophiae Doctor (PhD) Thesis

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ABSTRACT

This thesis analyses how contextual social, economic and political conditions interact and influence adaptation to coastal change, through an in-depth focus on two Belizean fishing communities. Belize is considered to be highly vulnerable to climate change and has been described as a place where climate change adaptation is urgent. The study is informed by social science oriented adaptation thinking and political ecology and uses mixed qualitative methods where interviews with local villagers constitute the core data. The thesis comprises four separate but interrelated papers that address how broader development processes, collective action and values intersect with local adaptation processes to coastal change. Research findings illuminate that livelihoods in the studied communities are highly dynamic and have undergone profound adaptations over Belize's colonial and post-colonial history. Long-term trends evident in both communities are the transition from land-based to marine resources and the decline of small-scale agriculture. While environmental change has been a factor in influencing livelihood adaptations, it is outweighed by political-economic forces and trajectories to which local livelihoods continuously have had to engage with and adapt to. Deep connections between local livelihoods and political-economic processes at national and global scales are identified in the thesis. More recent changes in the Belizean seascape have been emergence of tourism and marine conservation. The findings show that how climate change adaptation for ecosystems and fishers are envisioned by conservation organisations and government bodies, do not resonate with local realities and adaptive strategies. The thesis identifies consistent discrepancies between how dominant discourses portray risk and adaptation to coastal change and how such changes are experienced at the local level. Through a focus on coastal erosion, the analysis shows that coastal communities not prioritised by formal policy can, through local activism and collective action, contest government inaction on coastal protection and place adaptation on the decision-making agenda. The findings furthermore underline that how processes of coastal environmental change unfold locally are intimately linked to how different resources are valued. Localised aspirations of development and striving to safeguard or enhancing what is conceived of a good way of life in specific places emerge as a central motivation to why people undertake adaptive actions. The thesis argues that efforts to strengthen local capacity to respond to climate change in coastal Belize must build upon more localised aspirations of development and enable local groups to have a greater say in decisions that affect their lives and livelihoods. The social, political and economic issues related to adaptation discussed within the thesis communities are relevant to the wider Caribbean and other small, low-lying coastal states.

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Part II Compilation of papers

Paper I. Karlsson, M. and I. Bryceson (2014). Continuity and change: understanding livelihood shifts and adaptations in coastal Belize. *Local Environment:1-20 (ahead of print)*

Paper II. Karlsson, M. and G. Hovelsrud (2015). Local collective action: adaptation to coastal erosion in the Monkey River Village, Belize. *Global Environmental Change* 32 96–107.

Paper III. Karlsson, M., von Oort, B. and B. Romstad (2015). What we have lost and cannot become: societal outcomes of coastal erosion in Southern Belize. *Ecology and Society* 20 (1): 4.

Paper IV. Karlsson, M. Exploring Belizean fishers' perceptions and responses to climate variability and livelihood vulnerability (manuscript)

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1. INTRODUCTION

Climate change is considered to be one of the most serious challenges facing society in the 21st century (IPCC 2014). Small island developing states (SIDS), a grouping consisting of 52 states and territories to which Belize belongs, are widely acknowledged to have ‘an exceptional vulnerability’ to climate change and are portrayed as places where adaptation to reduce climate change impacts is particularly urgent (Nurse *et al.* 2014, Méheux *et al.* 2007, Pelling & Uitto 2001, Tompkins *et al.* 2005). Despite vast differences between these groupings, the SIDS tend to share a number of characteristics such as smallness, low-lying coastal areas (not necessarily islands), isolation from larger centres, small export-dependent economies, reliance on natural and in particular marine resources and high proportional vulnerability to natural disasters (Wong 2011, Briguglio 1995, Kelman & West 2009, UN 2005). Given these characteristics, it is plausible that climate change impacts are felt sooner and more intensely across SIDS than in other regions. SIDS are often, together with Arctic societies, depicted as ‘canaries in the coal mine’, meaning the way in which climate impacts are felt and adaptation proceeds across this region may be a preview of how climate change will affect other parts of the world.

However, climate change is both a material and discursive reality (Marino & Ribot 2012, Orlove *et al.* 2014). Climate change debates have been dominated by a focus on how changes in the global climate system – discerned by spatial modelling and extrapolated to specific localities – produce biophysical changes and subsequent vulnerabilities for economies, ecosystems and groups of people (O’Brien *et al.* 2007). This framing has resulted in adaptation often being conceptualised as technical measures, devised and implemented by experts and decision makers to reduce specific climate change impacts (O’Brien *et al.* 2007, Adger *et al.* 2011, Manuel-Navarrete *et al.* 2011). Adaptation to climate change has therefore been mainly portrayed as something that is done to vulnerable groups and places, such as SIDS, rather than by them (Lazrus 2009, Barnett & Campbell 2010, Mortreux & Barnett 2009). The representation of SIDS as places in peril due to climate change has moreover tended to obscure other social, political, and environmental factors contributing to vulnerability and influencing how adaptation can proceed (Kelman 2014). To date, the sense of urgency about adaptation for SIDS has not been matched by empirical knowledge on how local communities in SIDS experience environmental change, and what structural and contextual factors influence local vulnerability and capacity to respond to change (Barnett 2010, Dulal *et al.* 2009).

1.1 Approaching adaptation

As demonstrated by empirically grounded studies, social groups are continuously adapting to change in a broad range of political, socio-economic, environmental and climatic conditions (Smit & Wandel 2006, O’Brien *et al.* 2004, Schipper 2007, Hovelsrud & Smit 2010). A point of departure for this thesis is that adaptation to changing biophysical conditions must be seen as entwined with the social and political context in which such changes occur. This thesis therefore approaches adaptation as a

social, dynamic process, conditioned by political and economic structures, power relations and social values (Cote & Nightingale 2012). This implies that social groups have differential means of responding to change and also divergent preferences for outcomes of change (Coulthard 2012, O'Brien & Wolf 2010). From this vantage point, the study of adaptation requires an analysis of the political and economic relations that influence how adaptation can proceed as well as an understanding of the localised and social values that shape how change processes are experienced (Amundsen 2015, Adger *et al.* 2009, Burley *et al.* 2007). The thesis emphasises the influence of politics and economic development processes in shaping local groups ability to respond to change. By drawing on theoretical perspectives from political ecology, broader questions related to control over resources, rights to define risk and adaptation with respect to coastal change, and the means local groups have to influence and contest politics, are examined in the thesis. With the help of a range of theoretical social science perspectives on adaptation and political ecology, this study highlights the importance of situating human interactions with coastal change within the social and political context in which such changes occur.

The as yet under-researched themes addressed in the thesis include the importance of history and broader political-economic processes in shaping local adaptation paths and patterns of vulnerability, the role of collective action and local processes of contestation in influencing political decisions on adaptation, and the localised and social consequences of coastal environmental change.

1.2 Situating the study

These research themes are addressed through an empirical focus on communities in coastal Belize. Being a small and a low-lying country, Belize exhibits many of the characteristics stated to contribute to the SIDS's climate vulnerability. This includes Belize's small size, its reliance on natural and marine resources, its small economy tied to the vagaries of global markets and its yearly exposure to weather events such as hurricanes (Richardson 2009, Gordon & Greene 2011). As a former British colony, global political and economic processes have continuously influenced social change in Belize (Wilk 2007, Shoman 2011). Belize's development trajectories are characterised by natural resource extraction and export, first dominated by forestry and then by agricultural and marine products. Since the 1980s, tourism has been pursued as an economic development strategy, which has been accompanied by the designation of terrestrial and marine protected areas (MPAs). This has led to changes in access to, use and governance of marine resources (Palacio 2001). Belize's coastal livelihoods as well as its national economy depend heavily on the resources produced by its marine and coastal ecosystems and in particular on its barrier reef, the largest reef system in the Western Hemisphere. The barrier is considered to have become environmentally degraded since the 1980s, due to a range of stressors including climate change impacts, overfishing, inland clearing, agricultural run-off and pollution and coastal development (McField & Bood 2007). While Belize scores high on human development indicators, development is unevenly distributed within the country and poverty

levels have increased significantly over the last decade. In 2009, four out of ten Belizeans were considered to live in poverty (Halcrow/NAT 2010).

These development characteristics and the intersecting processes of coastal change motivate the study of adaptation in Belizean fishing village presented here. This thesis, with an empirical focus on coastal Belize, contributes relevant knowledge to the small but growing literature on locally grounded vulnerability and adaptation research in the Caribbean SIDS (Dulal *et al.* 2009, Shah *et al.* 2014, Baptise & Kinlocke *in press*).

1.3 Objectives and research questions

The main objective of this thesis is to critically examine adaptation and broaden the understanding of people's perceptions of and responses to intersecting processes of environmental, political, economic and social change. An empirical focus on coastal Belize forms the basis for the analysis and will aid in illustrating these processes. The study takes the form of an exploration into the salient factors that have influenced local adaptation to observed and interlinked changes, and further investigates how processes of change are experienced and articulated in two localities. To address this objective, I ask four research questions, outlined below, that correspond with the four papers presented in the thesis.

1. To what extent have coastal livelihoods changed over the last 180 years, and what factors have influenced livelihood shifts and adaptations?

The capacity of local communities to adapt to current climate and environmental change is nested in multiple temporal and spatial scales. The research question is addressed by analysing the interactions between Belize's historical political-economic development and environmental change in shaping local adaptation trajectories. Perspectives from political ecology help to identify linkages between political-economic processes and local vulnerability and adaptation patterns.

2. How can local collective action influence external support for adaptation and what motivates collective responses to environmental change?

Social groups' ability to act collectively is an important component of adaptive capacity. Perspectives on collective action linked to environmental contestation, advanced in political ecology, in combination with adaptation literature emphasising place identity, illustrate the role of and motivations behind local collective action with respect to adaptation.

3. How are risk and loss associated with coastal environmental change framed and experienced at the local level?

Understandings of change are conditioned by social values, which influence how risk is perceived and experienced. In order to answer the research question, a relational perspective on risk and the literature on the subjective dimensions of adaptation are used to identify the social experiences and consequences of environmental change.

4. What factors shape fishers' vulnerability and how do fishers respond to climatic and non-climatic stressors?

In order to answer the question, contextual approaches to vulnerability in combination with livelihoods literature are used to identify how fishers' perceive and respond to multiple stressors.

1.4 Structure of thesis

This thesis is based primarily on four scientific papers of which three are published in peer-reviewed journals; the papers are presented fully in Part II. Part I provides a broader and more integrated presentation of the background, theoretical and methodological approaches taken in the thesis. The first section in Part I introduces the research project and presents its objectives. The second section provides an examination of the theoretical perspectives that guide the analysis. This includes an examination of the research direction in adaptation and political ecology literature; it further discusses how an integration of these literatures can enhance the understanding of local experiences and responses to change. The third section delineates the methodological approach taken in the thesis, presents the case sites and provides a description of the methods employed and considerations taken during fieldwork and data collection. The fourth section presents a brief background to coastal Belize and the interlinked changes that are salient to understand local processes of adaptation. The fifth section consists of a summary and synthesis of the individual papers, showing their interconnectedness and offering a concluding discussion of the significance of the overall research findings.

2. THEORETICAL FRAMEWORK

The papers presented in this thesis draw upon different theoretical approaches, situated within the broad fields of climate change adaptation and political ecology. Through addressing four distinct research questions, the papers and the thesis as a whole elucidate local responses and perceptions of change processes, with a particular emphasis on environmental change. The local groups focussed on in this thesis have close and daily relationships and interactions with the environmental conditions of their natural surroundings: the coast. This opens up for major questions on how nature, the environment and society are conceptualised and how such conceptualizations shape our research on social-ecological systems and interactions. In the following section, I will reflect upon nature-society relations and in particular, how the conceptual separation between nature and society bears consequences for how climate change adaptation is approached.

Nature is, as famously claimed by Raymond Williams (1985), one of the most complex and ambiguous words in the English language. Nature is a word that connotes three different but interrelated meanings. First, nature can mean the intrinsic quality of or essential characteristics of something, for example the natural flavour of a foodstuff. Second, it can mean the universal forces that direct the world, such as natural and physical laws, and thirdly nature means the external world or the material aspects of our surroundings. The meaning of nature that is evoked has important implications for which nature we are discussing and studying. All three meanings, however, require contrasting nature to objects and ideas that are not seen as natural, such as technology, culture, civilisation and

industrialised landscapes (Sundnes 2013). The role of humans within these three meanings of nature is moreover ambiguous, and as noted by Ginn and Demeritt (2008:303), ‘an historical focus demonstrates that there are cultural politics at play in these distinctions’. In the West during the Enlightenment period, the emergence of the sciences, including mathematics, physics and astronomy, promoted a shift from understanding nature as ruled by theological agency to understanding nature as constituted of a set of natural laws (Macnaghten & Urry 1998). This led to a conceptual separation between nature and the social domain, which became further cemented during the 19th century (ibid).

This was underpinned by human exceptionalism, a view that regards humans as fundamentally different from and superior to non-human species, where nature is approached as something that can be subjugated and transformed to accommodate human progress (Soper 1999, Castree 2001). Seeing nature as separate from humans became instrumental during the industrial revolution and legitimised heavy human interventions in the environment that have continued and accelerated throughout the 21st century (Williams 1985, Soper 1999). Civilisation, modernisation and notions of societal progress have been closely associated with how much humans could distance themselves from direct reliance on nature (Brooks *et al.* 2009). Dominate conceptions of development equate the transformation of nature for economic growth and continuous increases in material standards of living, which in turn have required an extensive extraction and use of fossil fuels and natural resources (Brooks *et al.* 2009). Scholars have argued that a plausible explanation for why the ecological crisis now facing us is so severe (e.g. consequences from anthropogenic climate change), is that it is a result of locating the social domain outside nature (Heyd & Brooks 2009).

Nature-society dualism has given rise to a number of other similar dichotomies such as traditional-modern, rural-urban, primitive-civilised, pristine-polluted. These binary categories have been used to legitimise colonial expansion and more contemporary forms of control over resources for example through nature conservation- commonly equated with nature without humans and human activities (Neumann 1998). Cronon (1996) argues that the separation of nature from the social domain has thus simultaneously positioned humans as both rational managers of nature as well as protectors over the environment.

The nature–society dualism can be recognised in environmental management practices and climate change responses, where climate change is approached as an environmental problem, which directs responses towards biophysical rather than social processes (O'Brien *et al.* 2007, O'Brien & Wolf 2010, O'Brien *et al.* 2010). This is reflected in some climate change adaptation discourses where specific technical measures are devised to adapt environments to withstand climate change and allow for continued development (Brown 2011).

The conceptual separation of nature and society has been attacked from a number of theoretical angles. Marxist-inspired geographers have emphasised that environments are produced for the benefit of

dominant interests and groups, leading to an uneven distribution of both environmental benefits and problems (O'Keefe *et al.* 1976). Thus, what is seen as material and natural environments are products of specific socio-economic conditions, which are malleable and possible to change. In addition to being socially produced in a material sense, scholars drawing upon post-structural theory later added that nature is also socially constructed (Cronon, 1996). According to Soper (1995:3–4), this strand of literature points to 'ideological functions of the appeal of nature and [on] the ways in which relations to the nonhuman world are always historically mediated, and indeed "constructed" through specific conceptions of human identity and difference'. With the recognition that claims about nature are always a product of socially and historically contingent values and knowledge, comes the rejection of a singular, external nature and an emphasis on plural, social natures (Castree 2001).

The nature-society binary has further been unsettled by scholars such as Bruno Latour and Donna Haraway that emphasise the hybridity of humans and the rest of nature. Here, specific environments are seen to become constructed through networks or assemblages of human and non-human actors and objects (e.g., biophysical processes, technologies, animals). This research has focused on how socio-environments come into being through networks containing specific human practices and knowledges (Head & Gibson 2012).

Debates and ways of conceptualising society-nature relationships are by no means settled. Recent debates concerning the Anthropocene and whether humans constitute the main geological force on earth and to which extent humans really can influence biophysical and geological processes illustrate the depth and complexity of how society-nature relationships are conceptualised (Johnson *et al.* 2014). While these debates are beyond the scope of the thesis, an important point of departure for this study is that nature and society are intertwined, inseparable and co-constitutive (Braun & Castree 2005). By seeing nature-society holistically, the thesis aim to theorise and analyse how adaptations to biophysical change are entwined with specific social, cultural and political contexts. This brief reflection on nature-society relations provides an entry point into the thesis' conceptual framework.

2.1.1 Origins, critique and the re-emergence of adaptation concept

The concept of adaptation has received increasing attention over the last couple of decades and is today highly associated with climate change. However, the concept predates contemporary debates and has a history of past usages within the natural and social sciences. Adaptation can be traced back to evolutionary biology and the processes of natural selection (Schipper & Burton 2009). To Darwin, adaptation meant 'the organic modification by which an organism or species became adapted to its environment' (Orlove 2009:132). Within biology, adaptation is commonly defined as 'the process by which an animal or plant species becomes fitted to its environment; it is the result of natural selection acting upon heritable variation' (Global Britannica 2015).

The concept also emerges in thinking about how humans made use of their environment and entered the social sciences primarily through cultural ecology in the 1940s 1950s and 1960s (Pelling 2010, Robbins 2011). While retaining loose connections with its usages within evolutionary biology, factors including culture and institutions became important when adaptation was applied to humans (Orlove 2009). The anthropologist Julian Steward developed cultural ecology as a subfield within anthropology and geography. Inspired by landscape studies, Steward (2006), who studied Native Americans, viewed adaptive processes within specific local environments as giving rise to specific cultural patterns within societies in different geographical areas. The local environment was thus added as a factor that influenced culture. Steward (2006) claimed that some cultural features, including economic arrangements and subsistence activities, were more likely to be affected by environmental adaptations, which he called the 'cultural core'. Within cultural ecology, culture was the unit of analysis, as adaptive strategies to make use of natural resources were seen to give rise to 'multi-linear pathways of cultural evolution' (Pinkoski 2008).

Notably, cultural ecology was practised by a range of scholars with diverse backgrounds and approaches to adaptation. Geographers mainly engaged in cultural ecology focused on 'traditional' peoples in Melanesia, and through empirically rich and intensive studies of local groups examined the relations between factors, including the regional ecology, population and carrying capacity (Robbins 2011). Ecological anthropology, a branch of cultural ecology, drew inspiration from systems ecology and focused on human populations, approached as a species among others within a larger system. Here, human cultural conducts were hypothesised as the means by which populations adapted to the environment within a large stable system. Roy Rappaport's study of pig slaughter in the Tsembaga Maring tribe in Papua New Guinea, in the 1960s, provides the most well-known example of this approach. Rappaport essentially argued that the cultural ritual of pig slaughter should be understood as an adaptive regulator – seeking to prevent ecosystem destruction and to re-establish balance between humans and their environment (Rappaport 2000). He also discussed the concept of maladaptation, regarded as human responses that were not consistent with the 'homeostatic principles' of the living system they formed part of (ibid). While highly cited and referred to, Rappaport's functionalistic view of culture and his analysis of spatially confined ecosystems were contested by other scholars within cultural ecology (Biersack 1999). Nevertheless, adaptation remained a central concept within anthropology and geography with an underlying assumption that human cultures and ecological systems were separate and moreover strove to towards equilibrium (Head 2010).

An associated understanding of adaptation can also be found in hazard research, which built upon seminal work on flood exposure and human behaviour by the geographer Gilbert White (1945). White, together with Ian Burton and Robert Kates, viewed hazards (a term encompassing both natural events and technological risks) as the detrimental consequences arising through interactions between social and natural systems (Kates *et al.* 1978). In this school of thought, adaptation was regarded as

preventive adjustments or responses that humans devised to reduce their exposure to specific hazards or environmental effects, again reflecting a view of the environment as separate from society.

Both cultural ecology and hazards research encountered serious criticisms in the late 1970s and early 1980s. The influence of non-equilibrium ecology (e.g. Holling 1973) made it increasingly hard to maintain the notion of stable environments. Furthermore, the increasing expansion of the global economy and its influence on even remote and 'traditional' peoples challenged the idea of bounded and fixed cultures adjusted to specific ecologies (Watts & Peet 1996). Michael Watts (1983) provided the most well-known and theoretically underpinned criticism of cultural ecology and specifically the concept of cultural adaptation, through his study of the relationship between drought and famine among the Hausa peasants in Nigeria. Watts found that the Hausas' traditional agriculture had been flexible and highly adapted to climate variability. However, during British colonialism when cash crop agriculture was forcefully introduced, the Hausas lost self-sufficiency, and did not earn sufficient income to purchase foodstuff, which resulted in famines during drought periods. Watts' (1983) work stressed the importance of the influence of political-economic structures on local people's available options and choices when acting under adverse conditions. In his view, cultural ecology reduced adaptation to functionalistic behaviour and regarded nature and society as separate entities. Drawing upon Marxist understanding of political economy, Watts (1983:242) argued for an approach that understood human adaptation as '... the appropriation and transformation of nature into material means of social reproduction. This process is both social and cultural and it reflects the relationship to and participation in the production process'. Rather than being stable units, Watts (1983) illustrated that social systems and changes within them are highly contradictory, accumulative and unstable.

Moreover, Watts (1983) along with other scholars, including O'Keefe *et al.* (1976) and Hewitt (1983), confronted hazards research by emphasising that social structures effectively determined the outcomes of human interaction with the environment, and viewed disasters as socially produced rather than being natural. Rather than seeing humans as rational individuals, who adjusted strategically to avoid harmful outcomes, they contended that vulnerability was produced and reinforced through social and political structures, which for example forced marginalised groups to settle in areas known to be flood-prone. Drawing upon a Marxist interpretation of nature as physically produced by political interests, this literature emphasised that deeper societal changes rather than adjustments within the current system are essential to reduce vulnerability of social groups (e.g. Hewitt 1983).

Criticisms of cultural ecology and hazards research as lacking an analysis of class, poverty, access to resources, state actions, and market forces in shaping human interactions with the environment became a founding moment for political ecology (Robbins 2011). As a consequence of the widespread critiques from critical geographers and other disciplines, the concept of adaptation, closely associated with equilibrium thinking and determinism, largely vanished from social debates in the 1980s.

However, in this era the cultural geographer William Denevan made a noteworthy contribution to climate change adaptation research. He defined adaptation as ‘the *process of change* in response to a change in the physical environment or a change in internal stimuli, such as demography, economics and organisation’ (1983:401, emphasis in original). This broader framing of adaptation as a social process and a response to multiple changes is mirrored in recent social science applications of climate change adaptation.

The adaptation concept owes its re-emergence and current popularity to its incorporation in the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) documents (see Schipper & Burton 2009, Orlove 2009, and Pelling 2010 for a discussion of adaptation within IPCC). Climate change adaptation was mentioned in UNFCCC’s report in 1992, but only defined in 2001 as: ‘Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’ (IPCC 2001:365).

This definition remained unchanged in the Fourth Assessment Report in 2007 but was altered in the Fifth Assessment Report in 2014 to include the processual aspect of adaptation:

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC 2014:5).

A range of concepts associated with adaptation has developed along with IPCC and the burgeoning scholarship on climate change adaptation, including adaptive capacity, adaptation cost and limits to adaptation (Orlove 2009). Through its incorporation into climate change, Burton (1996) suggests that the term adaptation took on a more positive and active meaning as it became associated with human agency to plan for a reduction of climate impacts, in contrast with its previous deterministic connotations. However, the earlier IPCC reports on climate change adaptation have been much criticised for focusing on technical responses and for omitting relevant external factors, including non-climatic forces of change, the broader structures enabling or constraining adaptive capacity and internal factors such as culture and values (Nelson 2009). In the IPCC’s Fifth Assessment Report, such critiques were to some extent addressed by including new chapters focusing on human health, well-being, human security, livelihoods and poverty. Notably, IPCC summarises a broad range of literature in which the scientific conclusions, but the resulting operationalisation of concepts needs to be approved by delegates from participating governments, which prevents more radical proposals for change (Pelling 2010). Further, Orlove (2009) cautions that adaptation in the language of the IPCC conveys a false sense of security as it suggests that climate change impacts can be managed and risk avoided through concerted action. The relationship between IPCC and climate research is

characterised by an iterative process. IPCC comments on research gaps generate more research; on the other hand, the IPCC's reports have steadily expanded because climate researchers have found that the scientific knowledge presented by IPCC is insufficient.

2.1.2 Adaptation within the social sciences: a multiple factor approach

Climate adaptation research has developed in tandem with the physical science basis of climate change over the last two decades. Influences from systems theory and resilience have led most adaptation researchers to approach social and ecological systems (SES) as coupled and interdependent (Nelson *et al.* 2007). Social science-driven climate adaptation research has during this time evolved from focusing on specific climate or biophysical changes (now considered a misleading starting point) towards what has been called a 'multiple factor approach' (O'Brien *et al.* 2004, Wilbanks & Kates 2010). Essentially, the multiple factor approach maintains that meaningful engagements with adaptation require a broader investigation into the multiple conditions (social, economic, political and environmental) that constrain as well as generate adaptive capacity (Eriksen *et al.* 2011, Hovelsrud & Smit 2010). This understanding builds upon empirical findings emerging from local adaptation studies, which have emphasised that climate change is one of multiple and interrelated challenges affecting communities (Leichenko & O'Brien 2002, Turner *et al.* 2003, Luers 2005). Consequently, adaptations are seldom responses to climate signals alone. Instead, they emerge as a response to multiple processes of change (Berrang-Ford *et al.* 2011, Tompkins *et al.* 2010). Further, it has been demonstrated that the capacity to adapt to climate change is nested in broader structural conditions (Smit & Wandel 2006). Thus, empirical research has enhanced the conceptualisation of adaptation and simultaneously broadened the scope of inquiry for researchers.

Social scientists have conceptualised adaptation as a dynamic social process in response to change in a broad range of conditions, including environment, climatic, social, political and cultural changes (e.g. Smit & Wandel 2006, O'Brien *et al.* 2004, Schipper 2007, Hovelsrud & Smit 2010). The understanding of adaptation as a process rather than a state, project or specific measure informs the approach taken in this thesis. In the thesis, processes of adaptation (as any social phenomena) are seen to be embedded in history, power relations and cultural values, where social groups have differential means of responding to change and divergent preference for outcomes of change (Cote & Nightingale 2012). Local adaptations are typically undertaken to improve the current situation in some way (in the short or long term), whether this entails reducing exposure to change or engaging in activities that are seen as beneficial for the individual or group. However, this does not mean that the change process is necessarily intentional or that the outcome of the desired change is always clearly defined.

This direction of adaptation research require an analysis of the social and political relations and practices that influence people's ability to respond to changing environmental, climatic, political, economic and cultural conditions (Pelling 2010). This thesis will broaden the understanding of

adaptation by focusing on how recent history and political-economic processes, collective action and locally situated values and practices play a significant role in shaping responses to and the outcomes of change.

To understand the historical context is critical for adaptation research because development and adaptation trajectories as well as the values they accommodate are largely shaped by recent history (Hovelsrud & Smit 2010). Research with an historical interest has primarily focused on societies' past experience with environmental change, and how successful former civilisations (such as the Greenland Norse and Mayas, to name a few) have adapted to changing conditions (see Nunn *et al.* 2007 for a Pacific example). Other studies have emphasised how traditional strategies employed to deal with environmental change and variability may apply to current and future conditions (Mercer *et al.* 2007, Gaillard & Le Masson 2007). In contrast to studies primarily concerned with past responses to environmental change, this thesis acknowledges that recent history such as colonialism influence political-economic structures and thereby also contemporary patterns of vulnerability and local adaptation trajectories (Karlsson & Bryceson 2014). The inclusion of colonial history and its current political-economic articulations broadens the view of climate change adaptation from a local and contemporary problem to a challenge rooted in history and in multiple global and national processes (Cameron 2012).

A broad categorisation of climate change adaptation has emerged, depending on the intentionality (autonomous or planned), timing (reactive or proactive), temporal (short-term coping or adaptation) and spatial scale, form (technical, institutional, behavioural) and the social actors involved (individuals, civic institutions, governments or private sector) (see Smit *et al.* 2000). In practice, distinctions between different forms and types of adaptations are fuzzy and overlapping. As Adger *et al.* (2003) caution, typologies of adaptation may confuse rather than clarify the roles and responsibilities of different social actors. For example, autonomous adaptive actions taken by a community may occur because of a state not being able or willing to provide its citizens security from environmental risk. Decision-making levels are highly interconnected and 'embedded in social processes that reflect the relationship between individuals, their networks, capabilities and social capital and the state' (Adger *et al.* 2003:186). The interactions between different social actors in providing protection from environmental change remain an under-researched area. While studies show that communities are continuously adapting to change, many of the challenges exceed local adaptive capacity and necessitate assistance from governmental institutions (Van Aalst *et al.* 2008). That governments and other organisations will support communities with resources and expertise for adaptation is not a given, as national priorities often differ from local perspectives (Moser 2009, Eriksen & Marin 2015). Karlsson and Hovelsrud (2015) in this thesis argue that local collective action and contestation over rights to protection from environmental change can influence whether external support is granted to local adaptation processes. Based upon the paper's findings, this thesis asserts

that local activism and processes of environmental contestation can constitute a counterpart to formal arrangements such as adaptation policy and therefore warrant more attention within climate change research. An outcome of this research is that theoretical perspectives within political ecology are useful and complementary to adaptation studies, since political ecologists explicitly engage with environmental contestations (Rocheleau 2008).

A related and emerging area of interest is the trade-offs between, and the potential social impacts of adaptation measures undertaken at different scales and by different actors. As Pelling (2010: 21) argues, ‘positionality matters as vulnerability and adaptive capacity at one scale can have profound and sometimes hidden implications for other scales’. In addition, social groups whose livelihoods are closely tied to natural resources, and are exposed to climatic stressors, may as Marino and Ribot (2012) emphasise, be vulnerable to climate change politics. In a climate change mitigation context, studies have shown that afforestation programmes seeking to sequester carbon locally for global carbon offset schemes have displaced forest dwellers from their land (Beymer-Farris & Bassett 2012, Cavanagh & Benjaminsen 2014). The empirical literature on how climate change adaptation policies affect different social groups is to date relatively small. One empirical study from Mexico exemplifies that desalination technologies, implemented to reduce drought sensitivities, forced local groups to rely on unstable and costly water, which reinforced rather than reduced social marginality (McEvoy & Wilder 2012). Increasingly, climate change mitigation and adaptation proposals are merging with discourses advocating nature conservation and calls for nature conservation draw legitimacy from evoking ‘ecosystem- based adaptation’ (e.g. Colls *et al.* 2009). In Belize, and the wider Central American and Caribbean region climate change adaptation measures have foremost been integrated into existing marine conservation programmes, such as MPAs, promoted as solutions that strengthen coral reef resilience to warming oceans (Magrin *et al.* 2014). Conservation discourses often equates measures that enhance ecosystem resilience with increased adaptive capacity for resource users such as fishers (Dudley *et al.* 2010). Karlsson (*in prep*) in the thesis shows Belizean fishers’ view MPAs as source of a source of vulnerability due to loss of access to fishing grounds and marine conservation act as an additional stressor to which fishers have to adapt (also discussed by Bunce *et al.* 2010 in an East African context). Ecosystem-based adaptation presumably presents similar challenges as has long been debated within the protected areas–people literature, in terms of what social consequences nature conservation incurs and to what extent humans are considered as external and damaging to ‘nature’ (West *et al.* 2006). These examples demonstrate that an envisioned climate change adaptation policy benefiting certain systems; sectors or actors has implications for other social groups’ vulnerability and adaptive capacity, as Pelling (2010) suggests. The critical literature on adaptation politics and policy contends that planned responses need to include a range of normative considerations such as equity and long-term effects on ecological integrity in order to qualify as sustainable (Eriksen *et al.* 2011) and to avoid maladaptation (Barnett & O’Neill 2010).

Measures implemented by experts to increase economic profitability and reduce risk may also run counter to localised conceptions of well-being. Livelihoods with modest profitability and high risk levels such as fishing are often more than a source of income and are seen to constitute an integral part of identity and way of life (Coulthard 2012). The important question of what qualifies as meaningful lives for different social groups and how adaptation can either undermine or support such conceptions draws us to the role of social values in climate change adaptation.

2.1.3 Social values, risk and the qualitative dimensions of change

Anthropology has shown that an intrinsic characteristic of being human is our ability to endow the world around us with meaning (e.g. Geertz 1973). Rather than being inherent in the material world itself, conventions and meaning-making are learnt within contingent historical and social contexts. Understandings of events and change processes are hence conditioned by values, which are known to vary significantly between different societies or groups within the same society. Values matter in adaptation research because conceptions of well-being, morality and what the world is and should be like influence how environmental change is perceived and experienced and what kinds of responses to change are deemed necessary, or conversely which ones are considered intolerable (O'Brien & Wolf 2010). In general, attention to the differentiated human patterns of seeing and interacting with their surroundings – giving rise to diverse social natures – has been lacking in climate change research. As a legacy of climate science's drawing upon spatial and economic modelling, examples of nature–society dualism and dominant approaches to development, other non-quantifiable modes of seeing and understanding the environment have been ignored (Adger *et al.* 2009, Barnett 2010). This has led to what Adger *et al.* (2011:1) call 'an implicit assumption that climate change only becomes important to society when it affects material aspects of well-being, those most easily summarised in economic costs'.

This can be seen in the light of dominant framings of climate change that conceive adaptation as a means to safeguard current development paradigms centred on economic growth and market integration (Brown 2011). The shortcomings of such development paradigms in accounting for the pluralism of human values are well known (Beddoe *et al.* 2009). By proposing an anthropological theory of value, Graeber (2001) seeks to recast value as a model of human meaning-making, resting on human actions rather than material objects. In sum, Graeber (2001) argues that what is evaluated and regarded as meaningful and valuable has less to do with the quality of an object and more to do with the past human actions that went into making it and the capacity for future action that the object embodies. By drawing upon a range of ethnographic sources, Graeber (2001) shows that processes of meaning-making differ significantly from society to society and change over time. However, he argues that despite cultural differences, value is in effect ascribed to activities and actions that serve to reproduce or reform a larger, whole society – in which individual actors see their activities as meaningful parts (Graeber 2001:76). Value, according to Graeber, must be coordinated with others in

order to be realised, and it is in these processes that continuity, conflict or transformation of value may occur.

The technical, physical and economic criteria that most commonly define climate risk are largely incompatible with Graeber's perspective of value and may therefore miss the aspects that make human life meaningful. As Rappaport (1996:69) argues, 'vague conceptions of the good life cannot be ruled inadmissible because they resist quantitative representations, as these may be the aspects that populations take to be most seriously at risk'. Another side of this argument is that if environmental or climate change is portrayed as harmful only to physical objects and the economy rather than to what is important for most humans, it is unlikely to provide incentives to change our current actions and development trajectory.

A small but emerging body of adaptation research has sought to frame climate and environmental change in ways that are more attentive to what such changes might mean for society. This has been done by incorporating well-being (Coulthart 2012), worldviews and value systems (O'Brien & Wolf 2010), localised 'lived' values (Graham *et al.* 2013) and place attachment (Agyeman *et al.* 2009, Adger *et al.* 2011, Amundsen 2015). This thesis considers qualitative and subjective dimensions of change crucial to understanding what is at stake from environmental change. Karlsson *et al.* (2015) in this thesis found that local framings of risk and loss of coastal change involved what valued objects (such as land) used to be like and what they could have become in the future, which resonates with Graeber's (2001) conceptualisation of value. The research found that the loss of future development opportunities was locally seen as the most damaging effect of coastal land loss, because it reduced the possibility of residents' remaining in a place which was intimately associated with social meaning (Karlsson *et al.* 2015). The loss of place as a result of climate change has been emphasised as a negative, yet significantly undervalued consequence, one that limits the scope for meaningful adaptation in for example low-lying islands (Barnett 2010). However, because of the value and sense of identity people ascribe to specific places, place attachment has also been found to motivate people to engage in strategies to sustain, improve or defend the attributes of places they enjoy living in (Stedman 2002, Escobar *et al.* 2002, Amundsen 2014, Karlsson & Hovelsrud 2015).

It remains important to unveil the multiple and often contrasting perceptions and experiences of environmental change that different groups hold in order to enhance adaptation knowledge and allow for more equitable policy and planning (Hulme *et al.* 2007). It can therefore be problematic that the language of risk has increasingly been inserted in climate debates (e.g. IPCC 2012). Risk (as a probabilistic measure of vulnerability), most often assessed in quantitative terms, ultimately functions to standardise the likelihood of harm, rather than to account for how change is unevenly felt and experienced by social groups (Stanley 2013). This thesis draws on a body of literature that views risk as a specific knowledge used to frame events along lines of harm and danger in order to place them

within a moral order, which consequently refute the objectification of risk (e.g. Dean 1998). Risk is, as argued by Boholm (2003), always embedded in social relations, and as such risk definitions are socially constructed (Boholm & Corvellec 2011). In addition, Boholm and Corvellec (2011) maintain that understandings of risk, loss or change are always relational and involve value, because for something to be considered harmful and a risk it must be linked to something considered important and meaningful to humans. This understanding, explored in more detail in Karlsson *et al.* (2015), corresponds with climate research claiming that adaptation responses should focus on safeguarding what people consider valuable and understanding how different changes are perceived to pose threats to meaningful aspects of human lives (Adger *et al.* 2011, Barnett 2010, O'Brien & Wolf 2010).

Recasting value from individual, economic and material rationalities towards an appreciation of collective experiences, ecologies, and interspecies dependencies has also been proposed as necessary in transformation discourses (Escobar 2011, O'Brien 2012). The literature in this context, which is not limited to climate change, argues that radical changes in the way we live in and perceive the world are required to ensure the viability of current and future human and non-human generations. As drivers of climate change and other environmental crises largely overlap with factors that are seen to constitute social and economic development (e.g. high energy consumption, material standards, economic growth, market integration), climate change adaptation has been considered an impasse that accommodates further unsustainable development (O'Brien 2012). Given that development and adaptation pathways are closely entwined, scholars have called for a critical examination of what development is for, how it affects vulnerable groups and to what degree local groups can influence development policies (Eriksen & O'Brien 2007, Brown 2011, Ireland & McKinnon 2013, Eriksen & Marin 2015). In contrast to adaptation, the concept of transformation proposes a fundamental restructuring of dominant development ideals and ways of seeing and living with nature, along with the power relations, institutions and values that sustain currently 'unsustainable' economic structures (Pelling *et al.* 2014). This literature draws hope from human agency and society's capacity to make and remake its environment and its ability to deliberately reshape its futures and socio-natures.

2.2 Political ecology

Political ecology is a broad and eclectic research field with an explicit focus on how politics (state and market) influence human–environmental relationships. Environmental change is a central theme within the field and political ecologists consider interpretations and material outcomes of environmental change to be mediated by (often asymmetric) power relations (Forsyth 2013, Neumann 2014). Work within political ecology is characterised by a 'normative understanding that there are very likely better, less coercive, less exploitative and more sustainable ways of doing things' (Robbins 2004:12). Political ecology lacks a coherent theoretical or methodological framework, but some unifying perspectives in approaching environment and development can be distinguished as political ecology. This includes an explicit focus on power and politics, an attention to multiple temporal and

spatial scales and an approach that emphasises contextual factors where case studies and multiple methods are used. Furthermore, political ecology rejects the dualism between society and nature and approaches environmental issues as both socially produced and socially constructed (Neumann 2014). Although interdisciplinary research drawing on both natural and social sciences is considered to be a grounding tenet of political ecology, most research within the field is carried out from a social science perspective (Benjaminsen & Svarstad 2010).

This thesis considers political ecology and its emphasis on politics in shaping the environment as an important contribution towards understanding adaptation, and as complementary to the climate change adaptation literature. The individual papers in the thesis draw (more or less explicitly) on theoretical approaches within political ecology, including the focus on processes on multiple temporal and spatial scales, environmental contestation and narratives. Political ecology contributes to understanding environmental change and adaptation as political and social processes, which counteracts dominant framings of climate change as an environmental problem that requires environmental solutions. Furthermore, this thesis views political ecology's normative commitment to contributing knowledge to address the problems of vulnerable and less powerful groups as a central point of departure for studying climate change adaptation in a development context (Forsyth 2008).

The research field has a special relation to the concept of adaptation, as critiques of cultural ecology and hazards research have led to the emergence of political ecology (Robbins 2011). In addition to denouncing adaptation, early political ecology also developed as a critique to neo-Malthusian and apolitical explanations of environmental change (Neumann 2014). Such explanations placed the responsibility for environmental degradation on factors such as overpopulation and local groups' irrational behaviour. Drawing on Marxism and structural theories, early political ecologists instead used questions of class, inequality and state-market forces as the point of departure towards understanding the causes and consequence of environmental change (Robbins 2011).

The work of the geographer Piers Blaikie is primarily attributed to the development of political ecology as a specific research field (see Muldavin 2008). Through his analysis of the causes of soil erosion in developing countries, he demonstrated that soil erosion was caused by the effects of political economy on impoverished farmers (Blaikie 1985). In Blaikie and Brookfield's (1987) book *Land degradation and society*, widely regarded as the founding text for the field, they advanced 'regional political ecology' as a research approach for analysing land degradation. According to Blaikie and Brookfield (1987:17), 'political ecology combines the concerns of ecology and a broadly defined political economy'. Investigation of environmental change should in their approach, dubbed 'the chain of explanation', start with the local land manager and then examine the social relations of production inherent in historical decisions as well as national and global scales. Blaikie and Brookfield (1987) maintained that local resource users' choices were in effect determined by external influences

and that as such, environmental degradation should be regarded as a political problem located at multiple scales. They further argued that the definitions of environmental degradation are inherently social, depending on the perceptions different actors hold about the environment. In the later book, *At risk*, Blaikie et al. (1994) applied a similar multiscale and structural approach to understanding vulnerability to natural hazards. This structural branch of political ecology has directed its scope of inquiry towards the historical and political factors at work in creating and reinforcing vulnerability. These include colonial and post-colonial structures, the absence of political rights and influence, access and distribution of resources, weak/corrupt governments and unjust conditions for global market integration (Watts and Bohle 1993, Pelling 1999, Ribot 2010). Such structural approaches often lack an appreciation of human agency and the role of incremental change in enabling more socially and ecologically just environments. Nevertheless, this thesis acknowledges that political-economic structures acting on multiple scales have a strong but not deterministic influence on local vulnerability adaptation trajectories (Karlsson & Bryceson 2014, Karlsson *in prep*).

Scale, pluralisms of perceptions and engagement with political-economic structures remain important within political ecology. But from the 1990s onwards, influences from post-structuralism, post-colonialism and feminist studies have altered the scope of inquiry from a focus on how nature is materially produced towards a focus on how the environment is symbolically and discursively constructed (Watts & Peet 1996, Stott & Sullivan 2000). In particular, Michel Foucault and his conceptualisation of power/knowledge and discourse have had an immense influence on the post-structural direction of political ecology. Through tracing down madness and prisons through history, Foucault demonstrated that concepts taken to be timeless are developed in specific and political contexts, taking the form of discourses (Hajer 1995). Discourses are here understood as social constructs framing the hidden rules of what can or cannot be said and done in particular times, places and contexts (Hajer 1995). Discourses establish forms of truths as certain practices are given room and seem legitimate, while others are ignored, excluded and regarded as deviations (Andersen & Kaspersen 1999). Therefore, Foucault (1980) claimed that there is no knowledge without power and what is considered as true is an effect of power/knowledge. He conceptualised power/knowledge as a product of social relationships, being omnipresent and at once repressive and productive.

The realisation that objects and concepts taken to be natural or neutral are produced by specific practices and ways of knowing, has led political ecologists to examine how nature and environmental problems are socially and discursively constituted (Escobar 1996, Neumann 1998). The turn towards post-structuralism and a greater emphasis on how the environment is discursively structured have led political ecologists to engage with how different actors perceive, identify and launch claims about how nature should be constituted (Forsyth 2003, Stott & Sullivan 2000, Neumann 2014). An early feature of post-structural directions of political ecology was the acknowledgement that discourses and knowledge claims concerning the environment did not carry equal importance, with the implication

that dominant discourses produced practices that had material implications for less powerful social groups (Escobar 1996, Rocheleau *et al.* 1995, Bryant & Bailey 1997).

An emerging literature has analysed the discourses and narratives that accompany climate change and adaptation (O'Brien *et al.* 2007, Farbotko & Lazrus 2012, Orlove *et al.* 2014). Importantly, this literature has shown that dominant discourses feature climate change as threat to economic development, where adaptation becomes a means of safeguarding current development paradigms and the power relations and values that underpin them (e.g. Brown 2011). By unpacking climate change discourses, the taken for granted assumptions about climate change problems and solutions can be questioned, which may allow for novel and better suited framings to emerge (Marino & Ribot 2012). There are often power asymmetries between the actors who define and assign solutions to environmental problems and the social groups bearing the cost of such solutions (Bryant & Bailey 1997). Questions relating to who is given a mandate to interpret environmental problems and solutions within a climate change adaptation context are relevant to this thesis. In Belize, fishers and their extractive activities are by dominant discourse portrayed as causes of marine ecosystem degradation and solutions involve restricting fishers' access to marine resources, for example through the designation of MPAs (Karlsson & Bryceson 2014, Karlsson *in prep*).

A related branch of political ecology has focused on environmental contestations and mobilisations (Peet & Watts 1996), upon which Karlsson and Hovelsrud (2015) draw in this thesis. This literature has analysed conflicts and resistance between local groups and other interests that emerge when landscapes or livelihoods are altered or threatened, for example through infrastructure projects or nature conservation. Environmental mobilisations or movement are defined within political ecology as collective action campaigns that involve protests and demands for some sort of alternative development (Escobar 1995, Watts & Peet 2004, Bebbington *et al.* 2008). Peet and Watts (1996) with their edited book *Liberation ecologies* first drew attention to how environmental contestations are as much conflicts over symbolic meanings and interpretations of nature as over control over material resources. Processes of mobilisation and resistance to changes within environmental regimes have been found to give rise to new forms of identities and collaborations between actors who may otherwise have disparate interests (Robbins 2011). Importantly, claims made in environmental contestations often extend from environmental issues to broader social and political demands (Watts & Peet 2004). Mobilisations may therefore have the potential to influence politics and alter development pathways or provide alternatives to development that are more meaningful and beneficial to local groups (Escobar 2011). While some political ecologists tend to view global development and environmental politics as forces operating to the detriment of localised and traditional ways of living, Tsing (2005) emphasises that encounters between 'the global and the local' (approaches as mutually constitutive categories) are highly unstable, producing both conflicts and collaborations. The potential

in Tsing's (2005) view for novel processes, while complex and contradictory, to emerge through such encounters has not fully been explored within political ecology.

The acknowledgment that changes in environmental regimes may lead to contestation has to date received little attention in climate change adaptation research. Much of adaptation research instead focuses on getting the institutional conditions right to include a broader range of social groups in adaptation policy and planning (Cote & Nightingale 2012). Although participation and deliberation of adaptation options may reveal different preferences for adaptation outcomes, public participation must be distinguished from the actual ability different groups have to influence decision-making (Few *et al.* 2007). Adaptation politics, as any other area, are conditioned by asymmetric power relations that favour certain values and interests more than others. In a Belizean context, Few (2001) demonstrates that local participation in marine policy and planning decisions are 'contained' by practices that steer participation processes towards predetermined goals. As argued by Beymer-Farris *et al.* (2012), reconfigurations of power relations are likely to occur through struggles and contestation rather than through consensus-seeking deliberations. In a similar vein, this thesis views contestations and mobilisations against environmental politics as an important counterpart of formal arrangements such as adaptation policy (Karlsson & Hovelsrud 2015).

Furthermore, political ecology notably stands on the shoulders of other disciplines, including anthropology, which has examined historical change in more depth. In a Caribbean context, the work of Sidney Mintz (1985) demonstrates the deep connections between sugar producers and consumers and the interlinked processes of social change under the British Empire. Anthropologists have moreover analysed the reorganisation of the world that followed after the expansion of European powers through connecting regions and peoples in the margins of Empires (Wolf 2010). This line of research, emphasising the new cultural identities and forms of social organisations that emerged as a result of colonialism and how colonial discourses have presented different groups, is relevant to this thesis.

Today, identification with what has come to be associated with Creole or Mestizo cultures has implications for how people may respond to change, particularly if this cultural form is seen as threatened, as discussed by Karlsson and Hovelsrud (2015). Furthermore, ethnic-cultural categories still underline influence and access to political arenas due to discourses from colonial times and nation-making which emphasise Creole and Anglophone heritages as more 'native' and Belizean than, for example, Spanish-speaking groups like Mestizos (Medina 1997, Medina 2004).

More recently, political ecology has moved from agrarian societies in the global south towards the urban, the global north and new research objects such as the human body. Political ecology has incorporated thinking from science and technology studies (STS) by scholars such as Bruno Latour and Donna Haraway. Their scholarship has enhanced the understanding of the interaction and

interdependence between humans and non-human objects, further unravelling the dichotomy between human and nature and reaffirming the view of society and nature as co-produced.

3. METHODOLOGY

Development studies, climate change adaptation and political ecology are research fields characterised by interdisciplinarity between natural and social sciences and across natural and social sciences, which is also reflected in this study. One way of approaching interdisciplinarity is through the philosophical perspectives offered by critical realism. This philosophical position is suitable for research on the interface between social and biophysical change and have influenced climate change research (Bhaskar et al. 2010, Amundsen 2014) as well as political ecology (see Neumann 2014). The thesis is informed by ontological and epistemological perspectives from critical realism and considers this philosophical position as appropriate for the study of local processes to biophysical, social and political change.

Critical realism, widely associated with the philosopher of science, Roy Bhaskar, emerged as an objection to empiricism in the natural sciences and post-modernistic, relativistic currents in the social sciences (Proctor 1998). Critical realism reduces the classic ontological division between the natural and social sciences by combining the ontology of realism (claiming that reality exists independently from human thought) with the epistemology of constructivism (maintaining that knowledge about reality always emerges from specific social standpoints) (Soper 1999). Critical realism separates ontology and epistemology and argues for ‘the necessity to think science in terms of two dimensions, the intransitive dimension of the being of objects of scientific investigation and the transitive dimension of socially produced knowledge of them’ (Bhaskar 2010:2).

The ontological position taken in critical realism views reality as stratified in three domains: the empirical, the actual and the real. The empirical domain is what we can experience, the actual is the domain of events that can be said to have taken place, but cannot be experienced by humans, and the real is the generative mechanisms or structures that produce events (Proctor 1998). The role of science is to uncover the mechanisms that create and constitute events and phenomena (Danermark 2002). Since there are always deeper levels of mechanisms to uncover, scientific inquiry is endless and knowledge about reality will always be incomplete and partial (Proctor 1998). Critical realism is based on the principle of judgmental rationality, meaning that through detailed attention to knowledge-generating processes (logic, discourse, methodology, reflexivity); better explanations of phenomena can be distinguished from worse (Bhaskar 2010). Since critical realism asserts that social life and interactions with reality are conditioned and structured by discourse, the role of social science is to uncover values and structures that sustain discourses and create different social worlds. Moreover, critical realism stresses the importance of seeing phenomena such as climate change as embedded and inseparable from the social context in which they occur (Bhaskar 2010). Informed by this stance, the

thesis acknowledges that biophysical phenomena such as climate change to be real but asserts the importance of analysing the social processes and structures through which biophysical changes are experienced, given meaning and framed as a problematic.

Following a critical realism approach, this thesis draws on the epistemology of weak social constructivism. In contrast to the positions of realists and positivists, which assert that scientific knowledge can (at least partly) capture reality, weak constructivism approaches knowledge as something being made and constructed within particular social contexts and which can therefore not mirror an objective reality (Schwandt 2000). However, weak constructivism differs from stronger forms by claiming that language is not constitutive of reality but rather a tool for ordering and understanding it (Taylor 1995 in Schwandt 2000). While weak constructivism acknowledges that social factors shape what is considered true and legitimate interpretations of reality, it rejects the notion that any interpretation is as good as another. The methodological approach taken in this thesis is primarily qualitative, which hinges upon the understanding that reality is always coloured by the social background of the research and co-produced through the interaction with research subjects (Denzin & Lincoln 2000).

3.1 Research design

This thesis uses the case study as a research design. Case studies are advantageous in exploratory research and allow for in-depth and rich descriptions of phenomena, which suits the study of the contextual aspects of adaptation (Ragin 1992). The thesis follows Gerring's (2004:342) definition of a case study as 'an intensive study of a single unit for the purpose of understanding a larger class of (similar) units'. The selection of a case study research design is motivated by the exploratory nature of the research, as little has been written about how processes of environmental change unfold in localised settings in coastal Belize. In the thesis, the importance of gaining in-depth and locally situated understandings of responses and experiences of change is more essential than generalisable findings, for which case studies are less suited (Ragin 1992).

Following Gerring (2004), the overarching case this thesis analyses is how local groups perceive, experience and adapt to coastal change in Belize, which also contributes knowledge towards adaptation in the Caribbean and wider SIDS region. The overarching case is approached through an in-depth focus on the coastal villages of Sarteneja and Monkey River. The events and processes pertaining to coastal change within these subunits constitute the focus of the thesis and the individual papers. As Ragin (1992) points out, case studies often incorporate a number of nested cases, which emerge during the course of research and are bounded conceptually rather than geographically. The individual papers, which analyse different aspects of local experiences with and responses to coastal change within the same geographic area, are examples of nested cases. Taken together, the papers

elucidate the overarching unit of analysis, namely the most salient factors that inform adaptation within Belize, the Caribbean and wider SIDS region.

The in-depth and rich descriptions emerging from a case study can be advantageous for theory development (Flyvbjerg 2006). With respect to theory, Stake (2000) differentiates between intrinsic and instrumental cases. Intrinsic cases are studied when little is known about a phenomenon that is in itself of interest. In contrast, instrumental cases are used to enhance the understanding of general phenomena in order to build theory. I consider the case under analysis in this thesis to occupy a middle ground between descriptive, original research and theory development. The scarcity of in-depth social inquiries into the processes of adaptation in coastal Belize rendered the topic and case sites interesting in themselves. Although the conceptual frameworks employed in this thesis are not new *per se*, the combination of perspectives from adaptation, risk research and political ecology contributes to the nascent field of climate change adaptation and offer novel ways of seeing and understanding human interactions with coastal change.

The selection of case sites was partly influenced by the research setting and timing. In June 2010, I was hired by the Centre for International Climate and Environmental Research-Oslo (CICERO) as a research fellow and PhD student to undertake research for a project entitled 'Climate change vulnerability and adaptation for Small Island developing states', funded by the Research Council of Norway. This project was linked to a programme called Many Strong Voices (MSV), an initiative seeking to raise awareness, build collaboration and capacity and improve the understanding of climate change and means of adaptation for the Arctic and SIDS regions. Both regions are considered particularly vulnerable to the effects of climate change and despite their obvious differences, share a number of commonalities (see <http://www.manystrongvoices.org>). It was a requirement that my PhD project was conducted in a Caribbean SIDS and as a partner organisation to MSV, the Caribbean Community Climate Change Centre (CCCCC) soon emerged as an important collaborator. CCCCC, located in Belmopan, Belize, coordinates the Caribbean region's response to climate change and provides policy advice to the Caribbean community (CARICOM) member states through the CARICOM Secretariat. After initial desk studies and discussions with staff at the CCCCC, I chose to conduct my project in Belize. This choice was motivated by Belize's commonalities with other SIDS, including its small size, economy tied to global markets, reliance on natural and coastal resources and specific ecologies. Belize is furthermore hit yearly by tropical storms and hurricanes. It has a large coral reef system and is a low-lying country with a large proportion of its population and settlements located in the coastal zone. These characteristics made Belize suitable for an inquiry into how processes of coastal change unfold in specific settings. Belize's colonial history, centred on forestry rather than plantations, and its dual position as a Caribbean as well as a Central American country, provided interesting contrasts to other Caribbean SIDS. Moreover, the support of CCCCC and their

extensive network of contacts, which I felt would facilitate my fieldwork and data collection, influenced the selection of Belize.

The criteria I employed when selecting case sites within Belize included coastal location, reliance on fishing activities and experiences with environmental change. I met and discussed potential case sites with CCCC staff, representatives from government agencies and NGOs. From these discussions and desk studies, I selected Sarteneja and Monkey River as case sites, since they both met my criteria and shared commonalities such as remoteness, heavy reliance on fishing activities and both have endured severe hurricanes in the past. On the other hand, the village's histories, geographies, size and cultural and ethnic traits differ.

Table 1. Overview of similarities and differences between the study locations

	SARTENEJA	MONKEY RIVER VILLAGE
Similarities		
Coastal features	Remotely situated in the northeast corner of Belize, facing Chetumal Bay	Situated on the mouth of Monkey River, facing the Gulf of Honduras
Livelihoods	Fishing (over 70% of households), small-scale agriculture, services	Fishing (over 60% of households) tourism, services
Remoteness/	Dirt road leading to Sarteneja, flooded during wet season	Dirt road, flooded during wet season, last stretch has to be taken by boat.
Experience of environmental change	Hurricanes 1942 and 1944 and Hurricane Janet 1955 (salinisation of agricultural lands and wildfires)	Hurricane Iris 2001, coastal erosion >100 metres of lost land since 1987
Religion	Catholicism, evangelical Christianity (12 churches)	Catholicism, evangelical Christianity (2 churches)
Proximity to protected areas	Terrestrial Shipstern Reserve (est. 1987) and Bacalar Chico Marine Reserve (est.1996)	Terrestrial Payne's Creek National Park (est. 1993) and Port Honduras Marine Reserve (est. 2000).
Differences		
Population (2010)	1843	196
Geography and ecology	Northern district of Corozal, village accessible by public transport, coastal location facing Chetumal Bay, area consists of subtropical forests, saline wetlands and mangroves boarding lagoons	Southern district of Toledo, inaccessible by public transport, area consists of Coastal plains, mangrove forests, tropical broadleaf forests
Average yearly precipitation	1 260 mm	3 000 mm
Predominant ethnic-cultural category	Mestizo	Creole
Languages	Spanish, English	Kriol, English
Fishing practices	Migratory fishing 5–12 days away in all main areas of the barrier reef, sailboats, free diving after lobster and conch. No technical aids	In proximity of the village, 1 day away, motor powered skiffs, lobster traps, free diving, fin-fish, use of GPS and fish finders

The combination of contrasting and similar features made it interesting to study how perceptions of coastal change and adaptation occurred in the two case locations. Belize's small size and central mode of administration implied that national governance arrangements were quite similar in the villages.

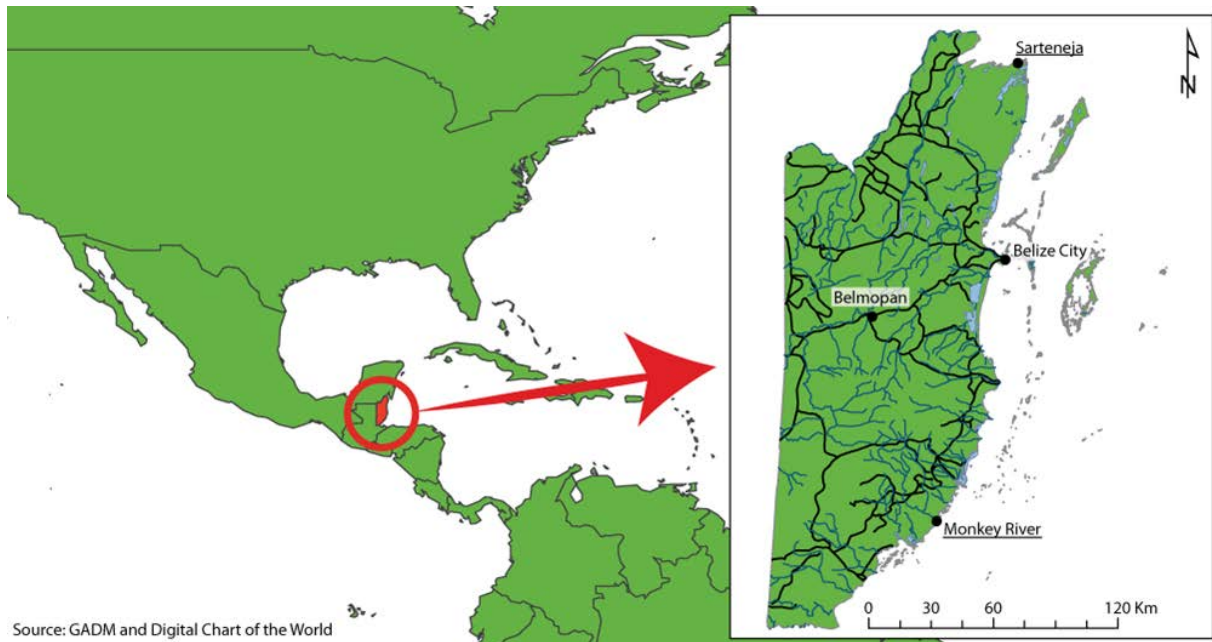


Figure 1. Map outlining the location of Sarteneja and Monkey River Village

3.1.1 Sarteneja

Sarteneja with a population of 1 834 is situated in the north-eastern corner of Belize, in the administrative district of Corozal (SIB 2010). The village faces the shallow Chetumal Bay and the area lays on a flat limestone plateau only a few metres above sea level (Nardini 2010). A variety of ecosystems is found in the area, ranging from subtropical forests to saline wetlands and mangroves bordering lagoons and the seashore, each attracting its own flora and fauna (Meerman & Boomsma 1993, Nardini 2010). Soil depths are shallow and vary between 20 and 60 cm (Nardini 2010). Sarteneja is one of the driest areas in Belize, with average rainfall amounting to 1 260 mm a year (Meerman & Boomsma 1993). The dry season normally starts in January and ends in May, with September being the wettest.

The settlement was established when 40 refugees from the Caste War of Yucatán arrived in 1854, and Sarteneja is marked on colonial maps from 1886. People in Sarteneja predominantly identify themselves as Mestizos and speak Spanish as their first language. Sartenejans were initially small-scale farmers occasionally involved in chicle bleeding (tapping the latex of the sapodilla tree; used as an ingredient in chewing gum) and sugar cane cutting, similar to other villages in Corozal (Abrams 1973). While Sarteneja has experienced several hurricanes, Hurricane Janet in 1955 is an important historic marker in the village as the destruction and the reconstruction that followed changed the character of the village from thatch-leaf houses to stone and concrete houses. From the end of the 1960s, the fishing industry became the village's main livelihood and Sarteneja is today Belize's largest fishing community. Studies estimate that over 70% of the village's households rely on incomes from fishing (Pantin *et al.* 2003, Conservation International 2010). There are few formal employment

opportunities for women in Sarteneja. Women mostly engage in domestic work and some work in shops, restaurants or the village's schools and nursery. Pantin *et al.* (2003) estimate that 82% of women are outside formal employment.

Sartenejan fishers engage in migratory fishing to all areas around the barrier reef and atolls, embarking from Belize City, where boats are harboured and landing and processing facilities are available. Fishers utilise sailboats, ranging between 20 and 60 feet, equipped with an outward engine and an icebox. Boats accommodate between 9 to 15 divers that live on board for the duration of the trip, which typically lasts between 5 and 12 days, and return to their communities for a couple of days in between trips. Divers fish independently from individual canoes in the proximity of the mother boat, targeting lobster, conch and fin-fish, depending on season. Lobster and conch are harvested by skin-diving up to depths of 30 metres using fins and a mask; fin-fish are harvested by various forms of harpoons, although hand-lines are also used when fishing is carried out from a sailboat.

Two protected areas are found in the vicinity of Sarteneja, the one being the land-based Shipstern Reserve established in 1987 by the Nature Conservancy, which includes a butterfly reserve, and the other being Bacalar Chico Marine Reserve, which lies within the UNESCO World Heritage Site of the Belize Barrier Reef Reserve System. The district of Corozol to which Sarteneja belongs is also known for its sugar cane production but has recently experienced increasing poverty; in 2009, 56% of the population were considered poor and the district is now ranked as the second poorest in Belize (Halcrow/NAT 2010).

3.1.2 Monkey River Village

Monkey River is a small Creole village in the southern district of Toledo with a population of 196 (SIB 2010). Monkey River is situated on the mouth of the Monkey River, which reaches the Gulf of Honduras, part of the Caribbean Sea. The Monkey River basin, fed by three tributaries, is the fourth largest in Belize. The area lies on limestone rock and coastal plains, including savannah grasslands and mangrove forests, which have been used for a variety of human activities such as banana cultivation, small-scale agriculture and, to the north of Monkey River, citrus plantations and shrimp farms. The upstream area is covered with tropical broadleaf forest (Heyman & Kjerfve 1999). There are distinct dry and wet seasons, with July to October receiving the most precipitation, totalling over 3 000 mm/year (*ibid.*).

It is assumed that mahogany-cutting Creoles and Garifunas settled in Monkey River around 1820. Monkey River's history is intimately linked to the fate of the banana industry that developed in the area around 1880 and drew labourers from Belize City and nearby settlements to Monkey River (Bolland 2009, Moberg 1996). Monkey River is estimated to have had around 1 000 residents around the turn of the nineteenth century as well as several shops and two schools. Since the decline and eventual collapse of the banana industry began in the 1920s, Monkey River has experienced large-

scale migration. People in Monkey River identify themselves with a Creole ethnicity and speak Kriol as well as English. Livelihoods in the village have traditionally combined farming with fishing, but have over the last couple of decades tourism has become more important than agriculture. Today, 52% of the households depend on fishing as their main source of income and fishing provides incomes to more than 60 % of its population (Conservation International 2010). Fishing is conducted in the proximity of the village and fishers use motorised skiffs. Fishers target lobster and fin-fish using a variety of methods, including diving, traps and hand-lines. Since the late 1980s, tourism has emerged as an important livelihood in the village. Tourism consists of guided day trips of the Monkey river area and its wildlife. Fishing and tour guiding are exclusively male occupations in the village. Women have fewer employment options, mostly engaging in domestic work but also in the schools, shops and restaurants. Monkey River was severely affected by Hurricane Iris in 2001, which destroyed up to 90% of the village's built structures (Beven *et al.* 2003). Since the 1980s, Monkey River has experienced significant coastal erosion, which has led to losses of coastal land and properties.

The administrative district of Toledo is ranked as the poorest in Belize with poverty rates of 60%, although poverty rates have decreased over the last decade (Halcrow/NAT 2010). Toledo has the highest percentage of people with indigenous ethnicity in Belize, referring to the Mayas. This group has traditionally been marginalised, largely leading to high poverty rates within the district (Bolland 2009, Wainwright 2008). Monkey River is situated between two nationally protected areas, the land-based Payne's Creek established in 1993 and Port Honduras Marine Reserve established in 2000.

3.2 Research timing, access and ethics

I visited Belize three times between December 2010 and May 2012, staying for a total of eight months. I made a preliminary three-week visit to Belize and the CCCCC in December 2010 to January 2011 to establish initial contacts and to discuss case sites within Belize. The main fieldwork was carried out between April and August 2011 and between February and May 2012 (see Table 2 for an overview of the fieldwork).

During my stays in Belize, the CCCCC hosted me in their Belmopan office and provided support in various matters ranging from visas and accommodation to inputs and advice for my research. Importantly, they also pointed me to relevant documents and material and provided access to a number of contacts. During the fieldwork periods, my time shifted between weeks of fieldwork in Sarteneja and Monkey River and time spent in Belmopan and Belize City, where I collected material, visited the archives and interviewed representatives from government agencies, environmental NGOs and interest groups such as fishermen cooperatives.

Qualitative research necessitates access to and rapport with the groups of people one wishes to study (Bryman 2012). All researchers conducting fieldwork in communities must reflect on questions pertaining to access and entry to the settings (Fontana and Frey 2000). I contemplated the advantages

and disadvantages of entering the case sites either as an independent researcher or in collaboration with local (environmental) NGOs. After meetings and discussions with some NGO representatives, I was uncertain to what degree my research objectives could be reconciled with theirs, since they expressed an interest in research that could directly feed into their ongoing projects. During a brief visit to Sarteneja, I sensed that fishers carried negative feelings towards conservation-orientated NGOs. These considerations informed my decision to enter Sarteneja and Monkey River as an independent researcher.

Table 2. Overview of fieldwork activities

FIELD PERIOD	ACTIVITIES
Scoping visit Dec 2010–Jan 2011	Meetings with representatives from: Ministry of Tourism Belize Fisheries Department CCCCC Climate Change Focal Person Healthy Reefs for Healthy People 4 informal interviews with residents in Sarteneja
Field period 1 April–August 2011	Interviews 21 local residents in Sarteneja 22 local residents in Monkey River Organisations: Belize Fisheries Department Coastal Zone Management Authority & Institute Sarteneja Alliance for Development and Conservation United Nations Development Program (UNDP) Belize, Small Grant Programme Wildtracks World Wildlife Fund Belize Toledo Institute for Development and Environment Southern Environmental Association Caribbean Regional Fisheries Mechanism Healthy Reefs for Healthy People Northern Fishermen Cooperative National Fishermen Cooperative Belize Fishermen Cooperative Association Participant observations Lobster hauling trip, tourist tour, Monkey River Tilapia breeding meetings, Sarteneja Conch fishing trip, 7 days, South Water Caye, 7 fishers from Sarteneja
Field period 2 February–May 2012	Interviews 9 local residents in Sarteneja 11 local residents in Monkey River Organisations: Belize Fisheries Department Coastal Zone Management Authority & Institute Wildlife Conservation Society, Belize Healthy Reefs for Healthy People Southern Environmental Association Toledo Institute for the Environment and Development Northern Fishermen Cooperative National Fishermen Cooperative Protected Areas Conservation Trust (PACT) Participant observation Conch fishing trips 8 days, Glovers Reef, 7 fishers from Sarteneja

‘Getting into’ Sarteneja and Monkey River proved to be two different experiences. In Sarteneja, immediately after being dropped off by the bus, I entered a small ice-cream parlour and restaurant and introduced myself as a PhD student interested in learning more about the village and its way of life, and inquired about possible forms of accommodation in the Sarteneja. The shop owner, a woman in her 50s, offered me a room to rent in her house. This coincidental meeting proved very fruitful as a point of access as it turned out that in addition to running a shop/restaurant, she was a school teacher and married to a commercial fisher. This family became my ‘sponsors’ (Bryman 2012), providing me with knowledge about the village and its way of life and enabling access to people in Sarteneja. Their friends and relatives who frequented their house were often willing to be interviewed and became my informants. To counter the reliance on this family and their networks, I also stayed a few nights with another family to broaden access to social circles within the village. In sum, the initial process of getting in and getting access to informants in Sarteneja was relatively unproblematic.

The process of ‘getting in’ proved more difficult in Monkey River. My first point of access, a former village leader whom I had met previously in Belmopan, arranged my transport and accommodation in Monkey River. I stayed in a room in one of the village’s guesthouses, run by an extended family that also had a restaurant where I took my meals. Upon my arrival in Monkey River, I learnt that the village’s residents had a long experience of being research subjects and targets for various environmental and development projects (cf. Palacio 2001). Some residents felt that their interests had been overlooked in previous projects and that information they had shared with researchers had been misused. In addition to a general research fatigue, my stay coincided with an ongoing conflict between the local fishers and environmental NGOs concerning an extension of a nearby marine reserve and the implementation of a new fishing licensing initiative. In this context, it was challenging to build trust and rapport; understandably, as an ‘outsider’ and researcher, I was met with some scepticism. Although I introduced myself as an independent student from Norway with some affiliation to CCCCC, I was frequently asked *whom I really worked for*. After some days, I learnt that my ‘presentational self’ (Fontana & Frey 2000) had been misunderstood as residents told me that they had assumed that I was hired on behalf of the local NGO, which the fishers were in conflict with. Gaining access to particularly fishers as informants therefore took time and patience. I approached this by keeping a low profile and aimed at getting myself known in the village by walking around and introducing myself and spending time in public places, including the village’s two shops, a strategy Bryman (2012) calls hanging around. In the end, spending time in these settings and with the extended family with which I shared my meals in the guesthouse/restaurant provided a means of establishing rapport and being accepted in the village. The return to Sarteneja and Monkey River in 2012 contributed to further rapport, demonstrating that securing access and trust with informants is a continuous process (Bryman 2012). My affiliation with CCCCC proved helpful in gaining access to official settings such as government agencies and NGOs.

3.3 Methods and data collection

In line with case study research and approaches taken within adaptation (e.g. Hovelsrud & Smit 2010) and political ecology (e.g. Benjaminsen & Svarstad 2010), I used several methods to secure an in-depth understanding of local perceptions and responses to coastal change. As Fontana and Frey (2000:668) note, ‘human beings are complex, and their lives are ever changing, the more methods we use to study them, the better our chances to gain some understanding of how they construct their lives and the stories they tell us about them’. The use of multiple methods therefore brings out different ways of seeing a phenomenon (Denzin & Lincoln 2000). Maxwell (2005) suggests that multiple methods can reduce specific weaknesses or biases associated with one particular method and strengthen the overarching research inquiry.

3.3.1 Studying processes of change through interviews

Qualitative interviews, ranging from semi-structured to unstructured interviews, make up the core data in the individual papers and the thesis. In total, I conducted 82 qualitative interviews recorded by audio or detailed note taking with local residents in Sarteneja and Monkey River and representatives from government authorities, fishing cooperatives and environmental NGOs. My strategy when I selected informants can best be described as a combination of purposive and snowball sampling (Bryman 2012). During the first fieldwork period, I was primarily interested in how those engaged in fishing and tourism activities experienced environmental change and other political and economic conditions. My criteria for locating informants were based upon engagement in coastal livelihood activities, experience of environmental change and knowledge about the villages’ history. In Sarteneja, I selected informants primarily based on livelihood occupation (fishing) and strived towards including fishers of different age, experience and status within the fishing industry, such as cooks, crew members, captains and retired fishers. Since fishing and tourism are exclusively male occupations in the villages, I mainly interviewed male informants. I found informants by going to the seafront, where most fishers at that time of the year repaired their fishing vessels. At times, one informant would suggest others for interview, based on their experience and knowledge of fishing. Fishers close to the interview setting often became curious and wished to ‘give me information’. In addition to the seafront, I visited other parts of the village and approached informants that held specific or general knowledge about the village’s history and fishing livelihoods. During the second field visit, I placed a greater emphasis on including women and people who engaged in non-fisheries-based livelihoods to capture different perspectives. Such informants were located through a mixture of snowballing and visiting places such as shops and schools. In Monkey River, which is significantly smaller than Sarteneja, both spatially and population-wise, it was easier to gain an overview of the community members who were willing to be interviewed and those who did not wish to participate. My criteria for selecting informants in Monkey River were similar to those I used in Sarteneja. I sought to interview fishers and tour guides of different ages and livelihood status, for example with fishing or tour guiding as their sole occupation and those who combined the two. In 2012, I particularly targeted elders and

people who lived or had lived near the seafront, given the research focus on coastal erosion, locating them through snowballing. Given that access to informants was more challenging in Monkey River, the residents' willingness to participate in the study became an important criterion in locating informants. The residents who did not wish to participate in interviews held strong views about coastal resource management and can be assumed to be well informed about change processes in the village and in southern Belize. Their experience and knowledge would have been of value for the thesis. To some extent, non-participating residents' opinions could be discerned through participant observations of everyday discussions in public settings. However, other residents who likewise had strong feelings about NGOs and research did participate in the study, so the results are not completely devoid of such views.

In Sarteneja and Monkey River, I approached interviews with individuals as 'a window of the community' (Harper 1992:146) and as a means of understanding past village events as well as everyday activities and concerns. The individual papers all focus on the findings and analysis of the interview data, but here I will provide a more detailed account of the interview process. In both case sites, I started the interview process by conducting a few initial interviews with residents, which informed the development of an interview guide for subsequent semi-structured interviews. The interview guide encompassed themes related to coastal livelihood activities, observations and experiences of environmental and climatic change, coastal resource management, livelihood challenges and opportunities and general sentiments towards the villages. It was altered according to the specific conditions in Sarteneja and Monkey River and was adjusted several times during the course of the fieldwork. I sought to cover roughly the same topics in these semi-structured interviews, but because the interest and knowledge of the informants differed, deeper elaborations on certain themes and shorter answers on other topics often occurred. The interview guide was an important aid in the beginning of the fieldwork, when I was new to the context and topics. Over time, as I gained more familiarity and knowledge of the themes, I did not have to rely on the interview guide as heavily and I could formulate relevant questions suitable for the interview situation (Kvale & Brinkmann 2009). Furthermore, being an 'outsider', I had to be prepared for being interviewed in turn and was often interviewed by the informants. By applying the interview guide more loosely, I experienced that the flow and depth of interviews were often improved. Research themes and questions were revised and reformulated during the course of the fieldwork as my own understanding improved and I could explore new and at times unexpected research directions. The semi-structured interviews provided insights into the fishing livelihoods, village life and challenges and into the multiple and diverging perceptions and experiences of change processes.

When I returned to Belize and the villages in 2012, I had gained further insights and knowledge through an initial analysis of the data from the 2011 fieldwork. The combination of knowing more and having a closer rapport with residents in the study sites allowed me to use a less structured interview

format. Rather than following an interview guide, I engaged in conversations with a few themes in mind, which allowed for a more conversation-like form of interview (Bryman 2012). The advantage of loosely structured interviews is the possibility of gaining deeper understandings of complex topics (Kvale & Brinkmann 2009). Many informal and unrecorded conversations were held during both fieldwork periods, which added depth and context to the findings (Fontana & Frey 2000).

To explore the history of the villages, to gain an understanding of what events and changes had occurred in the past and in turn how residents interpreted such changes, I conducted eight oral histories with older residents aged 62 and over in Sarteneja and Monkey River. The informants' experiences of the past played a central role and these interviews helped to build a history of the communities and to identify the change processes that were seen as important by the residents themselves. I inquired about the village history, traditions and past means of making a living. I tried to avoid interrupting the stories as much as possible, although at times I asked specifically about events such as hurricanes and previous livelihood activities and their demise.

In Monkey River, I conducted three photo-elucidated interviews (all with females) with the specific purpose of learning more about alterations in the village's physical appearance and how the informants interpreted such changes. According to Harper (1992:155), photo-elucidated interviews 'offer a rich potential in research problems where the study can be made visible'. Monkey River has undergone major physical changes due to coastal erosion and hurricane impact, and a visual account of the village's past appearance was therefore interesting for the study. These interviews uncovered some of the meanings of the loss of the coastline, and what 'the village used to be like'. I found that the photographs functioned as a medium for triggering communication about the informants' memories and interpretations of the past and present (Clark-Ibáñez 2004). By 'talking around' photographs, often depicting the informants, their relatives and friends, informants could recall and expand on events in depth, which was not possible without the visual aid of the photograph.

While many people in Sarteneja speak English, it is almost invariably their second language and their fluency varies. When I started interviewing, I only had a basic understanding of Spanish. Gradually, my Spanish improved and it was possible to conduct some interviews in a mixture of Spanish and English. For example, I would ask something in English and the informant would respond in Spanish. Despite some of the challenges and loss of detail this type of approach involves, I considered it an advantage to carry out the interviews without an interpreter because I felt that it was easier to establish rapport if I approached the fishers alone, rather than accompanied by someone else. The practical issues in locating informants also implied that it was difficult to hire an interpreter for a specific interview schedule, as I continuously searched for informants during my stays in the villages.

When selecting informants from government authorities, environmental NGOs and fishing cooperatives, I sought to include the relevant actors that in various ways participated in the

management or utilisation of marine resources. Representatives from local organisations active in the case sites were also targeted for interviews (see Table 2) I would normally locate the actors through snowball sampling and reviews of relevant literature, and contacted the organisations via email or phone to ask whether they were willing to be interviewed. In interviews with local residents and representatives from government and environmental NGOs, my affiliation with CCCCC positioned me as a researcher primarily interested in climate change. This unintentionally directed attention towards climate change consequences, while local residents often talked about whether climate change was real or not. The connection with CCCCC thus spurred conversations about climate change, which is likely to have coloured my data as it rendered climate change a bigger topic than if I had entered interviews without this affiliation.

Complete representativeness is rarely an objective in qualitative research and it was not a goal in my selection of informants either. Although I have included perspectives from individuals of different ages, backgrounds and occupations, the results in this thesis are biased towards male perspectives. I consider the gender bias justified because coastal occupations such as fishing and tour guiding are exclusively male ones, which imply that males to a larger extent have experience and knowledge about the marine and coastal environment. Through my initial focus on fishing livelihoods and male informants, I gained access to male-dominated settings (such as bars) at the expense of female-dominated settings. It should be noted that the majority of women in both case sites engage in domestic work and that their labour constitutes the backbone of the coastal economy.

3.3.2 Learning about everyday activities through participant observation

According to DeWalt and DeWalt (2010:260), ‘participant observation is a method in which an observer takes part in the daily activities, rituals, interactions, and events of the people being studied as one of the means of learning the explicit and tacit aspects of their culture’. I used participant observation as a complementary method to understand actual and tacit everyday behaviour (Bryman 2012). By temporarily residing in Sarteneja and Monkey River, I observed and to some extent participated in everyday village life. For example, by partaking and listening to discussions and conversations, I gained insights into the topics that were interesting and of concern to villagers and learnt how people acted in their normal settings and environments. In Monkey River, I participated in tourism tours, river excursions and a half-day lobster trap-hauling trip at a nearby fishing ground. This promoted an understanding of aspects of village life that cannot be communicated and captured in interviews, but instead reflect parts of a lived environment. This point is illustrated through a more detailed outline of my experiences as a ‘participant’ on longer fishing trips with Sartenejan fishers.

When conducting interviews and talking to fishers in Sarteneja, I was often told that ‘we spend eight months a year out in the blue’. As I gained more knowledge about the village’s main livelihood, it became clear that the lives fishers led in Sarteneja were very different from their lives at sea. One

evening whilst interviewing a fisher, I was invited to join him and the crew as a guest on their next fishing trip. I saw the invitation as a unique opportunity to gain deeper insights into livelihood practices and aspects of the culture that could not be achieved by staying in the village.

At first, many villagers were sceptical of my idea of joining a group of fishers at sea for a week. Sartenejan women never accompanied their husbands on commercial fishing trips and would only occasionally go for short, recreational trips in the local bay. It was extremely uncommon for women to join fishing trips and from what I was told; only one 'white' woman had previously done so. Understandably, several people were concerned for my comfort and safety on board, and some actively tried to dissuade me from going. I also felt slightly nervous about going fishing, not because of a possible lack of comforts, but because of warnings about the possibility of sexual harassment. My concerns eased after several discussions with the captain and his wife and after the father in the family whom I lived with also talked to the crew members to ensure my safety.

During the course of the fieldwork, I participated in two fishing trips, spending in total 15 days 'out on the blue'. In June 2011, I joined a crew of nine fishers including a captain and a cook on a seven-day conch fishing trip in the South Water Caye¹ Marine Reserve area. When I returned to Belize and Sarteneja in 2012, I was again invited to join another group of fishers (seven including the captain and cook), on an eight-day conch fishing trip to the Glovers Reef Marine Reserve. The two fishing trips followed similar procedures, although the crew composition and fishing areas were different. Both trips started on an early morning bus from Sarteneja to Belize City, to the harbour. I followed the fishers as they bought ice, fuel and provision for the trips and waited around in the harbour area before leaving. In the afternoon, we left Belize City. The days at sea normally started with breakfast around 06:00. An hour or so later, the fishers set off, working from their individual canoes. Equipped with a mask and fins, I would normally join one fisher in his canoe to dive for conch in different seagrass areas or 'patches'. The fishers dive up to 25 metres and I was encouraged to dive for conchs too. My presence in the canoe was probably more of a hindrance than help, although I did catch some conchs. The periods spent paddling in between patches offered fruitful conversations on the marine environment, fishing and the experiences and lives of the fishers. I could directly inquire about fishing practices, fish or coral that I had observed, which added to my knowledge about how fishers engaged in their coastal environment. All fishers would generally return to the mother boat after six to seven hours of work to clean their catch and I alternated between writing field notes and resting. I talked to the fishers during and after dinner, around 18:00. We went to bed early, between 20:00 and 21:00; during both trips I slept next to the captain on top of the icebox, where the produce is stored. This arrangement, as I understood it, was meant to ensure my safety on board.

¹ Spanish word for small island

I found that the small and intimate setting on the boats made it easier to get to know the fishers. While the sailing boat was a natural setting and even considered as a home by the fishers, it was a novel setting for me where I needed continuous guidance and help from the fishers. In addition to helping me with various tasks, even fishers who initially were shy or distant would typically approach me to share stories, experiences and knowledge about the seascape. In this setting, discussions centred on topics of a more sensitive nature such as the prevalence of illegal fishing and the role of cocaine transshipment in the local economy. Furthermore, by observing the interactions between the fishers on board and how they organised their workdays, I learnt more about the specific culture at sea and came to realise what statements such as ‘we eat good, we sleep good, we feel free, nobody tells you when you should start work’ meant.

Overall, the experience, conversations and observations obtained during these trips undoubtedly enriched my empirical material. This experience helped to guide the direction of my further inquiry. For example, some interview questions concerning specific fishing practices became unnecessary. Moreover, Sarteneja is a small village; upon my return, everybody seemed to know that I had been on a fishing trip and wanted to talk to me to see how I experienced it. This proved to be a good entry point when I was seeking informants, as I believe the fishers and villagers became assured that I was genuinely interested in their lives. I could also use the fishing trips as a starting point for discussions with fishers from Monkey River or with representatives from organisations.

3.2.3 Written sources and GIS mapping

During the research process, I collected a range of written sources in Belize and in London, United Kingdom. At the CCCCC’s library in Belmopan, I accessed policy documents and studies on climate change adaptation that I used as background material in the articles. Belizean government documents contained helpful background information well as a particular way of seeing climate change adaptation, for example by emphasising specific economic sectors. In general, I obtained colonial and historical documents on Belize and the case sites through visits to the Belizean Archives and Record Service in Belmopan. I also spent ten days in London in 2012, visiting the British Library and National Archives to study colonial records from Belize and other publications. During my visits to the archives, I reviewed bunches of correspondence between the colonial administration in Belize and Britain. These bunches were organised per year and contained a vast range of material, of which only a few documents were relevant to my research. I did not spend enough time to analyse the archival material in a systematic way, but I took pictures and notes of the documents I deemed relevant for my study. Few documents focused on the case sites specifically, but some colonial assessments of schools and sanitary issues in Monkey River provided insights into how the colonial administration viewed its interest. Concerning Sarteneja, hurricane damage and aid reports gave indications of the size and livelihoods of the village during that time. The data obtained from colonial records complemented my interviews in building and delineating historical events and developments, particularly in Paper I.

A literature review based on peer-reviewed and grey literature and other available documentation helped to build an understanding of the physical and ecological changes occurring in Monkey River Village. This review contributed towards Paper II and III. A GIS mapping exercise was used to analyse the physical extent of the coastal erosion in Monkey River, which added to the analysis in Paper III and provided context to Paper II. To quantify the local coastline changes, a set of twelve Landsat satellite images from the period 1987 to 2013 was obtained. The coastline was then manually mapped on each of the satellite images, by using a false colour composite of the short wave infrared, the near infrared and the blue band from Landsat's TM/ETM+ sensor. The purpose of the mapping exercise was to document the physical changes in the coastline over time and to see whether the coastal retreat had been occurring along the whole coastline or primarily near the river mouth, which may indicate whether riverine or oceanographic factors were driving the changes.

A review of media reporting on the coastal erosion in Monkey River formed an important data source in Paper II. Ten online articles were found and analysed after an Internet search, these news pieces provided an account of the journalists and residents line of argumentation in demanding support from the government. Finally, written materials collected during fieldwork including flyers, reports and information sheets distributed by environmental NGOs, international donors and the Fisheries Department have been important to analyse official accounts of marine conservation and the role of commercial fishing in Belize and the Mesoamerican Reef. Web sources outlining NGOs and the Belizean government's involvement in marine conservation programmes have also been important.

3.4 Data analysis and validity considerations

I have used a loosely grounded theory approach and the text analysis software QSR NVivo to code and analyse the data. As Bryman (2012) notes, coding is the starting point for most forms of qualitative data analysis. QSR NVivo is software that allows the researcher to organise empirical material and to categorise and code data, which facilitates data analysis (Bazeley and Jackson 2013). I imported transcribed interviews and field notes into NVivo and coarsely coded the material. The codes were initially based on the interview guide and included concepts such as MPAs, coastal erosion, hurricanes and village history. As the research questions for the individual papers were refined and new empirical findings emerged, however, new codes and subcodes were added.

The research process and data analysis followed an inductive and iterative approach, where I moved back and forth from the particularities discovered in the data towards broader concepts in the theoretical framework (Crotty 1998). I sought to counter validity threats by comparing my interpretation of the data to similar studies and to theoretical literature (Maxwell 2005). Moreover, in case studies and qualitative approaches, study objects 'talk back' and force the researcher to critically reflect upon and revise their preconceived views and concepts, which can strengthen the validity of the results (Ragin 1992). Throughout the research process, I had been aware of the need for self-reflection

and had to revise initial conceptual framings of the study. During the fieldwork, I discussed my preliminary analyses and shared short notes that I had written with informants, who commented on my interpretations of events. After these discussions, initial concepts and article ideas were revised and refined, a process that strengthened the validity of my analysis and interpretation. In this process, I aimed to strike a balance between what was important to the communities and what was interesting from a theoretical perspective. The empirical material collected for this thesis is richer than reflected in the individual papers, based on analytical decisions throughout the research process, which is common for qualitative research projects (Bryman 2012).

4. BACKGROUND TO COASTAL BELIZE

Belize, situated on the Caribbean coast of Central America, borders Mexico to the north and Guatemala to the east and has a land area of 22 960 km². Belize is Central America's youngest nation and received its full independence from Britain in 1981. Belize has a population of 360 838 split across rural and urban settlements (SIB 2014).

As a member of the Commonwealth, Belize is governed under the principles of parliamentary democracy based on the Westminster model. Belizean politics have been characterised by dominance of two parties, the centre-left People's United Party (PUP) and the centre-right United Democratic Party (UDP). Since the 1980s, power has typically changed hands at every election except in 2003 when PUP was re-elected and in the most recent election in 2012 when UDP was re-elected. At the local level, Belize operates a system of city councils (Belize City and Belmopan), town boards, and village and community councils, headed by elected officials.

Tourism is Belize's largest economic sector and foreign exchange earner. The primary industries, including agricultural production of citrus, banana, cane sugar and marine products, are an important source of employment and foreign exchange. In 2011, 38% of the workforce was employed within tourism, 28% within agriculture, 6% within fisheries, 1% within petroleum and the remaining 27% in other sectors (Kirkwood & Matura-Shepherd 2011). Unemployment levels differ between assessments; the Statistical Institute of Belize estimated unemployment rates at 12% in 2014, while Kirkwood and Matura-Shepherd (2011) estimated unemployment to be around 23%. Many Belizeans have migrated to the USA, and remittances constitute a large part of Belize's informal economy (Medina 2004).

Belize is ranked as a high human development country with a human development index (HDI) of 0.732, ranking 84 out of 187 countries, and had a gross national income (GNI) per capita of USD 9 364 in 2013 (UNDP, 2014) (UNDP 2014). However, this measure does not account for large disparities within the population. Poverty levels have increased substantially during the 2000s, from

34% in 2002 to 41% in 2009. The highest poverty levels are found in the southern district of Toledo, followed by the northern Corozal district (Halcrow/NAT 2010).

Belize is an ethnically diverse country, and its culture and composition of peoples have largely developed as a result of colonialism and from groups of people fleeing persecution elsewhere (Sutherland 1998). The majority ethnic-cultural group is Mestizo, followed by Creole, Maya, Garifuna, East Indians, Mennonites and small but growing percentages of Chinese, North American and British immigrants. Until the 1980s, Creoles were the main ethnic group, but an influx of people from neighbouring Central American countries has led to Mestizo dominance. It should be noted these ethnic-cultural categories are fluid and overlapping but nevertheless provide a sense of self-identity (Medina 1997). English is the official language of Belize, and Spanish the most prevalent spoken language; furthermore, the first language of groups varies throughout the country.

4.2 A brief account of Belize's history and development

Contemporary development in Belize is characterised by a natural resource dependent economy with close ties to global markets for imports and exports of commodities, and to transnational institutions and actors. Belize's contemporary development characteristics cannot be divorced from its colonial history that began long before it was declared a British colony, the British Honduras, in 1862 (Wainwright 2008).

Belize's role as a colony was to supply the British Empire with mahogany (Bolland 2009). In the early 17th century, logwood attracted British buccaneers to Belize. Towards the end of the 17th century mahogany, used for British luxury furniture, replaced logwood. As the demand grew, buccaneers and colonial officials began to import slave labour from Jamaica (Bolland 2009; Shoman 2011). British colonialism in Belize became intrinsically linked to the capitalistic interests of a few mahogany firms (Wainwright 2008, Shoman 2011). A small elite consisting of forestry firms and merchants dominated institutions controlling the colony's revenue and owned the main part of land within the then British Honduras (Bolland 2009). Colonial domination involved control over land and labour prior to and after the abolishment of slavery in 1838. In addition to forestry, agro-exports primarily through sugar and banana were pursued in the later stages of colonialism, towards the 19th century (Mobert 2003). While small-scale agriculture existed throughout Belize during colonialism, land monopolisation and a small domestic market compounded it. Small-scale farming therefore mainly served to complement seasonal employment for labourers in the forestry and agro-export industries (Ashcraft 1973).

Power relations between labourers and the colonial elite began to change in the 1930s when a national labour movement emerged. After a period of protests, universal suffrage was granted in 1954 and internal self-governance was achieved in 1963. Politics in Belize is characterised by PUP rule from 1954 to 1984 (Shoman 2011).

The development strategies undertaken by PUP in part followed those pursued during the colonial administration and continued to focus on the extraction and export of sugar, fruits and marine products (Medina 2004). PUP was committed to achieving independence from Britain, to nation building and to poverty alleviation through economic growth, an approach dubbed wise capitalism (Shoman 2011). PUP passed land reforms, prioritised diversification of economic activities, promoted the sugar industry in particular, introduced labour reforms, began building up the infrastructure and increased social services.

Belize's independence from Britain in 1981 coincided with a global fall in sugar prices, and as a result Belize became heavily indebted (Medina 2010). In the 1984 election, UDP broke PUP's three consecutive decades in power. A year after, a five-year development plan was crafted, shaped by loans from international financial institutions such as the International Monetary Fund (IMF) within the Structural Adjustment Programmes (Moberg 1991,1992). The plan entailed a continued commitment to the expansion of exports of agricultural produce, privatisation, cuts in public sector expenditures and the removal of price controls for agricultural produce (Shoman 2011).

Medina (2010) illustrates that the economic crisis of Belize in the 1980s coincided with a global biodiversity crisis and the rise of global environmentalism. The debt crisis, coupled with the emergence of international environmental NGOs in Belize, directed national development strategies towards ecotourism, supported by the government, foreign donors and development projects (Ramsey & Everitt 2008). The designation of protected areas played an important role in creating and marketing Belize as an ecosystem designation (Medina 2004). Through co-management arrangements between the government of Belize and environmental NGOs, international funds for conservation measures have been accessed (Young & Horwich 2007). This has also led to international NGOs having influence on how large parts of terrestrial and marine environment are managed (Medina 2010).

In the 2000s the government of Belize's commitment to privatisation continued in order to attract foreign investment, and it sold its telecommunications (renationalised again in 2009), electricity (renationalised again in 2011) and water sectors, airport and port authority (Mustafa and Reeder 2009). Belize was long characterised as one of the few countries in Central American and Caribbean regions with high annual economic growth rates. However, periods of high growth were characterised by large public spending and 'growth economics' achieved through international financial loans (Shoman 2011). Following high levels of public spending, hurricane damage and mismanagement of finances, Belize is now faced with a heavy debt burden amounting to USD 1.4 billion (Asonuma *et al.* 2014).

Recently, the discovery of onshore petroleum and the ensuing oil exports have become an important foreign exchange earner (Kirkwood & Matura-Shepherd 2011). Tapping into offshore petroleum resources within the Belize barrier reef has been promoted by the government as a means to balance trade deficits and stimulate economic growth. In 2015, the government of Belize considered

implementing new regulations that would allow for offshore drilling in 99% of its territorial waters, despite national opposition and much to the dismay of environmental organisations (Hackman 2015).

Belize's informal economy is linked to the drug trade, primarily cocaine transshipment, from South America to Mexico and the USA. Money laundering and gang violence related to the illicit drug trade are significant social challenges in Belize.

This brief overview of Belize's historical and contemporary development trajectories illustrates a continuous economic reliance on natural resources and export markets and how development processes in Belize continue to be integrated into global political-economic structures. Local livelihoods in Belize have consequently been closely connected to and affected by change processes on national and global levels (Wilk, 2006, Wilk, 2007, Moberg, 2003, Ashcraft, 1973). It is recognised that climate change coupled with the internationalisation of economic activity contribute to 'the double exposure' on local livelihoods in developing countries (O'Brien & Leichenko 2000). In Belize, this is not limited to new forms of globalisation; rather, intersecting processes of global change have continuously been influencing local adaptation options.

4.2 The coastal geography and climate

Belize's most famous coastal feature is its extensive barrier reef system, which constitutes around 80% of the Mesoamerican Reef system, the largest reef in the Western Hemisphere. The Belize barrier reef system extends 280 km along the Belizean coast and covers approximately 1 400 km². The reef system contains fringe reefs along the mainland coast, the barrier reef growing on the continental shelf and three offshore atolls, Lighthouse Reef, Turneffe Atoll and Glovers Reef (Gillett & Myvette 2008). The reef system is considered to be among the most diverse and well developed in the world (McField & Bood 2007). It hosts over 70 hard coral species, 36 soft coral species, 500 fish species and a number of invertebrates (Gibson 2011). Several threatened and endangered species are found within the reef such as elkhorn and staghorn corals, West Indian manatees, American crocodiles and hawksbill, loggerhead and green turtles (ibid). More than 1 060 mangrove cayes are found within Belize's marine territory. Most of the cayes are uninhabitable and were formerly used for fishing camps, but nowadays many have been developed for tourism.

The physical geography of Belize is diverse, since the country is situated between two contrasting geologies (Gordon & Greene 2011). The topography of northern Belize and its coastal plains is relatively flat and characterised by low limestone hills. The northern coastal areas are characterised by lagoon systems and low-lying freshwater wetlands. Southern Belize is in contrast more mountainous with the Maya mountains 1 124 metres above sea level, being the dominant feature. Surrounding the mountains are low karstic limestone hills that grade into an abbreviated coastal plain that meets with the Caribbean Sea. Several freshwater wetlands and rivers can be found in southern Belize as well as a number of swamps surrounded by broadleaf forest ecosystems (Gordon & Greene 2011).

Belize's climate is subtropical and characterised by seasonal variations in temperatures and precipitation, and by high humidity. Mean monthly temperatures range from 16–28 °C in the winter months (November to February) to 24–33 °C in the summer months (March to October). Distinct wet (May to October) and dry (November to April) seasons exist throughout the country, but are most pronounced in the northern parts. In general, northern Belize is much drier than the southern parts. Precipitation ranges from 1 100 mm in the north to 4 000 mm in the southernmost parts (Belize hurricane archive 2015).

4.3 Belizean fisheries and coastal livelihoods

Subsistence fishing has traditionally been an important source of protein for coastal communities in Belize (Craig 1966, Palacio 2001). Historically, Belize's land-based resources were commercially exploited much earlier than its coastal resources, although turtle, manatee and shark fishing were common in the early phases of colonialism (Craig 1966). Coastal resources started to be exploited on larger scales from the 1950s, when the US markets acquired a taste for the Caribbean spiny lobster, *Panulirus agrus*. Exports of the queen conch, *Strombus gigas*, began in the early 1960s and developed further in the beginning of the 1970s due to increases in demands and market prices (Craig 1966, Gibson 1978).

The establishment of domestically owned and operated fishermen cooperatives in 1960, granted exclusive export quotas, has been pivotal for the Belizean fishermen, who receive higher prices for their products than other Caribbean and Central American countries (Gibson 1978, Huitric 2005, Monnereau & Helmsing 2011). In 2012, there were five operative fishermen cooperatives, dominated by the National and Northern Fishermen Cooperatives. In 2008, more than 70% of the licenced fishers were members of a cooperative (Gillett & Myvette 2008). National and Northern Fishermen Cooperatives provide landing facilities and processing in Belize City, from where the products are exported. Profits made by the cooperatives are paid to the fishers in a second instalment at the end of the fiscal year.

The Belizean fisheries have been described as small-scale and highly commercial. Fishers target multiple species, using a simple harvesting techniques such as free diving, hand-lines, spear-guns, lobster traps, and shades (an artificial habitat) that require low capital investment (Huitric 2005, Gillet 2003). The spiny lobster is the most valuable commercial species, followed by the queen conch. Both are export commodities with the US market as a primary destination (Villanueva 2010). Finfish is targeted for the domestic markets. In 2010, the fisheries sectors employed 3 184 registered full-time and part-time fishers (Villanueva 2010), with an estimated 15 000 people relying directly or indirectly on the fisheries' resources (Gongora 2012). Lobster and conch stocks have remained fairly stable since the 1980s, suggesting that the stocks might be able to continue the current level of extraction (McField & Bood 2007). The total catch landings in 2011, recorded by the Fisheries Department were 611 160

lbs. of lobster meat and 865 424 lbs. of conch meat (Gongora 2012). However, the statistics provided by the Fisheries Department do not include domestic sells, subsistence fishing or extraction from foreign vessels (Gillet 2003). There is no reliable data available on fin-fish although individual studies suggest that fin-fish stocks are declining (Graham *et al.* 2008).

All Belizean residents over 18 are eligible to obtain a fisheries licence, although this open access regime is being phased out and will be replaced by a territorial rights system by 2020 (Foley 2012). The lobster and conch fisheries are regulated by minimum catch sizes and closed seasons. Fishing is prohibited in no-take zones in MPAs and the harvesting of certain species, including sea turtles, sharks and grassers such as parrot fish, is banned. In addition, special licences are required for spawning aggregation sites and sea cucumbers.

Coastal communities have traditionally engaged in different fishing practices, linked to their ethnicity or geographical location (Craig 1966). Whereas the Creole and Garifuna communities engage in fishing close to the coast, Mestizo communities from northern Belize engage in fishing from sailboats on the reef, thus traditionally not competing for the same resources. However, technological advances such as stronger engines have resulted in migratory and coastal fishers working in the same areas (Huitric 2005). Migratory fishers use sailboats, ranging from 20 to 60 feet, equipped with an outward engine and an icebox, while coastal fishers use small motor launches (5–10 m) with 15 to 75 hp engines.

Almost half of the active fishers are between 15 and 35 years, most originating from rural communities where educational and other occupational opportunities are scarce (Gillett and Myvette 2008). An overwhelming majority of fishers, 90%, have not completed secondary education and fishing is one of the few opportunities available for people with little formal education in rural coastal areas (Conservation International 2010).

In Belize, current tourist destinations originated from small fishing villages and several coastal communities have diversified from fishing to tourism (Diedrich 2007). Moreno (2005) argues that the extent to which coastal communities have been able to take advantage of tourism is related to how well they have been able to direct foreign investments to suit local interests. Occupations within tourism, in particular nature guiding, have been promoted as the preferred livelihood diversification strategy for coastal communities (e.g. Duffy 2003). However, tourism is seasonal and sensitive to fluctuations in the global economy, and overnight visitors are concentrated in a few Belizean coastal communities. In communities with proximities to tourism markets, fishing is typically combined with tourism (Key 2002, Palacio 2001, Conservation International 2010).

4.4 Interlinked processes of change

Because of political and environmental processes within and beyond Belize, the Belizean seascape has undergone major changes over the last three decades, influencing adaptation in coastal communities. These interlinked changes include the expansion of tourism and marine conservation; ecological changes with the marine ecosystems; and climate change.

4.4.1 Tourism and conservation

In the beginning of the 1980s, the Belizean seascape was primarily a site for the extraction of marine products and was used by a couple of thousand fishers. Commercial fishing was then considered a ‘truly Belizean industry’ due to its organisation in strong and nationally owned fishing cooperatives, which contributed important foreign exchange for the development of a nascent nation and its coastal communities (Gibson 1978).

After Belize started pursuing tourism as an economic development strategy in the mid-1980s, the Belize Barrier Reef and associated marine activities became popular tourist attractions (Ramsay & Everitt 2008). As the importance of tourism grew in the 1990s and 2000s, the rhetoric surrounding the barrier reef has shifted from one emphasising extraction of marine resources to one emphasising non-extractive use through the promotion of MPAs and ecotourism (Diedrich 2007). The expansion of tourism has been paralleled by the establishment of marine conservation measures (Gibson *et al.* 1998).

In 2012, Belize had 18 marine areas under some form of protection covering roughly 20% of Belize’s territorial sea. Three percent of the MPA areas are no-take zones where extractive activities such as fishing are prohibited (Healthy Reefs 2015). The Belizean government has committed itself to extending the current no-take zones to comprise ten per cent in 2015 (CZMAI 2015). The formation of a network of MPAs began in 1996 during the same year UNESCO adopted seven MPAs as a world heritage site, comprising the Belize Barrier Reef Reserve System (Cho 2005). The World Heritage statutes catalysed marine conservation in Belize and the Mesoamerican Reef, and international environmental NGOs have since the mid-1990s established regionally focused conservation programmes (McField & Bood 2007). Large international conservation organisations, including the Wildlife Conservation Society (WCS), World Wildlife Fund (WWF), Conservation International (CI) and The Nature Conservancy (TNC), are active in Belize and/or have established and contribute funding to local environmental NGOs. The establishment of MPAs has met with resistance from commercial fishers, as the conservation areas and fishing grounds overlap in the reef system (Palacio 2001, Cho 2005). To ease the discontent of the fishers, significant funding has been allocated to alternative livelihood projects in coastal communities, intended to provide displaced fishers with alternative sources of income (Heyman & Graham 2000, Cho 2005). Funding has primarily been spent on training fishers to become tour-guides, dive masters and fly-fisher guides.

The move towards tourism and conservation has led to new dynamics between foreign investors and local elites in enabling coastal development (Duffy 2002, and between international conservation interests and tourism operators in creating protected areas (Medina 2010). Throughout coastal Belize, land is being bought by foreigners intending to develop properties for residential ‘second homes’ or tourism purposes (Flomenhoft *et al.* 2007). The linked processes of tourism and conservation have restricted access to marine resources and coastal lands, but have for several communities also opened up livelihood options. Local environmental NGOs have moreover given coastal communities a greater voice in decisions concerning the marine environment.

4.4.2 Environmental change

The health of the Belizean reefs and associated marine ecosystems has declined since the 1980s, when they were considered to be in relatively good condition (e.g. McField & Bood 2007). A number of factors, including disturbance events such as hurricanes and stressors arising from human activities, have contributed to the overall poor condition of Belizean reefs (Healthy reefs 2015). This has resulted in a declining abundance of living corals and increases in fleshy macroalgae. Live coral cover is estimated at around 17% in 2015 (*ibid.*).

The interaction of natural events (such as hurricanes, increased sea surface temperatures linked to climate change and disease) and human activities influences reef health. For example, the coupled events of mass bleaching and Hurricane Mitch in 1998 resulted in a reduction with 48% of live coral cover (McField 1999). Key human threats to the reef include land use and agriculture run-off, sewage and pollution, fishing pressure (particularly on herbivore fish) coastal development and tourism, and climate change i.e. ocean warming and ocean acidification (Healthy Reefs 2015).

Coastal development and exploitation related to tourism development have exercised substantial pressure on marine ecosystems. In 2009, UNESCO listed the Belize Barrier Reef Reserve System as a world heritage site in danger due to privatisation and development of small cayes, mangrove clearances and coastal development within the site (UNESCO 2009). The clearance of mangrove forests in Belize, to make way for tourism facilities, has direct effects on ecosystems and the productivity of fisheries (Macintyre *et al.* 2009, Mumby *et al.* 2004). Furthermore, coastal aquaculture industries such as shrimp and tilapia farming contribute to the deforestation of mangroves (Young 2008). Pesticides and nutrients used within the agricultural sector have also been found to negatively affect marine ecosystems and organisms (Alegria 2009). Recent government decisions, such as the approval of a new cruise port on Harvest Caye, will vastly increase the number of visitors to southern Belize, with likely ecological and social consequences.

4.4.3 Climate change

The IPCC’s regional chapters on Central and South America (Magrin *et al.* 2014) and Small Islands (Nurse *et al.* 2014) are both relevant to Belize. Climate modelling projections suggest that the Central

American region will experience warmer temperatures, reductions in precipitation, increasing evaporation and reductions in soil moisture for land areas by the end of the 21st century (Magrin *et al.* 2014). For small islands, projected climate change effects in the 21st century include SLR, tropical and extratropical cyclones, increasing air and sea surface temperatures and changing rainfall patterns (Nurse *et al.* 2014).

Aggregated climate projections indicate that Belize will experience increased air and ocean temperatures, SLR and higher levels of ocean acidification. Downscaled scenarios for Belize City (for temperature only) project an increase of air temperature of around 3 °C for each season from 2000 to 2100 (McSweeney *et al.* 2012).

The observed climate changes for Belize include an increase in the mean annual temperature by 0.45 °C from 1960. Increases are especially noticeable during the wet season and the number of ‘hot days’ and ‘hot nights’ has also increased during summer (ibid).

The amount of SLR expected in the Caribbean region is a point of discussion. The latest IPCC report projects that the global mean SLR will increase by 0.35 to 0.70 metres to the year 2100 (IPCC 2014). Palanisamy *et al.* (2012) found that the mean rate of SLR in the Caribbean region over the last 60 years was similar to the global average. Studies from Belize indicate that the country’s tourism industry is at risk from SLR with many of resorts located in the coastal zone (Scott *et al.* 2012). Low-lying settlements, particularly in Northern Belize have been singled out as particularly vulnerable to SLR (Richardson 2009).

Projected increases in sea surface temperatures, higher levels of dissolved CO₂ and ocean acidification, expected to affect the function of coral reef systems are of concern for Belize’s barrier reef, associated ecosystems and marine organisms. Previous research has suggested that climate risks facing the Belizean fisheries are closely intertwined with those facing coral reefs, mangrove forests and sea grass beds (Gillett and Myvette 2008) Climate effects on fish species are uncertain (Richardson 2009), in particularly on the less-fished species (Mahon, personal communication, 2011). Gillett and Myvette (2008) note that climate change is likely to affect the distribution of fish species but that these changes are projected to occur within the national fishing waters.

5. SUMMARY OF PAPERS

Paper I.

The focus of the first paper is the history of coastal livelihood change in the two thesis case sites, Sarteneja and Monkey River. In the paper, I analyse how global and national processes of change have intersected with local events and environmental changes over the last 180 years, and influenced local livelihood trajectories. The analysis is based on oral histories and interviews with local residents as well as written sources, including colonial reports and correspondence, and scientific and popular accounts. By situating local livelihood adaptations within Belize's colonial and post-colonial history, the paper also touches upon some of the larger transformations that have occurred in coastal Belize.

The paper shows that Sarteneja and Monkey River, both currently relying on commercial fishing, have undergone profound changes in livelihoods and productive activities on several occasions. Despite historical, cultural and geographical differences between the two villages, a long-term trend in both involves a shift from land-based to marine resources. In particular, the role of small-scale agriculture has changed markedly; it has been transformed from a major to a minor livelihood in Sarteneja and in Monkey River, where farming historically served as a complementary livelihood, it has now been discontinued. Belize's economic development trajectory of natural resource extraction from mahogany to agro-exports and marine products and more recently tourism, is visible in past and present local livelihood activities, particularly in Monkey River. Changes in access to natural resources coupled with the mechanisms governing market exchange emerge as important factors in creating and constricting adaptation options at the local level. Global consumption patterns and demands for resources in combination with local conceptions of a desirable way of life have also played a large role in shaping livelihood trajectories.

Both Sarteneja and Monkey River have experienced environmental events and changes that have influenced livelihood adaptations and shifts. Gradual and episodic events such as erosion, hurricanes and a plant disease have on occasion forced livelihood diversifications and led to hardship. An important conclusion in the paper is that although future livelihood adaptations in coastal Belize will need to consider climate and environmental change, successful adaptations are equally or more contingent on how well local people are able to respond to changing political and economic conditions and what rights are granted to local people in accessing various resources.

Paper II

This paper analyses a local mobilisation in response to coastal erosion in Monkey River Village. Based on interviews with local residents and a review of media coverage, the paper examines the different strategies local residents used in the period 1990–2012 to influence government authorities to support them in curbing the erosion. The analysis draws on literatures in political ecology that address social mobilisation and local adaptation research. While narrow in geographical scope, the paper aims to enhance the general understanding of the linkages between collective action and adaptation.

The paper shows that when individual strategies proved unsuccessful to prevent loss and the erosion was seen to threaten a place-specific way of life, a collective response to the erosion emerged and the villagers started to appeal for support from external organisations. With limited access to national decision-making arenas, the residents developed alliances with journalists, NGOs and researchers to examine the possible causes of and solutions to the erosion and to create public awareness for the village's concern. After an intense media campaign in 2009, which directly appealed to the prime minister for immediate intervention, the government responded and constructed a temporary sea-defence. The findings propose that the local mobilisation eventually generated government support for adaptation.

The paper argues that strong linkages to place manifested in a shared sentiment that Monkey River Village should remain, became a unifying driver behind the local mobilisation. Furthermore, the case study demonstrates that it was essential that villagers could ally with 'bridging organisations' that legitimised, substantiated and widely disseminated local claims about the erosion. However, while the collective action campaign was significant in accomplishing support for short-term coping through the construction of the temporary sea-defence, it did not lead to a transformative process of change or the development of the village, as the residents hoped.

In conclusion, the paper underlines that attention to formal policy and planning processes alone has limited explanatory power for understanding how communities can effect change and undertake adaptations. Local activism may be a means for places and communities not prioritised for national adaptation measures to enrol external support. Therefore, theoretical perspectives engaging with collective action as contestations over rights to protection from environmental change can enrich adaptation research.

Paper III

The point of departure for the third paper is the local and societal consequences of coastal erosion and riverine change in Monkey River Village. Based upon interviews, a mapping exercise and a literature review, the paper analyses how villagers are experiencing the consequences of coastal change, how concepts of risk, loss and adaptation are framed at the local level and what the environmental changes mean for the socio-economic stability of the village.

The paper draws upon a relational approach to risk and adaptation research emphasising subjective and non-quantifiable consequences of environmental change. The literature review and mapping exercise reveal that there has been a gradual retreat of the coastline immediately south of the village from 1987 to 2009, resulting in losses of 100 metres of shore in some places. The main reason for the erosion is a reduction and changes in water flow in the river due to diversion for agricultural purposes upstream the village. Notably, agricultural activities in the watershed have caused additional changes in the river regime through sedimentation, riparian deforestation and an increased nutrient load.

The findings show that the villagers associate the coastal erosion and riverine changes with harmful outcomes on five categories of valued objects: social activities, properties, sacred sites, current livelihood stability and future development opportunities. The paper discusses the notion that the identification of risk and loss largely depended on the informants' perceptions of what functions the beach front and river should provide, informed by past experience, memories and current practices in these settings. An important finding from the paper is that the loss of land is seen to have constricted the prospects of tourism development and foreign investment in the area. This is a serious outcome, since development of the village is already constrained by limited livelihood opportunities and decadal processes of population decline. The paper suggests that the losses incurred and the prospect of increasing erosion have altered the residents' 'horizon of expectation' and led to a lack of faith in the village's development. 'Successful' adaptation from the local perspective therefore needs to go beyond protecting what is already there and allow for future development of the village.

Paper IV

Research on climate change and fisheries has primarily focused on the physical effects on fisheries resources and the ecosystems that sustain them. Climate change adaptation measures have therefore primarily centred on building ecosystem resilience through marine conservation. Using a contextual approach to livelihood vulnerability and adaptation, this paper explores how fishers in Sarteneja, Belize's largest fishing community, perceive and respond to climatic and non-climatic livelihood stressors. The paper is based on interviews with fishers and participant observation of two fishing trips.

This paper illustrates that Belizean fishers' situate stress related to current climate variability in a broader context of economic livelihood vulnerability, driven by local, national and global change. In the fishers' vulnerability narratives, hurricanes linked to periods without incomes, emerge as the most problematic climate element. In contrast to leading adaptation discourses, the findings illustrate that fishers' associate MPAs with restrictions and loss of access to fishing grounds and is instead considered as a key source of vulnerability. Sartenejan fishers' predominantly consider their vulnerability to be of an economic rather than ecologic character, this understanding was found to shape their repertoire of adaptive strategies. Three main categories of adaptive strategies used by fishers are identified in the paper including: storage, saving and borrowing; experiential knowledge and mobility; and diversification and intensification. Some of these strategies could be built upon in order to strengthen fishers' capacity to respond to current and anticipated climate variability and change. However, the analysis shows that fishers' current diversification and intensification strategies mainly act as a response to the lack of other sources of income. Rather than ensuring livelihood sustainability, strategies expose fishers to penalties and run the risk of exacerbating pressure on fishing resources and may in the long run be seen as an example of maladaptation.

Due to the nature of livelihood challenges experienced by Sartenejan fishers, the paper argues that vulnerability reduction measures and planned adaptation need to go beyond an ecosystem focus and address questions of fishers' economic and political marginalization.

7. CONCLUSION

This thesis has critically examined local adaptation to intersecting processes of coastal change through an in-depth empirical focus on two Belizean fishing villages. The four papers in the thesis have shown how broader development processes, collective action and values shape outcomes of and adaptation to coastal change.

The findings have illustrated the importance of including recent history and broader political-economic development in the analysis of local adaptation processes. The historical perspective taken in this thesis demonstrates the close connections between coastal livelihood adaptations and Belize's development trajectories. The dynamics of the colonial and post-colonial development of Belize is reflected in local livelihood shifts and adaptations. The empirical findings show that livelihoods, both in Sarteneja and Monkey River have shifted from agricultural activities to fishing. The thesis emphasises that the studied communities vulnerability and capacity to respond to climate variability and coastal environmental change are situated in political and economic processes, nested within multiple temporal and spatial scales. However, the analysis illustrates that the interactions between global and national development processes and local livelihoods are highly complex and produce contradictory outcomes in terms of creating and opening up certain adaptation options while constricting others. Coastal villages in Belize have co-evolved from globalisation processes spanning several decades, and the findings show that livelihoods that are less integrated into global markets, such as small-scale agriculture, are not desirable from a local perspective.

As a post-colonial territory, the making of Belize's development continues to be influenced by global political and economic institutions. More recent changes in the Belizean seascape including the emergence of tourism and marine conservation, also exemplify the influence of global development processes on coastal livelihoods. The focus on ecotourism as a development strategy has been accompanied by discourses with specific visions for how climate change adaptation and livelihood diversification for fishers should proceed. The empirical findings show that livelihood diversification schemes envisioned by conservation organisations and government bodies do not resonate with fishers' conceptions of vulnerability and their repertoire of adaptive strategies.

The findings have identified consistent discrepancies between how dominant discourses frame vulnerability and adaptation to coastal change and the localised experiences and responses to such change. The study of coastal erosion, a theme of relevance for the wider Caribbean and SIDS region with regards to projected sea-level rise (SLR), illustrates this point. The analysis shows that coastal communities not prioritised by formal policy can, through local activism and collective action, contest government inaction on coastal protection and place adaptation on the decision-making agenda. While

it is recognised that social groups' ability to act collectively is an important component of adaptive capacity, the thesis expands upon previous adaptation research by arguing that collective action can be used to leverage external support for adaptation. However, the empirical findings also point to limits of local agency in altering entrenched socio-economic drivers to environmental change, which in this case can be directly related to the agro-export sector's mode of production and irrigation practices.

The thesis has focused attention on the qualitative outcomes of environmental change and the localised values that motivate and influence adaptations. The findings underline that how processes of coastal environmental change unfold locally and how consequences are perceived are intimately linked to broad conceptions of what constitutes a good and meaningful life. The thesis identifies the need to examine which activities and values attached to specific resources are threatened by current and anticipated environmental change. The loss of development opportunities and the reduced possibility for people to remain in place where they enjoy living is highlighted as a particularly serious outcome of coastal environmental change. Aspirations of development and striving to safeguard or enhancing what is seen as a good way of life in specific places emerge as a central motivation of why people undertake adaptive actions.

The thesis supports the argument that adaptation policy would benefit from expanding the understanding of the aspects of life (material and subjective) that are considered important to safeguard at the local level. The thesis addresses this by identifying the need to scrutinise how global and national processes intersect with localised patterns of vulnerability and aspirations of adaptation outcomes. The findings therefore lend support to the argument that local influence over development decisions should be expanded, given their connectedness with local adaptation trajectories. Ultimately, efforts to strengthen local capacity to respond to climate change in coastal Belize must build upon more localised aspirations of development and enable local groups to have a greater say in decisions that affect their lives and livelihoods.

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Continuity and change: understanding livelihood shifts and adaptation in coastal Belize 1830-2012

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Continuity and change: understanding livelihood shifts and adaptation in coastal Belize 1830–2012

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This paper situates livelihood adaptations in two coastal villages within the broader context of Belize's colonial and post-colonial history and environmental processes of change. Through observations, qualitative interviews, and archival reviews, we explore the dynamics of livelihood change and analyse the diverse factors that have been influencing options and adaptation over time. The results reveal that both villages have undergone profound changes in livelihoods and productive activities on several occasions. While the villages' histories, geographies, and cultures are different, similarities in long-term trends include the transition from land-based to marine resources and the decline of small-scale agriculture. Our analysis illuminates the deep connections between local livelihoods and national as well as global political–economic processes, which favour extraction and export of natural resources throughout the period investigated, whereby resource access and market mechanisms create and constrict adaptation options for the villagers. Gradual environmental changes, such as erosion, and episodic events, such as hurricanes, have also influenced livelihood shifts and adaptations in combination with a wide range of political–economic factors. Despite the demonstrated importance of the influence of history and dimensions of political economy on contemporary adaptation options in the communities studied, the literature on climate change adaptation inadequately accounts for these factors. This paper adds new perspectives to current debates in climate change research by emphasising that longer temporal dimensions of livelihood change are important for understanding the current context for adaptation.

Keywords: livelihood change; coastal; adaptation; Belize

Introduction

Global political and economic processes have influenced social change in Belize for over two centuries (Wilk 2007, Shoman 2011) as the territory became a British colony under the name of “British Honduras” in 1862. The main interest of the British Empire was the extraction of logwood and mahogany (Bolland 2009). Belize's history is characterised by natural resource extraction and export, in which timber was followed by agricultural exports (including bananas, sugar, and citrus) and marine products. More recently, tourism has been pursued as an economic development strategy (Balboni and Palacio

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2007). Even seemingly remote and rural livelihoods in Belize have been continuously influenced by broader political–economic relations and processes transcending the national boundaries (Ashcraft 1973, Moberg 2003, Wilk 2006, 2007, Wainwright 2008). The development of tourism, the establishment of marine protected areas, and changing environmental conditions in coastal and marine ecosystems have significantly altered coastal livelihoods in Belize over the last 30 years and led to changes in the access, use, and governance of marine resources (Palacio 2001, Medina 2010). Fishing grounds, conservation priorities, and tourist attractions largely overlap in the Belize barrier reef system (Gillet 2003). A number of programmes initiated by international environmental and development organisations, national authorities, and local non-governmental organisations have encouraged fishers to diversify their livelihoods, and trained them to become nature guides for tourists (Cho 2005). The rationale behind these programmes is that fisheries resources are declining and that overfishing is detrimental to marine ecosystems; therefore non-extractive uses of marine resources through tourism and protected areas are promoted to benefit ecosystems as well as local people, reflecting global trends in market-based natural resource management (Buscher and Dressler 2007).

Market-based natural resource management have been critiqued, and scholars have pointed out that models ascribe complex environmental problems to local resource users and their nature practices, in ways that disregard political and economic forces that impinge upon local people's access to resources and markets (e.g. Dove 1993, West *et al.* 2006, Li 2007, Brockington *et al.* 2008). Furthermore, proponents of the model often have fundamentally different expectations from those of the local people being targeted for projects regarding the desired outcomes of conservation projects. Therefore, projects seldom succeed in satisfying local people's development needs and wishes through nature conservation and (eco) tourism (West 2006). Similar to global findings, alternative livelihood programmes in Belize have only resulted in patchy and partial transformations of livelihoods, while coastal communities' dependence on marine resources has actually persisted or increased (Conservation International 2010).

Increasingly, marine conservation and livelihood diversification are also being promoted as a means for climate change adaptation (Gillet and Myvette 2008, Dudley *et al.* 2010). The starting point for societal assessments of climate change vulnerability and adaptation is commonly the identification of current conditions and exposures, and the past and present strategies the local communities have employed to deal with change (e.g. Sutherland *et al.* 2005, Smit and Wandel 2006). Past experience with environmental change is considered to be an important basis for current and future adaptations (Gaillard 2007, Nunn *et al.* 2007), but a number of scholars have called for a renewed focus on the structural factors including historical institutions that constrict people's ability to adapt to change (e.g. O'Brien *et al.* 2007, Ribot 2011, Tschakert *et al.* 2013). However, broader and persistent questions related to control over resources and mechanisms governing them have received less attention within climate change research (Bassett and Fogelman 2013).

In particular, Cameron (2012) points out that research addressing the societal aspects of climate change inadequately considers colonial history and its past and contemporary legacies of resource extraction, which the approach of Wisner *et al.* (2004) identifies as the root causes to "unsafe conditions". Cameron (2012, p. 107) argues that the tendency to overlook past and present colonial relations leads to that adaptation risk being framed as "a technical contemporary and local problem that can be addressed with specific policy intervention" rather than an examination of the structural and systematic processes that influence people's capacity to adapt.

Since adaptation to climate change is considered urgent in Belize (Richardson 2009), it is important to extend the understanding of livelihood adaptations and transformations beyond present concerns. Adaptations rarely happen in response to climate or environmental change alone and livelihoods exist within larger systems which shape local adaptation trajectories (de Haan and Zoomers 2005). Broader political–economic processes intersect with peoples, places, and local events in profound ways, where a greater inclusion of the historical context can enrich analyses of connections between macro and local levels (Whitehead 2002).

We argue that a greater understanding of the history of livelihood change can enrich adaptation research. This paper therefore explores and analyses how processes of livelihood adaptation have unfolded in two coastal communities in Belize over the last 180 years, and illuminates the influence of colonialism on past and present adaptations. It contributes to current debates on adaptation by underlining the constantly changing characteristics of livelihoods, and emphasising the strong influence of history and politics in shaping adaptation trajectories.

A historical overview

During Belize's pre-colonial period, several groups of people referred to as Maya, associated with high degrees of civilisation lived in the area that today encompasses Belize, Guatemala, El Salvador, western Honduras, and southern Mexico. Encounters with the Spanish led to a decimation of the Maya population through disease, displacements, and military attacks on Maya settlements during the sixteenth and seventeenth centuries. The Maya fiercely resisted Spanish claims, which hindered Spain from permanently colonising the territory. Approximately 10% of the Belizean population is Maya today (Shoman 2011). In the seventeenth century, British buccaneers¹ settled along the Belizean coast and embarked upon extraction and export of logwood to Britain and after several battles with Spain, Britain declared the territory as British Honduras in 1862 (Bolland 2009).

Over the course of a hundred years, logwood was replaced by mahogany exports, and as demands grew, slave labour was imported from Jamaica (Bolland 2009). British colonialism became intrinsically linked to the capitalistic interests of a few mahogany companies, monopolising the trade (Wainwright 2008). Through export of mahogany to Britain and the USA, and imports of food and goods from Britain, capital was accumulated among merchants and mahogany firms, with little capital remaining in the colony, as Wainwright (2008, p. 45) notes:

The effectiveness of this strategy can be measured by the fact that the forests of Belize were almost cut over twice before any substantive buildings, roads or state institutions – apart from taxation and policing functions – were built in the colony.

British control was entrenched through land monopolisation by a few firms, coercive labour laws and debt bondage after the abolishment of slavery in 1838 (Bolland 2009). It was in the mahogany firms' interests to restrict the labourers' access to land, and thereby keep them dependent on wage labour. Small-scale agriculture existed, but only as a complement to other extractive industries, and an independent peasantry never developed (Ashcraft 1973, Shoman 2011).

Power relations between labourers and capitalists began to change in the 1930s (Bolland 1997, 2009), when the forestry industry collapsed during the Great Depression and a destructive hurricane hit Belize City in 1931, which exacerbated already poor

living and working conditions. Labourers responded by organising numerous protests in 1934/1935 and the labour organisations grew into an independence movement in 1950 when the People's United Party (PUP) was created.

The struggles led to the British colonial government conceding universal suffrage rights in 1954, and PUP won the first election. Full self-governance was achieved in 1963. PUP viewed the widespread poverty in Belize to be the result of a long history of colonial exploitation and the solution was seen as economic growth with reinvestment in Belize, branded "wise-capitalism" (Medina 2004, Shoman 2011). During the period of self-government, the economy was diversified from forestry to agriculture through a series of policy interventions, which sought to balance welfare with capitalist accumulation. Further reforms of labour laws, health and education services, and infrastructure improved living standards, but not at the rate people had anticipated (Ashcraft 1973, Shoman 2011).

Full independence was delayed by a border claim by Guatemala, but was finally achieved in 1981. Only four years after independence a development plan was created, heavily shaped by the Structural Adjustment Programmes (World Bank), the International Monetary Fund, and the U.S. Agency for International Development. The plan entailed a continued focus on expansion of exports, cuts in public sector expenditures, and the removal of price controls for agricultural produce (Shoman 2011). In the mid-1980s Belize began to pursue tourism as an economic development strategy with a focus on "ecotourism", and more than 40% of the country was designated as protected areas, ostensibly to offer a competitive edge to the tourist product (Ramsey and Everitt 2008, Medina 2010). Tourism has now become Belize's largest industry and foreign exchange earner. Since 2007, the Belizean economy has been characterised by a debt crisis (amounting to close to 1.2 billion dollars in 2012, roughly 80% of Belize gross domestic product) with dependence on the export of natural resources and on tourism, which are both susceptible to environmental change and market fluctuations (Pisani 2007). More than 4 out of 10 Belizeans are considered to live in poverty (Halcrow/NAT 2010). Many Belizeans have migrated to the USA, and remittances constitute a large part of Belize's informal economy (Medina 2004).

Belize is notorious as a drug transit country and its coastline is used for cocaine transhipment from South America to Mexico and the USA. Drug parcels dropped along the coast by aeroplanes or speed boats have provided large cash infusions in coastal communities (Sutherland 1998). In addition to the drug trade, money laundering and gang violence are significant challenges in post-colonial Belize. Violence is concentrated to urban areas and related to street gangs; as a result Belize City has one of the highest homicide rates in the Caribbean (Amandala 2013).

Study setting and methodology

The coastal villages of Sarteneja and Monkey River are representative of two cultural traditions in Belize: the Mestizo and the Creole, respectively. The term Mestizo was at first associated with refugees from the Caste War of Yucatán, Mexico, which increased the population of Belize in the mid-1800s and denominates people of a mixed Indigenous and Spanish origin. Due to being refugees of Spanish descent, they were considered inferior and less native than peoples of English descent (Medina 1997). The term Mestizo has also later been associated with Spanish-speaking groups of people in Belize.

The term Creole originally denoted slaves born in the West Indies rather than Africa, and later people of mixed African and European descent who became associated with Belizean nativeness during Independence struggles (Ashdown 1979). These broad categories

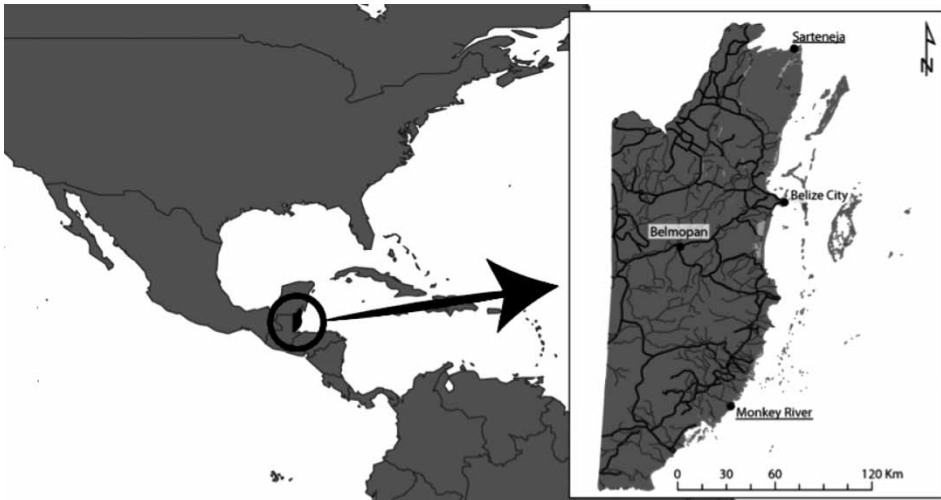


Figure 1. Map outlining the location of the two case communities, Sarteneja and Monkey River. Source: GADM and Digital Chart of the World.

include manifold identities and groups, but have, nevertheless, provided references of ethnic identities within Belize, as discussed by Medina (1997).

Although the villages' historical paths are entirely different, Sarteneja and Monkey River today share commonalities. These include geographical characteristics such as rural remoteness, livelihoods with a dependency on fishing, and weather events through their experiences of severe hurricanes. This combination of contrasting and similar features of the two villages renders them suitable as case sites (see Figure 1).

Sarteneja

Sarteneja has a population of 1834 and is situated in the north-eastern corner of Belize, in the administrative district of Corozal (SIB 2010). The village faces the shallow Chetumal Bay and is situated on a flat limestone plateau only a few metres above sea level (Nardini 2010). Sarteneja is among the driest areas in Belize, with average rainfall amounting to 1260 mm per year (Meerman and Boomsma 1993). The dry season normally starts in January and ends in May, with September being the wettest month. Spanish is the first language in Sarteneja, which is home to Belize's largest fishing community. Education levels in Sarteneja are generally low: 45% had no education, 41% had completed primary school, 4% secondary school, and 6% tertiary school (Conservation International 2010).

Monkey River

Monkey River is a small Creole village in the southern district of Toledo with a population of 196 (SIB 2010). Monkey River is situated at the mouth of the Monkey River, which reaches the Gulf of Honduras, part of the Caribbean Sea. The Monkey River basin is the fourth largest in Belize and is fed by three tributaries. The area lies on limestone rock and coastal plains, including savannah grasslands and mangrove forests, which have been used for a variety of human activities such as banana cultivation, small-scale agriculture and, to the north of Monkey River,

Table 1. Age distribution of interviewees in both Sarteneja and Monkey River.

Age	20–29	30–39	40–49	50–59	60–69	70+
Number	5	11	7	10	8	8

citrus plantations and shrimp farms. There are distinct dry and wet seasons, with July–October receiving the most precipitation, totalling over 3000 mm per year (Heyman and Kjerfve 1999). The villagers engage in fishing and tourism. Education levels are slightly higher than in Sarteneja with 7% having no education, 79% having completed primary, 11% secondary, and 3% tertiary school (Conservation International 2010).

Data collection

The core original data presented in this paper were derived from semi-structured interviews. The lack of local written and recorded history in both villages rendered interviews, designed to record local oral histories, the main available source of data. The interviews provided detailed accounts of change from the informants' own perspectives, which was necessary to build a history of the communities and identify key events and processes (Kvale and Brinckmann 2009). The fieldwork was carried out during 2011 and 2012 and lasted seven months in total. During fieldwork, the first author resided temporarily in the villages, staying with families and participating in everyday activities including fishing expeditions. This contributed to a deeper understanding of village life and issues pertaining to various livelihoods. In 2011, semi-structured interviews were held primarily with fishers; commercial fishing is an exclusively male occupation in the two study sites.

In the second field visit in 2012, semi-structured interviews were conducted with people of other occupations, including women. The early focus on fishers' livelihoods impacted the gender balance of the informants. In total 49 interviews were conducted, including 26 in Sarteneja (21 men, 5 women) and 23 in Monkey River (16 men, 7 women). The oldest informants in Sarteneja and Monkey River were 77 and 84, respectively (see Table 1 for an overview of the informants' age). Their memories stretched back to the 1940s, but they also recalled earlier family histories about the villages.

Archival studies at the Belize National Archives in Belmopan, the British Library, and the National Archives in London, UK complemented the interviews in delineating and triangulating historical events and developments. Few documents focused on these communities specifically, and records were fragmented over industrial sectors, specific hurricanes, or decisions relating to the colonial administration. The combination of data derived from archival studies and interviews was linked to literature from the region to illuminate livelihood adaptations.

Results

The following sections will delineate livelihood adaptations to environmental and societal changes and depict the main trends and changes. Figure 2 displays the contrasting population trends in the two communities over the last 160 years. Sarteneja has experienced a fairly steady population increase, while Monkey River's population rose and then decreased significantly since the beginning of the twentieth century. The timelines of livelihood

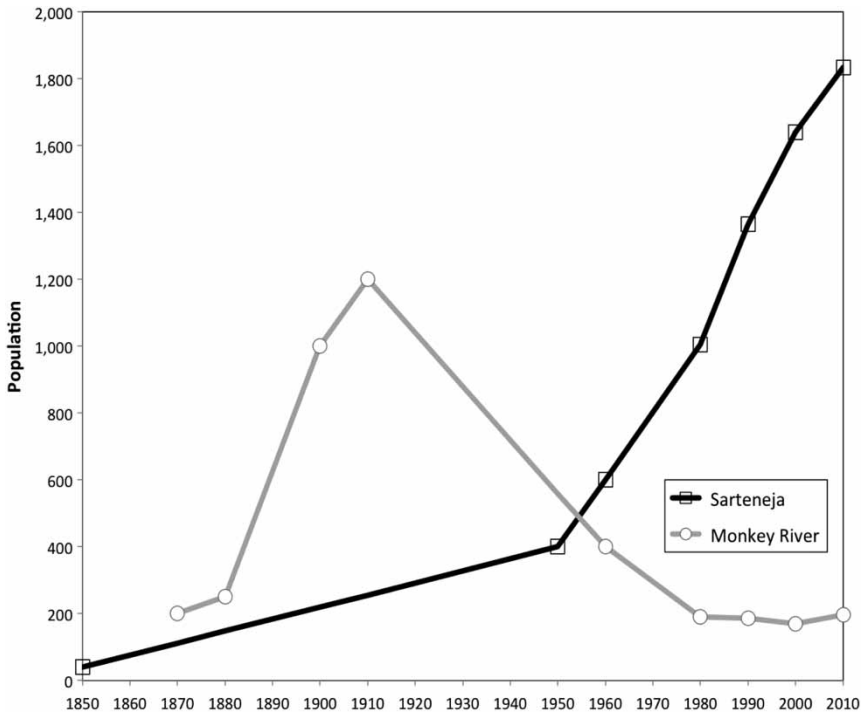


Figure 2. Population trends in Sarteneja and Monkey River over 160 years. Population data were derived from interviews, Moberg (2003), Glimpses, Glimpses of our history (1962) and the Statistical Institute of Belize (SIB 2006, 2010) (census reports from 1980, 1991, 2000, 2010).

activities, governance and policy changes, and ecological changes provide an outline of each village's history of adaptation (see Figures 3 and 4).

Sarteneja

Around 40 refugees from the Caste War of Yucatán settled in Sarteneja in 1854. Ashcraft (1973) stated that Sartenejans leased parcels of crown land, which they used for *milpa* farming, a small-scale shifting cultivating system common throughout Central America, where plots were cleared annually from forests and burned to release nutrients stored in the vegetation (Abrams 1973, Bernsten and Herdt 1977). Crops cultivated included corn, beans, sweet potatoes, tomatoes and plantains, and farming activities were combined with fishing and hunting. While farming was primarily intended for local consumption, certain crops such as plantains, tomatoes and pineapples were shipped and sold at markets in Belize City and coastal locations inaccessible by road transport (Pantin *et al.* 2003). Some villagers also worked as seasonal contractors in the *chicle* industry (the latex of the sapodilla tree, used as an ingredient in chewing gum). Small-scale farming was vulnerable to extreme weather events, evidenced by a hurricane in 1942 that severely damaged farms (Cave *et al.* 1943). Older informants described *milpa* farming as monetarily poor but food-secure.

In the local historical narrative, this way of life was disrupted by Hurricane Janet in 1955 and never fully recovered. Collectively regarded as a historical marker, this hurricane had wind speeds of 280 km per hour, followed by a storm surge of 1.8 m above normal tides, which destroyed *milpa* farms and all buildings except for three houses (Dunn *et al.*

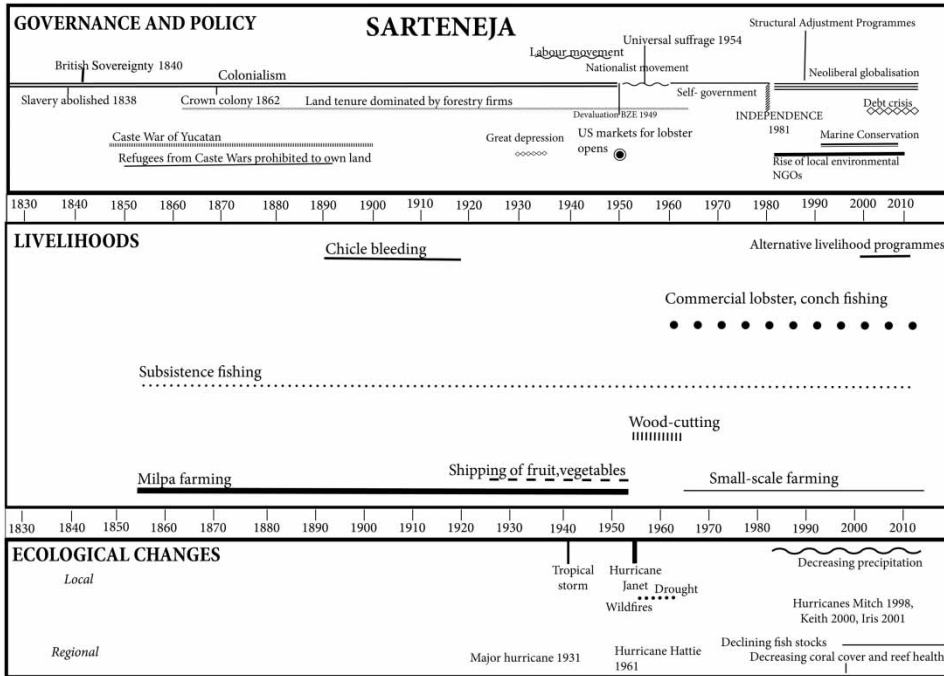


Figure 3. Timeline of livelihood activities in Sarteneja.

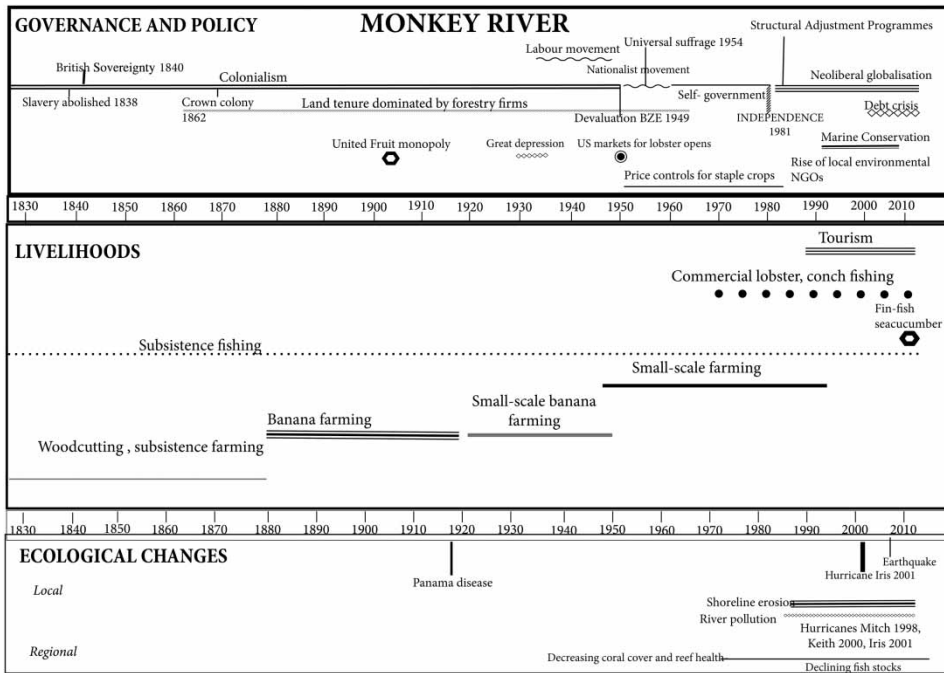


Figure 4. Timeline of livelihood activities in Monkey River.

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1955). Hurricane Janet was followed by large wildfires in 1956 (Nardini 2010), which coincided with a drought that informants claimed lasted for years. Once the village had been rebuilt, people tried to resume farming but found that it was difficult to re-establish their farming practices. One man in his 80s summed up his view of the changes:

This village used to sustain the inhabitants with farming: you plant corn, you plant beans and you had enough to sustain yourself the whole year but after that the weather changed . . . the amount of rainfall we used to have before the hurricane we didn't have it after.

This quote exemplifies how informants currently related the hurricane and natural events to changes in farming practices and village life in general. As a response to declining farm productivity, Sartenejans diversified their livelihood activities by cutting, selling, and shipping firewood in response to an increasing demand in Belize City. Woodcutting involved hard labour for small incomes and informants considered it inferior to *milpa* farming. The period that followed Hurricane Janet is collectively known as the "hardship period", which indicates that outcomes of the adaptation exacerbated poverty.

However, Sarteneja's shift to firewood cutting, coincided with the emergence of a lobster exporting business as the US markets for the Spiny Lobster, *Panulirus agrus*, opened in the 1950s (Gillet 2003). Men from Sarteneja had skills in boatbuilding, navigation, and swimming, which were advantageous in relation to lobster fishing. Since the beginning of the export fisheries, Sartenejans have engaged in migratory fishing to areas around the barrier reef using sailboats rather than fishing in the local bay, with each trip lasting between 6 and 12 days. Fishing practices and methods have largely persisted since the 1960s except for technological advances including engines and iceboxes. Export-oriented fishing was more lucrative than woodcutting or farming, and as prices and demands for lobster increased, more men joined the lobster fishery, and by the end of the 1960s fishing had become Sarteneja's main livelihood. In addition to lobsters, the Queen Conch, *Strombus gigas*, has also been exported to the USA since the 1960s (Gibson 1977).

Since the emergence of export markets, communities in northern Belize have constituted the mainstay of the export fisheries (Craig 1966, Gillet 2003, Villanueva 2010). Domestic fishing cooperatives were established in the 1960 and granted exclusive export quotas by the Government in 1965 to ensure that revenues remained within Belize (Gibson 1977). Fishing cooperatives provided incentives for fishers to become members, including scholarships, loans, and small pensions, and therefore brought significant social development to many coastal communities including Sarteneja (Huitric 2005). Belizean lobster fishers received higher incomes than their Caribbean and Central American counterparts as a result of the bargaining power of national fishing cooperatives in foreign markets.

The livelihood shift from farming and woodcutting to fishing was considered to have contributed to a better standard of living and physical appearance of Sarteneja. As one fisher in his 40s stated:

In the old times people used to be farmers more than fishers, but they didn't have nice houses people were very, very poor. The fishing left Sarteneja how it is now, nice houses and a different type of life. Life was harder before.

The lobster fishery also dramatically changed living standards in the nearby pioneering lobster village of Caye Caulker (cf. Sutherland 1986, 1998), which currently relies on tourism. However, since fishing remains the main livelihood of Sarteneja, challenges to

the fisheries sector have direct impacts on the village. Fishers have experienced declining profitability and many of the informants considered the future of the fisheries sector as bleak.

Several factors must be taken into account to understand the fishers' view. Since lobster and conch began to be extracted on commercial scales, stocks have been declining. Lobster production peaked in the 1980s and conch in 1972, but current stocks have remained fairly stable since the mid-1980s (Gillet 2003, Huitric 2005). Informants also frequently cited increasing numbers of fishers as a contributing factor to declining profitability, and hurricanes and adverse weather were also considered to impact fishing livelihoods. Fishers' vulnerability to natural events is compounded by their dependency on fishing incomes, and during hurricanes fishers are forced to stay ashore and lose income. Adaptation strategies often entailed fishing in different areas during periods of low productivity or adverse weather.

Weaker, indebted fishing cooperatives and decreased market prices for marine products have also resulted in fishers receiving less for their effort (Monnereau and Helmsing 2011). Fishers commonly respond to decreasing profitability by increasing their efforts and diversifying their catch and informants also claimed that they occasionally found conch pearls or drug parcels at sea, alleged at times to provide large infusions of money to the local economy (also discussed by Sutherland 1998).

The establishment of marine protected areas in the 1990s and 2000s has also reduced access to marine resources. Fishers contended that areas where fishing is completely prohibited correspond to the most productive fishing grounds, and marine protected areas were therefore conceived to be a major challenge to fishing livelihoods. In Sarteneja, alternative livelihood schemes intended to diversify fishers' incomes and compensate for displacement by marine protected areas include but are not limited to training courses for tour guiding, pig rearing, and tilapia fish farming. Tourism is still in its infancy in the village and draws small numbers of visitors, with its main attraction being its "unspoiled" culture and nature. In 2012, 35 former fishers were estimated to work as tour guides from Belize City; in addition 13 families participated in home stay programmes and around 42 fishers were also pig farmers (*Wildtracks* 2012, personal communication, Sarteneja, 11 Mar 2011). While the tourism industry in Sarteneja is small, properties facing the seafront are increasingly sold to foreigners as second homes (Pantin *et al.* 2003) and villagers often carry out the maintenance of these properties, which provides small incomes.

Interviewees considered that economic viability, internal divisions, poor infrastructure, and a lack of government support are factors that thwart the success of alternative livelihood schemes. Small-scale farming is being practised by around 20% of the villagers, but it constitutes a minor livelihood primarily to meet local needs. The amounts produced do not meet local needs at times, based on the general scarcity of local fruits and vegetables, as observed during both periods of fieldwork. Informants consider contemporary agriculture to be impacted by climate change, since lower precipitation levels have been observed over the last 20 years, which informants link to changes in the timing and strength of cold fronts.²

Some families have invested capital derived from fishing into furthering the education of their children, to broaden their livelihood options, similarly to lobster fishers in Caye Caulker (King 1997, Sutherland 1998). Yet, specialisation in fishing has rendered Sarteneja vulnerable to ecological change as well as changes in policies and markets; interventions intending to diversify the village's livelihood basis have so far not led to significant changes. Despite challenges with fishing, people often said that, out of the options available to them, fishing was the most profitable and enjoyable occupation. Furthermore, people

valued the quality of life in Sarteneja highly, because of a sense of security and tranquillity. Staying in Sarteneja is thought to contribute to well-being of families, while migration to other places in Belize with greater work opportunities is commonly linked to an insecure way of life.

Monkey River

Monkey River began as a riverbank settlement around 1820, described as a “settlement squatting on crown land” in 1875 within a day’s travel from a woodcutting camp further upstream (Fowler 1879). The first settlers were seasonal labourers in the forestry industry and small-scale farmers. Agricultural practices were adjusted to the seasonality of woodcutting and the insecure land tenure, through cultivation demanding little labour and a range of crops including swamp rice, root crops, and corn, using the tools they had available for mahogany cutting (Ashdown 1979). When the mahogany trade declined in the 1860–1870s, the colony sought to diversify its economy and the state decreased the price of crown land in Southern Belize to encourage banana production. Some labourers were able to invest in land and became small-scale banana producers (Romney 1959 in Ashcraft 1973). A banana industry began to flourish in the area around 1880, and larger plantations held by estates became established. The banana industry pulled labourers from Belize City and nearby settlements to Monkey River, which had an enormous impact on the population, estimated to have risen from 250 to 750 between 1881 and 1891 (Moberg 1996, 2003). Monkey River also served as a shipping point for bananas as steamers carried the fruit to New Orleans and other US markets (Shoman 2011). Given Monkey River’s prominent position within the banana industry, it was granted town status in 1891 and had an estimated population of 1000 around the end of the nineteenth century, with a school, police station, and several shops (Chamberlain 1897).

The livelihoods of Monkey River were tied to one industry, which eventually collapsed due to a combination of factors. On a macro level, the terms of trade and production changed when United Fruit, an American fruit corporation, monopolised banana exports in 1904 (Moberg 2003). United Fruit lowered producers’ prices and increased shipping fares, which forced an intensification of production. Moberg (2003) suggests that intense modes of production were linked to the 1917 outbreak and rapid spread of the Panama disease; a soil borne fungus attacking banana leaves. Over the next decade all large banana estates were forced to close as a result of the disease. Banana plantations around Monkey River were largely unaffected by the disease; however, as larger estates in the area had been closed, many wage labourers became unemployed (Shoman 2011). Most labourers remained entirely dependent on wages for their subsistence and were forced to seek work in other locations, which spurred waves of emigration from Monkey River lasting for several decades. In interviews, migration was often described as involuntary but necessary in order for people to survive. The result of outward migration was associated with a loss of social activities and the quality of life Monkey River had when it was populous. Those who stayed also expressed love for and a strong sense of attachment to Monkey River.

Those who held land adapted through converting from banana to the cultivation of beans, rice, corn, plantains, and other ground foods, and some engaged in fishing (Palacio 2001). Large-scale emigration and the return to small-scale agriculture caused hardship in Monkey River, as noted by Carey (1953): “the banana industry left some settlements, such as Monkey River stranded, able only to eke out miserable existence on unsuitable land far from the village.” Monkey River was also called the “the most uninhabitable

township in the Colony” in 1939 due to the appearance of a neglected town and lack of latrines or sanitation (Anderson 1939).

The situation improved when the Government started a guaranteed pricing scheme for rice, corn, and beans in the 1950s to promote national self-sufficiency in staple crops (Moberg 1991, 1992). Interviewees consider the government’s price incentive as important for farming efforts in Monkey River. Fishing was mostly for local sale and consumption (Craig 1966), until men from Monkey River joined the lobster fishery in the early 1970s, through a nearby village that had a cooperative. In addition to fishing and farming, hunting also provided villagers with meat and small incomes as some of the game meat was sold to nearby communities (Meerman 1995).

In Monkey River, national fiscal cuts in the 1980s led to the removal of the price incentive for staple crops, linked to the Structural Adjustment Programme (Moberg 1991, 1992, Wilk 2007, Shoman 2011). Informants claimed that the removal of the guaranteed price led to the decline of staple crop production and farming, also observed by other studies in the area (Moberg 1991). In particular the removal of the rice subsidies appeared to have been of significance as expressed by a man in his 50s:

I used to dry the rice over there so a Honduran boat used to come and carry the rice but the government didn’t support the rice so it died right off and the village was gone. Because the people didn’t have jobs so they had to go all around the country to look for work, but they didn’t want to leave.

The dismantling of the price control led to further migration as reflected in the quote above. People continued to practise farming on a smaller scale that did not constitute an important source of income. Instead, men in the village increasingly relied on cash incomes from fishing (Fischer 1993). However, in the beginning of the 1990s the economic situation in Monkey River was described as a hand-to-mouth existence (Fischer 1993, Meerman 1995). With the emergence of tourism in Belize in the late 1980s, Monkey River began to experience some moderate incomes from tourism, mainly consisting of locals taking tourists to view the wildlife up the river and particularly the black howler monkeys (Fischer 1993, Palacio 2001). Due to Monkey River’s proximity to nearby tourism markets and the almost guaranteed sighting of the black howler monkey, tourism has contributed to livelihood changes. Today more than 50% of the workforce engages in tour guiding (Conservation International 2010) and most people combine fishing with tour guiding, as the seasons for the two activities are distinct. Fishers from Monkey River primarily operate in fishing grounds in the proximity of the village and target lobster and finfish using hand lines, lobster and fish traps, and by skin-diving. Fishing is valued as an enjoyable occupation, associated with a sense of independence, and providing opportunities to stay in the village.

Overnight tourism in the village has not developed and the sandy beach, listed as one of the village’s tourist potentials in 1994, has eroded significantly over the last 20 years, which is believed to deter foreigners from investing in Monkey River. Most villagers regarded tourism as a blessing, yet complaints were commonly made about an unequal distribution of tourist revenues, which were believed to have been monopolised by a few families.

Contemporary challenges in Monkey River include decreasing numbers of tourists, fishing regulations, environmental change, pollution, and incursion of foreign fishers. The proximity of the village to plantations further upstream, known to use chemicals (Algeria 2009), as well as shrimp farms and tourist destinations has led fishers to associate

human activities with algal growth on corals, and detrimental effects on juvenile fish. The 2008 economic recession in the USA resulting in lowered tourist numbers caused tour guides to compete through lower prices to capture business, and informants claimed that fishing is currently more profitable than tour guiding. Hagan (2012) found that many tour guides in southern Belize had returned to fishing as a result of the fall in tourism. Fishing activities have recently been diversified as a Jamaican company has started exporting frozen finfish from Belize to Jamaica, thereby offering fishers a new market.

Similarly, in 2012 market prices for sea cucumber in Belize increased; some local fishers were successful in obtaining required special licences and now engage in the extraction of sea cucumber. Future challenges include the approved construction of a cruise ship harbour on Harvest Caye close to Monkey River, which is likely to compromise local overnight tourism in Southern Belize as well as exert significant pressure on the marine resources in the area. One informant feared that local river tours could be outcompeted by cruise tours.

It was common for informants to describe life “before” as simpler and easier due to a higher degree of self-sufficiency and access to local food stuffs, but most informants also appreciated having more cash incomes today. While informants commonly said that fishing and tour guiding were the only available occupations in the village, the next generation was not expected to follow in the same livelihood path. As one fisher said:

All the young ones coming up, what will they do . . . but I’m not worried about that, the younger ones have to fight for themselves, we had to fight for rights and ourselves, so they have to do that too.

Expressed in the quote is a sentiment that each generation was expected to invent and fight for their own livelihoods, and that discontinuity rather than stability in ways of making a living was anticipated and accepted.

Discussion

In our historical analysis, we illustrate how the two villages have experienced entirely changed livelihoods on several occasions during the past 180 years. Belize’s trajectory of natural resource extraction from mahogany to agro-exports and marine products to tourism is visible in past and present local livelihood activities, which have similarities in their reliance on natural resources.

Despite historical, cultural, and geographical differences between Sarteneja and Monkey River, both communities have shifted from land-based to marine resources over the time period studied. Within this shift, the role of small-scale agriculture has changed markedly, from a major livelihood to a minor livelihood in Sarteneja and ceased altogether in Monkey River. As a result of colonial legacies, scholars have argued that farming in rural Belize has foremost been practised as a complementary livelihood to work in seasonal, more lucrative activities (Ashcraft 1973, Wilk 2006). Small-scale farming in Monkey River can be understood through this lens, since it emerged as an important livelihood, for both local consumption and income, only when supported by the state-run subsidies and was discontinued when the price incentives were removed and marine resources became more lucrative. In Sarteneja, *milpa* farming had a more prominent role as a vital source of subsistence and small cash incomes, linked to the settlers’ heritage, known to be mainly agriculturalist (Wilk 2006). The full integration into a cash economy occurred through export fisheries instead of sugar cane cultivation, common in other Corozol villages

(Abrams 1973). These observations concur with other studies indicating that processes of agrarian change need to consider marine resources as factors in rural transitions (Dressler and Fabinyi 2011).

Changes in access to natural resources over time and the processes governing market exchange emerged as important factors driving livelihood adaptations. In colonial Belize, land was chiefly owned by mahogany companies and the Crown, forcing local people to lease or squat on land, which clearly restricted their adaptation options (Ashcraft 1973, Shoman 2011). In Monkey River, openings in land access, including the price reduction of Crown land enabled some labourers to purchase land, which led to a livelihood adaptation from woodcutting to banana production. People owning land could also transition to farming after the banana industry collapsed. Given that the colonial state and large plantation owners only reinvested negligible amounts locally, that local producers were unable to negotiate terms of trade with multinational fruit companies, and that the majority of labourers did not own land (factors linked to colonial capital accumulation strategies) meant that migration emerged as the only viable adaptation strategy for landless wage labourers when the banana industry collapsed.

Unregulated open access to marine resources may explain why Sarteneja, and later Monkey River, could enter the export fisheries, which enabled livelihood adaptations. Sarteneja's economic and social development in particular was closely related to the distributive mechanisms enabled by the strong fishing cooperatives. Access to marine resources has become more restricted after the coupled development of tourism and marine conservation, for example, by privatisation of islands and the designation of protected areas. The move towards tourism and market-led natural resource management has led to new dynamics between foreign investors and local elites in enabling coastal development (Duffy 2002), and between international conservation interests and tourism operators in creating protected areas (Medina 2010). In Sarteneja and throughout coastal Belize, this has resulted in land and properties being increasingly sold to foreigners, and major portions of the land and marine resources being closed off for local communities (Pantin *et al.* 2003). While currently considered a challenge to fishing livelihoods, these processes of enclosure have significant implications for future adaptation options for local communities.

How different ethnicities were connected to the colonial organisation as imported labour or refugees appears to have influenced adaptation paths, underlining that places interact with broader processes of governance in distinct ways (Scoones 2009). Monkey River follows the colonial and post-colonial development trajectories closely from mahogany to tourism. Sarteneja was more peripheral to the colonial state, as the mestizo ethnicity has been considered less "native"; this distance remains today through the language barriers from Spanish to English, which may also explain why the village has been less successful in entering the tourism sector (Wilk 2006).

Changes in desired lifestyles and consumption patterns also influence livelihood adaptations. In Belize, as elsewhere in the world, processes of cultural globalisation have led to the endorsement of a consumerist lifestyle, which implies that desirable livelihoods today need to enable people to acquire consumer goods (de Haan 2000, Wilk 2006). For example, to merely sustain family food needs through farming is no longer a desirable or feasible way of life and basic needs such as school fees and mobile phones also required cash incomes. In both villages, people want more market exchange to improve material standards, but on conditions that are fair and advantageous to them (Wilk 2006, Li 2007). Moreover, global changes in consumption patterns and demand play an important role in determining which resources are considered valuable. Before the opening of export markets, lobsters were considered trash fish (Craig 1966) and black howler monkeys were seen as a part

of the forest until foreign consumers were willing to pay to see them. This demonstrates that valuable resources in the future may again differ from the current ones, and that livelihood adaptations are likely to be partly driven by global consumer demands in combination with people's strategic decisions to improve their living conditions.

Environmental change has also been a significant factor in influencing adaptations, exemplified by Hurricane Janet in Sarteneja and the Panama Disease in Monkey River. The impact of these disasters resulted in what Ellis (2000) refers to as forced diversification of livelihood activities, which occurred through a change in resources in Sarteneja, and through relocation in Monkey River. Over the 180-year time period studied, farming livelihoods have evidently been highly vulnerable to natural disasters, and it appears that their capacity to recover from episodic environmental events has increased as resources and activities nowadays have been diversified to include marine resources with larger spatial distribution. But as livelihood resources have a wider distribution, they are also subject to a larger range of environmental changes. The cumulative effects of threats to marine resources, such as pollution, coastal development, and climate change, (MacIntyre *et al.* 2009) and slower processes of local environmental change, including shoreline erosion in Monkey River and decreased precipitation in Sarteneja, constrain current livelihoods and are likely to constrict future adaptation options.

The findings of this study underline that vulnerability is a highly dynamic process where livelihood adaptations create new sources of vulnerability while alleviating other sources. For example, small-scale farming traditionally cushioned the fluctuation in global markets, but as local food production declined or ceased, the villages became susceptible to hikes in global food prices as is the case for urban consumers (Aschcraft 1973). Simultaneously, as people in the villages began to earn money to buy food, they became less vulnerable to natural hazards such as droughts and hurricanes that directly impacted local food production. Importantly, a wide range of uncertain and unpredictable environmental and political-economic factors affected the vulnerability of Sarteneja and Monkey River. These factors often occurred as episodic events with considerable discontinuities and major variability in space and time. Therefore advocating building "stable livelihoods" in order to cope with climatic and environmental change (e.g. Gaillard *et al.* 2009) appears inconsistent with historical patterns of change, where livelihoods in flux are the norm rather than the exception.

A strong sense of place was found to drive adaptation processes in both communities and people engaged in finding solutions to remain in their villages (see also Amundsen 2012). The villages have adapted either by necessity or as a response to new opportunities. Shifts in assets and activities have often been of such magnitude that it is impossible to assess whether adaptations have enhanced the capacity to overcome future crisis. Given the changes over time, it was assumed that the coming generations, rather than following in the same footsteps as their parents, had to create their own livelihoods. From this perspective, the ability to respond to new opportunities was more important than achieving stability with little room for expansion.

Future livelihood options envisaged by the inhabitants of Sarteneja and Monkey River included further developed tourism, fruit preservation, and new ventures such as aquaculture. Local NGOs have already initiated projects such as small-scale farming activities that supplement peoples' incomes. Significant governmental investments into improved infrastructure and transport facilities constitute important prerequisites for further development of inhabitants' livelihoods. Investment in training would be necessary for successful development of new activities such as the cultivation of seaweeds or sea cucumbers.

Conclusion

Our historical analysis of two villages in coastal Belize has demonstrated that livelihoods are highly dynamic and characterised by discontinuities in major shifts in activities. Rather than viewing adaptation to global events and crises as contemporary challenges (e.g. de Haan 2000), we re-emphasise that global political and economic processes of change have persistently shaped the room for manoeuvre for local livelihood strategies in Belize (in agreement with Ashcraft 1973, Wilk 2007, Wainwright 2008, Shoman 2011).

There are close linkages between local livelihoods and national and global development trajectories throughout the time period studied. But Sarteneja's and Monkey River's distinct historical, geographic, and cultural traits have interacted with broader development trends and influenced local livelihoods. While people in both villages have demonstrated an aptness to adjust to changes, livelihood activities have continuously been dependent on natural resources and specific ecosystems. Their existing choices are linked to colonial history and its contemporary legacies, characterised by extraction and export of natural resources (cf. Cameron 2012). As such, modes of colonial economic production have not been fundamentally challenged and are still manifested in contemporary development paths (Wainwright 2008). Therefore, most livelihoods studied have had to deal with similar constellations of vulnerability to political–economic domination, restricted access to resources, fluctuations in global markets and environmental changes. Importantly, local people are not against market integration and actually desire more market exchange, but on conditions that are just to them (cf. Li 2007).

Environmental changes have clearly influenced livelihood options and resulted in shifts in livelihood activities but our findings demonstrate that climate change is only one of many forces that influence livelihood change. Certain climate impacts anticipated in the coming decades and centuries, such as sea-level rise have the potential to physically alter coastal communities. Changes that threaten place are likely to be experienced as more serious than changes that risk certain livelihood activities, as our findings show that most people wish to remain where they live and to continue to re-create their villages in their own way.

While future adaptations will need to consider climate and environmental change, they are equally or more contingent on how well local people are able to respond to changing political and economic conditions, through struggling for their rights to access valued resources. Questions of global consumer preferences and markets, in combination with highly dynamic local preferences for livelihoods are important for future transformations (Wilk 2007) and warrant more attention in future adaptation research.

In the studied villages desired adaptations have occurred when local people's rights to political, natural, and financial resources have been expanded. It is therefore problematic that adaptation discourses have promoted conservation measures that restrict coastal communities' access to marine resources without expanding their rights to other resources.

Some of the findings in this study are relevant to the regional context as coastal communities throughout the Caribbean share broad similarities in colonial history, geography, climate, and contemporary global market integration (Mintz 2010). Islands and territories in the region were colonised to exploit what could be cultivated or extracted on land, and similar to Belize, the economic importance of coastal resources has grown over the last decades primarily due to tourism. These similarities lead us to believe that historical analyses of coastal livelihoods in other Caribbean sites would reveal comparable shifts in livelihood activities as well as close connections to broader political–economic processes. At the same time it is important to recognise that constellations of structural factors interact with local conditions and produce specific livelihood options, strategies, and adaptations

(Chibnik 2011). What sets Belizean fishing communities apart from other countries in the Caribbean basin are Belize's relatively strong fishing cooperatives and comparatively healthy fish stocks (Monnereau and Helmsing 2011).

We conclude that the history of places and livelihoods is an important vantage point towards understanding contemporary interactions between environmental and political-economic forces of change. Our historical analysis of livelihood change contributes to current adaptation debates by underlining the dynamic character of livelihoods, and the strong influence of history and power in shaping adaptation trajectories.

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Notes

1. Historical term for pirates attacking the Spanish in the Caribbean during the seventeenth and eighteenth centuries.
2. An analysis of annual and seasonal total rainfall by BEST (2009) in three selected meteorological stations, 1960–2005 (none from the northern district of Corozal) shows no significant trends in rainfall patterns that can confirm the observations of people in Sarteneja.

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Local collective action: Adaptation to coastal erosion in the Monkey River Village, Belize



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ABSTRACT

Successful adaptation to environmental change and variability is closely connected with social groups' ability to act collectively, but many social-ecological challenges exceed local adaptive capacity which necessitate assistance from governmental institutions. Few studies have investigated how local collective action can be used to enrol external support for adaptation. This paper reduces this research gap by analysing a locally driven adaptation process in response to coastal erosion in Monkey River Village, Belize. Drawing on literature on adaptation and political ecology, we examine the different strategies the local residents have used over time to influence government authorities to support them in curbing the coastal erosion. Our findings show that the local mobilisation generated government support for a temporary sea defence and that collective strategies emerge as a response to threats to a place specific way of life. Our case illustrates that it was essential that the villagers could ally with journalists, researchers and local NGOs to make their claims for protection heard by the government. The paper contributes to adaptation research by arguing that local collective action, seen as contestation over rights to protection from environmental change, can be a means for places and communities not prioritised by formal policies to enrol external support for adaptation. Our study supports and adds to the perspective that attention to formal arrangements such as adaptation policy alone has limited explanatory power to understand collective responses to change.

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1. Introduction

The beach front in the Belizean village of Monkey River is dotted with partly submerged car tyres, and 50 m of the beach wooden poles stick out of the sea. Once the beach extended beyond those wooden poles, but has now retreated mainly as a result of human activities in the nearby river regime. The purpose of the government constructed breakwater structure of wooden poles and tyres is to protect the village from wave action and subsequent erosion. In this paper we analyse the local mobilisation process that resulted in the construction of the sea defence.

Coastal erosion poses major challenges to Belize and other countries in the Caribbean region (Fuller and Wilson, 2002; CCCCC,

2009). Coastal areas are under pressure from natural processes such as wave action, currents, climate variability and human activities including sand mining of beaches and rivers, inappropriate coastal development and land-use changes (Cambers, 2009; Lewsey et al., 2004). Anthropogenically driven climate change impacts such as sea-level rise and extreme events are anticipated to exacerbate coastal erosion in the region (Mimura et al., 2007). While Belize has initiated the development of a national climate change adaptation policy, it has not yet been implemented (Gordon and Green, 2011). The gap between policy development and implementation is a common challenge in the Caribbean region (Medeiros et al., 2011). Currently, sea walls, breakwater structures and piers are in place to protect coastal towns and tourist attractions in Belize.

In both academic and policy circles, adaptation to current and anticipated coastal erosion in the Caribbean has primarily been addressed in terms of measures that can protect important infrastructure and economic activities along the coast (e.g. CCCCC, 2009; Simpson et al., 2011). Within this discourse, adaptation usually pertains to top-down measures that include a combination

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of hard and soft engineering approaches such as sea-walls, land-use planning, ecosystem conservation, building codes, insurance schemes and managed retreats of settlements (Lewsey et al., 2004; Simpson et al., 2012; Chatenoux and Wolf, 2013).

Climate adaptation measures that are devised and implemented solely by experts and decision-makers, without input from local people, may miss the multiple stresses and empirical reality in which such impacts occur (O'Brien et al., 2007). A focus on local conditions is increasingly seen as imperative for understanding adaptation processes to changing conditions, but to date this research approach has largely been lacking in a Caribbean context (Dulal et al., 2009).

Locally grounded research has demonstrated that adaptation is a process undertaken by individuals, groups and local institutions to reduce vulnerability and to seize opportunities from a suite of interacting changes and stresses which are rarely driven by biophysical hazards alone (Leichenko and O'Brien, 2002; Turner et al., 2003; Luers, 2005). Local studies show that many of the social-ecological changes and challenges that are experienced at the local level do require assistance from regional or national governance levels (Van Aalst et al., 2008; Mercer et al., 2007), but that such assistance needs to take the local context into account to be successful. As demonstrated in the Pacific, coastal erosion presents challenges that may exceed local capacity, requiring regional and national government assistance to avoid losses (Sutherland et al., 2005; Monnereau and Abraham, 2013).

The ability of communities to both seek and receive external advice is partially influenced by the functioning of local institutions (e.g. Hovelsrud and Smit, 2010). Drawing upon a number of case studies, Agrawal (2010) found that in the cases where external support for adaptation was provided it was also invariably requested and channelled through local institutions. The connections between local and higher level institutions will thus largely influence the extent to which local communities can secure external support.

How Caribbean communities can gain access to external assistance to support adaptation has received relatively little attention in adaptation research. To date studies have primarily assessed vulnerability and adaptive capacity of communities (Manuel-Navarrete et al., 2007; Shah et al., 2013; Jaja and Dawson, 2014) rather than investigating how local capacity is operationalised. Similar critique has been raised against local adaptation research in general (see Moser, 2009a; Tschakert et al., 2013), but has to an extent been addressed in studies of Norwegian municipalities. These studies show that adaptation is added to municipal agendas despite the absence of national adaptation policies, through factors such as engaged officials (initiating and driving the processes), focusing events (extreme weather events), observations of real world indicators (floods, storm surge, mud slides) and researcher involvement (Dannevig et al., 2013). This illustrates the rich empirical depth that emerges from focussing on the local adaptation processes.

Inspired by this approach to understand local motivations and strategies to deal with change, this paper analyses the adaptation process to coastal erosion in the Village of Monkey River in Southern Belize. We focus on the time period between 1990 and 2012, which captures different stages in the coastal retreat and the adaptive responses undertaken by the community. We examine the different strategies the residents of Monkey River have used to influence government authorities to support them in curbing the coastal erosion. The paper will show how environmental challenges translate into collective strategies and how a local village influences the adaptation processes through a collective action campaign. Through an analysis of the adaptation efforts undertaken by the Monkey River community, the paper

argues that local activism is an important counterpart to formal adaptation policy. Our aim is to contribute to our general understanding of the linkages between collective action and adaptation.

2. Adaptation, social mobilisation and place

It is now widely recognised that adaptation is highly context specific and that values, world views and culture are relevant factors of adaptation (see for example IPCC, 2014). Adaptation will therefore differ depending on the needs, the resources and the rate and magnitude of change, and not the least how various actors perceive risk (Hovelsrud and Smit, 2010; Hovelsrud et al., forthcoming). We approach adaptation as a social process, which hinges on a number of internal and external barriers and triggers including institutional frameworks, economic conditions, access to technology information and resources, problem recognition or awareness, and knowledge (Adger et al., 2005; Dessai et al., 2005; Pitt and Randolph, 2009; Hovelsrud et al., 2010).

Local adaptation is closely linked to adaptive capacity, which reflects the ability to cope with, adjust to or recover from an exposure-sensitivity (the manner and degree to which a community is sensitive and exposed to particular conditions, forces or stresses) (Smit et al., 2010, p. 5). Adaptive capacity is determined or shaped by a number of institutional and societal factors, including access to knowledge and resources, power and equity, culture and identity and by people's ability to engage in collective strategies and action to deal with environmental change and variability (Adger, 2003; Smit and Pilifosova, 2003; Smit and Wandel, 2006; Keskitalo et al., 2011; Kofinas et al., 2013). The concept of collective action, which is the focus of this paper, is commonly referred to as the communal management and pooling of natural, financial and human resources (Adger, 1999, 2003; Tompkins and Adger, 2004). Local institutions (formal and informal) mediated by social capital provide knowledge and procedures for collective resource management (Pelling and High, 2005). Moreover, Agrawal (2010) argues that collective strategies undertaken by local institutions have a greater potential to leverage support from external institutions. Mobilisation of social capital leading to collective action has been found to substitute adaptive measures that typically fall within the responsibility of the state (e.g. Adger, 2003). Within political ecology, social mobilisations are commonly defined as collective action campaigns that involve protest and demands for some sort of alternative development (Escobar, 1995; Watts and Peet, 2004; Bebbington et al., 2008). We find it useful to consider collective action in relation to social mobilisation and contestation in Belize, because this perspective lends itself well to our quest for understanding how the local case community leveraged support, resources and assistance to adapt. In this paper we discuss to what extent collective action and social mobilisations in response to real world events have the potential to influence the decision-making agenda on adaptation.

Social mobilisations involve contestation to various forms of political decisions (or indecisions) and the construction and promotion of particular ideas through establishing collective identities and building resources and alliances with other actors and institutions. Mobilisations arise from a shared and negotiated understanding of a challenging condition, which include ascriptions of blame, responsibility and an alternative vision of how things should be (Benford and Snow, 2000). Involvement of researchers, journalists and NGOs in mobilisations (as is the case in Belize), can enable local concerns to be heard at higher political levels, so called scale jumping (Smith, 1992). The availability of such 'bridging organisations' (Almudi and Berkes, 2010; Beazley, 2009) that can frame and advance local demands to political arenas

have been found to be an important factor to consider in local mobilisations (Holmes, 2014).

Importantly, claims made in environmental movements often extend from environmental issues to broader social and political demands (Robbins, 2012; Watts and Peet, 2004; Leach and Scoones, 2007). New social movements, in contrast to social movements associated with class, labour unions, political parties, are not only about social rights, but link the politics of equitable distribution of economy and resources with human rights and cultural identity (the politics of recognition) (Watts and Peet, 2004, p. 4). For one Robbins (2012) argues that issues related to environmental justice, such as the destruction or alteration of certain natural resources, can unify otherwise disparate groups across class, ethnicity and gender to engage in collective action.

Territory and place are factors that have been found to give rise to a strong sense of identity that may strengthen mobilisations (Bebbington et al., 2008; Escobar et al., 2002). The role of place and place identity in shaping adaptation strategies has also gained increased focus in adaptation research (Agyeman et al., 2009; Adger et al., 2009, 2011; Devine-Wright, 2013; Fresque-Baxter and Armitage, 2012; Amundsen, 2015). Place identity and attachment vary between individuals, groups and across scales but have been found to affect how people perceive and respond to change and can thereby influence adaptation processes. While place identity may explain what motivates people to mobilise or engage in adaptive

strategies, it may also pose barriers to change and adaptation through strict definitions of what the place ought to be like (Adger et al., 2009). Moreover, places are sites of multiple identities and not everyone benefits equally from claims made in the name of a place or community (Watts and Peet, 2004). It would therefore be naïve and misguided to presume that residents of a community will always be in agreement. Yet, social mobilisation can be a force in adding local communities' concerns to decision-makers' adaptation agendas (Moser, 2009b). A range of social actors, each operating with distinct ideas about adaptation and with different social statuses and power, are involved in either enacting adaptation decisions or being affected by these decisions (Heyd and Brooks, 2009). Processes of contestation over rights to protection from environmental change or rights to development are viewed as essential in understanding local adaptation (cf. Cote and Nightingale, 2012). The role of collective action and local mobilisation in the adaptation process in Monkey River will be discussed in Section 5, but first we present the study site and the methods.

3. Study site

The coastal village of Monkey River is situated at the mouth of the Monkey River, which reaches the Gulf of Honduras, part of the Caribbean Sea (see Fig. 1). The Monkey River basin is the fourth largest in Belize and is fed by three tributaries Swasey, Bladen and



Fig. 1. Map outlining the location of Monkey River Village; smaller map in the right corner shows the location of Belize. Source: GADM and Digital Chart of the World.

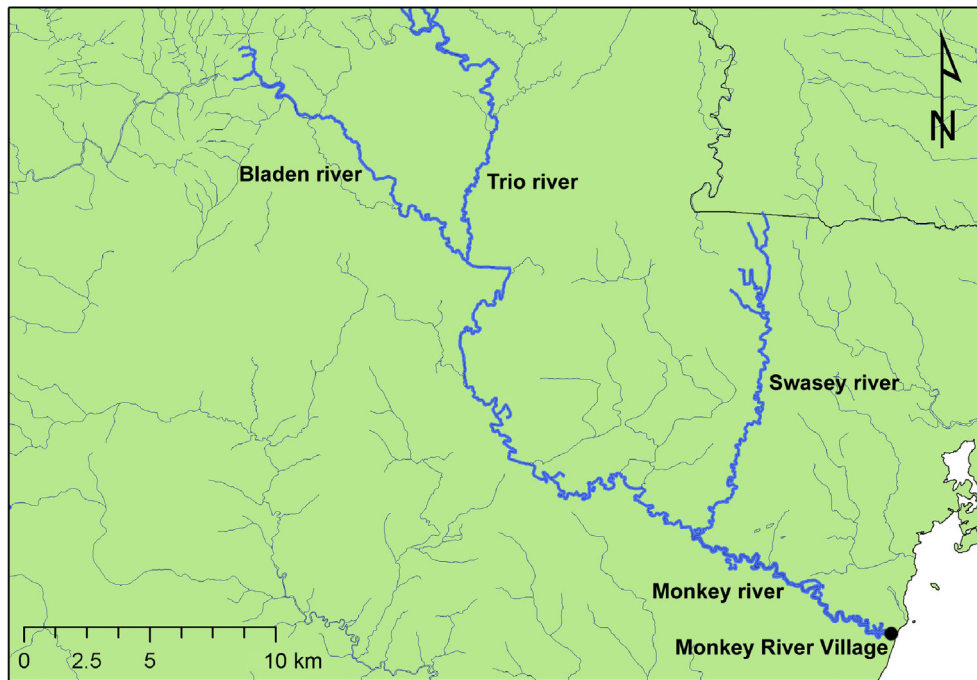


Fig. 2. Overview of Monkey River watershed.

Source: Biodiversity & Environmental Resource Data System of Belize (BERDS), adapted by Karstensen. Portions of this work include intellectual property of Jan Meerman and are used herein with permission. Copyright © 2015 Jan Meerman. All rights reserved.

Trio River (see Fig. 2). The area lies on limestone rock and coastal plains, including savannah grasslands and mangrove forests, which are used for a variety of human activities such as banana cultivation, small-scale agriculture and, to the north of Monkey River, citrus plantations and shrimp farms (Heyman and Kjerfve, 1999; Algeria, 2009).

The village has a population of 196 (SIB, 2010). There is limited road access to the north side of the river where five families live, and entry to the main village is only possible by boat. Monkey River Village was first connected to the power grid in 2009 and to piped water in 2007. The majority of the residents belong to the ethnic and cultural category Creole. Creole is a broad category which originally denoted slaves born in the West Indies rather than Africa, and later people of mixed Anglophone descent who became associated with Belizean nativeness during independence struggles (Ashdown, 1979). Creoles were the major ethnic group in Belize until the 1980s, but today the major ethnic group is Mestizo – an ethnic category associated with Spanish speaking groups of people. Creole (Kriol) is recognised as its own language, but most Creoles also speak English, the official language of Belize.

Monkey River Village is remote but its main livelihoods fishing and tourism are integrated into international markets, particularly the US, for export of lobster and visiting tourists. Fishers mainly target lobster and fin-fish and tourism includes guiding day-trip tourists on river tours, with the wildlife and particularly the Black Howler Monkeys being the main attractions. Tours include a lunch stop in the village at one of its three restaurants. Fishing and tour-guiding are commonly combined due to their seasonal characteristics and are exclusive male occupations in the village. Women are employed in the school, shops or restaurants but for most domestic work is their main occupation.

Monkey River Village is situated between two protected areas. The terrestrial protected area Payne's Creek National Park, established in 1993, and the marine protected area, Port Honduras Marine Reserve, established in 2000. These are

co-managed by the local NGO, Toledo Institute for Development and the Environment (TIDE), and the Forestry Department and the Fisheries Department, respectively. The village is a stakeholder community to TIDE and other environmental NGOs operating in Southern Belize.

While the village's contemporary livelihoods are fishing and tourism, banana production upstream used to be the backbone of the local economy. In 1880s, Monkey River Village was a settlement for labourers working on larger estates and small-scale banana producers and served as a shipping point for banana exports to the USA. Due to the settlement's importance to the banana industry, it was declared a town in 1891. Two decades later Monkey River had more than 1000 residents, several shops, two schools and a police station. In the late 1920s, the banana industry collapsed following an outbreak of the Panama Disease, a fungus attacking the banana plants, and as a result the village experienced large-scale work emigration lasting for several decades (Moberg, 2003). The village's history is marked by social and environmental changes that have led to outward migration, population decline and livelihood shifts. Outward migration and population decline have contributed to a self-proclaimed sense of resilience for those who have remained and wish to continue living in Monkey River Village (Karlsson and Bryceson, 2014).

Today, over 60% of Belize's banana plantations are located along Swasey and Bladen rivers, the tributaries to Monkey River. The intensive use of these rivers for agricultural purposes such as preparation, irrigation and processing have resulted in river pollution (Algeria, 2009). Despite Monkey River Village's proximity and historical ties to the banana industry, none of its residents engage in plantation work today because it is considered economically unviable (Karlsson and Bryceson, 2014).

Due to the natural dynamics of the estuary and coast, cyclical patterns of coastal erosion and accretion have always been occurring in the village. These changes, determined by seasonal variations in flood regimes and coastal dynamics, characterise the estuary zone where river and maritime environments meet

(Newton et al., 2012). But the rate of erosion has increased since the 1980s and as a consequence a large portion of the beach and associated properties have been lost (GUARD, 2007; Fischer, 1993). The erosion has led to the loss of a recreational ground, the sandy beach, lots of land and houses (<40 lots), and a decreased likelihood for investment in overnight tourism (Karlsson et al., 2015).

Beach loss can be attributed both to coastal changes and to riverine changes inland. An in-depth study and literature review on the village's beach erosion prepared by Galen University (GUARD, 2007) concludes that sediment continues to be transported from the Maya mountains through the Swasey and Monkey Rivers, but that it no longer reaches the coastline. A regular supply of riverine sediments is critical for replenishing coastal beaches (Syvitski et al., 2005). The main reason for reduced sediment load is the diversion of water for agricultural purposes, which reduces and changes the river flow. Notably, water pumped out is not diverted back into the river, leading to a decreased water flow. There are also other human activities such as gravel mining and deforestation that have an impact on the sedimentation levels upstream (Esselman, 2001). The reduced sediment transport downstream adds to the local effects of waves, tides, currents and hurricanes.

4. Methods and data collection

This study is part of a larger project examining coastal communities' vulnerability and adaptation to multiple processes of change. Monkey River Village constitutes one of two study sites within this project. The village was selected because of its remoteness, the dependency on coastal resources combined with the current reality of coastal erosion, previous experience with hurricanes, and after the village leadership expressed an interest in participating.

The first author conducted fieldwork during 2011 and 2012, spending a total of eight months in Belize, five weeks of which were spent in Monkey River. The core data for this paper is derived from semi-structured interviews with residents in Monkey River Village, carried out in two fieldwork periods. In June/July 2011, the first author stayed in Monkey River for three weeks. An interview guide was developed on the basis of initial and informal interviews with the residents. Coastal erosion immediately emerged as an important topic and became one of the focal areas for the interviews. Questions pertaining to the erosion included its duration, impacts on the village, local responses and strategies utilised to influence decision-makers, satisfaction with the already constructed sea defence and locally desirable alternative solutions.

During the first stay in Monkey River, the research primarily focused on fishing and tourism activities and impacts from environmental change. As noted above, commercial fishing and tour guiding are male occupations in the village; therefore the majority of informants were male residents. In total 20 (17 male, 3 female) semi-structured interviews were held in 2011.

Analysis of interview data and background material about the village and erosion allowed for a refinement of the research focus for the return trip to Monkey River in April 2012. During these two weeks of fieldwork the researcher established further rapport and familiarity in the village and the second round of interviews clarified and expanded on the themes emerging from the first field period. Semi-structured in-depth interviews provided the interviewees (5 females and 3 males) with an opportunity to elaborate on themes including village history and livelihoods, management of natural resources and coastal erosion. In addition, many informal interviews and daily conversations were held during both field trips, which added depth and context to the findings.

Former and current beach front residents, older residents and members of the village leadership were sought out for interviews using a snowballing method in which the researcher locates informants through enquiry (Kalton and Anderson, 1986). Three of the interviews concentrated on old photographs of the village, proving effective in triggering memories and facilitating communication about the village's history (cf. Clark-Ibáñez, 2004). Particularities associated with responses to erosion events could also be situated in time by for example estimating the age of a child featured in a photograph.

During both field periods interviews, lasting from 40 to 120 min, were held in public places or in the informants' homes. The focus on fishers' livelihoods in the first round of interviews affected the informants' gender balance skewing the results towards male perspectives. However, the eight interviews with female residents did not reveal any major differences from the male residents in responses to questions about the erosion.

Monkey River residents reported that the erosion occurring in the village had been featured in the media, exemplified by ten on-line articles. In addition, residents had created an Internet petition that urged members of the public to support the village in trying to convince the government of Belize to help them deal with the erosion problem. Three of the news articles had been televised but only the on-line articles converted to text were accessible at the time of study. Several radio channels were also reported by the residents to have broadcasted stories about the coastal erosion, but we were not successful in accessing these. Nevertheless, the news articles and the village's on-line petition constituted an important part of the data, as they provided an account of the residents' line of argumentation at the time of campaign.

5. Findings

This section describes three phases reflecting consecutive adaptation strategies in Monkey River. The phases are increasingly complex and illustrate the villagers' attempt to develop different strategies when the previous ones fail. The first, incremental adjustments, pertains to individual strategies in response to erosional impacts on property. The second phase, resource mobilisation, concerns the development of collaboration with external organisations to produce knowledge, create public awareness and seek government support to deal with the erosion. And the third phase, outreach, describes how the villagers through a media campaign enrolled governmental support for adaptation. Table 1 presents an overview of the phases organised along a time dimension, illustrating the type of adaptation activities that took place in the village.

5.1. Phase one: incremental adjustments

The findings show that the beach has always been eroding and accreting in cycles. Due to the high variability both seasonally and in the natural dynamics of the beach, residents could not pinpoint exactly when the erosion went from being an expected natural variation to becoming a problem. They estimated that the beach had been eroding without corresponding accretion since the 1990s. An area designated for tourism development directly south of the village with four cabanas and a couple of concrete structures was rapidly eroding in 1993 (Fischer, 1993) and is gone today.

Owners of beach properties were the first to feel the impacts of the increased coastal retreat. And once it began to encroach on the village's residential area, property owners responded by three strategies: local shore protection, relocation within the village and migration from Monkey River. Together these three strategies, pertaining to individual measures to protect personal items, comprise the first phase in Table 1, referred to as incremental

Table 1
Overview of adaptation activities in the period 1990–2009.

	Erosional threats to	Local actions	Involved actors and/or institutions	Outcomes
Incremental adjustments 1990–2005	Individual properties Communal beach front, recreation ground Area designated for tourism development	Protection of property Relocation within the village Migration from the village	Individual residents	Strategies ineffective, individual properties submerged Communal beach area reduced Tourism development area destroyed
Resource mobilisation 2006–2007	Individual properties Village school Village cemetery	Information gathering and awareness building Forming alliances with external institutions Creation of local institutions (erosion committee)	Individual residents Village council Village leader National media Research institutions NGOs	Achieves public attention Co-production of knowledge
Outreach 2008–2009	Individual properties Village school Village cemetery	Media campaign Online petition for the general public	Individual residents Village council, Village leaders Erosion committee National media	Achieves public support Achieves communication with, and support from, the government of Belize Construction of a sea defence

adjustments (e.g. Nelson et al., 2007). In order to protect their homes, residents living on the beach constructed sea barricades of palm wood and placed sand bags in front of their properties. Home owners reported in the interviews that they hoped such measures would minimise impacts on their properties; in addition they wanted to be active and felt that “*they had to do something*”.

These measures were largely ineffective; protection was short-lived as the material decayed and in some instances local protection was counterproductive by exacerbating erosion rates in nearby locations (GUARD, 2007), corresponding with findings from Micronesia (Monnereau and Abraham, 2013). Despite the local efforts over 20 beach properties have been lost since the mid-1990s (GUARD, 2007). The adaptive responses by the affected owners included forced relocation, rebuilding houses on stilts and purchasing new houses within the village, and migration away from Monkey River.

Hurricane Iris that made landfall in the village in October 2001 compounded the impacts of the erosion and destroyed up to 90% of the village’s built structures, including beach properties that already were at risk from the erosion (Beven et al., 2003). While the village was rebuilt with support from the government and humanitarian organisations, the shocks and impacts resulting from the hurricane diverted focus from the challenges associated with the erosion and can be described as a distracting event (Moser, 2009b).

The erosion rate increased between 2003 and 2006, resulting in 20–30 m of shoreline retreat illustrated in Karlsson et al.’s (2015) GIS mapping exercise. This reduced the beach area significantly and led to further property losses. The coastal retreat started to threaten the next row of beach properties (including a former village leader’s house) and the village’s cemetery. Residents feared that relatives and friends buried at the cemetery could be washed away at sea if the erosion continued. Moreover, the school building was perceived to be at risk from erosional impacts within a few years. Rebuilding and relocating houses, the school and the cemetery further inland was not seen as a viable option, because the land is swampy and would have to be drained and filled with sediments at a high cost. A relocation of the cemetery could according to some residents also disrupt spirits in the village. These factors illustrate that the social limits to further adaptive adjustments had been reached.

5.2. Phase two: resource mobilisation

The local responses to the erosion shifted from customary adjustments to environmental variability to appealing for support

from external organisations. The second phase of responding to the erosion is referred to as resource mobilisation where the community acquired resources and support from other actors to launch a collective action campaign (Edwards and McCarthy, 2004). The village’s leadership used national media and appealed for external support on News 5 in Belize (News 5, 2006). The televised news piece reported that seven houses had collapsed over the course of 12 months and that urgent action was required to protect the village from further erosion. In our interviews, people credited the initiation of the mobilisation to the village’s former chairman, who passed away in 2007. In addition to being the leader of Monkey River, the former Chairman was also the president of the National Association of Village Councils and served on boards and committees of several organisations including the local NGO Friends of Nature, the Belize Tourism Industry Association, Toledo and the Payne’s Creek National Park. Her dedication to Monkey River Village and her access to local and regional networks, coupled with her experience of negotiating within and between organisations was an important asset for the collective action campaign. Residents reported that the Chairman’s skills in enabling support from organisations had been pivotal in rebuilding the village after hurricane Iris and for connecting Monkey River to the electricity grid. Her ability to navigate negotiations for the benefit of rural communities was by several residents seen as instrumental in drawing (external) attention to the village’s erosion problem.

The media publicity resulted in a grant, from the Protected Areas Conservation Trust (PACT), to investigate the causes of the erosion and potential solutions for its mitigation. PACT had also participated in discussions in the National Association of Village Councils where the Chairman served as president, suggesting that her contacts were important in enabling the grant funds. Additionally, Monkey River’s position as a stakeholder community to several protected areas likely played an important role in this decision.

Since the 1990s, local environmental NGO’s with close links to the North American and European non-profit counterparts have increasingly been involved in the management of Belize’s natural and marine resources, for example through co-management arrangements (Young and Horwich, 2007; Medina, 2010). Over the last three decades, global discourses have also embraced the idea that the support and involvement of local communities are a prerequisite for successful biodiversity conservation and that protected areas should deliver benefits to communities in order to enrol local support (e.g. Adams and Hulme, 2001). Both PACT and TIDE adhere to a community-oriented approach to conservation, in

sharing a mandate to protect the natural environment as well as contributing to local sustainable development. Without Monkey River, these conservation organisations would have limited opportunities of promoting community-based stewardship of the terrestrial and coastal resources they seek to protect. In a news interview, the then grants director of PACT motivated their involvement in the erosion issue by saying that: “*the community has passion for conservation so that is the driving force behind this initiative*” (News 5, 2007).

It should be noted that the relationships between the national and local NGOs and the village are ambiguous and at times strained; the residents feel that the promised local benefits from the two nearby protected areas have not yet occurred. Yet, Monkey River’s financial support from a conservation organisation rather than from a government authority reflects global conservation trends away from state-led approaches to ‘hybrid governance’ forms where local communities are seen as partners to NGOs (Igoe and Brockington, 2007).

The allocation of the PACT grant occurred after local residents had pledged for support in national media; supporting findings from other studies that local institutions need to be proactive to attract external support and funding (Rothman and Oliver, 1999; Agrawal, 2010). The PACT grant led to a process of knowledge co-production (Armitage et al., 2011) with the Belizean Galen University commissioned to undertake erosion assessments, resulting in the GUARD report in 2007. In addition, students and researchers from the University of the West Indies have been monitoring the shoreline since 2006. The GUARD report concluded that the coastal retreat could be attributed to three major factors:

“(1) Stresses to the river system of the Monkey River Watershed, (2) the effects of marine and climatic conditions on the Gulf of Honduras, and (3) the effects of global climate change. Principal among the stresses on the river system is the diversion of millions of gallons of water for agricultural purposes. The stresses to the river system reduce sediment transport to the coast and exacerbate the effects of the marine and climatic conditions on the coastline and the effects of global climate change” (GUARD, 2007, p. 2).

Four potential mitigation options are discussed in the report: beach nourishment and back beach establishment, beach nourishment and groyne (concrete boulders), coastal seawall and retreat/relocation of the village. Beach nourishment and back beach establishment were presented as the most suitable options for Monkey River Village, with a very high potential for beach restoration. This mitigation option necessitated artificial replenishment of the beach by using sediment from other sources, such as the riverbed. The report stated that “*no action is indicative of an imminent doomsday for Monkey River*” (GUARD, 2007, p. 63), claiming that a broad intervention was necessary to avoid relocation or retreat of the village.

Villagers’ suspicions that the erosion was caused by agricultural practices upstream (Esselman, 2001) were confirmed by scientific evidence in the GUARD report. The report’s findings thus legitimised the villagers’ claims as expressed by a former leader “*we found that for sure the farming practices were causing the erosion*”. The findings of the GUARD report influenced and extended the village’s demands since the residents were able to blame the agricultural firms for the erosion and claim that it was the government’s role to mitigate the erosional impacts. This explanatory scheme was heavily used in the activism and outreach phase as is illustrated in the following section.

5.3. Phase three: outreach

Outreach reflects how the villagers describe their actions towards the government after the release of the GUARD report’s

findings in 2007. In the absence of a governmental response, the village leadership decided to launch a more aggressive media campaign expressed in statements such “*we need to speak out*” and “*to wake up our government to do something*”. During 2008, press releases were issued to television, radio channels and newspapers and an online petition was created to build public awareness in support of the village. In addition, an erosion committee was established to monitor and work on finding solutions in collaboration with the village council. The online petition ‘Save the Monkey River Petition’ urged the Government of Belize to take immediate action.

The petition conveyed powerful discourses of loss (cf. Rothman and Oliver, 1999), framing the erosion as acute and disastrous with the potential to destroy the whole village. Monkey River Village was presented as valuable and unique, not only for its residents but also for Belize and beyond as illustrated in an extract from the petition:

“*Beloved by its residents, by Belizeans both living in Belize and throughout the world, and by the many visitors who value and admire the beauty, culture and history of Monkey River Village, this village must not be allowed to die*” (<http://www.ipetitions.com/petition/mrv/>).

Arguments drawing on symbolic values played a pronounced role in the portrayal as a village worthy of protection. Risks to the cemetery and the school building were described as threats to their loved ones and the villagers’ hopes for the future. In the petition, governmental inaction was equated with the irretrievable loss of one of the oldest and most beautiful villages in Belize and along with it its unique Creole culture.

The petition, relying on the GUARD report, evoked themes of environmental justice by reiterating that river diversification schemes benefitted large agricultural firms at the expense of local residents. The causes of the erosion were described as both highly unjust and unnatural. It proposed that the river should be dredged to restore the river’s flow and that recovered river sediments should be placed on the beach for artificial replenishment and restoration. Demands in the petition also included a dialogue with agricultural firms to minimise their water usages. Combined, these measures were framed as “*turning the clock back and let nature repair the damage created by man*”. If implemented, the measures were anticipated to invigorate the local economy. The text also emphasised the importance of the people of Monkey River as guardians of Port Honduras Marine Reserve and Payne’s Creek National Park and argued that these reserves would be greatly impoverished without the village. This suggests that the NGOs framing of the erosion problem – as a danger to the continued natural resource management of the area – influenced the villagers’ line of argumentation. The claims made in the petition resemble recurring themes in many global environmental movements, which often hold (transnational) corporations responsible for environmental degradation (see Peet and Watts, 2004; Robbins, 2012). Framings of environmental problems often relate to broader social and political reasons and the villager’s complaints towards the agricultural firms can be seen in the context of Monkey River’s long and complex relationship with banana agriculture. The collapse of the banana industry in the 1930s transformed Monkey River from a town to a village, which older residents in particular associate with a lower quality of life (Karlsson and Bryceson, 2014). After plantations have been re-established in the watershed, residents feel that they have to bear the environmental costs of agricultural activities, in terms of coastal erosion, river pollution and deforestation without receiving economic benefits.

Although the agricultural firms were blamed for the coastal erosion, local residents believed that it was ultimately the

government's responsibility to protect them from environmental change. In news articles, the need for a government intervention was also emphasised by officials from PACT. Residents also held the government accountable for the losses incurred in the village: *"I guess everybody in authority has just sat back for all these years and watch us just losing our properties, losing our houses to the erosion and nobody has done anything. Now it has gotten to this"* (7News, 2009a,b).

When regional authorities failed to respond the villagers intensified the media campaign. Headlines in four news articles contained words such as 'crisis', 'catastrophe' and 'threat' (Amandala, 2009; Placencia Breeze, 2009; 7News, 2009a,b; Ambergis Caye Forum, 2009). Officials from PACT and GALEN researchers stated that they shared the villagers' concerns, and after a direct village appeal to the Prime Minister for immediate intervention, the national government responded.

The result was the construction, by the Ministry of Works, of a temporary sea defence consisting of heavy length of timber and used tyres to minimise the impact of wave action and thereby protecting the village from further erosion. Funds from the national government, voluntary labour by the villagers and tyre donations by the public and companies made the construction possible (see Table 2). The villagers' success in securing the media's attention continued throughout the construction (7News, 2009a,b; Guardian, 2009).

The village's leadership and residents clearly welcomed the sea defence as it halted the coastal retreat. Our interviews indicate that the residents are less worried about the erosion after the implementation, and that threats to beach properties, the cemetery and school building are no longer seen as imminent. Interviewees believed that their campaign had at least temporarily saved Monkey River. But, the sea defence was intended and conceived of as a temporary emergency measure and a far cry from the solutions the village had demanded. In a news interview, the erosion committee's chairman said: *"It's important that we don't sit back and believe that the job is now done"* and emphasised that the area behind the defence should be backfilled and the root causes (river water extraction) should be addressed (Guardian, 2009).

Since the sea defence was constructed in 2009 the erosion committee has been dormant and the village council is not actively searching for alternatives to find a more permanent solution to the erosion problem. This suggests that the government intervention has halted community mobilisation and collective strategies to find a permanent solution. Some

informants contended that they had tried to negotiate water usages with the agricultural firms directly but that these efforts proved unsuccessful. Several residents believed that the government was reluctant to intervene in the firms' practices due to their contribution to the national economy. Such distrustful sentiments towards the government are common in rural Belize (cf. Sutherland, 1998) and in Monkey River politicians and government officials are often perceived to work on behalf of the 'big guys' rather than for the poorer people.

Therefore, residents do not believe that a permanent solution to the erosion problem will emerge without further local activism. A former village leader states that a future campaign needs to be reframed and focused on the wider implications of agricultural practices (e.g. pesticides and nutrients), for coastal ecosystems rather than localised erosional impacts. He speculates that the village may form alliances with international conservation organisations and the tourism industry, which would have the necessary weight to challenge the government to act and enforce legislation in the watershed. In contrast, some informants believe that the government prefers a slow retreat of the village due to the high protection costs. The sea defence was showing signs of decay during the fieldwork periods and future solutions to the erosion problem are at the time of writing unclear.

6. Concluding discussion

The Monkey River case illustrates the linkages between collective action and adaptation. Two perspectives central to these linkages warrant particular attention: factors triggering collective action, and the means through which collective action campaigns may lead to adaptation. After a discussion of these perspectives we reflect on the ability of Monkey River Village to effectuate change, and on the broader implications of collective action for adaptation.

6.1. Factors triggering collective action

Environmental variability and change, including cyclical patterns of coastal erosion and accretion in the estuary and local beach characterise Monkey River Village. The findings show that the villagers' normal coping range was exceeded (Smit and Wandel, 2006) when the rate and magnitude of the coastal retreat increased, and incremental adjustments such as the local protection of individual properties and relocation proved insufficient to avoid loss. As community functions were perceived to be threatened, and relocation was not a viable option, a social limit to further adjustments had been reached (see Adger et al., 2009). The impact of the erosion was a 'real world indicator', triggering an adaptive response, a finding corroborated in other studies (e.g. Dannevig et al., 2013).

When the cemetery, the school and more properties were seen as threatened, we argue that the erosion issue entered into a collective system of meaning; it became not only a problem for property owners but a threat to the whole village and its way of life (Watts and Peet, 1996). People's responses to risks that are perceived as threatening 'higher principles of life' are often strong and charged with emotion (see Rappaport, 1996). What followed in Monkey River Village was a collective process of resource mobilisation which developed from a shared understanding of grievances that the villagers wanted to change but had insufficient capacity to mitigate on their own (Watts and Peet, 2004).

In this case strong linkages to place emerge as an important motivator for the villagers' engagement in collective action (Escobar et al., 2002). Place attachment has a role in adaptation and can encourage people to act to sustain attributes of place

Table 2
Overview of the construction and outcomes of the sea defence.

Properties of sea defence	Temporary break water structure consisting of heavy timber poles placed in horizontal lines in the sea and used tyres submerged along the beach front
Involved actors/institutions	Government of Belize through the Ministry of Works, provides technical and financial support (US \$ 67,500) Local residents provide labour for its construction National media announcements call for donations of used tyres General public and companies donate used tyres
Outcomes of the sea defence	The sea defence reduces erosion rates and alleviates immediate threats to the village The local mobilisation around the erosion disintegrates and erosion committee becomes dormant

(Amundsen, 2015). As illustrated in a study of land-loss in coastal Louisiana, the physicality of place constituted an integral component of individual and communal identity (Burley et al., 2007). While the village is a site of multiple identities based on kinship, livelihoods, church and political party affiliations – at times leading to internal division – it is important to note that these sources of identity are all anchored in place. Therefore, when the coastal erosion altered physical space and posed risks to the continuity of the village, a shared sentiment that Monkey River Village should remain transcended internal divisions and became a unifying driver behind the mobilisation (Bebbington et al., 2008; Escobar et al., 2002).

According to Pelling (2003), strong social bonding is often linked to survival rather than the development of a group. Social bonding normally weakens once things go back to normal, as is found in the aftermath of natural disasters. This perspective is useful in understanding how place identity influenced collective action in Monkey River. The residents had been willing to act collectively and ‘defend’ the village once the threat was seen as imminent (as argued by Stedman, 2002), but after the construction of the sea defence, Monkey River was considered to be temporarily safe and the mobilisation disintegrated. Yet, our case illustrates how shared values and identity anchored in place can play an important role in influencing people to organise collectively in order to seek support for adaptation (Fresque-Baxter and Armitage, 2012).

6.2. The means through which collective action led to adaptation

While the Monkey River residents pronounce that the government have an obligation to protect the village (Beazley, 2009; Holmes, 2014), they are not satisfied with the way formal institutions responds to their rights and needs (cf. Palacio, 2001; Sutherland, 1998). At the time collective action, in the shape of resource mobilisation and outreach, was seen as “the [only] way of getting things done” and making the village voice heard by authorities.

With limited access to national decision-making arenas, the residents developed alliances with journalists from several media channels (one from News5 who followed the village’s fate over time), local NGO representatives, PACT, and researchers from the Galen University and the University of the West Indies. These informal networks rather than formal institutions were more important for the community in trying to gain support for adaptation. The journalists, researchers and NGOs can be understood as ‘bridging organisations’ (Almudi and Berkes, 2010; Beazley, 2009), which enabled the local concerns about the erosion to jump scale (Smith, 1992) and reach higher political levels.

One important function of collaborating organisations are their ability to ‘narrativise’ local claims, that is to frame and supplement arguments in order to gain sympathy and become politically legitimate in ways that local communities rarely accomplish on their own (Haarstad and Fløysand, 2007). This conceptualisation is useful to understand how the villagers’ alliances with NGOs, journalists and researchers shaped the collective action campaign. In Monkey River, the process of ‘narrativisation’ began during the resource mobilisation phase, where the residents collaborated with environmental organisations and research institutions to gather information, to frame the erosion issue within community-based conservation discourses and to produce knowledge about the erosion. Science and knowledge about what was causing the erosion and what could be done to prevent further impacts became an important tool in the outreach campaign, illustrated by the frequent citing of the GUARD reports findings (see Leach and Scoones, 2007).

Moreover, media coverage evolved around a simple storyline portraying the local villagers as victims of large firms’ agricultural practices, where the village’s future would be jeopardised unless the government took urgent action. We argue that the clear framing of the situation drawing upon a combination of scientific findings and discourses of loss contributed to its appeal. Through the use of media as a site of contestation (Leach and Scoones, 2007), the residents were able to directly confront the government with their demands for adaptation. By forming alliances with environmental organisations, national researchers and media, the local claims were legitimatised, substantiated, expanded and widely disseminated.

The local mobilisation in Monkey River can be seen as a process of opening up or claiming decision-making space that is typically inaccessible to local influence (Gaventa, 2006). While formal adaptation policies may include some degree of local participation, the potential for local groups to influence decision-making are often greater when such groups claim spaces for specific causes. There is evidence from the literature that the groups who create such spaces are more likely to have more influence on decision-making agendas (Cornwall, 2004). Our findings suggest that the Monkey River collective action campaign claimed space and added the village’s concerns to the decision-making agenda at the national level (Moser, 2009b), which led to the construction of the sea defence in 2009. Without this mobilisation the national government may not have reacted as evidenced by the course of events preceding the phase of incremental adjustments (see Table 1).

The residents, however, did not receive the measures and resources they had demanded and felt they needed from the national government, such as the reconstruction of the beach and changes to the agricultural firms’ water usages. The sea defence is illustrative of what Pelling (2011) terms adaptation as resilience, as the measure merely maintains status quo and allow the village to function without addressing the underlying drivers of the erosion. This shows that dominant global framings of adaptation – as a technical measure designed to reduce specific environmental impacts rather than tackling root causes of vulnerability – are pervasive in shaping government interventions also at the local level (Adger et al., 2001; Klein et al., 2007). Social mobilisations have at times been romanticised as having the potential to radically alter development trajectories (Escobar, 2011). This conception have been nuanced by empirical research that shows that although movements often have significant difficulties in challenging economic structures, they may be more successful in influencing political decision-making (e.g. Bebbington et al., 2008). While the collective action campaign in Monkey River was a significant accomplishment in securing support for short term coping, it did not result in a transformative process of change or to a development of the village as hoped for by the residents. On the other hand, the mobilisation opened up a transient space for collaboration and local influence, which have enabled some community members to envision future actor alliances and new ‘tactical articulations’ (Escobar, 2011) of the environmental problems in the area. This suggests that collective action may remerge once the erosion becomes pressing once again.

In conclusion we emphasise the importance of investigating the practices through which collective strategies are generated and carried out in order to secure support for adaptation. Collective action as a means for adaptation in Monkey River, as it is elsewhere, is largely shaped by the specific culture and traditions of the local community, the wider governance conditions in combination with the physical properties of the risk that is to be mitigated (cf. Holmes, 2014). Our case study shows that it was essential that (1) the erosion was perceived to threaten a collective

and place specific way of life, (2) that the village could ally with existing 'bridging organisations', and (3) that a free press was available to distribute the local claims. This underlines the argument that attention to formal arrangements such as adaptation policy alone has limited explanatory power to understand collective responses to change (cf. Cote and Nightingale, 2012). Local activism may be a means for places and communities not prioritised for national adaptation measures to enrol external support (Agrawal, 2010; Moser, 2009b). While the role of mobilisations in transforming adaptation pathways should not be overestimated, protests and demands for adaptation are likely to grow as impacts from climate change worsen. Theoretical perspectives engaging with collective action as contestation over rights to protection from environmental change can therefore enrich adaptation research.

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Research

What we have lost and cannot become: societal outcomes of coastal erosion in southern Belize

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ABSTRACT. Countries in the Caribbean region, including Belize, are vulnerable to coastal erosion. Experts and scholars have assessed the effects of coastal erosion in the region in physical and economic terms, most often from a sectoral perspective. However, less attention has been directed to the localized and nonquantifiable effects of coastal erosion in the region. We address this research gap by presenting an empirical study of a village in southern Belize that has experienced significant coastal erosion since the mid-1980s. Drawing on interviews, a mapping exercise, and a literature review, we analyze how villagers are experiencing the impacts of coastal change, and what the resulting risks and losses mean for the socioeconomic stability of the village. We identify five categories of local values affected by coastal erosion, ranging from alteration of social activities to the loss of properties. We demonstrate that the totality of impacts bear consequences to the village's continued viability, which adds uncertainty to the lives of local residents.

Key Words: *adaptation; Belize; Caribbean; coastal erosion; risk and loss*

INTRODUCTION

Coastal erosion linked to natural and anthropogenic factors is a problem in the Caribbean region, including Belize (Fuller and Wilson 2002, Lewsey et al. 2004, Cambers 2009). In Belize, approximately 45% of the population lives within 10 km of the coastline, and much of the country's economic activity and important infrastructure are located in the coastal zone (Richardson 2009, Simpson et al. 2012). Coasts are dynamic, and coastlines continually evolve as a result of natural processes, including erosion and deposition of sediments, wave action, climate variability, topography, and fluctuating sea levels. Human interference in natural systems also influences processes of erosion, for example, by altering sediment budgets, disrupting longshore drifts, and modifying ecosystems and topographies (Cooper and McKenna 2008). Anthropogenically driven climate change impacts, including sea-level rise and extreme events, are anticipated to exacerbate processes of coastal erosion in the coming decades and centuries (Mimura et al. 2007, Caribbean Community Climate Change Centre 2009).

Dominant modes of assessing risk from current and anticipated coastal erosion use spatial models, scenarios, and probability calculations to estimate impacts and vulnerability to existing resources in the coastal zone, including infrastructure, settlements, and economic sectors (Simpson et al. 2011, Scott et al. 2012, Simpson et al. 2012). Impacts are typically considered in monetary terms to inform cost-benefit analyses of possible adaptation options. Because of the economic importance of tourism in the Caribbean region, risks to the tourism sector have been prioritized in assessments (as argued by Scott et al. 2012). Local studies from Belize have similarly focused on communities hosting overnight tourism (see Simpson et al. 2012).

Such assessments correspond to decision-makers' focus on risks to and means of adaptation for sectors important to the national and regional economy (Adger et al. 2011, Manuel-Navarette et al. 2011). However, they do not tell us what the loss of coast means for affected people and their livelihoods. A body of research has

critiqued the fact that economic, technical, and physical criteria have come to define what is considered to be at risk and how adaptation to environmental change should proceed (Smit and Wandel 2006, O'Brien et al. 2007, 2010, Adger et al. 2009). A key concern raised by scholars is that the framing of risk (as a probabilistic measure of vulnerability) fails to incorporate nonquantifiable impacts of environmental change related to conceptions of well-being, identity, and culture (Adger et al. 2009, O'Brien and Wolf 2010, Coulthart 2012, Graham et al. 2013). As a result, aspects that may be of high importance for people affected by environmental change are largely unaccounted for, which may in turn render policy responses inefficient (Turner et al. 2008, Agyeman et al. 2009, Adger et al. 2011).

In a coastal context, research has shown that physical alteration and loss of coast often affect localized conceptions of identity and belonging (O'Collins 1990, Burley et al. 2007, Graham et al. 2014). A recent study from Korsra, Micronesia (Monnereau and Abraham 2013) illustrates that coastal erosion can have a series of adverse consequences at the local level. In addition to damaged houses and disrupted farming practices, the authors found that erosional impacts are threatening local burial practices, as burial grounds are traditionally located close to the sea. The totality of erosional impacts has led to falling levels of social cohesion and compromise both the social and economic well-being at the study site (Monnereau and Abraham 2013).

Simpson et al. (2011) emphasize that locally grounded research is required to enhance adaptation knowledge for anticipated sea-level impacts in the Caribbean. However, to our knowledge, there are no empirical studies on how local communities experience impacts from coastal erosion in the region. We address this research gap by presenting an empirical study of Monkey River village in southern Belize. The causes of erosion at the study site are primarily related to agricultural practices upstream from the village, where the river water is diverted and used for irrigation (GUARD Institute 2007). Because of these practices, less river-supplied sediment reaches the coast, an alteration known to have

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strong influences on coastal erosion (see Syvitski et al. 2005). In Monkey River village, human activities in the watershed area have led to two sets of consequences downstream: coastal retreat and river pollution.

We explore how local residents consider the coastal erosion and riverine changes to have affected their lives and their village by drawing on a relational approach to risk (Boholm and Corvellec 2011). Here, risk is conceptualized as a social and cognitive act whereby a potentially harmful phenomenon is connected to something considered to be of value through a causal relationship. Our objectives are to identify what objects of value are considered to have been affected by the environmental changes, how loss and risk are framed by local residents, and what the changes mean for the current and future socioeconomic stability of the community. By analyzing a village already affected by coastal erosion, our findings demonstrate how physical changes influence social systems and can provide an empirical example of how projected impacts of sea-level rise in the region may unfold locally.

CONCEPTUAL FRAMEWORK

This work follows a body of research that views risk as specific knowledge that is used to frame events along lines of harm and danger to make them meaningful and place them within a moral order (Dean 1998). Risk and the methods by which it is assessed and managed are manifold but inform responses and policies to events and processes (such as coastal erosion and sea-level rise), and can therefore be seen as a governing technique (Dean 1998, O'Brien et al. 2007, Stanley 2013). The rationale for our study originates from the prevailing focus on biophysical risks and monetary losses in relation to current and anticipated processes of coastal change in which little weight has been given to how these changes are experienced at the local level. A number of scholars have argued that alternative framings of risks related to environmental and climate change are required to incorporate a broader range of impacts and to orchestrate more equitable and efficient policy responses (e.g., Adger et al. 2009, 2011, Agyeman et al. 2009, O'Brien and Wolf 2010).

We draw upon a relational theory of risk developed by Boholm and Corvellec (2011:176), which seeks to “answer the key theoretical and practical question of why and how something is considered a risk.” Influenced by scholars such as Hilgartner (1992) and Rosa (1998), Boholm and Corvellec (2011), conceptualize risk to be a social and cognitive act whereby a potentially harmful phenomenon is connected to something of value through a causal relationship. A risk definition is then constructed by three elements: the risk object, the relationship of risk, and the object at risk.

A risk object can be a natural phenomenon, technology, or behavior that is considered to have the potential to produce harmful outcomes on something that is endowed with value. In conventional risk appraisals, risk objects are commonly referred to as hazards or risks, but here, a risk object is not seen as dangerous per se, but only when connected to a valued object at risk. Consider, for example, that coastal erosion is a continuous process that occurs worldwide and is only identified as a risk when it occurs in areas deemed to have importance for humans (Cooper and McKenna 2008).

An object at risk is something that is endowed with value and therefore is considered important and worthy of protection. This object can be human health, nature, infrastructure, economy, or cultural representations. Connections between the risk object and the object at risk are made through a relationship of risk, which identifies how and in what way a risk object threatens an object at risk. Such connections can be made by the use of models, probabilities, or narratives and are embedded in social contexts as Boholm and Corvellec (2011:180) state, “Embedded in the observer’s cultural idiosyncrasies, a relationship of risk reflects an observer’s knowledge and understanding of risk objects and objects at risk. The relationship encapsulates the properties the observer considers prominent rather than reflecting the properties of these objects as such.”

Two examples of risk definitions concerning anticipated coastal erosion as a result of sea-level rise illustrate this point. In Scott et al.’s (2012) study of sea-level rise impacts on the tourism sector in the Caribbean, the relationship between sea-level rise (the risk object) and the tourism sector (the object at risk) is established through global scenarios, downscaled models, and quantification of coastal resources. The regional scenario of 1-m sea-level rise is generalized to cause 50–100 m of horizontal erosion or loss of coast; losses are then evaluated according to the economic value of existing infrastructure and resorts. Thus, an economic rationale for adaptation measures underpins the study and informs how risk is understood. In contrast, in Sutherland et al.’s (2005) community-level study in Samoa, local residents connected sea-level rise (the risk object) through scientific projections as well as their current experience of erosion to threats to their safety and sense of belonging (the objects at risk). For the villagers, sacred lands and burial plots were considered among the most important community functions to protect from land loss because they see their ancestry and cultural heritage stemming from these lands. These two cases exemplify the co-existence of several risk definitions around the same phenomena, depending on what is considered to be of value and therefore worth protecting.

Numerous studies have demonstrated that understandings of risk vary markedly between various actors and social groups (e.g., Boholm 1998, Slovic 2000, Wolf et al. 2010). A relational perspective on risk emphasizes that risk definitions hinge on what people value, which is culturally embedded. Risk definitions are therefore continuously subject to interpretation and negotiation. A similar line of argument can be found in values-based approaches to adaptation (see O'Brien and Wolf 2010). However, values in O'Brien and Wolf's (2010) account concern broader structures of moral principles such as modernity, whereas Boholm and Corvellec (2011) focus on the practical evaluation of what is considered important. We therefore consider that the relational approach to risk is more suitable for empirical operationalization.

Although Boholm and Corvellec's (2011) proposition concerns risk, namely, a situation in which the outcome is uncertain, we include the concept of loss, which we consider to be one potential outcome of risk. Understandings of risk build upon past experiences. Similar to risk, a loss needs to have been ascribed value and connected to a harmful phenomenon. People conceive the present with memories and imageries of the past (West 2006), and the inclusion of past experiences of environmental change

are therefore important to understand current risk understandings and preferences for adaptation (e.g., Smit and Wandel 2006).

We consider a relational perspective on risk to correspond well with the emerging adaptation literature focused on subjective dimensions of change related to values and place (Adger et al. 2009, O'Brien and Wolf 2010, Fresque-Baxter and Armitage 2013, Graham et al. 2013, Amundsen 2015) and to have the potential to inform "more geographically and culturally nuanced risk appraisals" (Adger et al. 2011:20). Similar to value-based approaches to adaptation, the relational approach to risk does not provide an explanation as to why some risk definitions are considered more legitimate and given more weight than others. In line with Heyd and Brooks (2009) and Cote and Nightingale (2012), we argue that dominant modes of assessing risk are related to power relations rather than simply an inappropriate understanding of nonquantifiable values. However, the means and practices through which one view precedes over another are beyond the scope of this paper.

CASE BACKGROUND

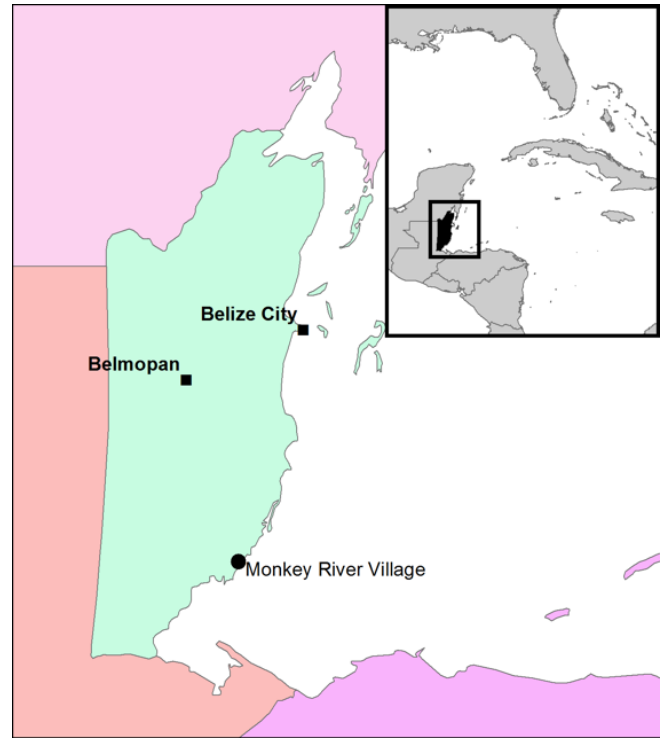
Monkey River village

We studied the coastal village of Monkey River (MRV) and the coastline immediate south of the village. The area was selected because of its remoteness, reliance on coastal resources, current reality of coastal erosion, previous experiences of hurricanes, and interest by the village to participate in the research.

MRV is remotely situated on the mouth of Monkey River (Fig. 1). Road access is limited: a dirt road leads to the village, but the last stretch has to be taken via boat. MRV is a small creole village with a population of 196 (Statistical Institute of Belize 2010). The term creole denotes people of mixed African and European-Anglophone descent, who became closely associated with a "native" Belizean identity during the struggle for independence (Ashdown 1979). Belize Kriol (Creole) is recognized as its own language, but most Creole speakers also speak English, the official language of Belize. MRV history is entwined with the establishment of banana production upstream in the 1870s. At that time, it functioned as a shipping point and a settlement for laborers and producers. It was declared a town in 1891, and at the turn of the 19th century had over 1000 residents, several shops, two schools, and a police station (Chamberlain 1897). The outbreak of Panama disease (a soil-borne fungus that attacks banana leaves) caused the banana industry to collapse in the late 1920s, with MRV experiencing large-scale labor emigration as a result (Moberg 2003). In 1981, MRV was downgraded from a town to a village with 181 residents (Palacio 2001). Since the late 1980s, the villagers' main livelihoods have been fishing and tourism. Fishing grounds are located in the proximity of the village; fishers target lobster and finned fish using a variety of methods, including skin-diving, traps, and hand-lines. Close to the tourism hotspot of Placencia, MRV offers tourists half-day boat trips departing from Placencia, with MRV guides to view wildlife upriver, particularly black howler monkeys. These trips include a lunch stop in the village. Fishing and tour guiding are exclusively male occupations within the village. Women have fewer employment options, mostly engaging in domestic work but also in the school, shops, or restaurants. MRV was severely

affected by Hurricane Iris in 2001, which destroyed up to 90% of the village's built structures, including beach properties that were at risk from erosion (Beven et al. 2003).

Fig. 1. Map showing the location of Monkey River village, Belize. Inset: Location of Belize in the context of the Caribbean.



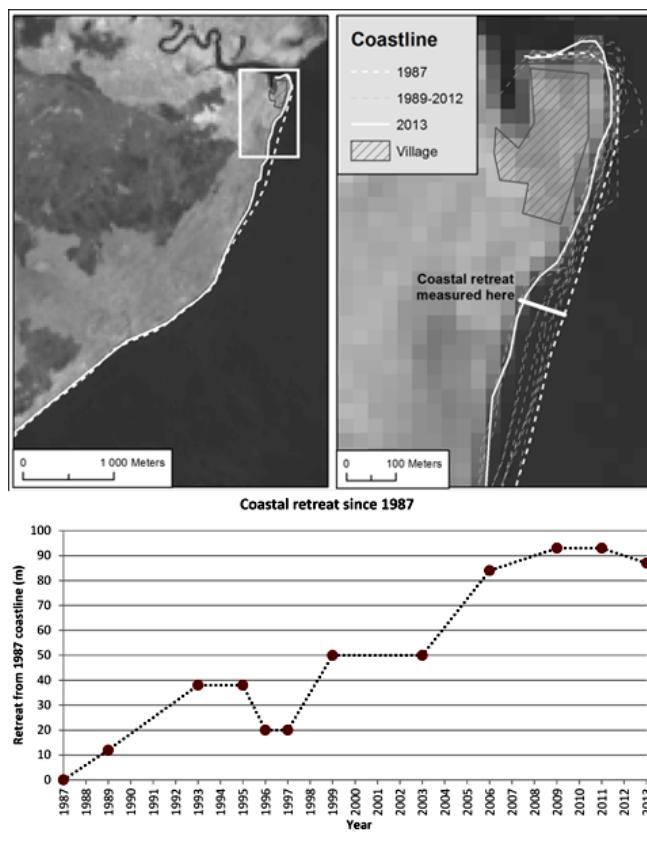
Physical and ecological changes

Monkey River lies along the Maya Mountain Marine Area Transect, a 4047 km² (1 million acre) ridge-to-reef corridor consisting of six watersheds that feed a mangrove-lined coastal embayment (Port Honduras) and the southern tip of the Belize barrier reef (Esselman 2001; see Gischler and Hudson [2004] for an overview of the geological development of the Belize Barrier Reef). The upstream area is covered with tropical broadleaf forest and thin but fertile soils (Heyman and Kjerfve 1999, Esselman et al. 2006). Distinct dry and wet seasons characterize the area, with the months between July and October receiving the most precipitation. In total, > 3000 mm/yr precipitation is received (Heyman and Kjerfve 1999). The area lies on limestone rock and coastal plains, including savannah grasslands and mangrove forests, which have been (and are currently) used for a variety of human activities such as banana plantation, small-scale agriculture, and, to the north of the river, citrus orchards and shrimp farms.

Since the mid-1980s, MRV has experienced coastal retreat that, according to residents, has led to the loss of two rows of houses, a street, a football field, and the sandy beach. Our coastline mapping, using satellite images, indicates that there has been a gradual retreat of the coastline along a 1 km long section immediately south of the village (Fig. 2). Here, up to 100 m of

shore has been lost to the sea during this time, totaling approximately 6 ha of land. Satellite images do not reveal any systematic trend of coastal changes along the remainder of the coastline. At the mouth of the river, the coastline seems to vary substantially from year to year. These variations could be real, but it is also likely that the higher turbidity of water in this area makes it difficult to identify the coastline accurately. In the southernmost part of the area, the images reveal little or no change over this period. The coastline retreat occurs mainly in two periods: 1987–1993 and 2003–2006. In 2009, after a local demand (see Save the Monkey River petition: <http://www.ipetitions.com/petition/mrv>), the government of Belize installed a temporary sea-defense consisting of wooden stakes and used tires along a coastal stretch outside the village. This measure appears to have halted the erosion.

Fig. 2. Landsat ETM image from June 04, 2013, with the manually mapped coastlines near Monkey River village, Belize, overlaid (top two panels). Coastal retreat relative to 1987 (bottom panel) was measured along the profile indicated in the top right panel.



The coastal retreat can be attributed both to coastal changes and riverine changes inland, according to an in-depth study by Galen University, Belize (GUARD Institute 2007). The study report concludes that sediment transported from the Maya mountains through the Swasey River and Monkey River no longer reaches the coastline. The main reasons for this are reductions and changes in the river's water flow because of diversions for

agricultural purposes. The Swasey and Bladen rivers join together to form Monkey River and provide > 60% of irrigation water for Belize's banana plantations. The banana plantations require this water for a variety of purposes, including chemical preparation, irrigation, and processing (Alegria 2009). Importantly, water pumped out of the river for irrigation is not returned to the river, leading to a decrease in water flow. The reduced sediment transport downstream amplifies the local effects of waves, tides, currents, and storms. Coastal erosion is especially a problem at coastal hotspots that are under pressure from natural forces (wind, waves, tides, and currents) and human activities (beach sand removal and inappropriate construction of shoreline structures; e.g., Simpson et al. 2012). Hotspots also include river-mouth systems, where fluxes of water and sediment are focused (Newton et al. 2012). To understand local erosion patterns and causes, long-term monitoring of diverse variables is necessary, including local tidal conditions and development. However, no such data are available for the local study site. A study of Carrie Bow Caye, located in the barrier reef, indicates that major storms as well as increased coastal development contribute to increased coastal sediment loss (Koltes and Opishinski 2009).

No comprehensive details are available for the specific periods of large major coastal retreat (1987–1993 and 2003–2006). The Belizean coast experienced several storms and floods in 1990, as well as Hurricane Wilma and tropical storm Gamma in 2005 (<http://innovatebelize.blogspot.no/2012/04/natural-disasters-in-belize-19312005.html>). Also, coastal erosion is exacerbated by the loss of coastal mangroves, which take a long time to recover. Thus, intensified storm and hurricane events in preceding years (e.g., Hurricanes Keith, Mitch, and Iris in 1998, 2000, and 2001, respectively) may have caused the loss of mangroves, providing the basis for coastal erosion in subsequent years.

Notably, the drivers of coastal erosion have caused additional changes. Esselman (2001) mapped stresses to the ecosystem along the Monkey River and its tributaries and found that sedimentation, riparian deforestation, fishing pressure, and increased nutrient load originating from agricultural activities adversely affect the basic food web of the river. Alegria et al. (2009) found that some pesticides discharged via rivers are transported offshore to waters overlying and threatening coral reefs and its organisms. Nutrient and sediment loading of reefs and coastal mangroves, overfishing, and tourism stress on the coral reefs pose further challenges to coastal and marine ecosystems and livelihoods (Nyström et al. 2000, World Resources Institute 2004). Thus, inland agricultural practices can have far-reaching implications for the coastal beach, mangroves, and reef (threatened by the same drivers) that perform protective and provisioning services (e.g., World Resources Institute 2004, Mason 2010).

Importantly, residents of MRV do not differentiate between changes to the river and beachfront, as they see the totality of damage originating from agricultural practices upstream. This understanding is informed by their experiential knowledge, as well as the results of previous studies in the area, which have often involved the assistance of villagers. Based on the residents' understanding of the totality of change and damage, riverine changes were also included as part of our study.

METHODS

Our study draws on a combination of qualitative fieldwork, GIS mapping of the coastline south of the village, and a literature review of ecological processes and other activities in the area to illuminate societal outcomes of coastal erosion. After a 3-wk scoping trip in January 2011, the first author conducted fieldwork in two periods: April–August 2011 and February–May 2012, spending approximately 8 mo in Belize in total. The core data were derived from semi-structured (Kvale and Brinckmann 2009) and in-depth (Fontana and Frey 2000) interviews with residents. In June–July 2011, the first author stayed in MRV for 3 wk and conducted 20 interviews (18 males, 3 females), loosely structured around an interview guide. Questions specific to the erosion and riverine changes included past and present uses of the beach and river, responses to the erosion, and if and how the changes were perceived to impact the village's life and livelihoods. During the second fieldwork period, the author returned to MRV in April 2012 for 2 wk. This stint established further rapport between the residents and researcher. Informants who had lived or lived on the beachfront and older residents were specifically targeted for interviews. Snowball methodology (e.g., Atkinson and Flint 2001) was used to locate informants. Eight in-depth interviews (three males, five females) were conducted around the themes of village history, livelihoods, and environmental change. Three of these interviews (all with females) centered on informants' personal old photographs, which is an effective means to facilitate communication and stimulate memories about past physical features and social events in the village (Clark-Ibáñez 2004). During the first fieldwork, the research focus was directed toward fishers' livelihoods; this affected the gender balance of the informants, with the results biased toward male perspectives. In questions concerning erosion, the eight interviews with female residents did not reveal any major differences compared to those with male residents. In addition to in-depth interviews, many informal interviews were held with residents (male and female) in 2012. These informal interviews often elaborated on themes and topics discovered during the first stay in MRV and added depth and context to the findings.

In total, 29 semi-structured and in-depth interviews were conducted (Appendix 1). During both field periods, interviews normally lasted between 40 min and 2 h. Most interviews were recorded and transcribed, but some informants were uncomfortable with the recorder, and these interviews were instead recorded through detailed note taking. In addition to interviews, participant observations of fishing trips, river tours, and walks in the village allowed for a deeper understanding of village livelihoods and everyday activities. Moreover, being at sea or on the river facilitated conversations on topics related to the environment and added depth to the themes explored in the interviews.

The research process and data collection was iterative (as suggested by Maxwell 1996). The qualitative methods were influenced by studies emphasizing nonquantifiable dimensions of change. Interviews were thus designed to capture informants' perceptions and experiences. However, specific outcomes of coastal erosion were not assumed a priori but were identified through insights from the fieldwork, following the approach of Hovelsrud et al. (2010). The data analysis followed an inductive logic, moving from particularities discovered in the data toward

broader concepts in the conceptual framework (Crotty 1998). The categorization of outcomes was derived from critical reflection on the applicability of the concepts to our specific case. We elaborate further on the particular literature that influenced the identification of five risk objects in the section *Local and Societal Outcomes*.

To quantify the local coastline changes reported by the informants, we obtained a set of 12 Landsat satellite images from the period 1987–2013. For each image, the coastline was mapped manually by interpreting a false color composite of the short-wave infrared, near infrared, and blue bands from Landsat's TM/ETM+ sensor. For a single image, the spatial accuracy of the mapped coastline is limited by the 30-m spatial resolution of the satellite images, but when a series of images are used, trends can be discernible even at scales below the size of a single pixel. The purpose of the mapping exercise was to document whether the coastline changes had been occurring along the whole coastline or primarily near the river mouth, which could indicate whether riverine or oceanographic factors are driving changes. By weaving together these data, we could compare informants' perceptions with the mapping results and literature review, thereby serving to contextualize our findings.

A literature review complemented the interviews and analysis and helped to build an understanding of the physical and ecological changes and their impacts in the region. The literature analysis is based on peer-reviewed and non-peer-reviewed literature and other available documentation collected through archival studies at the Belize Archives and Records Service, Belmopan, Belize, and the National Archives and British Library, London, UK.

CONTEXTUALIZING ENVIRONMENTAL CHANGE

To situate residents' experiences of environmental change, we briefly outline the positive and negative aspects informants associate with living in MRV. In interviews, MRV was described as a "beautiful little place" nested between the sea, river, and jungle. All informants expressed attachment to the village, which they ascribed to its natural beauty and a sense of safety, community, and culture. Informants conceive the village and its way of life as unique, often stating that there was no other place like it in the world. Proximity to the sea and river is seen as beneficial, especially by fishers and tour guides, who said that their workplace is just outside their doorstep. The jungle and its associated wildlife are considered an asset that villagers have come to value and appreciate more after the introduction of local tourism, even if informants also simply enjoy viewing animals such as black howler monkeys in the village.

When asked what they liked about living in MRV, all informants mentioned the safe and tranquil way of life, a sentiment captured in the statement, "You can sleep good with your door open and hang your clothes out to dry without anyone stealing them." The general absence of theft, drugs, and violence, which are believed to be commonplace in larger communities, is attributed to the close-knit community (claimed to consist of six extended families), in which everyone knows each other. Furthermore, because MRV is only accessible by boat, people in the village always know who is entering. Informants are also proud to be custodians of a creole culture that they feel is at risk of disappearing in other parts of the country.

Table 1. Summary of the local impacts of coastal erosion and ecological changes in the riverine system on five categories of valued objects for Monkey River village, Belize.

Valued objects category	Effect of coastal erosion	Effect of ecological changes in the riverine ecosystem	Informants identifying the effect
Social activities	Loss of recreational ground, sandy beach (walks, games, social events)	None	Older residents (≥ 40 years old)
Properties	Loss of land and houses (< 40 lots)	None	All informants and particularly people that used to or currently live on the beach
Sacred sites	Risk to the cemetery	None	All informants
Current livelihood stability	No direct effects	Decreased fish stocks, reduced water quality, loss of potential source of drinking water, off-shore effects on coral, negative effects on fisheries nurseries	Fishers and tour guides (male residents)
Future development opportunities	Decreased likelihood for investment (overnight tourism), reduced tourism attractiveness	Decreased fish stocks, reduced water quality, off-shore effects on coral (tourism, fisheries), future attractiveness/availability of riparian forest	Majority of informants

However, the smallness and remoteness of the village also has a flip side. Limited livelihood opportunities lead informants to perceive the economic development as stagnant and village life as boring, and many wish to see more jobs and people in the village. Because of the small population, some informants say it is difficult to find spouses within the village. Living in the village is moreover seen as difficult and expensive: all foodstuffs and products consumed in MRV must be purchased in other locations and then transported to the village. Health services are unavailable within the village, meaning that residents have to travel in case of illness. Although MRV is small, several internal divisions exist within the community, mainly linked to political party lines and livelihoods. Older informants claim that communal spirit and cooperation were better in the past. Moreover, MRV's transformation from a town with > 1000 residents in 1910 to a village with < 200 residents in 2010 has altered social activities and the use of public spaces.

LOCAL AND SOCIETAL OUTCOMES

Based on the interview findings and a literature review, we identified five categories of valuable objects at risk affected by coastal erosion and riverine changes: social activities, properties, sacred sites, current livelihood stability, and future development opportunities (Table 1). A critical reflection on concepts and categories available in the literature on subjective dimensions of change resulted in the five objects of risk (Turner et al. 2008, Adger et al. 2009, 2011, Graham et al. 2013). We deemed the social activities category to be more precise and relevant to our case than broader concepts such as lifestyle losses (Turner et al. 2008), which we felt would impose larger meanings on the data. Here, the properties category represents both material and symbolic meanings (Adger et al. 2011) because land and property simultaneously contain economic value and provide people with a sense of belonging (Bebbington 1999). The sacred sites category was influenced by literature emphasizing the role of sacred places such as cemeteries in processes of place-identity (Mazumdar and Mazumdar 1993, Scannel and Gifford 2005), as well as empirical findings from the Pacific (Sutherland et al. 2005, Monnereau and Abraham 2013). We drew upon the literature on community-based vulnerability assessment (e.g., Smit and Wandel 2006,

Hovelsrud and Smit 2010) to select the current livelihood stability category. The future development opportunities category is a modification of Turner et al.'s (2008) discussion of lost opportunities for local communities as an important but rarely acknowledged impact of change.

In accordance with a relational perspective to risk and loss, the five objects of risk were selected to correspond with what informants identified as negative outcomes from the coupled environmental changes. It is possible that the changes have affected other aspects in MRV, for example, health (as suggested by Turner et al. 2008 and Graham et al. 2013), through a reduction in recreational options; however, this association was not drawn by residents in our interviews. The five categories are interdependent and overlapping, and range from loss to risk and uncertainty.

Social activities

In interviews, the loss of 50 m of beach and a recreational ground was linked to alterations and reductions in social and recreational activities. The beachfront had been an important public space used for walking, stargazing, parties, and weddings. For example, one woman showed her wedding pictures from 1994 that showed a sandy beach. Notably, younger residents do not link land loss to alterations in social activities, but older residents consider the losses to be profound. They often recounted cherished childhood memories tied to activities carried out on the beach. After the reduction of the beach area and the loss of the former recreation ground (Fig. 3), social activities have ceased to take place in the way older residents were accustomed. Although the village now has a new recreation ground located further inland, informants claim that the former was more suitable for games because of its drier location. Walks, games, and activities that used to take place on the beach and recreational ground are missed and believed to affect the social cohesion of the village as stated by a man: "We used to have a lot of games down there especially in the dry season, we used to take food and drinks down there and have a lot of fun in those days, but it's not like it used to be in those times man... we don't have so much action now" (informant MRV 8).

Fig. 3. Monkey River village's former recreation ground was located at the second row of wooden poles, according to informants.



Older informants recall a “brighter” (happier and better kept) MRV in the past, and associate land losses that have led to a reduction in social activities with a lower quality of life. During both periods of fieldwork, only young children were observed to play on the beach.

Properties

One of the most direct outcomes of coastal erosion is the loss of beach properties and homes. The GUARD Institute report (2007) estimates that 40 beach properties have been lost since 1980, with an economic value in the range of USD \$1–2 million. Remnants of houses were visible during fieldwork (Fig. 4). All informants felt that the loss of beach properties has had negative outcomes on the village, but the loss of properties and the prospect of increasing erosion are primarily felt by residents who used to live or currently live on the beachfront. Affected property owners were forced to relocate once their houses became unsafe. A woman previously living on the beach said that her family decided to move once the veranda collapsed; her family was able to relocate to a piece of land intended to be the future home of her children. In contrast, several affected families were forced to squat on other people's land before finding a permanent solution, and some families left the village after the loss of their homes. The cost of purchasing or constructing new homes placed a large economic burden on families, who did not receive any compensation for their losses. However, informants do not articulate economic costs explicitly; rather, they emphasize the challenges involved in relocating and an associated sense of loss. As woman who had to relocate said, “I miss it because I had my home out at the front at that time and out there was so cold and so quiet” (informant MRV 17).

Women often emphasize the emotional aspects involved in losing their home more than male informants do. Informants assign specific qualities, including tranquility and pleasant climate, to living on the beach. These qualities were lost with relocation for some. Residents currently living on the beachfront worry that the erosion will increase and that they will encounter a similar fate.

Fig. 4. Remnant of a building affected by coastal erosion at Monkey River village, Belize.



Sacred sites

In the early 1990s, the village's cemetery was located behind a street, the former recreation ground, and a sandy beach. During fieldwork in 2012, approximately 3 m separated the cemetery from the sea (Fig. 5). According to informants, the sea is breaching closer to the burial ground during storms. The cemetery has important community functions and provides a connection to the village's past. It therefore has high symbolic value, illustrated by a quotation from the Save the Monkey River petition (<http://www.ipetitions.com/petition/mrv/>): “We greatly fear that the burial ground, where so many of our loved ones rest, will soon be washed away.”

Fig. 5. Coastal erosion is encroaching on the cemetery of Monkey River village, Belize.



Since the coast eroded, residents have to carry their deceased across water rather than on the street that previously led to the burial ground, which informants consider to be degrading. If the cemetery becomes submerged or relocated, some residents worry that it will disrupt the spirits of the deceased. Our interviews indicate that people are concerned that the coastal retreat will

increase and that friends and relatives resting at the cemetery will be washed to sea. There is a deep emotional value attached to the cemetery, and threats to it are therefore considered very serious.

Current livelihood stability

Older informants say that the river used to be deeper and faster flowing. A retired fisher stated, "The river is getting shallower; when I was little it was deep and rich and it had a lot of big fishes, but now it is small and dry. Right now you can't go nowhere. Once ago you could go miles up the river, and now they are making a lot of diversions." (informant MRV 17). Yet, it is primarily the invisible aspects of riverine changes that are of concern for the village. The river was traditionally a source of drinking water and was used for small-scale fishing, hunting, bathing, and washing clothes. MRV gained access to piped water in 2000, but according to interviewees, the village stopped using the river as a source for drinking water long before that because of the amount of chemicals they believe are present in the water.

Deforestation and the use of pesticides, chemicals, and nutrients associated with upstream plantations are the principle causes for depleted fish stocks, according to fishers and tour guides in the village. The effects on juvenile fish are of particular concern. Nutrient export through agricultural use is also connected with algal growth on the nearby coral reef and is considered to deteriorate habitats for lobster, which is the most commercially valuable species in the area. As explained by a fisher, "What happens is when there is a lot of fungus on the stones, they get slimy and lobster are smart animals, they love certain rocks more than some and if you damage that rock just slightly they go away. Slime is from the environment in the sea. But our coastline is washing away and since that happened, the slime happens more in the ocean" (informant MRV 11).

Recent forest clearance for plantations has been observed close to the river. Residents engaged in the tourism industry fear that this could destroy some of the area's natural beauty and wildlife and therefore deteriorate the village's attractiveness to tourists. Moreover, informants are concerned that increased deforestation will lead to amplified erosion rates. The effects of a changed river regime in combination with deforestation and use of chemicals are considered to add to other stresses on fishing and tourism livelihoods, such as fishing pressure, aquaculture, and coastal development. Fishers and tour guides have observed riverine and coastal changes, and their concerns have been passed on to other residents, as the village derives its main income from fishing and tourism. Importantly, the riverine activities, as changes and drivers of coastal degradation, have a greater effect on Monkey River than the loss of the beach. These are perceived to have negative effects on current natural resource-based livelihoods and are also considered to harm future options for local livelihoods related to marine resources and tourism.

Future development opportunities

The beach was considered an asset in conjunction with a local development project in 1995, which stated, "The project area has a high tourist potential. The picturesque village of Monkey River is strategically located on a sandy beach, at the mouth of an 'unspoiled' river with a coral reef nearby" (Meerman 1995:12).

The informants consider some form of tourism, initiated by foreign investors, to be the most realistic development path for

MRV. Overnight tourism, including resorts and larger hotels, has developed in other coastal communities in southern Belize, and the informants had expected that MRV would follow the same trajectory because they regard nearby tourist locations to be "full". According to local residents, a lasting outcome of coastal erosion and the loss of the sandy beach is the discouragement of investment in the area: "It [the erosion] affected all of us. We used to have some foreigners buying land here too, but as far as I know, we have two folks and they had to leave because the place washed away" (informant MRV 9).

Informants describe the current local economic development as slow with few livelihood opportunities. Development, generally envisioned as more jobs, people, shops, and services, in many ways bridges what older informants feel has been lost in the transition of MRV from town to village and what younger people hope to occur. The loss of land is seen by several informants to have diminished the prospect for positive change and led to uncertainty about the future. A younger informant stated, "For a lot of people, their land is going; no one wants to come and live due to the erosion, and pretty soon we got to move away, I think" (informant MRV 7).

Nevertheless, development, and what it may imply for the village, is not uniformly seen as positive. One woman explained that it could also threaten aspects of village life through the influx of drugs and theft, leading to the degeneration of the youth. Negative aspects of development are commonly described this way. While most informants recognize that development would compromise valued aspects of life in MRV, they also believe that change is necessary to provide young people with more livelihood opportunities and thereby allow them to stay in the village. One woman explained, "We don't have land for investors, and that's what we need. I wish Monkey River would develop but I am not seeing it at all. It is so sad. I really wish it would develop so people could stay. I have three children and they are getting older, and when they are finished with school, what will we do here? It is not like you want to move, but it is like you have to move.... They [the children] won't find any jobs here" (informant MRV 19).

After the coastal retreat, informants feel that foreigners are scared to invest in coastal properties. The land loss is therefore seen to have constricted future development options in the village.

DISCUSSION

Through the perspective of a relational theory of risk, we next expand on how local residents in MRV associate risk and loss with the coastal erosion and riverine changes and reflect on what this means for the social and economic stability of the village. We found that the identification of risk and loss largely depended on the informants' perceptions of what functions the beach front and river should provide, informed by past experience, memories, and current practices in these settings (Manzo 2005). The importance of the five objects at risk (Table 1) therefore varies between different groups in the community. For example, older residents associated coastal erosion with a loss of social activities that used to take place on the beachfront, whereas younger informants did not. Preferences for social engagement change over time, and younger residents engage in social activities within and outside the village despite the physical alterations. This finding emphasizes that outcomes of environmental change are defined endogenously (Adger et al. 2009).

Risks to the current livelihood stability were identified by fishers and tour guides, who observed a slow deterioration of fish stocks and natural resources in the area. Several of them have also assisted researchers in the past, and the combination of this knowledge and their practical experience led them to develop an extensive understanding of how riverine changes influence the resources on which local fishing and tourism livelihoods depend. Changes in the natural resource base are slower and subtler than land loss but are considered serious. Risks to the current livelihood stability do not only have implications for fishers and tour guides, but can potentially undermine the ability for people who are directly or indirectly relying on these livelihoods to remain in the village.

The findings show that there are strong spiritual and emotional aspects at stake from risks to the cemetery, concurring with studies from the Pacific (Sutherland et al. 2005, Monnereau and Abraham 2013). Notably, residents fear that further erosion at this sacred site could, in addition to the loss of an important function and marker of place, also have the potential to disrupt the spiritual order (see Stoffle and Arnold 2003 for a telling case). This empirical example illustrates the importance of including local cultural values in planned responses to coastal erosion and anticipated impacts from sea-level rise (e.g., Adger et al. 2011, Graham et al. 2013).

The connection between coastal retreat and loss of property represents a direct and casual relationship of risk, identified by residents and emphasized in local impact assessments (e.g., GUARD Institute 2007). Our study shows that in addition to monetary losses, affected owners, and particularly women, associated losing properties to a sequence of adverse outcomes, including emotional loss and challenges in the relocation process. The loss of land and property also go beyond individual homeowners' negative experiences and are seen to affect the collective functioning of MRV through subsequent outward migration and altered visions of future development paths in the village.

Experiences of risk and loss are context dependent (e.g., Boholm 2003); salient aspects of life in MRV are limited livelihood opportunities and decadal processes of population decline (Karlsson and Bryceson 2015). This provides an explanation of why the decreased prospect of investment in overnight tourism in the area is seen as a serious outcome of erosion. Our findings suggest that the losses incurred and the prospect of increasing erosion has altered the residents' "horizon of expectation" (Sejersen 2012) and has led to a lack of faith in the village's development. In line with Rappaport (1996) and Turner et al. (2008), we argue that uncertainty is a significant but underestimated outcome of environmental change. Uncertainty about the future influences how some informants judge their current options and can inform actions such as the decision to move in search of more employment opportunities and better access to social services.

Whereas Boholm and Corvellec (2011) argue that risk must involve a situation in which the outcome is uncertain, we found that loss and risks are entwined concepts in MRV. The experiences of loss strongly influence how threats are understood today and how the future is conceived. Local residents establish relationships of risk through historical and practical experiences, instead of

seeing valued objects at risk as they are: their way of knowing risk involves what these objects used to be and what they could have become. This framing diverges from risk appraisals based on probabilistic and community-level approaches (e.g., Smit and Wandel 2006), which tend to link potential threats to the current state of objects, resources, or livelihoods.

In MRV, as in most communities, there are tensions between which objects and functions should last and which ones can be sacrificed to gain something else. However, we found that the majority of informants would accept losing some of the valued aspects of living in MRV for more jobs and increased resident population to safeguard the village's future. From a local perspective, monetary aspects of land and livelihoods are framed as the possibility to remain in the village and as a pre-condition for the continuous cultivation of its social life. Informants expect each generation to create their own way of life, and they see the possibility to develop, rather than to conserve existing traditions, as a way to guarantee MRV's continuous existence. Therefore, taken together, we argue that the five categories of valued objects link to a primary object at risk, namely the continuity of place.

Coastal erosion has forced the residents to confront an uncertain future because it is unclear what will happen to the village once the sea-defense decays. Importantly, despite the losses incurred, local residents link their way of life to a place containing unique qualities. A planned or gradual retreat of the village is for that reason considered highly undesirable (corroborated by GUARD Institute 2007). Some informants claim that their well-being is so intimately tied to the village that they would rather die than move somewhere else. In contrast, others, as elaborated earlier, are contemplating leaving MRV, and juggle the trade-offs between staying in a place they are attached to and being better off somewhere else (Coulthart 2012). While individual responses differ, villagers' particular ways of life, history, and culture are closely associated with the physicality of MRV (Burley et al. 2007). Hence, the loss of the physical site has the potential to result in larger lifestyle losses (as discussed by Turner et al. 2008).

CONCLUSION

Recalling our objectives, we have used a relational perspective on risk and loss to analyze societal outcomes of coastal change in Monkey River village, Belize. We find this reconceptualization of risk useful to comprehend and practically examine how risks from environmental change are experienced at a local level. We have shown how local residents in Monkey River village develop understandings of risk from historical and practical experience. Our empirical case reveals that coastal erosion and riverine changes are associated with harmful outcomes in five categories of valued objects: social activities, properties, sacred sites, current livelihood stability, and future development opportunities. The majority of these outcomes correspond to what Turner et al. (2008) denominate "invisible losses," which have been excluded from conventional assessments of coastal erosion in the Caribbean region. There exists a shared local conception that the village should remain, and the losses and risks to the five valued objects can be regarded as threatening to the continuity of place (Monnereau and Abraham 2013).

Our findings demonstrate that the losses incurred have implications for how people judge their future opportunities and have led to a disbelief in positive change. Successful adaptation

from a local perspective needs to go beyond protecting what is already there to allow for the village's future development. In contrast to probabilistic and community-level assessments of risk and vulnerability, both of which tend to link biophysical threats to existing resources, our results emphasize that historical meanings and future intended uses of current resources need to be considered to understand their importance and value in people's lives and livelihoods.

In conclusion, we argue that relational perspectives of risk (Boholm and Corvellec 2011) have the potential to unveil the multiple and contrasting understandings of risk and preferences for adaptation, advocated as a necessary entry point for adaptation planning and policy (Adger et al. 2009). This reconceptualization of risk can thus add to the emerging literature on the role of social and cultural values in adaptation (O'Brien and Wolf 2010, Adger et al. 2011, Coulthart 2012).

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/7050>

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Appendix 1.

Overview of informants

	OCCUPATION	AGE	SEX
MRV1	Fisher	42	Male
MRV2	Fisher/ tour guide	58	Male
MRV3	Housewife	51	Female
MRV4	Fisher/ tour guide	26	Male
MRV5	Fisher	39	Male
MRV6	Carpenter	68	Male
MRV7	Fisher/ tour guide	28	Male
MRV8	Retired fisher, shop owner	63	Male
MRV9	Fisher/tour guide/ carpenter	39	Male
MRV10	Fisher	58	Male
MRV 11	Tour guide	48	Male
MRV 12	Fisher	27	Male
MRV 13	Fisher	62	Male
MRV14	Restaurant owner	73	Female
MRV15	Retired fisher	77	Male
MRV16	Retired farmer	75	Male
MRV17	Housewife	47	Female
MRV18	Health worker	62	Female
MRV19	School teacher	45	Female
MRV20	Housewife	35	Female
MRV 21	Cock	30	Female
MRV22	Shop owner	51	Female
MRV23	Fisher	25	Male
MRV24	Fisher	42	Male
MRV25	Tour guide	23	Male
MRV26	Tour guide	40	Male
MRV27	Fisher/ hunter	63	Male
MRV28	Tour operator	36	Male
MRV 29	Ranger	46	Male

Exploring Belizean fishers' perceptions and responses to climate variability and livelihood vulnerability

(manuscript)

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Abstract

Research on climate change and fisheries has primarily focused on the physical effects on fisheries resources and the ecosystems that sustain them. Climate change adaptation measures have therefore mainly centred on building ecosystem resilience through marine conservation. Using a contextual approach to livelihood vulnerability and adaptation, this paper explores how fishers in Belize's largest fishing community perceive and respond to climatic and non-climatic livelihood stressors. Based on interviews and participant observations, the findings show that fishers consider current climate elements such as hurricanes as challenging in a broader context of economic livelihood vulnerability. In contrast to leading adaptation discourses, the paper illustrates that fishers' associate marine conservation as a source of vulnerability due to loss of access to fishing grounds. The adaptive strategies used by fishers emerge primarily as responses to an experienced economic vulnerability. Due to the nature of livelihood challenges experienced by Sartenejan fishers, the paper argues that vulnerability reduction measures and planned adaptation need to go beyond an ecosystem focus and address questions of fishers' economic and political marginalisation.

Key words: adaptation, Belize, climate variability, fishing, livelihoods

1. INTRODUCTION

It is well-established that climate variability and change influence the productivity of marine ecosystems and fish stock production (Hoegh-Guldberg and Bruno, 2010). Small-scale fishers with high exposure to current climate variability and livelihoods that are tied to marine resources have therefore been highlighted as groups that are particularly vulnerable to climate change impacts (Badjeck et al., 2010). In general, research on climate change and fisheries has primarily focused on the physical effects on the fisheries resources and the ecosystems that sustain them rather than on fishers and their livelihood context (Coulthard, 2009). However, there are other social, political and economic factors that contribute to how climate variability and change are experienced in fishing communities (Allison and Ellis, 2001, Béné, 2003, Coulthard, 2009, Bunce et al., 2010b, Jentoft and Eide, 2011). Considering this broader vulnerability context, the paper explores how Belizean fishers perceive and respond to climatic and non-climatic stressors.

In Belize, the fishery sector is small-scale and fishing is carried out in the country's barrier reef system (Gillet, 2003, Villanueva, 2010). Similar to other Caribbean countries, the fisheries in Belize provide livelihoods, an important source of protein as well as foreign exchange (Mahon, 2002, Nurse, 2011). Coral reef fisheries are vulnerable to climate change due to the high susceptibility of reefs to thermal heating, which can lead to coral bleaching, mortality and decreased fish stocks (Cinner et al., 2012, MacNeil et al., 2010). Previous studies have suggested that climate risks facing Belizean fisheries are closely intertwined with those facing coral reefs, mangrove forests and sea grass beds (Gillett and Myvette, 2008). In addition to ocean warming, climate change impacts (including ocean acidification, sea-level rise and changes in the intensity and frequency of extreme events) have been highlighted as threats to the ecosystem that supports fisheries resources (Mahon, 2002). Extreme events and sea-level rise are moreover likely to affect coastal communities and the physical infrastructure and equipment that underpin the fisheries sector (Richardson, 2009).

In Belize and the wider Central American and Caribbean region, climate change adaptation has foremost been integrated into existing marine conservation programmes, such as the designation of marine protected areas (MPAs) (Magrin et al., 2014). In addition to protecting biodiversity, MPAs are promoted as a solution to enhance coral reef resilience to climate change impacts such as increasing sea-surface temperatures (Carilli et al., 2009; Halpern et al., 2010). It is argued that MPA's fully protected from human activities can aid biodiversity recovery and allow for the return of important species such as herbivore fish, grassing on corals and thereby prevent macroalgae colonisation. By reducing localised stress on reefs, it has been found that coral reef ecosystems stand a better chance of responding and recovering from global environmental change, including ocean warming (Micheli et al., 2012). In Belize, 20 % of its territorial sea is located within a MPA. Enhancing coral reef resilience is an important argument for a planned extension of the MPA's no-take zones (where no extractive activities are allowed) (Dahlgren, 2014). Environmental conservation organisations commonly equate measures that enhance ecosystem resilience with increased adaptive

capacity for resource users, such as small-scale fishers. The Nature Conservancy (TNC), which is active in Belize, states for example that marine conservation and climate change adaptation for coastal communities 'have irrefutably become the same goal' (TNC 2015). However, MPAs with large no-take zones limit human activities such as fishing and may therefore act as an additional stressor to fishing livelihoods (Bunce et al., 2010a, Cinner et al., 2012). Research has illustrated that there are often trade-offs between adaptation measures taken at different scales and by different actors (Adger et al., 2005, Pelling, 2010). Social groups, whose livelihoods depends on natural resources and are exposed to climatic stressors, may in addition be vulnerable to externally driven climate change policies (Marino and Ribot, 2012).

An understanding of the intersecting factors that influence fishers' vulnerability and capacity to respond to current climate variability is seen as essential for climate adaptation policy and planning (Badjeck et al., 2010, Daw et al., 2009). How small-scale fishers' experience vulnerability to climate variability and the interactions between factors that influence adaptation have begun to be explored, primarily in Africa and South Asia (Islam et al., 2014, Coulthard, 2008, Bunce et al., 2010b). In the Caribbean region, there is to date a scarcity of research on small-scale fishers' vulnerability and adaptation in relation to climate variability and change (Mahon, 2002, Nurse, 2011, Baptiste and Kinlocke, in press). This paper contributes directly to this knowledge gap by exploring how fishers in Sarteneja, Belize's largest fishing community, perceive and experience livelihood stressors and how they currently respond to these challenges. Drawing upon a contextual approach to livelihood vulnerability and adaptation, this paper illustrates the cross-scale and interacting set of climatic and non-climatic factors that affect Belizean fishers' livelihoods and argues that adaptation must go beyond ecosystem management to enhance fishers' capacity to respond to change.

2. CONCEPTUAL FRAMEWORK

Research has demonstrated that climate variability and change is one of multiple and interrelated challenges that affect local communities (Leichenko and O'Brien, 2002, Luers, 2005, Turner et al., 2003). Contextual approaches to vulnerability (O'Brien et al., 2007) recognise that biophysical conditions together with dynamic political, social and economic processes influence groups' and individuals' ability to adapt to changing conditions. Stressors impinging on local communities are thus shaped by a range of environmental, political and social processes across scales, which together constitute the vulnerability context (O'Brien and Leichenko, 2000, Eriksen and O'Brien, 2007, Ribot, 2010, Bunce et al., 2010b).

A common set of stresses for small-scale fishers has been identified in the literature, including climate variability and extreme events, fluctuating resources and incomes, loss of access to marine resources, lack of access to resources and formal credit, physical remoteness and political marginalisation and weak governance arrangements (Béné and Friend, 2011, Allison et al., 2009, Jentoft and Eide, 2011, Allison and Ellis, 2001). Rather than being separate entities, these stressors form synergies that influence livelihood vulnerability and adaptation (Bunce et al., 2010b).

Livelihoods research has explored how people access resources through a range of institutions and in turn what livelihood strategies can be developed from that context (e.g., Scoones, 1998). As such, a rich literature on the micro level strategies rural groups use to respond to crises and stresses have emerged from this body of knowledge (Ellis, 2000). Livelihood studies typically differentiate between coping and adaptation strategies, with the main difference lying in the time frame and extent of response to change (Ellis, 2000, de Haan, 2000, Scoones, 2009). In this paper, the term adaptive strategies are used to identify local responses spanning over both shorter and longer time scales.

Adaptive strategies undertaken by fishers, as well as other local groups, are thus seldom a response to biophysical change alone (Coulthard 2009). Because fishing communities around the world have had to cope with uncertainty, resource fluctuation and climate variability, they often draw upon a repertoire of autonomous adaptive strategies (Badjeck et al. 2010). In their analysis of small-scale fishers, Allison and Ellis (2001) show that commonly employed strategies are diversification, geographic mobility and flexibility. Diversification refers to activities that intend to spread risk across different resources and income sources. For example, members of a fishing household might engage in agriculture or seasonal wage labour to reduce vulnerability to fluctuating fish resources and/or markets. Shifts in fishing gear or vessels are also forms of diversification strategies that can enable fishers to access other fish species. Flexibility in species and harvesting technology are interrelated components of diversification carried out within fishing operations. Mobility, on the other hand, is commonly used to spread risk across space, for example by moving from one fishing area to avoid seasonal climate elements. In addition, mobility and migration are often a prerequisite for diversification strategies that involve working in other sectors for longer and shorter time periods (Allison and Ellis 2001). Agrawal and Perrin (2009) have identified a categorisation of adaptive strategies undertaken by farming, forestry and pastoral livelihoods that in addition to mobility and diversification also include storage (spreading risk across time), communal pooling (sharing resources and risk) and market exchange (that can substitute other strategies). National adaptation policy has to date been slow to include and build upon the micro level strategies used by rural livelihoods (Agrawal and Perrin, 2009).

What strategies fishers and other groups use to respond to stresses is not only a function of an 'objective' set of physical and economic conditions but are also related to how livelihood vulnerability is perceived (Hovelsrud et al., 2015). A small but growing body of literature focused on the subjective dimension of change has illustrated that social values and worldviews influence how vulnerability is understood and what kind of responses are deemed necessary, or conversely, which ones are considered intolerable (e.g., O'Brien and Wolf, 2010). In the South Indian fishing context, Coulthard (2008) illustrates that values and conventions linked with caste identity prevent livelihood diversification strategies towards certain fish species-associated with lower castes. Moreover, fishing activities are often interwoven with specific lifestyles, traditions and cultures. Thus, people may wish to remain within fishing livelihoods despite low remunerative returns and high risk because they find the lifestyle rewarding (Coulthard, 2012). Since human perceptions mediate behaviour, it is

important to understand how fishers' view livelihood challenges and how such understandings in turn influence responses to change. This paper uses a contextual approach to vulnerability to understand how fishers' experience livelihood challenges and draws on an adapted version of Agrawal and Perrin's (2009) categorisation to analyse the fishers' adaptive strategies.

3. RESEARCH SETTING

Fishing in Belize is almost exclusively carried out in the shallow waters of the Belize barrier reef, which extends 280 km along the Belizean coast and covers approximately 1400 km². The reef system contains fringe reefs along the mainland coast and three offshore atolls, Lighthouse Reef, Turneffe Atoll and Glovers Reef. The reef system is considered to be among the most diverse and well-developed in the world (McField and Bood, 2007). Belize is located in the Atlantic hurricane belt and annually exposed to tropical depressions, storms and hurricanes.

The Belize barrier reef is used by overlapping and competing human activities including fishing, tourism, marine conservation and more recently also petroleum speculation. Tourism, Belize's largest foreign exchange earner, is largely concentrated around the coast and within the reef system. The development of tourism has been accompanied by marine conservation and the presence of international environmental NGOs (Gibson et al., 1998, Medina, 2010). The formation of a network of MPAs began in 1996. During the same year UNESCO adopted seven MPAs as a world heritage site, 'the Belize Barrier Reef Reserve System' (Cho, 2005). In 2012, Belize had 18 marine areas under some form of protection, covering roughly 20% of Belize's territorial sea. Three percent of the MPA's are no-take zones where extractive activities such as fishing are prohibited. The Belizean government has committed to extend the current no-take zones to comprise 10% in 2015 (Gibson, 2011).

The Belize barrier reef system is considered to have become environmentally degraded over the last three decades. In 2012, the Belizean reef was described to be 'on the verge of a crisis' (Vasquez, 2012) as a result of disturbance events, such as hurricanes and other stressors. Key threats to the reef related to human activities include: climate change, land use and agriculture, fishing, coastal development and tourism and climate change (Healthy Reefs, 2014). Extensive coastal development related to the tourism industry has exerted additional pressure on the marine resources (McIntyre et al. 2008).

3.1 The Belizean fisheries

The Belizean fishery sector has been described as highly commercial and small-scale. Fishers target multiple species, using simple harvesting technique with low capital investment but rely on export markets (Huitric, 2005, Gillet, 2003). The Spiny lobster, *Panulirus agrus*, is the most valuable commercial species; followed by the queen conch *Strombus gigas*. Both being export commodities whose primary destination is the United States of America. (Villanueva, 2010). Fin-fish such as Mutton snapper *Lutjanus analis* and Nassau groupers *Epinephelus striatus* are targeted for the domestic market. In general, the fishers harvest lobsters through diving with hook sticks, lobster traps and shades (an artificial habitat). Conchs are caught by

free-diving, while fin-fish is caught through traps, lines or spear-fishing. In 2010, the fisheries sector employed 3 184 registered full and part-time fishers (Villanueva, 2010), with an estimated 15 000 people relying directly or indirectly on fishery resources (Gongora, 2012). The wild capture sector contributed to around 2, 2 % of GDP in 2012 (ibid). Lobster and conch stocks have remained fairly stable since the 1980s, suggesting that the stocks might be able to continue the current level of extraction (McField and Bood, 2007).

The Belizean fisheries are characterised by open access. Fishing is prohibited in no-take zones in MPAs and the harvest of a species including sea turtles, sharks and grassers such as parrot fish is banned. In addition, special licenses are required for spawning aggregation sites and sea cucumbers. Enforcement of fishing regulations is carried out by the Fisheries Department and in southern Belize two NGOs also patrol the ocean. However, due to the lack of financial and human resources, enforcement of fishing regulations and MPA zonings remains patchy (Huitric, 2005, Healthy Reefs, 2014).

Belize is renowned for its domestically owned and operated fishing cooperatives. Due to this organisation, Belizean fishers receive higher incomes than others fishers in Central American and the Caribbean region (Gibson, 1978, Monnereau and Helmsing, 2011). In 2012, there were five operative fishermen cooperatives. The largest ones, National and Northern Fishermen Cooperatives, provide landing facilities and processing in Belize City from where the products are exported. Profits made by the cooperatives are paid to the fishers in a second instalment at the end of the fiscal year. Almost half of the active fishers are between 15 to 35 years of age. Most originate from rural communities, where educational and other occupational opportunities are scarce (Gillett and Myvette, 2008). The majority of fishers (90%) have not completed secondary education and fishing is one of the few opportunities available for people with little formal education in rural, coastal areas (ibid).

The majority of active fishers originate from communities in Northern Belize. The northern fishing communities are divided between trap fishers and dive fishers. In Sarteneja, the field study area of this paper, fishers engage in migratory dive fishing. Dive fishers engage in migratory fishing in all areas around the barrier reef and atolls. They embark from Belize City, where boats are harboured and landing and processing facilities located. Fishers utilise sailboats, ranging between 20-60 feet in length, equipped with an outward engine and an icebox. Boats accommodate between 9 to 15 divers that live on board for the duration of the trip. Typically a trip lasts between 5 and 12 days, afterwards they return to their communities for a couple of days before starting on the next trip. Fishers normally start working on fishing vessels as cooks. Sailboats are typically owned by the captain who charges individual fishers a percentage of the catch for boarding. Fishers work independently from individual canoes in the proximity of the mother boat, targeting lobster, conch and fin-fish depending on the season.

3.2 Study site

Sarteneja, with a population of 1 834, is situated in the northeast corner of Belize, in the administrative district of Corozal (Statistical Institute of Belize, 2010). The village is accessible through a dirt road constructed in 1980 and often becomes flooded during the rainy

season. People in Sarteneja primarily belong to the Mestizo ethnicity, which denominates a people with a mixture of indigenous and Spanish decent, similar to other fishing communities in the north. Spanish is Sarteneja's first language. The regional and local importance of the fisheries sector is well represented in Sarteneja, with around 800 active fishers). Between 77% (Pantin, 2005) and 60 % (Conservation International, 2010) of the households depend on incomes from fishing. The livelihood basis for Sarteneja was up until the 1950s primarily small-scale farming. Hurricane Janet in 1955 caused major devastation to Sarteneja, which according to local history, contributed to the demise of small scale farming. Sarteneja has specialised in export fisheries since the 1960s and 1970s and returns from lucrative lobster fishing has contributed to the socio-economic development of the village (Karlsson and Bryceson, 2014). Small-scale farming is today only practiced by around 20% of the population. It is not primarily the lack of land that inhibits farming in Sarteneja. Rather, the dry climate in northern Belize, coupled with low market prices for agricultural produce make it less lucrative. In addition, to make returns comparable to those of lobster fishing, significant investment in machineries and fertilisers is required. Fishing in contrast has much lower entry costs than farming - in principle all that is required is a mask and swim feet. Fishing in Sarteneja is an exclusively male occupation. Women mostly engage in domestic work and some work in shops, restaurants or the village's schools and nursery. There are few employment opportunities for women in Sarteneja. Pantin (2005) estimate that 82% of women were outside formal employment. Incomes from fishing is thus often the single source of income in households, which in combination with high fertility rates (5.3 children per woman) lead to a high degree of dependency on the employed member of the household(ibid). Education levels in Sarteneja are generally low. 45% had no education, 41% completed primary school, 4% secondary school, and 6 % tertiary school (Conservation International, 2010).

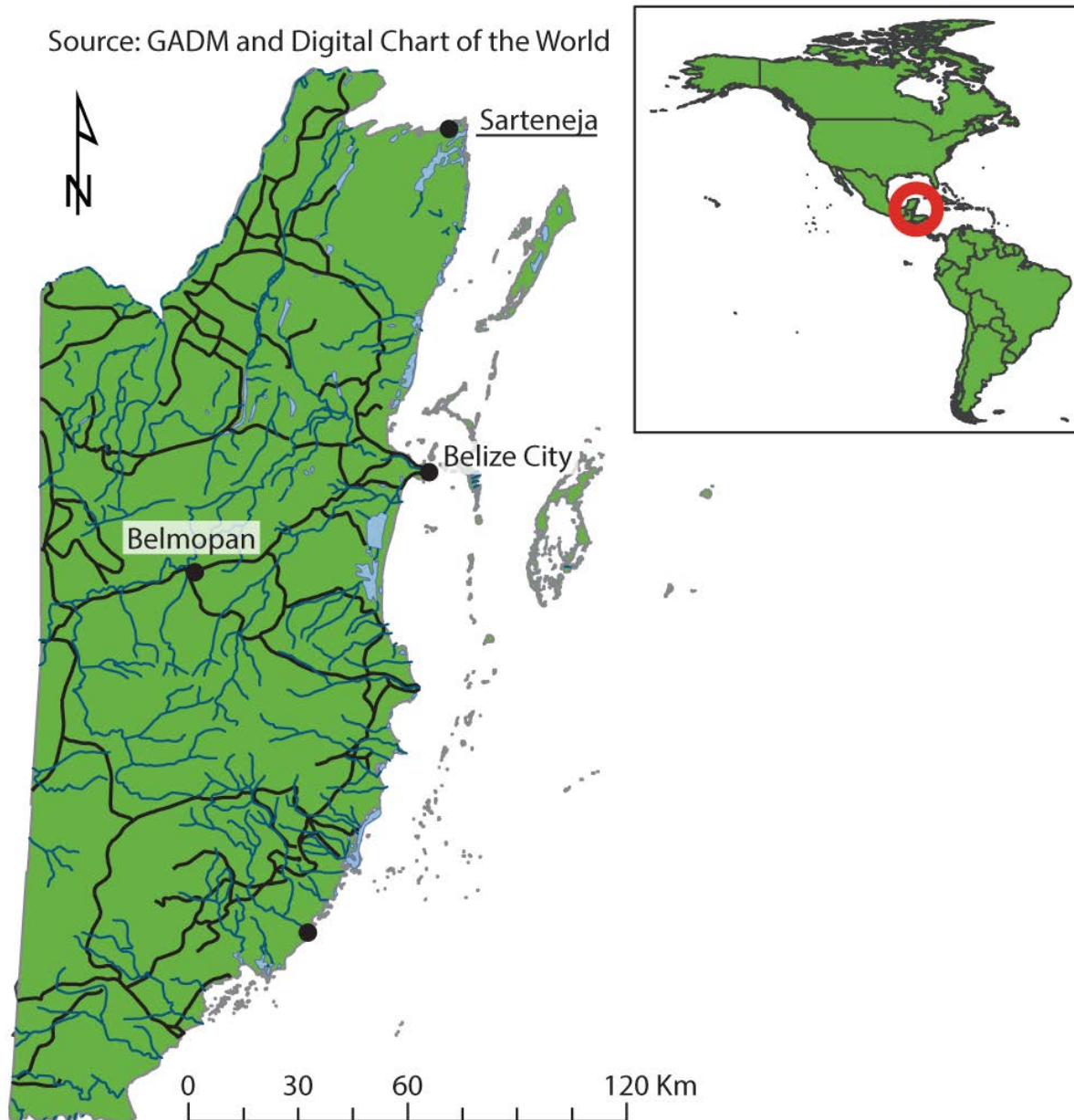


Figure 1. Map outlining location of Sarteneja

4. METHODS

The paper uses semi-structured and informal interviews, as well as participant observation to examine how Belizean fishers perceive and respond to climatic and non-climatic livelihood stressors. The main data was derived from semi-structured, open-ended interviews with dive fishers from Sarteneja. Data collection was undertaken in two fieldwork periods: April-August 2011 and February-May 2012. The main part of the fieldwork was spent in Sarteneja, where the researcher resided with a fishing family. In total 20 semi-structured interviews were held with fishers in Sarteneja. The interviews were designed to capture fishers' perceptions of challenges to fishing livelihoods and the most common adaptive strategies.

Fishers' were asked what challenges they experienced in relation to their livelihood and what strategies they used to deal with stressors. Interviewees were located in Sarteneja and a balance between obtaining fishers of different ages, experiences and status within fishing operations such as cooks, crew members, captains and retired fishers were sought. Interviews were held in English, the second language of most fishers.

Participant observation during fishing trips was used to complement interviews and gain a deeper understanding of fishing livelihoods. The author joined two conch fishing trips (June 2011 and March 2012) with different sailing boats and crew. In 2011, the crew consisted of nine fishers including a captain and cook and the trip lasted for seven days in the vicinity of the South Water Caye area. In 2012, the crew was composed of seven fishers including the captain and a cook. The trip took place out close to Glovers Reef and lasted for eight days. By joining individual fishers in their canoes during the day and spending the afternoon and evening at the mother boat, familiarity and rapport between the researcher and fishers was established. This allowed for in-depth and recurring conversations with fishers over the course of the trip. Being at sea enabled an understanding of specific fishing practices and facilitated conversations on what fishers viewed as challenging and also how and which adaptive responses they used. For example, windy conditions at sea sparked conversations on how fishers usually responded to storms and hurricanes.

In addition to semi-structured interviews and participant observations of fishing trips, many informal conversations were held with residents in Sarteneja. By staying with a fishing family, deeper understanding of the village, its way of life and livelihoods was obtained. The research process and data analysis was iterative and the methods influenced by a contextualised approach to vulnerability and adaptation (e.g. Smit and Wandel, 2006). Livelihood challenges and adaptive strategies were not assumed *a priori* but identified through the insights from the empirical data following the approach of Hovelsrud and Smit (2010).

5. FISHERS' VULNERABILITY CONTEXT

In interviews, fishers described their livelihood conditions to have become more and more difficult over the last fifteen years and most described the future of the fisheries sector as bleak. A number of interacting challenges were cited to contribute to these increasing difficulties.

Interviewees frequently stated that 'bad weather' was a challenge to their livelihoods. Certain climate elements were highlighted as particularly challenging for fishing operations. These included strong winds, waves and currents (related to storms and hurricanes) which challenge the seaworthiness and possibility to navigate sailboats and canoes. Events reducing water visibility such as strong winds, rain, flooding and algae blooms were also forwarded as problematic because they prevent fishers' from diving for lobster and conchs. During periods of 'bad weather' fishers said that they were forced to stay ashore or to work with reduced capacity at sea, which at times compromised their personal safety. 'Bad weather' was first and foremost seen as a challenge that affected their ability to generate income, rather than affect their personal safety. Fishing trips incur expenses, including the purchase of fuel, food and

ice. Costs of which are divided among crew members before they set off to sea. Interviewees emphasised that during periods of bad weather, fishers often become indebted as these operating and living costs need to be covered, as stated by a fisher: *“Because when we have bad weather we can’t work and we depend on the fishing, we can’t work until the weather pass and we go again. But in these days we’re only spending money we’re not doing nothing”*.

Hurricanes and storms were in this regard seen as particularly challenging as they combine climate elements (strong winds, waves, currents and poor visibility) that could force fishers to stay ashore for several weeks at a time.

Fishers’ described their economic situation as impeded by a number of interacting factors, including declining catches. Older fishers’ in particular noted a falling abundance of lobster and conch stocks, as expressed by a fisher who had been active since 1980, *“there have been big changes, there was a lot of lobster when I started, then in one week I got 1500 pounds but now it’s 300 pound per week”*. However, for younger fishers changes in lobster and conch stocks were not so noticeable; instead they pointed to the fluctuating character of stocks captured in the statement *“some year you do good and some you do bad, it comes and goes”*. Ecosystem change, in particular in coral reefs had been observed by the majority of fishers, who linked such changes to lower productivity of fish stocks. Ecological change was primarily attributed to hurricanes and storms and to coastal development and tourism related activities (tourists touching or walking on corals).

However, managerial changes including the establishment of MPAs, were perceived by fishers’ as far more significant livelihoods challenges. Although interviewees stated that some degree of marine protection was necessary, the current extent of MPAs was described to be ‘hurting the fishers’ and ‘making the ocean smaller’. The core problem with MPAs , as viewed by fishers, was that more and more water had been set aside as reserves, restricting fishers’ access to resources and leaving less water available for fishing. Patterns of access to marine resources have changed rapidly over the last three decades. Older fishers said that the ‘whole ocean’ was available to them when they began fishing. Consequently they associated more ocean space with greater catches. Since Sartenejan fishers work throughout the reef system, the closure of one fishing ground forced displaced fishers into areas already used by other fishers leading to increased competition. An interviewee summed up his view of the problem *“we have a lot of reserves now and that’s a big problem for the fishermen and we don’t want no more...the problem is that the reserve was a good area where fishermen were diving and right now you can’t go fishing there and the fishermen who were working there have to come where we are working and that is damaging us”*.

Fishers also stated that the no-take zones, where fishing is prohibited, corresponded with the most productive fishing grounds. Many felt that the purpose of MPAs was for the benefit of tourism rather than the fishing sector. Tourist developments through the construction of resorts on small cayes have, according to interviewees, also restricted access to places previously used by fishers for temporary camps or shelter. Dissatisfaction with current

management arrangement and fishers' limited possibility to influence conservation decisions further contributed to scepticism towards marine conservation.

The interviewed fishers' discontent with marine conservation is intimately linked to their dependence on incomes derived from fishing and the scarcity of other job opportunities. Many said that they had started fishing at a young age to support themselves and their families, as stated by a fisher in his 60s, "*I never went to the college and the only way to live here is doing fishing. Right here in the village we only have fishing for work. Only that*".

While fishing for many was described as a calling and an occupation characterised by a sense of independence that generated better incomes than for example farming, several wished to see more livelihood options within Sarteneja. Alternative livelihood programmes has so far not provided economically viable alternatives to fishing. Tourism is still in its infancy in the village, but some Sartenejans work as tour guides for cruise tourists in Belize City. Factors including the physical remoteness of the village, poor infrastructure, low education levels and language barriers have been found to inhibit tourism development (Pantin 2005).

Increasing numbers of fishers were by the majority of interviewees seen to compound their livelihood situation. Other villages in Northern Belize, traditionally relying upon cane sugar agriculture, have entered the fisheries leading to more competition for the resources. Sartenejan fishers' view themselves as traditional fishers that depend solely on the sea in contrast to the 'new' fishing villages that had the option to farm for example during the hurricane season. Fluctuating market prices for lobsters and other commodities such as food and fuel were in addition cited to aggravate their economic situation. For example, during the economic recession in 2008 market prices for lobsters dropped significantly, while food and fuel prices were high.

The fishers' narratives illustrate the climate elements are considered challenging in the context of and in relation to other factors that taken together were seen to be threatening to fishers ability to maintain decent incomes and livelihoods. As illustrated in the next section, the adaptive strategies used by fishers emerge primarily as responses to an experienced economic vulnerability.

6. ADAPTIVE STRATEGIES

To respond to livelihood stressors, fishers' employed a range of strategies. These are grouped into three main categories: storage, saving and borrowing; experiential knowledge and mobility; and diversification and intensification (following an adapted version of Agrawal and Perrin 2011). It should be noted that fishers' employ and combine all strategies but the importance of each strategy varies according to stressors and season.

6.1 Storage, saving and borrowing

This category of adaptive strategies was used to prepare for time periods when fishers were forced to stay onshore, for example during bad weather. Such periods, in particular the hurricane season, were anticipated by fishers who responded by storing, saving and borrowing. The most common form of storage and saving was to buy staple foods such as

rice, corn and beans immediately after the lobster season had opened and catches and incomes were good. Fishers said that staple foods lasted long if stored correctly and could later be consumed during lean periods, as explained by a fisher, “ *we are used to this type of life sometimes when you have money you buy a stock of food that lasts a little while, then when the bad times come you still have a little food, that’s how we survive. You put a little aside so when it gets bad you still have some*”.

It was more common for fishers to store food instead of saving money. Besides storage and saving, borrowing also emerged as an important component in this bundle of adaptive strategies. Fishers said that they often obtained informal credit in food shops or from family members. Younger crew members often turned to boat captains for informal credit. Fishers explained that previously it had been easier to obtain formal credit from fishing cooperatives but due to a debt crisis facing the two main cooperatives, this option is now largely restricted. Other financial institutions such as banks were not accessible or viable options for credit for fishers because of their high interest rates, short repayment timeframes but also because many fishers could not provide any security. Several interviewees desired additional financial support and sustenance loans with low interest rates during hurricane season.

6.2 Experiential knowledge and mobility

This category of adaptive strategies concerns the responses fishers employed to deal with climate elements and fluctuating resources at sea. Experiential knowledge, in terms of time-tested skills, experience and familiarity with the seascape and climate elements, was an important component in avoiding weather risks such as boat damage and personal injury, while mobility was a crucial strategy in averting bad weather or low productivity in on specific fishing ground.

Normally fisher tried to avoid bad weather by staying ashore or returning to harbour if they received bad weather forecasts whilst at sea. However, at times weather and climate elements such as storms could develop quickly when fishers were out at sea. When caught in bad weather, the captain’s and crewmembers’ experience and knowledge were stated to be highly important. Once a storm and cold front developed quickly, fishers explained that they had to take shelter in the surrounding seascape, such as a channel (more shallow) or a small island or caye and fasten the boat, place a tarpaulin above it and wait for the weather to pass. Older, experienced fishers and captains often stated that they knew the sea ‘like the back of their hand’- meaning that they knew how to read the weather, where to find suitable places for shelter and what should be done to be safe. This kind of knowledge was transferred from older to younger family members and refined through experience gained from spending large portions of their lives at sea. In general, fishers consider their knowledge and existing strategies to deal with weather events at sea sufficient to avoid personal injuries or damage to boats. Yet, most fishers could recall a storm that had placed themselves and the boat at risk. In the event a fisher had gone missing or a boat had been damaged during a storm it was foremost considered as a consequence of bad judgement, insufficient experience or greed that led captains to go out even when the weather forecast was bad.

To prevent risks from bad weather or to try to minimise income losses when the production of for example lobsters were low, mobility in where to fish was highlighted as an important and commonplace strategy. One fisher explained “*if the weather is bad in Lighthouse Reef [fishing ground] we move closer to Turneffe Atoll [fishing ground], we like to move about in the barrier reef and to do fishing in one area today and another one tomorrow*”. Informants also emphasised that fish and lobster moved according to weather and ocean changes, which required fishers to be flexible and work in several areas to be able to make enough income.

6.3 Diversification and intensification

Diversification and intensification strategies were used in order to maintain their livelihoods onshore or at sea. Diversification during hurricane season or periods with little income from fishing foremost concerned engaging in ‘small jobs’ in Sarteneja to earn enough money to cover running expenses besides food such as utility bills, medications and school fees. These jobs typically involved helping out on a day to day basis in construction or maintenance of properties or other small businesses. A young fisher described what he meant “*i know some little jobs, measuring make a room, put some wires... I can do some little maintenance jobs so sometimes I do that to get some extra cash*”. Through interviews it emerged that such jobs were obtained through social networks, for example the fishers’ extended families. Due to programmes run and funded by NGOs some families gained extra incomes through pig rearing and occasionally hosting tourists in their homes.

Diversification strategies were also used at sea. For example, when weather conditions inhibited diving, fishers used hand lines from the boat to catch barracuda or fin-fish. . The Belizean coasts are also used for cocaine transshipment and several fishers used their sparetime at sea to search for lost drug parcels, “*We stay on the boat or go looking for drugs and line fish for barracuda. But that is just a part-time job then, we can’t sustain ourselves on that*”. Winning the “sea lottery” (finding and later selling drug parcels) could provide large but unpredictable incomes for fishers.

Diversification strategies also involved fishing outside of fishing seasons, inside marine reserves and below minimum size limits. Fishers explained that such responses were closely linked to their need to compensate for lost incomes “*Some need it to pay the bills because if they are not fishing on the reserves they don’t bring nothing*”.

Such strategies are related to intensification strategies, used to compensate for periods when incomes from fishing had been low and fishers tried to recuperate during the subsequent trips as explained by a fisher “*you have to go to the sea again and work harder, more days, if you take 4-5 days from fishing in hurricane, we have to go 8-10 days to try to pay back*”.

The ability to increase their effort and thereby regain incomes was by fishers seen as a token of their independence and as a security against livelihood failure.

7. CONCLUDING DISCUSSION

This paper illustrates that Belizean fishers' situate stress related to current climate variability in a broader context of economic livelihood vulnerability, driven by local, national and global change. In the fishers' vulnerability narratives, hurricanes linked to periods without incomes, emerge as the most problematic climate element. The study points to the need of directing adaptation measures such as financial support mechanisms or temporary forms of employment to the hurricane season when fishers' experience seasonal vulnerability. While the onset and length of the hurricane season is not a novel climate phenomenon in Belize, the findings suggest that the consequences of climate events may be greater when other interacting challenges aggravate the fishers' livelihood situation. Fishers' consider their current strategies as sufficient to cope with weather events with respect to risks to their personal safety. Perceptions of high resilience to climate elements among fishers are common in the adaptation literature and have, in other studies, been linked to daily exposure to and interaction with climate variability (West and Hovelsrud, 2010).

Climate change resilience and adaptation for fisheries and ecosystems in the Caribbean is often conceptualised and enacted in the form of stricter fishing regulations and increased conservation measures, such as MPAs with large no-take zones (Nurse, 2011). In contrast to leading adaptation discourses, the findings illustrate that fishers' associate MPAs with restrictions and loss of access to fishing grounds and is instead considered as a key source of vulnerability. MPAs in Belize and elsewhere have multiple objectives and are, in addition to protect biodiversity, often used to attract tourists. In Belize, MPAs have played an important role in creating and marketing Belize as an eco-tourism destination (Gibson et al., 1998). Eco-tourism operates under the rhetoric of 'non-consumptive' use - seen as compatible with tourism and conservation- but not with extractive usages such as fishing (Buscher and Dressler, 2007). The establishment of MPAs in Belize has been accompanied by alternative livelihood programmes seeking to reduce fishing pressure on the reef resources by diversifying fishing livelihoods, primarily towards tourism (Cho, 2005). Despite Sartenejan fishers' heavy reliance on fishing incomes within MPAs, they have received minimal access to socio-economic benefits from ecotourism (Conservation International, 2010). Instead of a source of livelihood diversification, the coupled development of tourism and conservation are experienced as a major livelihood challenge (also discussed by Bunce et al. 2010a). Studies from Belize have shown that communities often have little actual influence over conservation strategies, despite local consultation processes (Few, 2001, Palacio, 2001). This illustrates that there are politics and trade-offs at play in incorporating climate change adaptation within existing conservation discourses and practices, which are likely to prioritise tourism sectors over fishing livelihoods.

Furthermore, the paper argues that it is important to consider how and why fishers' consider themselves vulnerable to climate and non-climatic stressors (Hulme 2008, Coulthard 2009, O'Brien and Wolf, 2010). The findings demonstrate that Sartenejan fishers' predominantly consider their vulnerability to be of an economic rather than ecologic character. This understanding was also found to shape the repertoire of adaptive strategies used by fishers. Some of these strategies could be built upon in order to strengthen fishers' capacity to respond

to climate variability and change (as discussed by Daw et al., 2009; Badjeck et al. 2010). For example, improving fishers' access to formal credit and rendering small loans less expensive to fishers could strengthen current storage, saving and borrowing strategies. Future research should to a greater detail examine fishers' local knowledge concerning climate elements and map the cayes and channels used for shelter during adverse weather conditions. Similar to Gillet and Myvette (2008), this paper argues that it is important to ensure fishers' access to cayes that, for example, have been developed into exclusive tourist resorts.

However, the analysis shows that fishers' current diversification and intensification strategies mainly act as a response to the lack of other sources of income. Rather than ensuring livelihood sustainability, strategies (including illicit fishing) expose fishers to penalties and run the risk of exacerbating pressure on fishing and may in the long run be seen as an example of maladaptation (e.g., Barnett and O'Neil, 2010). In the absence of other economic opportunities, fishers' are likely to continue to respond to stress by diversification and intensification strategies. In this context, conservation and adaptation policy fails to connect with fishers' perception of livelihood vulnerability and addressing the economic issues at hand is unlikely to meet goals of ecological resilience. Fishers wish to see other income generating activities within Sarteneja and are aware of the need for livelihood diversification. Low education levels, language barriers, physical distance and poor infrastructure currently inhibit local development strategies in Sarteneja (Pantin 2005, Conservation International 2010, Karlsson and Bryceson, 2014).

The paper highlighted the predicaments and trade-offs between how vulnerability and adaptation for coral reef fisheries are envisioned in much of the climate literature and how Sartenejan fishers experience and respond to livelihood vulnerability. Due to the nature of livelihood challenges experienced by Sartenejan fishers, the paper argues that vulnerability reduction measures and planned adaptation need to go beyond an ecosystem focus and address questions of fishers' economic and political marginalisation (Béné and Friend, 2011, Jentoft and Eide, 2011).

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