



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

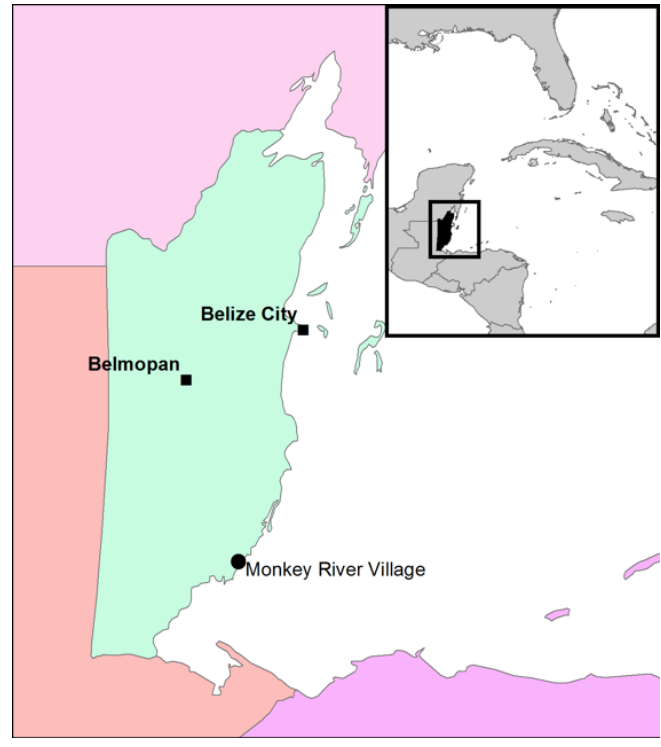
Monkey River village

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.



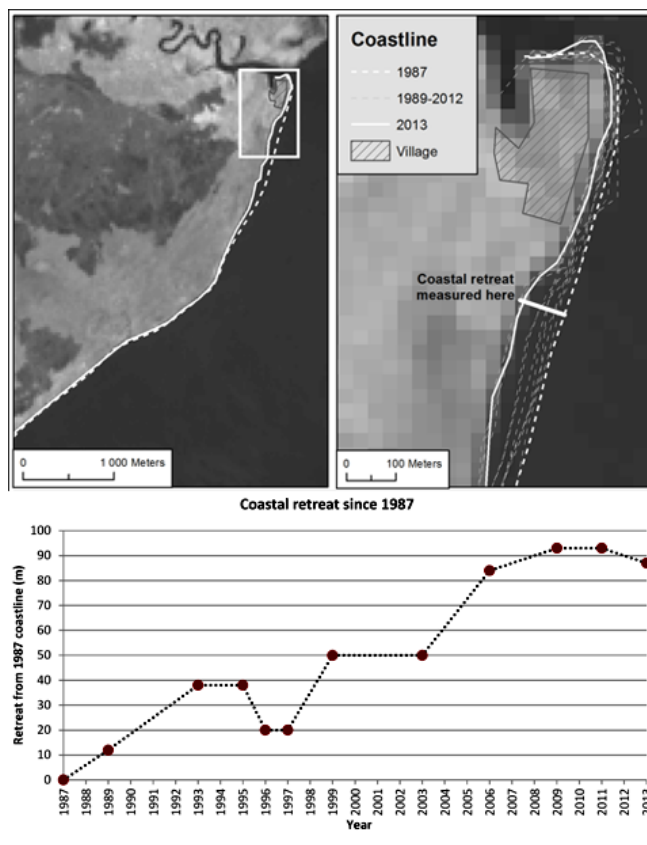
Physical and ecological changes

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