

MANAGING FOR SELF-ORGANIZATION IN A CHANGING WORLD: SOCIETAL RESPONSES TO SHORELINE  
CHANGE

SHONA K. PATERSON

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DIRECTOR OF DISSERTATION: DAVID K. LOOMIS

MAJOR DEPARTMENT: INSTITUTE OF COASTAL SCIENCE AND POLICY

ABSTRACT: Catastrophic, episodic natural disasters such as hurricanes and earthquakes along with slower long-term natural processes such as erosion and sea level rise can have severe effects on the structure and function of human communities. These effects can be mitigated or magnified by management decisions, land use plans and public policies. However, they can also be influenced by the abilities of the affected communities to cope with and adapt to the changes brought about by the events in question. Determining how individuals and communities cope with such impacts - their resilience - can provide insight and understanding into avenues for adaptive management and strategies to cope with a range of coastal issues. This study sought to develop of a robust conceptualization of social resilience and generate a set of measurable indicators for one of the sub-components, self-organization. An examination of the ability of North Carolina coastal residents to cope with shoreline changes and their preferences for management actions was undertaken to test the model once it was developed. Based on social psychology and sociology literature, it was hypothesized that the ability to self-organized would exist upon a continuum within individuals and across communities. An index was developed to sub-group individuals along that continuum. This provided the basis to test a series of hypotheses aimed at determining if a linear increase in the importance that respondents attached to relevant social processes and institutions key to shoreline management would also be detected as self-organization level increased. Nine of the twelve null hypotheses developed during this study were rejected with significant differences found between levels of self-organization across multiple indicators. Although ultimately self-organization level was shown to

have no affect on respondents' preferences for shoreline management actions in North Carolina, this study did provide new insight into the role that self-organization can play in future coastal management.



MANAGING FOR SELF-ORGANIZATION IN A CHANGING WORLD: SOCIETAL RESPONSES TO  
SHORELINE CHANGE

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DOCTOR OF PHILOSOPHY

BY

(SHONA K. PATERSON)  
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BY

SHONA K. PATERSON

APPROVED BY:

DIRECTOR OF  
DISSERTATION

\_\_\_\_\_  
David K. Loomis, Ph.D.

COMMITTEE MEMBER

\_\_\_\_\_  
David G. Kimmel, Ph.D.

COMMITTEE MEMBER

\_\_\_\_\_  
Jamie L. Kruse, Ph.D.

COMMITTEE MEMBER

\_\_\_\_\_  
Gary C. Matlock, Ph.D.

COMMITTEE MEMBER

\_\_\_\_\_  
Lisa C. Schiavinato, J.D.

DIRECTOR OF COASTAL RESOURCE MANAGEMENT Ph.D PROGRAM

\_\_\_\_\_  
Hans Vogel song, PhD

DEAN OF THE GRADUATE SCHOOL

\_\_\_\_\_  
Paul J. Gemperline, PhD

## DEDICATION

This dissertation is dedicated to two of the finest men I have ever had the privilege to know, to Bob and Fuz, whose influences on this world were incalculable

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# CHAPTER 1. INTRODUCTION

## 1.1 ISSUE FRAMING

Despite rapid improvements in technological, economic and material well-being, human progress still relies heavily on naturally provided ecosystem goods and services. Human societies, as the dominant component of most ecosystems on the planet, continuously impact, and are impacted by, natural processes from local to global scales. However, ecological systems are being subjected to an increasing frequency and intensity of natural perturbations (Adger, 2006; Cutter & Emrich, 2006b; Dahlberg, 1992; B. Walker, 1998) and are currently transformed by human use at a more rapid and unpredictable pace than at any time in human history (Boyce & Shelley, 2003; Brand, 2009; Dore & Webb, 2003; Leslie & McLeod, 2007; Underdal, 2010). Catastrophic, episodic natural disasters such as hurricanes, earthquakes and tsunamis, along with slower long-term natural processes such as erosion and sea level rise are poised to have severe effects on coastlines as well as the structure and function of human communities. The effects of these natural disasters can either be mitigated or magnified by management decisions including land use plans and public policies (Cutter & Emrich, 2005; De Sherbinin, Schiller, & Pulsipher, 2007; Perez-Maqueo, Intralawan, & Martinez, 2007; Stallworthy, 2003; The H. John Heinz III Center for Science Economics and the Environment, 2000b), and also by the abilities of the affected communities to cope and adapt to the changes brought about by the events in question (Cutter, 2008; Doherty et al., 2008; Hinrichsen, 1990; Jacob & Showalter, 2007; Lertzman, 2009; Stallworthy, 2009).

These episodic events, coupled with increases in demand for natural resources due to a growing human population, have meant that more stringent public policies that regulate the use of, or access to, natural resources are being implemented more frequently in many countries across the world (Ostrom, 1999,

2010; Ranganathan et al., 2008; Stallworthy, 2003; Weinstein et al., 2007). However, resource managers work in complex and unpredictable social, economic, cultural and political systems. In the face of this reality, and perhaps at a crucial time in human-nature interaction complex, natural resource management has become stuck in an era of turbulence (Brechin, Wilshusen, Fortwangler, & West, 2002; Brunner et al., 2005; Glover, Earle, & Kelleher, 2004). Goals are frequently contested, temporal and spatial scales of analysis are constantly debated and significant uncertainty exists about the effects and effectiveness of management actions. This state is exemplified by growing public dissatisfaction, expressed in many forms, including a lack of public participation, animosity and distrust toward government, appeals and litigation (Lockwood, Davidson, Curtis, Stratford, & Griffith, 2010; Murphy, 2009). The implications of this state are far reaching and the argument has been proposed that, from a social perspective, resource management may actually be doing more harm than good at times (Lachapelle, McCool, & Patterson, 2003). Determining how individuals and communities cope with the impacts – their social resilience – brought about by not only the disasters, but also the subsequent policies, can provide insight and understanding into avenues for adaptive management and effective strategies to cope with a range of coastal issues.

A resilience approach to social issues identifies available social resources and adaptive capacity that people, both individually and collectively, can utilize to overcome the problems that may result from a change in circumstances. Resilience does not preclude the prospect, or even inevitability, of disturbance to a community. Instead, it is the capabilities and actions that allow sense to be made of the distress post disturbance and provides possibilities for society, at multiple scales, to cope with the change induced by such events. Governments and decision makers have become increasingly interested in applying resilience science to policy initiatives. Theoretically, this could be achieved by actively building or eroding aspects of a particular system configuration to either prevent the system from moving to an undesirable state or push the system to a more desirable state (Cinner, Fuentes, & Randriamahazo, 2009). However, before major resources are committed to this new approach to management, it is important to

understand and test the utility of this relatively abstract, all-encompassing, multi-dimensional construct. The initial focus of this study therefore was to explore the theoretical foundation of social resilience and develop a robust model of this construct. The process of developing an overall model of social resilience allowed the identification of critical sub-components. One principle sub-component, self-organization, was selected as the primary focus for subsequent investigation. Limiting the study focus allowed a more comprehensive examination of one of the principles of social resilience with the aim of developing a functional and appropriate metric.

Self-organization represents a series of inherent characteristics that provide individuals the aptitude to coalesce for short and long term post disturbance benefits. This implies that this aptitude will vary among individuals and a range, or continuum of ability will be found within society. This has particular relevance to natural resource management. With grass-roots initiatives, bottom-up management, and community involvement becoming more prevalent in governance approaches (Borrini-Feyerabend, Pimbert, Farvar, Kothari, & Renard, 2005; Cundill & Fabricius, 2010; Lockwood, et al., 2010), the ability for individuals and communities to self-organize be scrutinized more heavily than ever before. It can be hypothesized that the higher the degree of self-organization, and the higher the ability to self-organize, the more capable an individual and/or community would be of coping with changes brought about by natural and human-induced alternations to their environment. Therefore, defining, conceptualizing, and testing self-organization becomes a critical step in understanding the effectiveness of management initiatives as well as providing the basis for some limited inference about the role that social resilience may play in management. A resilience framework can be applied to a myriad of coastal management issues, but due to its current saliency, and increasingly well-recognized potential for major social and environmental transformations, this study focused on the issue of shoreline change, an overarching term for long-term processes including sea level rise and coastal erosion.

## 1.2 SHORELINE CHANGE

Coastal areas are among the world's most productive and diverse natural areas, as well as being one of the landscapes most vulnerable to impacts such as climate change and sea level rise (IPCC, 2007a). The United Nations Environment Programme estimate that approximately 2.75 billion people currently live within 100 kilometers of the coast, which includes over half of the population of the USA (UNEP, 2009). Coastlines and their associated habitats provide a myriad of important regional and national ecosystem services including tourism, recreation, fisheries, trade, and aesthetic and cultural values. Many of these benefits are nonmarket values and so are not captured by traditional economic tools based on market transactions. With that in mind, it must be acknowledged that even a relatively modest rise in sea level may have a substantial effect on these human and natural systems. With global sea level models estimating rises at the rate of  $1-3 \text{ mmyr}^{-1}$ , the direct impacts of climate change, including inundation and increased susceptibility to changes in hurricane frequency and intensity, must be considered as key areas of natural resource management focus (IPCC, 2007b; Poulter et al., 2009). There is historical evidence that suggests that both human and ecological systems have adapted, at least to some extent, to sea level rise. Examples of this adaptation can be found in patterns of human settlement (J. Day, Gunn, Folan, Yanez-Aranciba, & Horton, 2007) or in the emergence of changing natural systems such as coastal wetlands (Morris, Sundareshwar, Nietch, Kjervfe, & Cahoon, 2002). However, the size and permanency of today's coastal societies and infrastructure have lowered both social and ecological resilience to the dynamic nature of the earth's climate (Nicholls, 1995). It must also be acknowledged that sea level rise is only one of the many processes that result in shoreline change. Natural processes like coastal erosion and accretion along with human-induced alterations from coastal development must also be considered when debating the potential effects of coastal change on social systems.

It has been argued that changing shorelines will increase the social and physical vulnerability of

individuals, households, communities, and cultures (Cutter & Emrich, 2006b; The H. John Heinz III Center for Science Economics and the Environment, 2000a; Wu, Yarnal, & Fisher, 2002). Demand for uses of the shoreline, and the subsequent pressure for additional development, places high economic and social values on coastal property (Camfield & Morang, 1996). Increased recreation and tourism, for example, often leads to communities that depend on the tourism/recreation industry and its supporting infrastructure, jobs and revenue. Therefore, in the interest of fiscal and societal sustainability, hazard reduction has become an essential consideration for public officials. Decisions, such as whether to allow unrestricted construction of high-valued property, or to implement regulations that prevent developments that will be exposed to major hazards in the future, are waiting to be made. This is not a strictly either/or situation, and the tradeoffs must be considered carefully by management agents aiming to balance economic, social, and ecological needs (Ranganathan, et al., 2008). As with any contentious and complex issue where the potential for winners and losers exists, there are a multitude of opinions, preferences and attitudes surrounding the answer to the most basic question “what should be done in the face of changing shorelines?”

Reducing the impacts of changing shorelines is a not an easy issue for policy makers and natural resource managers to address effectively and efficiently. For the most part, shoreline change is a slow, creeping, long-term problem that is widespread. Scientific uncertainty about the magnitude and rates of a process like sea level rise, that contributes to shoreline change, have added to the difficulties policy-makers face. However, it is fair to say that the ecological and economic impacts of changing shorelines could be significant if the issue is ignored (Nicholls and Lowe, 2004), especially in light of potentially non-linear trajectories (Anthoff, Nicholls, & Tol, 2010; Poulter, et al., 2009).

Sea level rise is difficult to isolate from, or can be perceived as merely aggravating other, more apparent coastal processes such as coastal erosion, flooding, or saltwater intrusion (Hay & Mimura, 2005; The H. John Heinz III Center for Science Economics and the Environment, 2000b; Tol, 2007). This makes it a

less tangible issue for most members of the general public. Since sea level rise is often lost as a priority under more acute and visible coastal problems, it is an issue that policy makers can easily postpone tackling since it is not perceived as an immediate management concern. However, and paradoxically, it cannot be ignored due to the overwhelming potential for long-lasting and irreversible implications for coastal land use, populations, and ecology (Meehl et al., 2007). It is therefore, important to consider management strategies that have wide-reaching and practical applications for coping with the overall effects of change across this critical ecosystem.

The act of coping with the threat of shoreline change will have to be achieved at multiple scales from individual responses to local strategies and through state and national policies. However, deciding what those approaches will be, and determining what the effects of those decisions will be on society in the short and long-term time frames, is a complicated and multifarious task due to the multi-dimensional nature of the problem.

### **1.3 STUDY PURPOSE**

Shoreline change poses a variety of threats to society, including but not limited to the loss of infrastructure, property, and recreational opportunities. Therefore it represents a key management issue that resonates across local and global coastlines. The development of a functional and appropriate metric of self-organization that could be used to examine social responses to such management issues, and possibly predict future responses, may provide an avenue to reducing the level of turmoil currently present in resource management.

The overall aim of this dissertation was to improve our understanding of self-organization, an integral component of social resilience, through its conceptualization and measurement. An empirical data

collection was designed to investigate the role of self-organization in answering two research questions: “Are there differences between people’s capabilities to deal with shoreline change?” and “Do people’s capabilities to deal with shoreline change influence management preferences?”

The primary aims of this study were:

- (i) The development of a robust conceptualization of social resilience based upon a cross disciplinary approach,
- (ii) The conceptualization and development of measurable indicators for self-organization,
- (iii) An examination of the ability of North Carolina coastal residents to cope with shoreline changes and their preferences for management actions, through the conceptual lens of self-organization.

The values and priorities of society as expressed by our social, political, and economic systems drive coastal management. Therefore, the way in which different shorelines and marine environments are managed is a reflection of what society wants from those environments. With the identification of a management goals and objectives, comes a responsibility to manage towards that state and a need to measure success (Palumbi, McLeod, & Grunbaum, 2008). Overall, considering the current levels of turbulence surrounding resource management, it is important to provide coastal managers with tools that can be used to assess the capabilities of people to deal with potential policy changes that may affect their livelihoods, identities, cultures, and social networks (Ranganathan, et al., 2008; Rechkemmer & von Falkenhayn, 2009). This study aspires to add to the existing body of literature on social resilience and seeks to provide new insight into the role that self-organization can play in future coastal management.

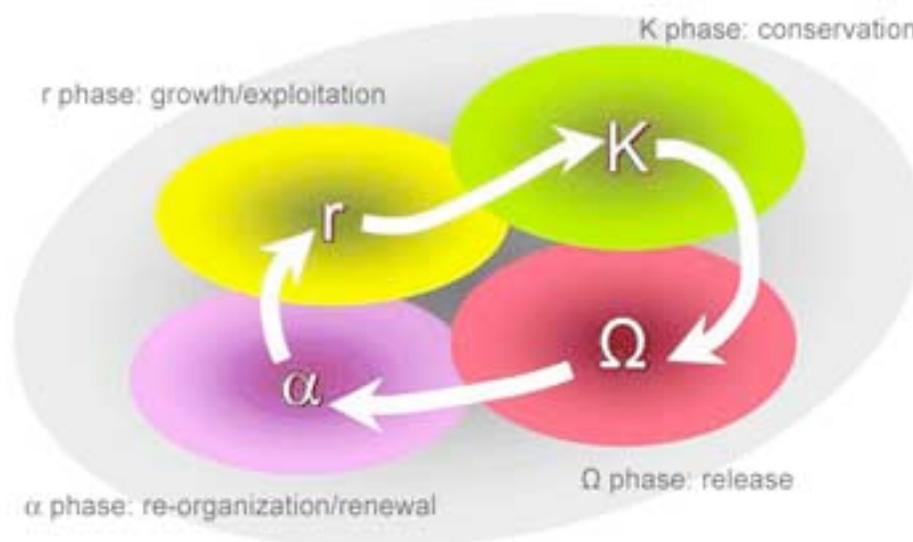
## CHAPTER 2. LITERATURE REVIEW OF RESILIENCE

### 2.1 RESILIENCE

Resilience as a concept has been applied to multiple issues across a myriad of scientific disciplines, with roots in both physics and mathematics, and scales from specific properties of building materials to entire system oscillations following a displacement event. In physics in particular, resilience as a principle is not concerned with the size of the displacement or the severity of the oscillations but instead is focused on the speed with which homeostasis is restored following the event (J. Walker, 2011). It was that principle that Holling (1973) initially explored when conceptualizing ecological resilience as ‘the capacity of a system to absorb and utilize, or even benefit, from perturbations and changes that attain it, and so persist without a qualitative change in the system’s structure’. This definition has been expanded and the resilience of an ecological system is now usually described as a combination of three main characteristics: the magnitude of shock that the system can absorb and remain within a given state; the degree to which the system is capable of self-organization; and the degree to which the system can build capacity for learning and adaptation (Folke et al., 2002; Holling, 1973; B. Walker, 1998).

Resilience can incorporate both intrinsic factors, such as biological characteristics of an ecological community (e.g. potential for recruitment success) as well as extrinsic factors, such as physical features (e.g. current patterns and connectivity that govern larval dispersal). This provides many different avenues of potential exploration and measurement. One approach is to focus on where within the cycle of growth and change the system may be in order to predict the impact of disturbances. Ecological systems tend to move through four distinct phases in a cyclical fashion: the rapid growth phase, the conservation phase, the release phase and the reorganization phase (Figure 1). Each phase is defined by growth rates, species

composition and energy release (B. Walker et al., 2004; B. Walker, Hollin, Carpenter, & Kinzig, 2004). Two of the phases, the growth and exploitation phase (r) merging into a conservation phase (K), comprise a slow, cumulative forward loop of the cycle, during which the dynamics of the system are reasonably predictable. As the K phase continues, resources become increasingly locked up and the system becomes progressively less flexible and responsive to external shocks. It is eventually, inevitably, followed by a chaotic collapse and release phase ( $\Omega$ ) that rapidly gives way to a phase of reorganization ( $\alpha$ ), which may be rapid or slow, and during which, innovation and new opportunities are possible. The  $\Omega$  and  $\alpha$  phases together comprise an unpredictable backloop. The  $\alpha$  phase leads into a subsequent r phase, which may resemble the previous r phase or be significantly different. These phases provide a platform for quantitative ecological community composition and dynamics studies as a basis for resilience.



**Figure 1. The adaptive cycle (source: [http://www.resalliance.org/index.php/key\\_concepts](http://www.resalliance.org/index.php/key_concepts))**

Resilience has also been applied to social systems and used to describe adaptive capacities across a range of socially based scales such as individuals (Bonanno, 2004; Butler, Morland, & Leskin, 2007; Ewart, Jorgensen, Suchday, Chen, & Matthews, 2002; N. Marshall & Marshall, 2007), households (Cinner, et al., 2009; N. Marshall, Fenton, Marshall, & Sutton, 2007) human communities (Brown & Kulig, 1996; Marschke & Berkes, 2006; Onyx & Bullen, 2000) and larger societies and institutions (Adger, 2000;

Folger, 1987; Godschalk, 2003; Langridge, Christian-Smith, & Lohse, 2006; Olsson, Folke, & Berkes, 2004). This has obviously led to a broad and diverse range of definitions and descriptions of resilience with a variety of components and factors being emphasized by different authors (Table 1).

Across this range of definitions, there appears to be at least some consensus on two main points:

1. Resilience is more functional when conceptualized as an ability or process rather than as an outcome (Brand & Jax, 2007; Brown & Kulig, 1996)
2. And secondly, resilience must be conceptualized as dynamic adaptability as opposed to stability (Carpenter, Walker, Anderies, & Abel, 2001; B. Marshall & Jones, 2005; Reusswig, 2007)

This suggests that current literature and research characterises the capacity for resilience as a cognitive coping predisposition, nourished and fostered by continuous social learning processes rather than an innate condition (Herrera, Byron, Kancans, & Stenekes, 2006). It also suggests that instead of an either/or scenario, a continuum of resilience should exist at all scales from individual to species. This continuum, from high to low resilience, would manifest itself in terms of the population of interest's flexibility and adaptability. Individuals at the high end of the spectrum would also expect to be more proactive in planning efforts in order to develop coping strategies to deal with change (D. Day, 1997; Leahy & Anderson, 2008; Lusthaus, Adrien, & Perstinger, 1999).

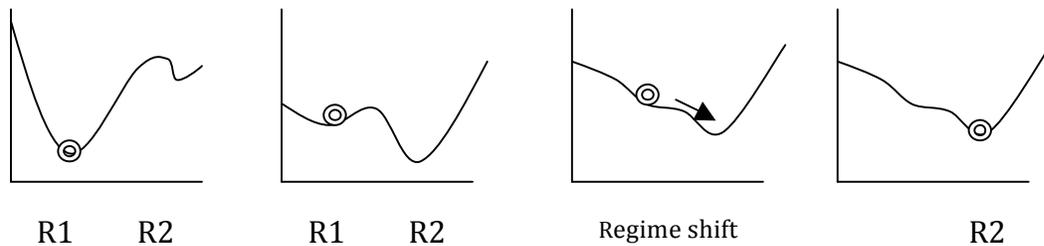
*Table 1. Representative definitions of resilience across disciplines and scales*

Citation (First author & year)	Unit of analysis	Definition
Norris, 2008	Community	A process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance
Luthar, 2000	Community	A dynamic process by which positive adaptation in conditions of drastic adversities is the ultimate outcome
Brown, 1996	Community	The ability to recover from or adjust easily to misfortune or sustained life stress
Pfefferbaum, 2007	Community	The ability of community members to take meaningful, deliberate, collective action to remedy the impact of a problem, including the ability to interpret the environment, intervene and move on
Holling, 1973	Ecological system	The capacity of a system to absorb and utilize, or even benefit, from perturbations and changes that attain it, and so persist without a qualitative change in the system's structure'
Resilience Alliance, 2006	Ecological system	The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure and feedbacks – and therefore the same identity
Butler, 2007	Individual	Good adaptation under extenuating circumstances; a recover trajectory that returns to baseline functioning following a challenge
Marshall, 2007	Individual	The flexibility with which resource users can cope and adapt to changes in resource policy
Young, 2010	Institutions	The capacity of a system to experience disturbance and still maintain its ongoing functions and controls
Godschalk, 2003	Social	A sustainable network of physical systems and human communities, capable of managing extreme events; during disaster, both must be able to survive and function under extreme stress
Bradley, 2004	Social	The ability of groups and individuals to tolerate and respond to environmental and socio-economic constraints through adaptive strategies
Bruneau, 2003	Social	The ability of social units to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize social disruption
Rutter, 1993	Social	A pool of social and intra-psychical processes enabling people to remain positive and constructive in a harsh environment
Gaillard, 2010	Social	The capacity of a system, community or society to resist or change in order that it may obtain an acceptable level of functioning and structure
Cutter, 2003	Social	The ability of the human system to respond and recover
Grotberg, 2001	Social	The capacity of human action in the face of adversity not only to bounce back but also to be transformed
Folke, 2002	Socio-ecological system	The ability of a socio-ecological system to cope with and adapt to external social, political or environmental disturbances
Walker, 2006	Socio-ecological system	The capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity.
Adger, 2000	Socio-ecological system	The ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change
Carpenter, 2001	Socio-ecological system	The amount of change a system can undergo and still retain the same control on function and structure; degree to which the system is capable of self-organization; and the degree to which the system expresses capacity for learning and adaptation

Any predisposition to resilience is obviously subject to a range of confounding variables such as the presence of certain conflicts or specific power differentials within society (Cox, Ostrom, & Walker, 2011). However, as is the case with some conflicts, some of these confounding variables can be seen as a force for positive social change with their presence being a visible demonstration of society adapting to a new political, economic or physical environment (Warner, 2000). Under certain circumstances, stability, or the failure to change, could demonstrate a lack of resilience (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008; Vogel, Moser, Kasperson, & Dabelko, 2007). The resilience of some systems, for example economic markets, depends on one component of the system being able to change or adapt in response to changes in other components. The system would fail to function if that component remained stable (Adger, 2000; Coleman, 1988). Socially resilient systems are therefore adaptable, flexible and able to cope with both change and uncertainty (Hughes et al, 2005). It follows then, that non-resilient systems are prone to irreversible change and are at risk of shifting into another, less desirable state. This state shifting has been best described using the ball in the basin metaphor developed by Walker et al. (2004) shown in Figure 3. Although this is a representation of an ecological system, the same model can be used to describe any chosen social system as well.

Essentially, with this model the ball represents a combination of variables present within the system. Within any given basin, defined by a certain structure, function and series of feedback loops, the ball tends to gravitate towards an equilibrium state. However, since the basin is constantly shifting its shape due to the dynamic nature of the system, this equilibrium is never fully reached. From a resilience perspective the main question becomes how much change in the system can occur before the ball is forced to leave the basin. At the point of some critical threshold, there is a change in the feedbacks and the system is forced onto a different equilibrium pathway. The ball then essentially enters a new basin and a different regime defined by different characteristics. Once the state shift has occurred there may, or may not be, a return to the original state or as in the case of the Figure 2 example this return may be increasingly difficult. The point must also be made, however, that resilience is not always necessarily

desirable. Systems may be resistant, yet not resilient (i.e., they don't allow for self-organization and learning), and, in turn, some undesired system configurations may indeed be both resistant and resilient. Building resilience of a desired state requires enhancing the structures and processes that enable it to reorganize following a disturbance (Pahl-Wostl, 2009).



**Figure 2. A two-dimensional representation of the ball-in-a-basin model**

R1 can be used to describe a regime such as a coral reef that is dominated by corals and resilient to shocks from a disturbance such as a coastal storm. This is demonstrated by the depth of the basin. The algal regime (R2) is a possible state of existence for the system but the basin of attraction is very small and a large amount of energy would be needed to move the ball from one basin to the other. If a greater degree of disturbance is then added to the system, say in the form of overfishing or eutrophication, the coral regime loses its resilience and R2 becomes a more likely state. The system is now easily moved from one regime to the other (Adapted from Walker et al. 2004)

## 2.1.1 DIMENSIONS OF RESILIENCE

### 2.1.1.1 INDIVIDUAL PREMISE

“Individuals strive to obtain, retain, protect and foster those things they value” (Hobfoll, Freedy, Lane, & Geller, 1990). This statement forms the basic tenet of Hobfoll’s 1990 Conservation of Resource Theory (COR). The theory suggests that the motivational precept of people is that they endeavor to obtain and protect their personal and social resources and, subsequently, experience stress when circumstances threaten or result in loss of those valued resources (Hobfoll, et al., 1990). With this theory, resources are defined primarily as social objects, conditions, personal characteristics or energies that are either valued by the individual or serve as a means of obtaining a valued outcome. Hobfoll proposes the idea that there are three basic circumstances under which stress can occur 1) when the threat of the net loss of resources

exists, 2) when resources are actually lost, and 3) when there is a failure to gain resources proportionate with prior actual or perceived investment (Hobfoll, 1988). Central to COR is the concept that individuals must invest resources in order to protect against resource loss, recover from losses, and gaining resources. With this in mind the idea is generated that those with greater social resources are less vulnerable to loss and more capable of resource gain (Norris, et al., 2008; Rutter, 1987).

COR theory has become a major field of investigation in hazards research since a range of object resources (e.g. housing), personal characteristics (e.g. safety) and energies (e.g. time and money) are threatened after a catastrophic event. Although focused on social resources, COR can be broadened to incorporate a range of resource loss including natural resources. A change in resource dynamic, either natural or management-induced, can threaten job security, personal well-being, money, social status, social networks and esteem. However, it must be noted that a loss of social and natural resources is rarely felt only by the individual, instead affecting multiple scales of society (Kaniasty & Norris, 1993; Pfefferbaum, Reissman, Pfefferbaum, Klomp, & Gurwitch, 2007) with an influence over migration patterns, crime levels, community structure and cohesion (Grotberg, 2001; Waner, 2010).

#### **2.1.1.2 COMMUNITY PREMISE**

In order to more fully comprehend the resilience of physical and social communities, with the purpose of developing a metric for measurement, it is important to consider certain key properties. Bruneau et al. (2003) described four such properties during their attempt to measure and enhance seismic resilience in community responses to earthquakes and earthquake related disasters:

- *Robustness*: the ability of the chosen unit of analysis to withstand stress without suffering degradation or loss of function.
- *Redundancy*: the extent to which elements within the unit of analysis are substitutable in the event of disruption or degradation. A concept related to redundancy is that of “resource diversity.”

Communities that are dependent on a narrow range of resources are usually less able to cope with change that involves the depletion of that resource, a state that is commonly referred to as “resource dependency” (Adger, 2000).

- *Resourcefulness*: the capacity to identify problems, establish priorities and mobilize resources when conditions threaten to disrupt the system
- *Rapidity*: the capacity to achieve goals in a timely manner in order to contain losses and avoid disruption to the unit of analysis

In addition to the key principles suggested by Bruneau et al. (2003), resilience, especially in the context of natural disaster management, has also been conceived as a process that encompasses four interrelated dimensions: technical, organizational, social and economic (Bruneau et al., 2003; Cutter, Boruff, & Shirley, 2003). The *technical* dimension refers to the ability of the system to perform to acceptable/desirable levels when subjected to disturbance. This is primarily a technological fix for a material component such as the integrity of a sea wall or levee for example. The *organizational* dimension refers to the capacity of organizations and institutions that manage facilities or resources that are critical to disturbance mitigation and have responsibility for such actions. The *social* dimension, in this context, consists of measures specifically designed to lessen the impact to which communities and governance systems suffer negative consequences due to the loss of critical services such as infrastructure or insurance. Finally, the *economic* dimension refers to the capacity to reduce both direct and indirect losses resulting from a disturbance event.

### **2.1.1.3 COMMUNITY RESPONSES**

Herreria et al. (2008) presented a different interpretation of community resilience and resource dependency, specifically in the context of water resources. The authors described a composite index combining three indicators: *social vitality*, *social distress* and *social inclusion*. In this context the *social*

*vitality* dimension refers to the capacity of a community to sustain its level of attractiveness as a place for providing opportunities. As such, it is measured in terms of skilled labour and changes in the working age population. The *social distress* dimension accounts for the capacity of a community to lessen the level of stress associated with social and economic insecurity and so is a measure of household income and unemployment in an area. The *social inclusion* dimension relates to the capacity of a community to enhance and increase opportunities for self-promotion and self-development. Social inclusion draws on demographic and census data including variables like the extent of women's participation in the skilled occupations and the engagement of young people in educational activities. Assumptions attached to this index are that resilient communities are those that sustain *social vitality*, lessen the level of *social distress* and enhance *social inclusion*.

With these principles in mind and drawing on a variety of social science theories, the Canadian Centre for Community Enterprise (CCCE) proposed a modified interpretation of resilience. The CCCE proposed that the resilience of rural communities is comprised of four interrelated core components (Brown & Kulig, 1996):

- *Attitudes and behaviour of people in the community*: this component explores values and perceptions related to leadership, initiative, education and optimism. This component also evaluates a sense of pride and openness to new ideas and alternatives, education, and awareness of economic impact of social issues.
- *Attitudes and behaviour of organisations in the community*: this component explores the 'assets' (organisations and institutions) and their capacity to cope in times of social and economic change.
- *Awareness and use of resources in the community*: this component analysis not only the 'level' of resources but also the way in which those resources are viewed and utilised.

- *Thinking, participation and action in the community process*: this component examines the planning, participation and implementation process in the community and how communities analyse inherent risk and plan for their future.

These core components enhance the idea that a resilience approach to social issues identifies available resources and adaptive capacities that a community can utilize to overcome the problems that may result from change (Bradley & Grainger, 2004; Cutter, et al., 2003). This also builds upon the inherent capacities of a community, rather than only relying on external interventions to overcome vulnerabilities (Adger, 2006; Luthar & Cicchetti, 2000). It must then be recognized that the social resilience of a community must represent the sum of the varying adaptabilities of all its inhabitants. A resilient community is able to respond to changes or stress in a positive way, and is able to maintain its core functions as a community despite those stresses. A particular change may have vastly different consequences in different communities, and different communities will demonstrate varying degrees of resilience to the change (Kelly, 2004).

With the current iteration of views on social resilience being more centered on the capacity of a community to respond to a change adaptively rather than simply the ability to return to a pre-existing state, the focus is now shifting towards creating governance opportunities that allow this to occur, such as co-management arrangements (Folke, 2006; Olsson, Folke, et al., 2004; Rasmussen et al., 2009). This transformational view of resilience is, therefore, concerned with concepts of renewal, regeneration and re-organization. A resilient community should be able to use the experience of change to continually develop and to reach a higher state of functioning (Norris, et al., 2008). Therefore, rather than simply surviving an enforced change, a resilient community may respond in creative ways that fundamentally transform the basis of the community. This perspective recognizes that given the dynamic character of communities, returning to a pre-existing state is unlikely, but transformation in an adaptive way to external change is possible and possibly preferable. This concept can be visually represented (Figure 3) in the form of a

series of recovery curves reminiscent of the Intermediate Disturbance Hypothesis (Connell, 1978).

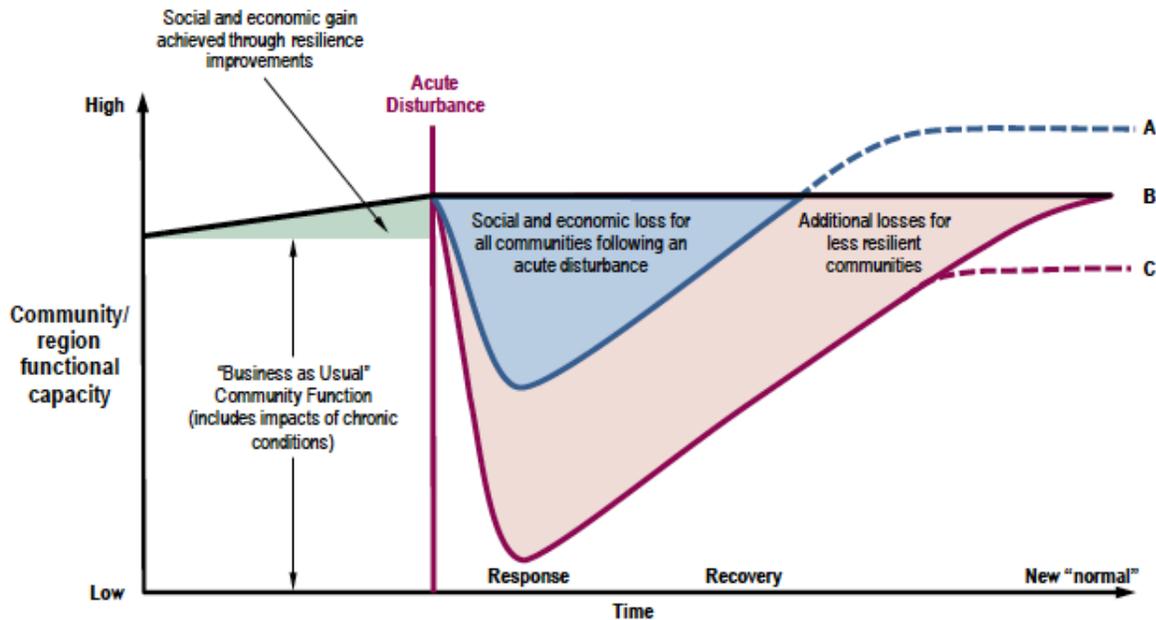


Figure 3. The resilience loss recovery curve (Community & Regional Resilience Institute, 2011)

Viewing resilience as transformation draws into focus the adaptive capacities of a community, the characteristics that enable the community as a whole to develop and innovate in response to a change, rather than its vulnerabilities (Maguire & Cartwright, 2008). This highlights the powerful capacity of people to learn from their experiences and to consciously incorporate this learning into their interactions with the social and physical environment. This analysis of resilience is important because it acknowledges that people themselves are able to shape the ‘trajectory of change’ (Herreria, et al., 2006) and play a central role in the degree and type of impact caused by that change. When social systems are transformed by a changing dynamic between people and natural resources, attributes of systems that support innovation should be favored over attributes that maintain the status quo (Armitage, 2005). Armitage (2005) suggests that adaptive capacity depends on the characteristics of individuals, institutions, and organizations that foster learning in the context of change and uncertainty. These characteristics include the willingness to learn from mistakes, the willingness to engage in collaborative decision-making, and

the extent to which institutional diversity and redundancy is encouraged or accepted (Armitage et al., 2009). Involving the community in a fair and just process and allowing that learning element to occur, therefore provides the necessary avenues for this adaptive capacity to be realized through self-organization and self-governance.

### **2.1.2. WORKING DEFINITION OF SOCIAL RESILIENCE**

Acknowledging the vast range of definitions and potential components of social resilience that are currently found in an ever-expanding body of literature, it is key to define the precise foundations that will be used for the remainder of this study. Three overarching themes, common in all resilience definitions, can be described as critical attributes for such a definition: flexibility, adaptability and pro-activeness. With these attributes in mind, it is clear that both process and capacity are important components of the over-arching construct. Essentially, at its most fundamental, social resilience is concerned with how individuals and communities cope with the impacts of change. Therefore, for the purposes of this study, Bradley and Grainger's 2004 description will be used as the overriding working definition: *"The ability of groups and individuals to tolerate and respond to environmental and socio-economic constraints through adaptive strategies"* (Bradley & Grainger, 2004).

However, the point must be made that the scales used in this definition are not synonymous. Resilient individuals will not always result in resilient communities and institutions, just as resilient communities will not always breed resilient individuals. It is therefore important to remain cognizant of the scale at which any investigation into social resilience occurs and to be mindful of inferences across those scales.

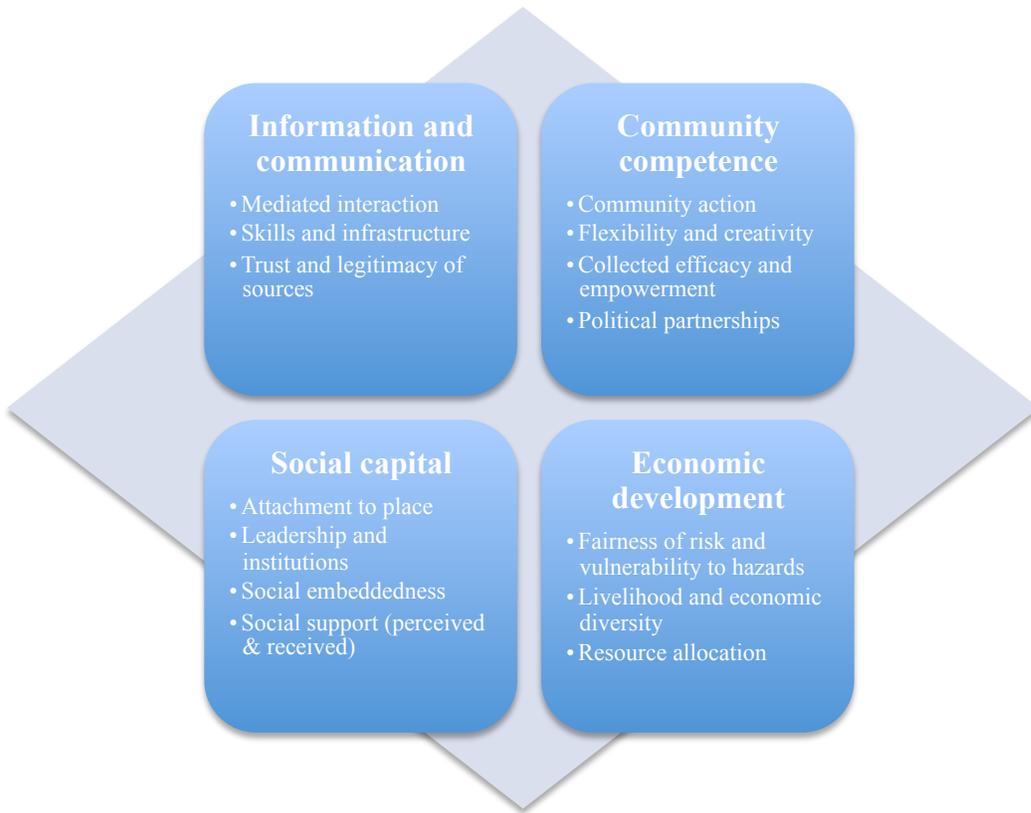
### 2.1.3 MODELS OF SOCIAL RESILIENCE

In an attempt to conceptualize resilience as a set of capacities, utilizing the community as the unit of focus, Norris et al. (2008) identified four primary sets of networked resources as key to harnessing transformational capabilities inherent in people. These resources include: economic development, social capital, information and communication and community competence. Each of these categories can be further dissected to help demonstrate linkages between resilience and key social theories, such as procedural justice, issue framing and participation. A modified version of their conceptual framework of community resilience, altered to incorporate these concepts is presented as Figure 4.

In order to broaden the scope, to a scale larger than the community, and from a synthesis of several case studies, Folke et al. (2002) identified and developed four critical factors that interact across temporal and spatial scales and that seem to be required for dealing with the dynamics of social systems during periods of change. The authors proposed these factors as principles for building resilience and emphasized their interaction and interdependence (Figure 5).

Each principle can be defined using the following descriptions:

- **Learning to live with change and uncertainty (adaptability)**
  - o *This principle emphasizes the necessity of accepting change or crisis and living with uncertainty and risk. To enhance resilience, strategies for management should take advantage of change and turn it into an opportunity for development.*



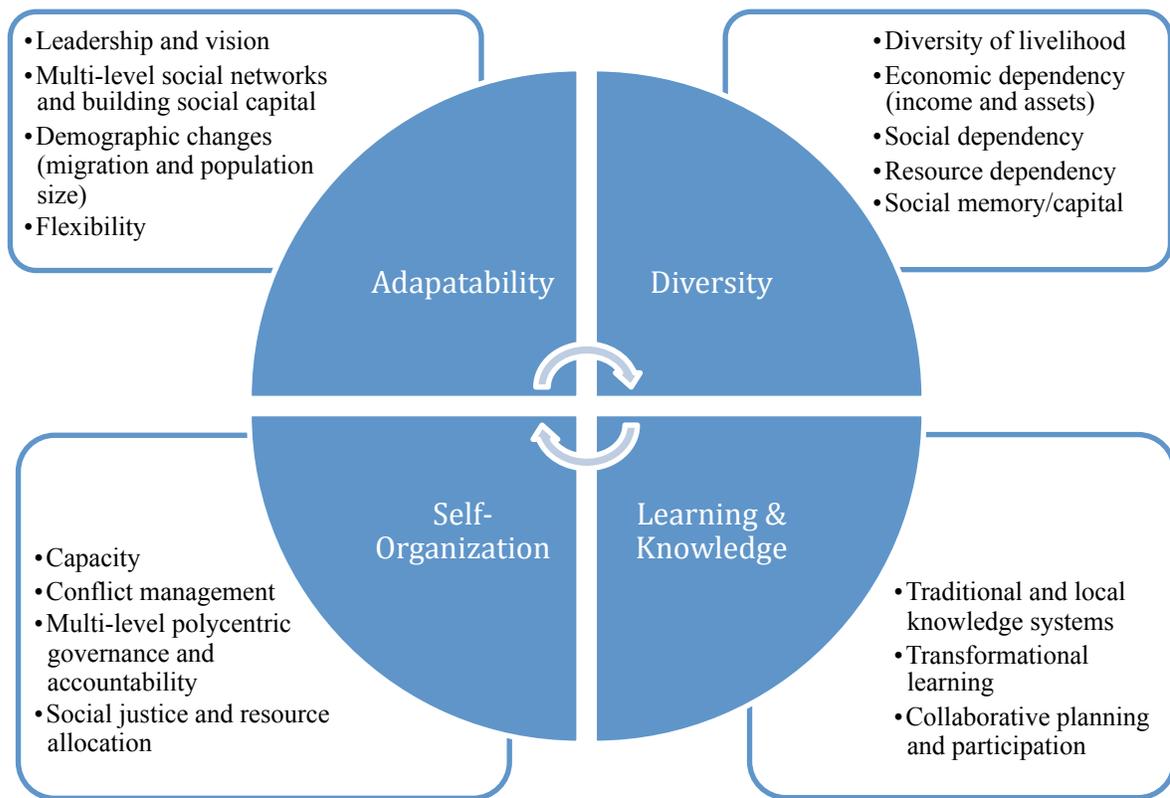
*Figure 4. A conceptual framework of community resilience (adapted from (Norris, et al., 2008)*



*Figure 5. An overarching conceptual framework of social resilience (Folke et al. (2002)*

- **Nurturing diversity for reorganization and renewal (diversity)**
  - *This principle explains the importance of nurturing diversity for resilience, recognizing that diversity is an insurance to uncertainty and surprise. Diversity of knowledge, institutions and human opportunities, and diversity of economic options all contribute to sustainability and adaptive opportunity (Folke, et al., 2002) . Diversity is also related to social memory, or the components of history that make development and innovation possible after a change or crisis.*
  
- **Combining different types of knowledge for learning (learning & knowledge)**
  - *This principle addresses the significance of people's knowledge, experience and understanding of complex systems, their inclusion in management systems and their complementary nature to conventional management. Social memory is also an important component of this principle since it is critical for building knowledge and learning due to the fact that it links past experiences with present and future policies.*
  
- **Creating opportunity for self-organization (self-organization)**
  - *The ability to self-organize is important in systems of adaptive co-management and is an essential element of adaptive capacity. Folke et al. (2002) defines adaptive co-management as a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing self-organized process of learning-by-doing. Adaptive co-management is also a way to operationalize adaptive governance, which often involves a multi-layered institutional structure (Lebel et al., 2004; Moberg & Folke, 1999; Olsson, Folke, et al., 2004). This makes governance less rigid, less vulnerable and more capable of self-organization and also allows for improved decision-making and problem solving among individuals and organizations. Overall adaptive management and governance builds resilience by increasing the likelihood of flexible and adaptive responses or behaviour among stakeholders during periods of crisis, reorganization or uncertainty (environmental, political, social or economic).*

However, as with the other conceptual diagrams presented, each of the principles proposed by Folke et al. is an amalgamation of several social constructs. These principles can therefore be deconstructed further to more fully explain the integral nature of social resilience as a whole (Figure 6). The conceptualization in Figure 7 draws on several aspects of resilience that have already been presented earlier in this chapter.



*Figure 6. A social-theory based conceptual framework of social resilience*

#### 2.1.4 MEASURING SOCIAL RESILIENCE

Irrespective of approach, a concept like social resilience is of limited utility unless it is measurable. The dimensions, key principles and indices presented here demonstrate the fact that resilience, in its many forms, cannot be measured by any one single metric of performance. Instead different metrics and

measures are required for the different systems and different scales under investigation. Using a broader conception of resilience, and incorporating a greater range of processes in its definition increases the transferability and utility of the overall concept. Understanding the capacities and capabilities that contribute to resilience, and how to measure resilience at various scales, will provide information on the ability of communities and regions to cope with changes brought about by processes like climate change and sea level rise. It is with this in mind that the remainder of this literature review will focus upon measurable components of resilience as a broad concept rather than a narrow one.

As Figures 5 & 7 demonstrate, social resilience in response to change can be measured by reference to socio-economic variables or indicators derived from an extensive range of baseline data sources at a variety of temporal and spatial scales. Due to the variation seen at each level, authors have highlighted different indicators as vital to measuring social resilience, while marginalizing others at the same time (Nelson, Adger, & Brown, 2007). This variation is also a reflection of the definitions and units of analysis chosen to investigate specific case studies as demonstrated earlier in Table 1. If some indicators are indeed more or less important at varying scales, then ensuring that fact is reflected in the analysis and assessment of each indicator becomes a vital step for the overarching goal of measuring social resilience.

It is also important to recognize factors or variables that may constrain resilience from manifesting within a community. Measuring the existence and extent of inhibitors can provide insight into potential areas of improvement and solution-oriented opportunities and, in doing so, empower local communities to enhance components of social resilience that may have direct and immediate benefit at a small scale. A series of enabling and inhibiting factors of social resilience from an individual welfare perspective were synthesized from research conducted by the Healthy Communities Institute (Table 2).

*Table 2: Factors that enable or inhibit social/community resilience*

Enabling factors	Inhibitive factors
Altruism	Paternalism
Empathy	Fatalism
Solidarity	Red tape
Civic engagement & participation	Fraud/Corruption
Supportive networks	Discrimination/Prejudice
Equality in access to social services	Violence (physical and symbolic)
Endurance	Egoism
Confidence in community leadership	Manipulation

A range of indicators and constructs has been suggested in the current literature as potentially important to the measurement of the social resilience at various scales (Table 3). As expected, several of these indicators are a reflection of components included in the conceptual framework of social resilience (Figure 6). Methods that have either been used in the past or have been demonstrated to show potential for use have also been included to demonstrate the broad range of potential investigative procedures.

Some of the studies present in the literature today have used one, or a maximum of three, of these indicators as surrogates for social resilience as opposed to attempting to combine multiple concepts into a one multi-dimensional, aggregated measure (Cinner, et al., 2009; Milman & Short, 2008). This approach is in direct contradiction with methods typically employed when investigating social vulnerability and risk. Although this single indicator approach is understandable considering limited budgets, time restraints and research priorities, it does allow construct validity to remain high on the list of concerns that can be leveled at social resilience research.

*Table 3. Previously employed indicators of social resilience*

Potential Indicator	Linkage to conceptual model	Description	Methods of analysis used or proposed*
<b>Social networks and social capital</b>	Adaptability Learning and knowledge	Public and personal identity Strength of local community and family ties Federal and regional support mechanisms Formal and informal institutional capacity	Social network analysis Institutional analysis
<b>Resource dependency</b>	Diversity	Income diversification, stability Income and asset base (tied to food security) Capital (human, social, natural, political) Access to initial resource base	Resource dependency framework Livelihood analysis Power analysis
<b>Economic dependency</b>	Diversity	Livelihood alternatives, assets and income Externalization of risk through subsidies and insurance Lack of diversity approach due to incentives for economic maximization	Livelihood analysis Input-output models Cost- benefit analysis Risk assessment
<b>Demographic changes and socio-economic status</b>	Adaptability	Loss of capacity and change of social dynamic Migration and mobility Overall population change Local, community, family networks	Public census Social network analysis Capacity assessments
<b>Planning and participation</b>	Learning and knowledge Self organization	Adaptive capacity Speed of reaction and mechanisms for change Collaboration and process Fairness and power	Institutional analysis Stakeholder analysis Procedural justice framework
<b>Governance structure</b>	Self organization	Polycentric structure or potential Transparency and accountability Legitimacy	Institutional analysis Procedural justice framework

#### 2.1.4.1 COMPOSITE INDICES

A composite index is formed when individual indicators are compiled into a single metric on the basis of an underlying model (Saltelli, 2007). Once developed, a composite index should ideally represent the fundamental multidimensional concepts that cannot be captured by a single indicator, *e.g.* competitiveness, industrialization, sustainability, power, social resilience and social vulnerability (Barnett, Lambert, & Fry, 2008; Cutter, et al., 2003; Yohe & Tol, 2002). Composite indices that compare performance across multidimensional issues have been increasingly recognized as useful tools in policy analysis and public communication. This usefulness has especially been demonstrated on a global scale when comparing country performance on a range of large-scale economic, social, political or environmental measures (Bandura, 2008).

Aggregated indices have become more widely used over time, although not without controversy. Some authors state that indices are useful in terms of simplifying and quantifying highly complex systems of risk in ways that are scientifically rigorous, easily interpreted and useful to decision makers (Barnett, et al., 2008). However, on the opposite end of the spectrum, some believe that the majority of indices that are currently created have a tendency to be developed in such a way that oversimplifies complex problems into single metrics and are too generic to be truly useful (Boruff, Emrich, & Cutter, 2005).

#### UTILITY

One argument for the development of such indices is that it is simpler for the general public to interpret composite indicators than attempt to identify common trends across many separate indicators (Hoskins & Mascherini, 2009). Composite indices are, therefore, being increasingly recognized as a useful tool for policy-making and public communication. They also allow for benchmark setting across the global community, a key component of the ever-shrinking political landscape. However, forcing any complex

system into a single metric, such as a composite index, faces empirical challenges including issues such as data quality, indicator selection, indicator importance and weighting (Eakin & Luers, 2006). Composite indices can send misleading policy messages if they are poorly constructed or misinterpreted and the nature of the simplified results may invite users to draw simplistic analytical or policy conclusions. It is, therefore, vital that these measures be seen as a means of initiating discussion and stimulating public interest rather than the sole link to policy development (Reisig, Bratton, & Gertz, 2007; Saltelli, 2007; Waner, 2010).

## WEIGHTING

Another issue that must be considered when developing a composite index is that of variable weighting. The act of applying weights can heavily influence the resulting index especially since weights typically tend to be subjective in nature (OECD, 2008). There are differing schools of thought when discussing the role of indicator weighting. Weighting is essentially linked to the balance of items chosen. One approach states that weighting should be equal unless there is a compelling and obvious reason why weighting should be employed (Babbie, 2007, 2010). One such reason could be if two items essentially reflect the same aspect on one construct. If so, weighting can be a vital tool in reducing the effects of covariance but avoiding this issue through better item selection will also deal with this issue. The other school of thought is that individuals may place differential importance on specific items and that indices used to measure complex constructs should reflect this differentiation (Henderson, Wells, Maguire, & Gray, 2010). One way of determining such nuances would be to conduct a factor analysis to examine if individual items make unequal contributions to the latent construct under review (Reisig, et al., 2007).

The issue of weighting raises another important point when considering the development of a composite index, that of aggregation technique. The majority of studies in social and political science tend towards the use of linear summation of weighted and normalized indicators. This technique requires that the

indicators are preferentially independent. Geometric aggregation and multi-criteria analysis have also been used as techniques in index development, especially where independence of numerous variables is considered impossible to achieve and so must be controlled for (OECD, 2008).

#### EXAMPLES OF COMPOSITE INDICES

Two examples of widely used vulnerability indices are 1) the Coastal Vulnerability Index (Pendleton, Thieler, & Williams, 2005) and 2) the Social Vulnerability Index (Cutter, et al., 2003). Both of these indices provide a potential framework for the development of a social resilience metric. The coastal vulnerability index (CVI) was developed by the USGS in the Northern Channel Islands. CVI is based on six physical factors: geomorphology, historical rates of shoreline change, coastal slope, relative sea level rise, wave action, and tidal range. A product mean was used to produce a single, relative number for the vulnerability of each stretch of coast using the following equation where **a** through **f** represent equalized (on a scale of 1–5) values for geomorphology, historical shoreline change, coastal slope, historical relative sea level rise, wave action, and tidal range. The result is a relative scale for the vulnerability of each segment of coast to erosion.

$$CVI = \sqrt{\frac{a * b * c * d * e * f}{6}}$$

The Social Vulnerability Index (SoVI) synthesizes 32 socioeconomic variables, predominately sourced from the US census bureau, in order to measure a community's ability to prepare for, respond to and recover from hazards. Input variables, which range from measures such as socioeconomic status to housing density and unemployment, are standardized using z-scores. A principle component analysis is then performed using a varimax rotation and Kaiser criterion for component selection. Factors are named via the choosing of variables with significant factor loadings (or correlation coefficients), usually greater than 0.500 or less than -0.500. All selected components are summed to generate the overall SoVI. This

measure can then be utilized as a comparison number across sites and provide a basis for visual representation and mapping tools, which are key for dissemination and management.

Social resilience does lend itself to this type of summated scale based upon a cumulative measure of each principle. However, no single measures, either simple or complex, exist for each of the principles in their entirety. Cutter (1996) points out that although social vulnerability indicators are often single variables, they are typically manifestations of multidimensional factors such as institutional development, social relations, or political power. Criticisms of construct validity and reliability, scale validity, and inter-principle covariance are easily leveled at existing attempts to replicate vulnerability indices within a social resilience context. The four technical themes most commonly discussed include (a) inconsistent use of subscales and indicators to reflect the construct under investigation, (b) inattention to the construct validity of key concepts, (c) failure to utilize statistical methods that are appropriate for ordinal indicators, and (d) the inclusion of similar indicators on both sides of regression analysis equations contributing to inaccurate and confounded correlation statistics (Henderson, et al., 2010; Reisig, et al., 2007).

### **2.1.5 UTILITY OF SOCIAL RESILIENCE**

As noted in the introduction of this document, adapting and coping with any complex coastal management issue will require actions across multiple scales. Three main criteria must be considered in order to define a resilience strategy that has the potential to be successful: 1) human capacity and capital must be fully utilized, 2) technological solutions developed and implemented, and 3) difficult allocation decisions examined. However, it is also important to test the utility of an umbrella concept like social resilience by using it to examine specific management issues.

Climate change induced shoreline change poses a variety of threats to society, including but not limited to the loss of infrastructure, property and recreational opportunities. However, as with any contentious and complex issue where the potential for winners and losers exists, there are a multitude of opinions, preferences and attitudes surrounding the answer to the most basic question “what should be done in the face of changing shorelines?”

The issue of shoreline change will engage every level of governance, formal and informal institutions, and level of society that currently exists. It is also important to realize that, in order to achieve this level of adaptation to such a broad reaching issue, trade-offs will be necessary in the choices that policy and decision makers must make. This will lead to controversy, and potentially to conflict at many different levels of society. This conflict will be driven by differing social values, expectations and ideal outcomes and has the potential to be highly negative and disruptive. Understanding the sources of these conflicts, and mechanisms for reducing conflict will be a key step in providing the basis for long-term strategic approaches to adapting to the threat of shoreline change.

All the management considerations mentioned here (governance, conflict and resource allocation) are key components of the self-organization principle of social resilience (Figure 7). Due to the sheer variety of social constructs involved in measuring social resilience in its entirety, and the range of techniques and methods required, one study is unlikely to be sufficient to achieve that end. Budget and time constraints must also be considered. Therefore, without marginalizing the importance of the other principles and components of social resilience such as diversity or learning & knowledge, this study will focus on conceptualizing and operationalizing the self-organization principle. Limiting the study focus will allow a more comprehensive examination of one of the principles of social resilience with the aim of developing a functional and appropriate metric.

## CHAPTER 3. LITERATURE REVIEW OF SELF-ORGANIZATION

### 3.1 SELF-ORGANIZATION

In social psychological terms, self-organization refers to the role of self-conscious, creative, reflective, and knowledgeable human beings in the creation, and subsequent reproduction, of social systems (Fuchs, 2003). It therefore symbolizes a series of inherent characteristics present at the individual and collective level. The basic premises of the theory of self-organization are that 1) a social system and its structures do not exist outside of human activities, 2) these structures are the outcome of actions, and 3) this recursive relationship is essential for the overall re-creation/self-reproduction of society (Fuchs, 2003; Leydesdorff, 2003; Ostrom, 1995).

Self-organizing systems are therefore by definition complex in nature and have intricate and circular causality (Mingers, 2001; Zeleny & Hufford, 1992) . This implies that causes and effects cannot be mapped linearly since similar causes can have different effects and different causes similar effects (Giddens, 1984). Small changes of causes may have large effects, whereas large changes may result in only small effects or vice versa. This suggests a large degree of innate variability and instability associated with any attempts to measure the degree of self-organization of a particular social system. This variability may have the effect of reducing the predictive utility of self-organization as a concept, but instead provides a useful insight into the degree of potential that exists for individuals and communities to take advantage of change at one point in time.

The concept of self-organization becomes much narrower when viewed through the disciplinary lens of resource management. As is the case with the Folke et al (2002) description of the construct (See Chapter

2), self-organization is often limited to descriptions regarding adaptive co-management when it comes to natural resource problem solving (Cundill & Fabricius, 2010; Olsson, Folke, et al., 2004). This implies that the key variables necessary for the perpetuation of self-organization include enabling legislation, the ability to monitor environmental feedback loops, information and social networks, and arenas of collaborative learning (Olsson et al., 2004). These variables assume a level of collective action and cooperation across different scales of organization.

### **3.1.1 COLLECTIVE ACTION**

A common thread to theories of self-organization is the recognition that collective action requires networks and flows of information between individuals and groups to facilitate decision-making (Adger, 2003). The basis for collective action provides an explanation for how individuals use their relationships to other actors in societies for their own and for the collective good (Ostrom, 2000). This collective good, or welfare, includes elements of cultural and spiritual goods as well as social norms. Therefore, collective action essentially describes the nature of social relations and uses it to explain outcomes in society (Ostrom, 1995, 2000).

However, collective action, and by extension self-organization, does not exist in a political vacuum, and its existence alters the power relationships between civil society and the state (Bebbington & Perreault, 1999). A key question remains, whether collective action exists only outside the state or if it is rather a cause or simply a symptom of a progressive, resilient society? (Abel, Cumming, & Anderies, 2006; Adger, 2003; Brown & Kulig, 1996).

The importance of the potential role that the state may play in facilitating self-organization provides a direct link to the effectiveness of strategic environmental planning for climate change. If a government can provide physical infrastructure or regulatory decision to minimize the potential impacts of a coastal

threat, such as shoreline change for example, will this intervention ever be sufficient for adaptation if its use does not resonate with existing social norms at a variety of scales in society? Potential episodes like the example described provide important social learning opportunities that include such collective activities as discourse, imitation, and conflict resolution (Adger, 2003; Onyx & Bullen, 2000; Zahran, Brody, Vedlitz, Grover, & Miller, 2008). However, it must be noted that collective action is not necessarily in everyone's best interest at all times. Existing hierarchies and inequalities in resource allocations and entitlements are rarely re-examined or redistributed in the course of adaptation, and external changes, such as extremes in climate and other natural hazards, tend to reinforce these inequalities (Adger, Kelly, & Ninh, 2001). As individuals and groups interact with the state, so the state institutions evolve in a process of policy learning. Adaptation in the political sphere involves periodic shocks to ideologies and paradigms of policy intervention on short time scales in response to changing social values. These shocks are vehicles of social learning and adaptation and form the basis for management actions.

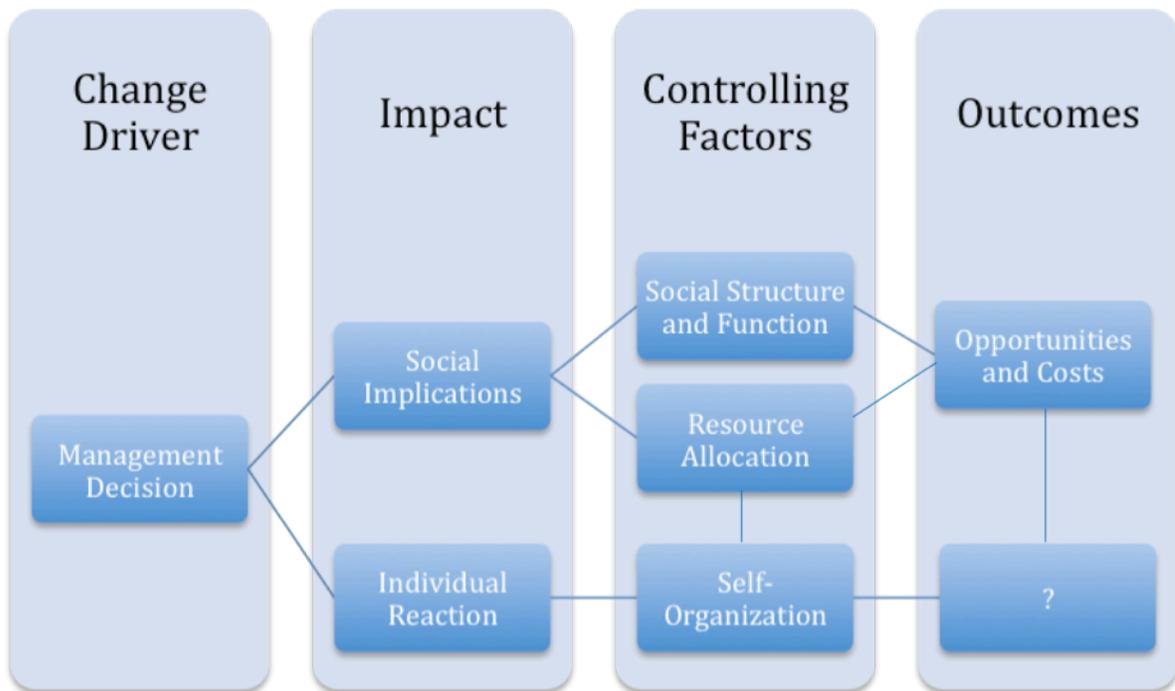
### **3.1.2 MANAGEMENT**

Management can be defined as a set of actions taken to guide a system towards achieving desired goals and objectives, usually subject to a set of externally imposed constraints (Davidson, Wood, & Griffin, 2009). There is a diverse array of formal and informal social constraints that exist throughout society on how people should, and do, interact with resources and ecosystems, on the distribution of rights to access, and responsibilities for stewardship (Lertzman, 2009). A management process, therefore, is the sum of these actions, the goals and objectives, the procedure through which they are legitimized by social norms, values, and the institutions and actors involved in carrying out said actions. Management actions that have a large impact on the lives and identities of communities often have the potential to be contentious, controversial and emotionally charged, frequently resulting in long running conflicts between management agencies and stakeholders (Suzuki & Iwasa, 2009; Wilshusen, 2009).

Understanding the influence and impacts of management processes and decisions on human community structure and function can be key to determining potential social outcomes and effects of particular policies. Management actions, routinely driven by governmental decisions and politically relevant short-term time frames, essentially alter the relationship between people and the natural resources upon which they depend. Changing the dependency dynamic leads to a period of readjustment by the affected community at various scales, followed by a degree of adaptation resulting, eventually, in the formation of a new balance between people and the resource (Brand & Jax, 2007; N. Marshall, et al., 2007; N. Marshall & Marshall, 2007). Communities that are modified, either through opportunity or constraint, by a management action must adapt to changing circumstances without losing critical social relations, economic options or political stability (Underdal, 2010). The capacity and flexibility to adapt can vary for a myriad of reasons across all social scales.

Recognizing the consequences of altering the relationship between people and the natural resources upon which they depend is critical to minimizing negative impacts, improving long-term viability and increasing the management effectiveness of the actions taken. This complex interaction between individuals, community, management, and resource is an iterative process due to the fact that management itself must continually adapt to the changing social values, environmental conditions and societal needs that govern the nature of possible actions and desired outcomes (Figure 7). Recognizing, and increasing, the degree to which individuals can cope with the changes brought about by management actions, especially those dealing with natural processes, can potentially provide necessary solutions to the current stalemates seen across the resource management arena. Focusing on how individuals employ attributes of self-organization provides a key insight into differences between command and control management strategies and co-management initiatives and how these approaches may result in different outcomes.

Each component of Figure 7 can be broken down further into either a series of overarching states or a collection of social processes and capacities. Change drivers, for example, may be social values, resource or economic condition, or a new governmental regime. Scale of process presents instability at each stage of the model. Concepts such as conflict, resource allocation and justice are examined as sub-components of those presented in this model. There are obvious linkages both laterally and medially throughout this model, implying that perturbations in one area will have knock-on affects in at least one other area if not several. Due to the dynamic nature of society, the constraints of being able to take advantage of the opportunities presented by the change, and the unknowns associated with the resilience within a particular system, the outcome of a specific management decision remains unknown.



*Figure 7. A conceptual diagram of the human-resource-management interaction*

### 3.1.3 WORKING DEFINITION OF SELF-ORGANIZATION

Self-organization can be defined as the ability of a system to spontaneously arrange its components or elements in a non-random manner, under appropriate conditions but without the help of an external agency (Ostrom, 1995). At its most basic point, self-organization is concerned with a ‘process’ of some sort that individuals and/or groups of people go through in order to be better placed to deal with an event in time. This description introduces some key factors that provide a basis for quantifying self-organization. Firstly, the concept of a process or the development of a course of action reinforces the idea of planning and pro-active behavior that was discussed in the social resilience literature review (See Chapter 2). The assumption here is that the actors enter into this process with the expectation that long-term benefits will out-weigh short and long term costs (Pretty, 2003). Secondly, the idea of self-organization at a scale greater than the individual implies cooperation and collaboration amongst actors for long-term gain (Reiff, 2009; Sanginga, Kamugisha, & Martin, 2010; Yohe & Tol, 2002). Finally, the introduction of some component of self-regulation must become apparent if the collective self is to benefit from any action. A violation of the formal and informal rules that are established through deliberation negotiation or traditional social etiquette would be expected to result in a breakdown in the organization across different scales (Tyler, 2001; Wolford, 2008).

This definition reinforces the suggestion that some social constructs, such as social resilience and self-organization, exist on a continuum within society and across scales. This continuum, from low to high ability to self-organize would manifest itself based upon the three factors presented here: planning and process, collaboration, and self-regulation. This continuum presents a useful way of sub-grouping populations of interest in order to examine differences across potential indicators of self-organization. The critical step within this process is to avoid the creation of a tautology whereby self-organization is defined and then measured using the same terms.

## 3.2 CONCEPTUALIZATION OF SELF-ORGANIZATION

Using social theory, the framework presented in Figure 6, and the conceptual models of social resilience suggested by Folke et al. (2005) and Norris et al. (2008) as a foundation (Figures 4 & 5), the self-organization principle of social resilience was conceptualized as an amalgamation of four main multi-dimensional components. Each component was systematically examined in order to identify potential indicators and metrics. The identified components were:

- Capacity
- Conflict management
- Multi-level polycentric governance and accountability
- Social justice and resource allocation

### 3.2.1 CAPACITY

Capacity is often defined as the performance, ability and capability characteristics of an object or a person (Armitage, 2005). The social manifestations of capacity could be regarded as traits such as judgment, will, ambition, justice and/or equity. Often, capacity is used interchangeably with other, similar concepts such as community empowerment (Mutz, Bryner, & Kenney, 2002), competence (Ostrom & Ahn, 2003) and readiness (Maguire & Cartwright, 2008). In this context capacity is general defined either as “the community’s ability to pursue its chosen purposes and course of action” (Fawcett et al., 1995) or as the aggregate of individual- and community-level endowments in interaction with conditions in the environment that impede or promote success (Jackson et al., 1997).

There are many groupings of definitions used with respect to capacity. Some aspects of the literature have used definitions focused on the existence of commitment, skills, resources, and problem-solving abilities

often connected to a particular program or institution (Goodman et al., 1998; Meyer, 1994). Other authors emphasize the participation of individual community members in a process of relationship building, community planning, decision making, and action (Goodman, et al., 1998). On the whole, these attempts to define community capacity have provided the basis for a definitional framework based upon four fundamental characteristics of community capacity: (1) a sense of community, (2) a level of commitment among community members, (3) the ability to solve problems, and (4) access to resources (Chaskin, 2001). While it is difficult to argue that these characteristics do not exist to some degree in every community, there are likely threshold levels necessary for a community to accomplish certain ends. It also suggests that although conditioned in part by both microlevel and macrolevel contextual influences, community capacity may be built through strategic intervention (Magis, 2010).

Capacity building is a multidimensional concept associated with the creation and realization of enabling conditions for individuals, institutions and communities to realize their potential, gain skills, learning, and knowledge, and enhance their abilities to cope with situations that arise over time (Yohe & Tol, 2002). In general terms, capacity building has been defined as a process or activity that improves the ability of an individual or entity to achieve stated objectives (Fazey et al., 2007). More specifically, capacity building *“encompasses the country’s human, scientific, technological, organizational, institutional and resource capabilities. A fundamental goal of capacity building is to enhance the ability to evaluate and address the crucial questions related to policy choices and modes of implementation among development options, based on an understanding of environment potentials and limits and of needs perceived by the people of the country concerned”* (United Nations Conference on Environment & Development, 1992).

It is satisfactory, therefore to conceptualize capacity building inherently as a continual process of improvement within an individual, organization, or institution with the objective of maintaining or improving the current state of the system (Lusthaus, et al., 1999). Although capacity building is essentially an internal process, it can clearly be enhanced or accelerated by outside entities, especially

with regard to specific skill sets that may facilitate the individual, organization, or institution improving its own internal functions or abilities (Taschereau, 1998). However, with that said, it has to be recognized that the term capacity building has now come to encompass a much broader ideal than just an education and/or training component that is often associated with developing skills. Instead capacity building has been expanded to include not only this aspect but also encompass other facets (Boyce & Shelley, 2003):

- Human resource development
  - The process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively
- Organizational development
  - The amplification of management structures, processes and procedures, both intra as well as inter-organizational and inter-sectoral (public, private and community).
- Institutional and legal framework development
  - Modifying legal and regulatory frameworks to enable organizations, institutions and agencies at all levels and in all sectors to enhance their capacities and capabilities

While recognizing disparity across different levels of organization, to encompass many of these concepts at a more local and contextually rich scale the UN attempted to define community capacity building as *“the process and means through which national governments and local communities develop the necessary skills and expertise to manage their environment and natural resources in a sustainable manner within their daily activities”* (United Nations, 1996). The more succinct definition that is gaining traction in the literature is capacity as the combined influence of a community’s commitment, resources, and skills that can be deployed to build on community strengths and address community problems (Chaskin, 2001; Meyer, 1994; Narayan & Cassidy, 2001). It is this definition that begins to resonate with the overall conceptualization of self-organization that has been presented in this document.

### 3.2.2 CONFLICT MANAGEMENT

Conflict within a social system is virtually inevitable due to the natural variety in social values, priorities and approaches to issues that are inherent to the human race. Different types of conflicts can be categorized in terms of whether they occur at the micro–micro or micro–macro levels. That is, whether the conflict exists between community entities themselves or between communities and government, private or civic organizations (Grimble & Wellard, 1997; Warner, 2000). Micro-micro types of conflicts can be broken down further still into inter and intra conflicts, whether the conflict is occurring within the group directly involved in a particular resource management regime or between this group and those not directly involved (Conroy, Mishra, Rai, & Chan, 2001; Warner & Jones, 1999). Examples of both intra and inter micro–micro conflicts and micro–macro conflicts are listed in Box 1 as modified from Warner (2000). The adverse impacts of conflict can range from a temporary reduction in the efficiency of a particular action, to complete collapse of initiatives, to long-term legal proceedings, all of each are detrimental to both management and resilience.

Conflicts can manifest themselves in a large variety of ways in a community or between a community and a governmental or decision making body.

#### **Box 1 Types of conflicts arising from shoreline management**

##### **Intra micro–micro conflicts:**

- Disputes over land and resource ownership
- Disputes over land boundaries between individuals or groups
- Latent family and relationship disputes
- Disputes due to natural resource projects being only focused in areas based on limited criteria
- Breaking of constitutional or operational rules, e.g. construction of shoreline protection barriers
- Disputes over the unfair distribution of assistance or economic gain

##### **Inter micro–micro conflicts:**

- Conflict between property owners and resource users e.g. between private and public trust lands
- Conflict between long-term resident groups and more recent migrants (e.g. second home owners)
- Disputes generated by jealousy related to inequalities, perceived or real
- Lack of co-operation between community groups
- Resentment built up due to lack of representation on community committees

##### **Micro–macro conflicts:**

- Contradictory natural resource needs and values, e.g. between habitat protection and local livelihood security or recreation opportunities
- Cultural conflicts between community groups and outsiders
- Disputes over project management between community groups and outside project-sponsors (e.g. beach nourishment projects)
- Disputes caused by political influence (national, provincial or local)
- Disputes arising from differences between the aspirations of community groups and expectations of pressure groups or commercial companies
- Off-site environmental impacts unintentionally affecting third parties

The rationale behind specific conflicts can be just as varied and may remain latent for a range of reasons such as fear, distrust, peer pressure, financial constraints, or exclusion from certain conflict resolution procedures. Conflicts over natural resources are growing in scope, magnitude and intensity (Suzuki & Iwasa, 2009; Wilshusen, 2009). Conflict management is based around understanding, analyzing and managing conflicts both before and after they occur. It seeks the development of participatory and consensus building strategies, and it builds upon existing formal and informal conflict management mechanisms within local communities. Conflict management can also be used as a mechanism in of itself to strengthen the capacity of local institutions and communities. The transfer of information between involved parties is also noted as a key mechanism in conflict reduction (Mushove & Vogel, 2005; Wagner & Fernandez-Gimenez, 2009).

### **3.2.2.1 MANAGEMENT APPROACHES**

There is no perfect strategy for managing conflict in contentious and emotional issues such as how to best manage for sea level rise. Any adopted strategy must be practical, given the available resources and capabilities of the conflicting parties and local implementing agencies, issues of safety and security, and the availability of viable conflict mitigation options. The key strategies of conflict management can be summarized (Figure 8). As the diagram demonstrates, the approaches utilized may differ depending upon the extent to which a conflicting party values the continuance of good relations with other parties; and the importance each party places on achieving its own goals (Warner, 2000). Each component is described further in order to demonstrate its utility depending upon the circumstances.

#### **Force**

Conflict can be managed through force, where one party has the means and inclination to prevail into actions regardless of the impacts to any other party involved, and regardless of damages caused by those impacts to relationships (D. Day, 1997). Not all parties involved in a conflict will be able to use force as a

strategy, especially if the conflict is with a governmental agency. The use of force depends largely on the power differential between parties. One of the more relevant uses of force for the issue of sea-level rise includes the exertion of economic dominance. In some cases recourse to the legal system is also a form of force. Some less obvious but often no less powerful forms of ‘force’ include adversarial negotiation tactics, political expediency, manipulation of the electoral system, use of the media to rally public support and public protest.

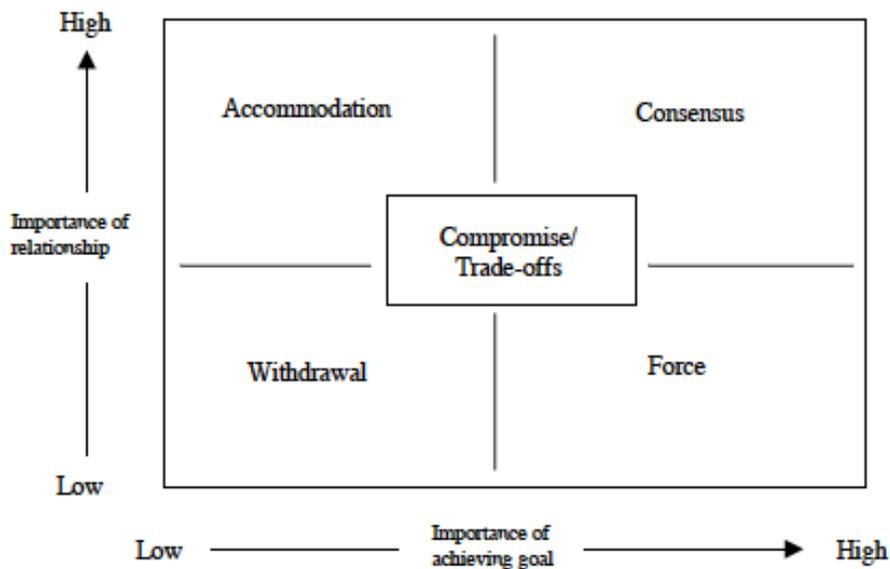


Figure 8. Five conflict management strategies (modified from (Thomas & Kilmann, 1974).

### Withdrawal

Withdrawal is an approach to conflict management utilized primarily by those entities whose desire to avoid confrontation outweighs the initial gain of achieving the desired goals. Types of withdrawal include withdrawal of funding; avoidance of volatile locations; refusal of certain stakeholders to engage in a negotiation process; the deployment of delaying tactics or postponement of project decisions.

### Accommodation

Accommodation is most common when one entity in a conflict situation decides that a strong and continuing relationship with one or more of the other parties is more important in the long term than

achieving specific goals (De Cremer, Cornelis, & Van Hiel, 2008). In some cases, one entity may elect to concede to all or most of another's demands. Although such outcomes may at times resemble the same outcome as those achieved through force, the difference is that rather than losing outright, the accommodating party perceives itself to have gained by way of securing good relations, accompanied perhaps by an element of good will and the option to achieve some greater goal at a future date (Davidson, et al., 2009).

### **Compromise**

Compromise is often confused with consensus. To compromise in a negotiation may sound positive, but it means that at least one of the parties perceives that it has had to forgo something. In planning projects, compromise, particularly the notion of trade-offs, is now prevalent, based on the need to make rational resource allocation decisions (Davidson, et al., 2009; Lertzman, 2009).

### **Consensus**

Although processes of consensus building sometimes contain elements of compromise within the final agreement, there are some key differences between the two approaches. Consensus-building explicitly sets out to avoid trade-offs altogether, seeking instead to achieve a 'win-win' outcome (Warner & Jones, 1999). In contrast, a compromise approach seeks to minimize what are considered to be inevitable trade-offs. The fundamental principles of consensus building are to steer conflicting parties away from:

- negotiating over their immediate demands and hostile positions, towards addressing those underlying needs which are the true motivating factors behind the each sides perception of the conflict;
- thinking about only one solution, towards considering the widest possible and most creative range of options for meeting the parties' underlying needs;
- personalized and often exaggerated demands, towards clarity and precision in describing parties' 'underlying needs' and the range of proposed options.

One area that can play a critical role in encouraging participation and helping to create a less combative atmosphere of collaboration is that of issue framing and communication. Framing has been used in the fields of communication and dispute resolution to help practitioners understand different perspectives of parties in conflict. Frames act as lenses or filters through which people interpret and process information (Lewicki, Gray, & Elliott, 2003). Procedural justice advocates for trustworthy information as well as providing for the opportunity to correct misinformation (Daigle, Loomis, & Ditton, 1996). Obviously, any information presented during a management decision-making process must meet decision makers' needs in terms of timing, content, and form of presentation and be at an appropriate scale for the level of management (Davidson, et al., 2009). However, making sure that information is easily accessible to community participants not only physically but cognitively is a vital step towards creating a fair process and a learning opportunity.

Current literature on resource management strongly confirms the importance of appropriate problem definition or framing—getting the context and questions right before actions are taken (Anderies, Walker, & Kinzig, 2004; Antal & Hukkinen, 2010; Bundy, Chuenpagdee, Jentoft, & Mahon, 2008; deReynier, Levin, & Shoji, 2010; Low, 2010). Failure to ensure that effective problem framing and subsequent actions occur often leads to:

- Stating a problem so diverse interests cannot understand it.
- Stating the problem so it cannot be solved.
- Solving the wrong problem.
- Solving a solution - for example, working on a technical solution for a problem that, at its core, requires a social or political solution.

Issue framing may, in fact, be the most important step towards providing a flexible and favorable environment for communities to exert inherent traits such as social capital and social memory. Social

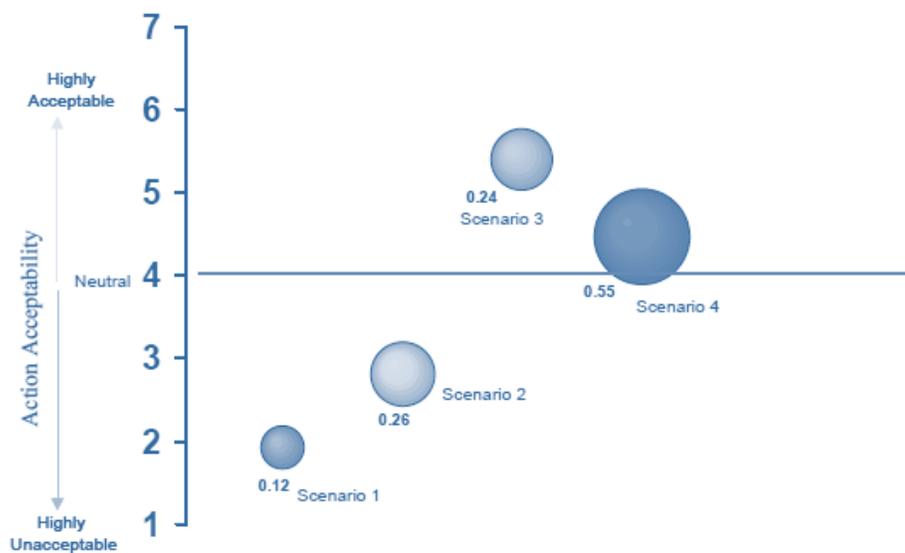
capital refers to the features of social life such as networks, bonds, norms, and trust, which enable participants to act together to pursue shared objectives (Coleman, 1988; Putnam, 1995). Social capital is particularly important in understanding the ways in which collective action is achieved (Ostrom & Ahn, 2003) and can, therefore, be considered central to both the self-organization and adaptability factors of social resilience (Folke, 2005; Pelling & High, 2005). Pretty (2003) identified four features of social capital that are important for collective action: relations of trust, reciprocity, common rules, norms and sanctions, and connectedness in networks and groups. Trust, a core feature of social capital because it enables cooperation, is also recognized as a key component of procedural justice providing further evidence for a relationship between procedure and resilience (N. Jones, Sophoulis, Iosifides, Botetzagias, & Evangelinos, 2009; Leahy & Anderson, 2008). By constructing salient frames and communication strategies that resonate with community members, the issue of encouraging participation becomes less burdensome since interest already exists (Antal & Hukkinen, 2010). It also allows common ground between groups with differing common values to be established, potentially reducing conflict, building societal confidence and ownership of the process of resource management (Rodroquez-Izquierdo, Gavin, & Macedo-Bravo, 2010).

### **3.2.2.2 MEASURING CONFLICT**

Measuring micro and macro conflicts is not a simple concept. Attempting to predict how individuals will perceive different management solutions or scenarios is an important initial component of understanding where conflict is likely to be occurring as well as how it could manifest itself with the community. A variety of tools exist to examine the type of conflict and the subsequent impacts, especially in the field of civil and national combat. However, conflict generated by natural resource management is less well studied. One such tool is The Potential Conflict Index (PCI). PCI builds upon normative theory and is represented by a number, ranging from 0 to 1, based on the distribution of scores on a response scale that includes a neutral point (e.g., highly acceptable to highly unacceptable with a neutral point). The PCI is

based on the difference of the ratio of scores falling on opposite sides of the neutral line, and accounts for how far from the neutral point the scores fall (Manfredo, Vaske, & Teel, 2003). A PCI of zero indicates the least potential for conflict (e.g., 100% of respondents falling on one side of the neutral line) and a PCI of 1 indicates the maximum potential for conflict (e.g., 50% responding highly acceptable and 50% responding highly unacceptable). A hypothetical representation of a PCI graph displays several pieces of information (Figure 9) including:

- Central tendency (means)
- Shape of distribution
- Agreement consensus



*Figure 9. Hypothetical PCI Analysis*

Management actions with a high PCI and a large bubble indicate a high level of potential conflict, whereas management actions with a low PCI and a small corresponding bubble indicate a low level of potential conflict (assuming the implementation of the management action corresponds to the direction of mean response). In Figure 9, Scenario 1 represents a management action that respondents find unacceptable. Further, there is considerable agreement amongst respondents that this scenario is

unacceptable, indicated by the low PCI value. Scenario 4 represents the management action with the most disagreement. Its mean for acceptability is acceptable, however the relatively large PCI value indicates that respondents did not have strong consensus that it was an acceptable management action. PCI offers a direct way of quantifying potential conflict, and can be easily used to examine shoreline change management options for instance.

### **3.2.3 MULTI-LEVEL POLYCENTRIC GOVERNANCE AND ACCOUNTABILITY**

Governance provides the social context that allows collective actions, rule making and institutions for social coordination (Dietz, Ostrom, & Stern, 2003). Society is constructed from a myriad of rules, some formal, others informal such as cultural practices, which determine how people interact with each other and the ecosystems around them. Formal institutions consist of codified rules such as constitutions, laws, organized markets, and property rights, while informal institutions include the rules that express the social or behavioral norms of a family, community, or society (Brunner, et al., 2005; Kauffmann, Kraay, & Zoido-Lobaton, 1999; Leach, Scoones, & Stirling, 2010). Together, these interacting institutions form the governance system that guides how society functions and makes decisions. Governance has been defined as the structures and processes by which people in society make decisions and share power and distribute rights, obligations and authority (Folke, Hahn, Olsson, & Norberg, 2005; Lebel, et al., 2004). This definition must therefore, as Kaufman et al. (1999) show, include i) the processes by which governments are selected, evaluated and replaced, ii) the capacity of the government to effectively formulate and implement sound policies and iii) the interactions of citizens and the state with the institutions that the govern economic and social interactions between them.

Governance, however, can also be defined, using a slightly different emphasis, as a social function centered on steering human groups towards mutually beneficial outcomes and away from mutually

harmful outcomes (Brondizio, Ostrom, & Young, 2009). This definition highlights the role that social capital and social networks play in guiding governance at different scales with both formal and informal structures. It also introduces the need for an adaptability component by stressing the dynamic, complex nature of governance systems required to respond to the costs and benefits of a changing global identity. This definition also demonstrates the connectivity between the different levels of governance, the potential for actions at one level of social structure (e.g. state or regional) to have major impacts on arrangements operating at other levels (Brondizio, et al., 2009) and the opportunity for governance breakdown at one or many levels of the social organizational structure.

The governance of natural resources has been shown throughout time to primarily be a series of power struggles aimed at gaining control over how those resources are allocated. Human history has provided a myriad of examples of cultural and political clashes, including wars and violent conflicts over natural resources of all types. Governments obviously exert an important influence on many of these allocation decisions but they are only one of the many powerful actors that play a role in the governance systems now seen worldwide (Heylings & Bravo, 2007). The influence of other actors, such as indigenous peoples' organizations, non-governmental organizations with environment and development goals, transnational corporations, bodies of international and national law and the scientific community has been growing as globalization becomes more of a reality across the world.

This changing dynamic, where conventional centralized, hierarchical authority is no longer as accepted by society as the only governance solution, has led to innovative institutional arrangements, both within national governments and between governments and society, moving toward more flexible, multi-party arrangements characterized by interdependence among the actors and shared authority (Pimbert & Wakeford, 2001). A variety of collaboration approaches among communities, government, business and other actors (public interest partnerships) have been developed in many countries with the emergence of

movements like Free Trade and initiatives such as the Forestry Stewardship Council. Abrams *et al.* (2003) present two key factors to explain why these new models of governance are emerging:

1. Governments are seeking to implement their policies and programs in a more cost-effective, responsive manner to increase overall social benefits.
2. Citizens are demanding more influence on decisions affecting their lives and, as appropriate, the redressing of past injustices.

A power-sharing continuum has been proposed to describe various models of governance systems for decision making with, at the one extreme, an official state agency vested with unencumbered decisioning power and, at the other end, a local community or private entity (e.g. an indigenous organization, an individual, a corporation, a foundation) with complete control (Borrini-Feyerabend, et al., 2005). Another approach has centered around eight institutional design principles<sup>1</sup> to explain the robustness of governance arrangements for environmental resources at local and subregional levels (Brondizio, et al., 2009). However, there seems to be little agreement on how to actually measure governance in the broader sense (Court, Hyden, & Mease, 2002).

Three specific methodological problems have been identified with using existing country specific data to observe governance as a construct applicable to multiple scenarios. These are: i) ill-defined or broad concepts used to drive enquires about governance systems resulting in reduced research capacity; ii) a lack of viable indicators to measure key governance issues across heterogeneous nations iii) the practice of aggregating measures by combining indicators from different sources to produce an inaccurate representation of the described circumstances (Kauffmann, et al., 1999). In an effort to address these very failings and develop viable cross-country indicators, The World Bank's Development Research Group has constructed six composite indicators of broad dimensions based on several hundred variables obtained

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<sup>1</sup> 1. Clearly defined boundaries; 2. Congruence between local conditions, appropriations and provision rules; 3. Adaptability; 4. Appropriate monitoring; 5. Graduated and implementable success; 6. Mechanisms for conflict resolution; 7. Recognized rights to organize; 8. Nested enterprises

from 31 different data sources (Kauffmann, Kraay, & Mastruzzi, 2010; Kauffmann, et al., 1999). Three basic concepts of governance are examined through these six indicators a) the process by which governments are selected, monitored, and replaced, (b) the capacity of the government to effectively formulate and implement sound policies, and (c) the respect of citizens and the state for the institutions that govern economic and social interactions.

**1. Voice and Accountability (VA)**

- The perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

**2. Political Stability and Absence of Violence/Terrorism (PV)**

- The perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

**3. Government Effectiveness (GE)**

- The perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

**4. Regulatory Quality (RQ)**

- The perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

**5. Rule of Law (RL)**

- The perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

**6. Control of Corruption (CC)**

- The perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

Both the political stability and the control of corruption indicators have limited utility in the context of sea level rise and shoreline change although they do offer a vital insight into the overall context of governance. However, the remaining four indicators offer a general framework from which specific principles can be extracted and operationalized through the lens of social resilience. Observed linkages between governance and the capacity to manage for resilience through "good" governance attributes were initially described by Lebel et al (2004) (Figure 10). This approach implies that some level of governance structure across a range of scales is required before resilience can be realized. Several of these components were echoed by Lockwood et al. (2010) who stated and defined eight principles of "good" governance in the context of natural resource management: legitimacy, transparency, accountability, inclusiveness, fairness, integration, capability, and adaptability (Lockwood, et al., 2010).

There is the potential for a degree of overlap and redundancy in some of the concepts described in the breakdown of the governance component. This can be demonstrated utilizing an example such as accountability. In the backdrop of a traditionally conceived democratic state, the most tangible, and probably most important, accountability relationships are those that exist between the general public and holders of public office and, within offices, between elected politicians and civil servants (Collier & Mahon, 1993; Linberg, 2009; Mulgan, 2000). The concept of accountability has, therefore, conventionally encompassed voting and the mechanisms through which voters can hold elected representatives responsible for their policies and accept electoral retribution as well as how members of the general public can seek redress from government agencies and officials if expectations are not fulfilled (Deleon, 1998; Finn, 1993; Mulgan, 2000; Ostrom, 2010). This could conceivably overlap with indicators such as regulatory quality and government effectiveness as they are described above.

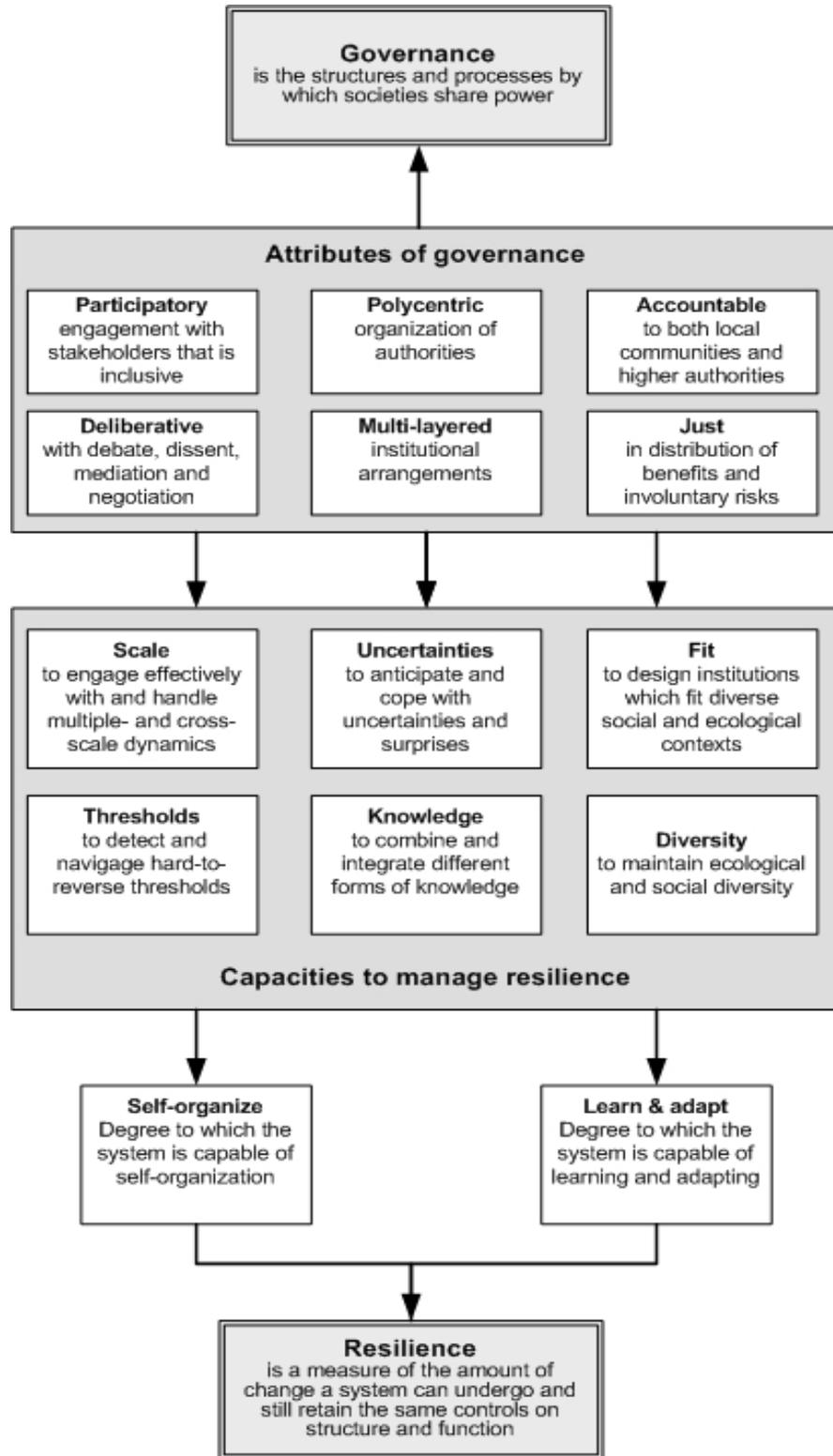
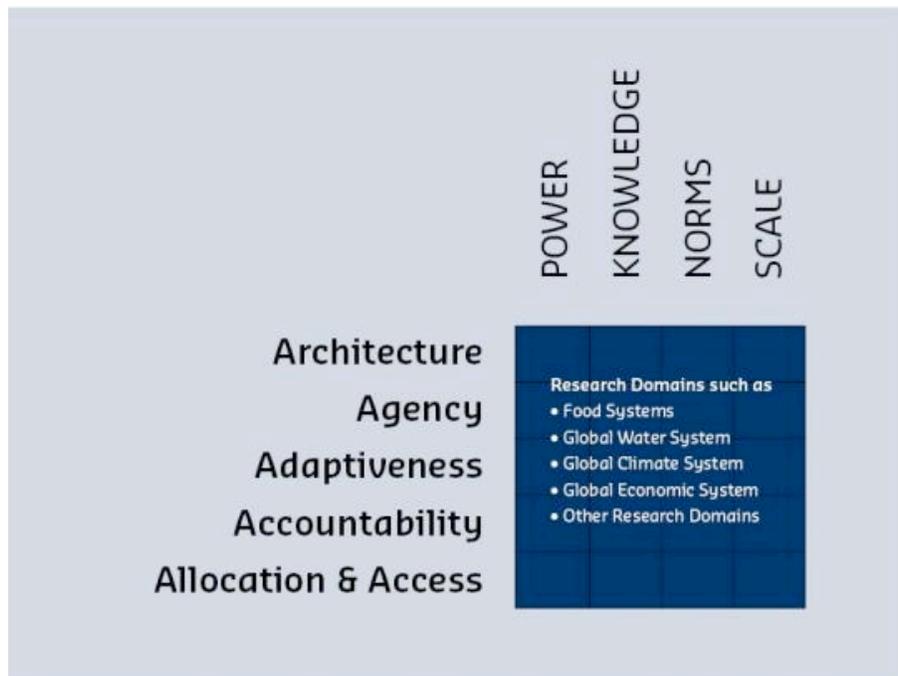


Figure 10. Associations between selected attributes of governance systems and the capacity to manage resilience (Lebel, et al., 2004).

Another approach that has been considered while examining this sub-component of self-organization is the Earth System Governance (ESG) conceptual framework (Dellas, Pattberg, & Betsill, 2011). Earth system governance is defined as “*the interrelated and increasingly integrated system of formal and informal rules, rulemaking systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies toward preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development*” (Biermann et al., 2009). ESG has been organized around five main analytical problems using the cross cutting themes of power, knowledge, norms, and scale to investigate large-scale social issues (Figure 11).



**Figure 11. The Earth System Governance conceptual framework**

The analytical problems have been defined the following ways:

- Architecture relates to the emergence, design, and effectiveness of governance arrangements.
- Agency addresses questions of authority, who governs the earth system and what approaches are taken.

- Adaptiveness describes the ability of governance systems to change in the face of new knowledge and challenges as well as to enhance the adaptivity of social–ecological systems in the face of major disturbances.
- Accountability refers to the democratic quality of environmental governance arrangements
- Allocation and access are focused around justice, equity, and fairness

One aspect of governance that is relevant to all the definitions and conceptualizations discussed above is that of adaptive governance. Adaptive governance approaches recognize cross-scale interactions and promote interactions across organizational levels. Adaptive governance emphasizes the capacity to adapt to changing relationships between society and ecosystems in ways that sustain ecosystem services (Nkhata & Breen, 2010; Olsson, Gunderson, et al., 2004; Sanginga, et al., 2010). By definition the characteristics of adaptive governance must include features of experimentation; new policies for management; novel approaches to cooperation and relationships within and among agencies and stakeholders; new ways to promote flexibility; and new institutional and organizational arrangements (Duit, Galaz, Eckerberg, & Ebbesson, 2010; Lebel, et al., 2004; Young, 2010). Adaptive governance systems can therefore be seen as a key component of self-organization through the encouragement of flexibility, inclusiveness, diversity, and innovation (Abrams, Borrini-Feyerabend, Gardner, & Heylings, 2003; Yang & Wu, 2009). It is also important at this stage to highlight aspects of laws and legality that are key components of the governance realm. For relevancy sake only laws and legal frameworks that apply to the coastal issue of shoreline change will be examined.

### **3.2.3.1 LAWS AND LEGALITY**

Shoreline change is a ubiquitous coastal threat that is difficult for people to perceive, but that has a magnifying effect on other coastal hazards such as flooding, storm surge, shoreline erosion, and shoreline recession. Changing shorelines also threaten the use of and access to public trust resources, water

resources and quality, private property and development, economic stability, historic and cultural resources, agriculture, forestry, and infrastructure (Anthoff, et al., 2010). The legal basis for the three IPCC sea level rise strategy options presented in this document is not always clear, especially due to the fact that the scale of this threat is beyond the scope of anything undertaken before (See Chapter 5). This is also compounded by the fact that multiple institutions and agencies with various, and sometimes conflicting mandates, share responsibility for decision-making in this process (Carriger & Rand, 2001). Shoreline change has the potential to change the delineation of property lines, render infrastructure unusable, and drastically alter the shape and accessibility of existing shorelines (Horstman, Wijnberg, Smale, & Hulscher, 2009), demonstrating the sheer breadth of laws that must be scrutinized in this situation.

At the present time, no coastal or ocean laws in the U.S. directly address climate-induced shoreline change or its potential management, although some laws and their regulations include accommodations to do so. This void is complicated by the fact that state approaches to coastal threats vary greatly in interpretation and implementation. In 2007, two-thirds of the coastal states reported to the National Oceanic and Atmospheric Administration (NOAA) that coastal hazards are a high priority (Coastal States Organization, 2007) and that number has continued to increase over time (Pew Center on Global Climate Change, 2009). This has provided the impetus to embark upon the development of five-year strategies examining the social, environmental, and economic impacts of accelerated sea level rise scenarios that would address flooding, shoreline erosion, and coastal storms. There are, however, several frameworks and laws that must be examined when debating the legal components of this issue.

### *3.2.3.1.1 PUBLIC TRUST DOCTRINE*

The Public Trust Doctrine (PTD) states that public trust lands, waters, and living resources in a state are held by the state in trust for the benefit of all of the people (Baur, Eichenberg, & Sutton, 2007). The

principle also establishes the right of the public to fully enjoy public trust lands, waters, and living resources for a wide variety of uses such as navigation, commerce and recreation (Kalo, Hildreth, Rieser, & Christie, 2007). The PTD implies that lands defined by a boundary such as the mean high tide line must be held in perpetuity by the state and must be accessible and usable by the public. In some states the PTD is a creature of the common law, which means there is no constitutional basis on which to rely for guidance, but in other states the PTD is included in their constitutions. Adding to this complexity is that individual states have the authority to define the limits of the lands that are held in public trust, and by extension the limits or extent of private holdings. Therefore, the PTD varies across states, and this variation is especially notable when considering the historical timeline of state formation across the U.S.

Public trust lands have, over time, been defined by three general tenets:

- All lands under navigable waters
- All coastal lands seaward of the high-water mark
- All lands subjected to tidal influence

Typical public rights that are protected by the PTD include the traditional triad of public trust rights – fishing, navigation, and commerce. However, the right to use and enjoy public waters for recreational purposes, including traveling along the shore, is also protected by the PTD. Despite differences in state interpretation and enforcement of the PTD, there are five main core principles that now prevail in every state in the U.S. (Baur, et al., 2007). Each state:

- Has public trust interests, rights and responsibilities in its navigable waters, the lands beneath these waters and living resources therein
- Has authority to define the boundary limits of the lands and waters held in public trust
- Has the authority to recognize and convey private property rights in its public trust lands, as long as public use and enjoyment is not substantially impaired
- Has a trustee's duty and responsibility to preserve and continuously assure the public's ability to fully use and enjoy public trust lands and waters

- Does not have the power to abdicate its role of trustee

It is within this definition of these principles that the full scope of the PTD becomes apparent. The PTD essentially creates a duty for states to protect the common heritage of their coastal lands and waters for preservation and public use. In effect, it establishes a public easement held by the state over tidelands and submerged lands, including those lands transferred to private ownership (Titus, 1998). Perhaps even more significantly, U.S. courts have defined the PTD to include the preservation of those lands in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat for birds and marine life and which favorably affect the scenery and climate of the area (Eichenberg, Bothwell, & Vaughn, 2010), highlighting the utility of the PTD in terms of modern day coastal management. This approach highlights the overlap between the federal Coastal Zone Management Act and the PTD in terms of coastal resource management and conservation, but also demonstrates the dual management mandate that exists when trying to operationalize either or both of these guiding principles.

Due to concerns such as increased coastal erosion on many beaches and shifting ideas about the suitable protection and management of natural and cultural resources fundamental for the public good, the scope of the PTD is expanding. Courts at all levels are using the PTD not only to protect uses, but also to prevent the overexploitation of resources, including those having natural, scenic, aesthetic, or economic value (Ryan, 2001). As such, local governments must now consider using PTD concepts when developing coastal management plans, designating protected areas, creating or amending development regulations, and designing habitat protection strategies.

The Public Trust Doctrine is, at its essence, a legal mechanism to ensure that the government safeguards those natural resources necessary for public welfare, well-being, and survival. In the context of sea level

rise, the PTD can function as a powerful judicial tool to ensure that the legislative and executive branches of government protect the basic rights held by citizens, such as access to public areas. One of the core principles of the PTD is that the government holds vital natural resources in “trust” for the public. As trustee, the government must, therefore, protect the existing nature capital for present and future generations by not allowing irrevocable harm to critical resources by private interests (Higgins, 2008).

However, as sea levels rise, society at a variety of scales will have to decide whether to defend their coasts or implement policies of retreat. Sea level rise will also increase state ownership rights due to the migration of the mean high tide line. Allowing the protection of private property may be the most popular approach to these issues, either through private or public funded initiatives such as beach nourishment or coastal armouring. It is well recognized that the use of hard structures to protect property and infrastructure may cause irreparable damage to coastal ecosystems, such as beaches (Finkl, Benedet, & Campbell, 2006; Good, 1994; Parsons & Powell, 2001). Unfortunately, the resulting coastal squeeze where the coastal margin is systematically reduced between the fixed landward boundary and the rising sea level is a direct violation of the PTD. A recent federal-court ruling in *United States v. Milner* (2009) held that the mean high tide line should be measured in its unobstructed state as if shoreline protection was not present. *Milner* cited as authority the seminal case of *Leslie Salt Co. v. Froehlke* (1978), in which the Ninth Circuit Court of Appeals held that navigable waters of the United States, in the context of the Rivers and Harbors Act, extend to all places covered by the ebb and flow of the tide to the mean high tide line in its unobstructed, natural state. Shoreline protection that stops water levels and the mean high tide line from advancing landward could therefore be construed as a violation of the PTD.

The implications of shoreline change on PTD are such that the boundaries between public lands and private properties will be redefined gradually by the resulting change (Higgins, 2008). This may result in property owners attempting to protect their investment by resorting to armouring or periodic re-nourishment in order to control land loss. Legal implications will arise for both private and public actions

that encroach on the PTD. Shoreline protection structures often impact lateral public access along the shoreline, a right protected under the public trust doctrine. Hardening of the shoreline often contributes to the narrowing and loss of beaches, as well as inhibiting the public's right to lateral shoreline access. The provisions of the PTD also provide authority to mitigate a wide array of impacts from climate change and sea level rise for projects located below mean high tide. For example, coastal states could require that any new development projects built on tidelands and submerged lands to be designed so they are protected from rising sea levels. Maintenance of public access may require that dredging or filling activities of submerged environments are undertaken in order to protect persons and property from flooding, in order to minimize impacts of changing shorelines.

#### *3.2.3.1.2 COASTAL ZONE MANAGEMENT ACT*

As a response to growing concerns regarding the need for effective management of ocean and coastal resources, Congress passed the Coastal Zone Management Act (CZMA) in 1972. Within the CZMA, the federal Coastal Zone Management Program (CZMP) declares that it is national policy to “*preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation’s coastal zone for this and succeeding generations*” (“Coastal Zone Management Act,” 1972). This long-term environmental sustainability viewpoint is coupled with a utilitarian perspective whereby states are encouraged to develop programs to achieve “*wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development...*” (“Coastal Zone Management Act,” 1972).

The CZMA is administered by NOAA, a branch of the U.S. Department of Commerce. One purpose of the CZMA is to encourage coastal states to manage their coasts for optimum environmental protection while not sacrificing economic development. The CZMA operates, essentially, as a partnership (via contract agreement) between NOAA and participating coastal states to allow mutually beneficial

cooperation across differing scales (Duff, 2001). However, basic responsibility of coastal management was designated to individual states. The CZMA does not mandate state participation, but is instead voluntary and encourages participation by coastal and Great Lakes states through a series of incentives, such as funding and technical assistance. In order for a coastal state to become eligible for these incentives, the development of a comprehensive, state-specific coastal management plan is required. The CZMA has established standards for approval by the Secretary of Commerce of state coastal management programs. This approval is contingent upon states demonstrating “adequate consideration” to numerous issues such as national energy needs, as well as to local interests (Yi, 1982). If a state coastal management plan meets the standards set forth by NOAA and is approved, federal funds would become available to that state to implement its coastal management plan; in return, the federal government would gain a cohesive system of coastal management plans that meets a series of national objectives (Carriger & Rand, 2001; Chasis, 1985).

One important component of the CZMA that provided functionality to the partnership between federal and state governments is the consistency provision. Approval of a state coastal management plan (CMP) by the Secretary of Commerce provides assurances that federal agencies will conduct themselves in a manner that is consistent, to the maximum extent practicable, with that approved plan. As part of this assurance, the consistency provision allows the state to review federal activities that may impact its coastal resources for consistency with its CMP. The consistency review revolves around elements in the approved CMP that act as enforceable policies. This review involves state review of federal activities that will affect coastal resources and uses, and a determination is made whether or not that activity is consistent with the state’s enforceable policies to the maximum extent practicable (i.e., to the extent that the agency has the legal ability to comply with those policies) (Kalen, 2010). A consistency certification is also necessary when reviewing private activities that require federal licensing or permitting. If a disagreement arises over a state’s consistency determination, then the federal agency’s judgment prevails, unless the state mediates and resolves the dispute or otherwise takes the agency to court and wins

(Cheston, 2003).

The CZMA mandates, under §1452 (Section 303-2(B)) that participating states must develop management plans for coastal development that “*minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands.*” It is, therefore, difficult to argue that the CZMA not only legally authorizes, but also commands, coastal states and their coastal programs to develop effective policies in response to the implications of SLR. However, the CZMA does not offer any specific guidance for how to integrate policies and management strategies of this nature into current legislation, preferring instead to rely on individual states to develop their own approach (Moser, 2005).

### *3.2.3.1.3 TAKINGS*

In the U.S., protection of private property rights is as essential as protecting public trust rights. Takings law endeavors to find a balance between protecting natural resources with private property rights. Takings law is invoked when the government imposes regulations on private land that leads to a loss of value to the landowner, and the courts uphold the claim that due compensation must be paid to the claimant (Titus, 1998). The power to take private property is regarded by U.S. courts as inherent, and sometimes necessary, to the nature of sovereignty, requiring no constitutional recognition. The takings clause in the Fifth Amendment to the U.S. Constitution does not remove the power of the Government to take property, but it does limit the Government’s power to take without just compensation, i.e., fair market value of the land taken. As Meltz et al. state: “The Takings Clause is relevant only when the particular interest, expectation, or desired state of affairs which government is adversely affecting is one that can be called “property”.

Two forms of takings are most commonly recognized both in the law and in literature: physical takings and regulatory takings. A physical taking occurs when the entry and occupation of private property is realized by the government itself or by another entity authorized by the government (Meltz, Merriam, & Frank, 1999). A regulatory taking, on the other hand, can be total, temporary or partial in nature, and refers to regulations imposed upon a property to the extent that eminent domain is all but exercised without the government actually removing ownership of the property (Epstein, 1985). While regulatory takings tend to be more relevant in the ocean and coastal arena, and so will be the focus of this section, it is possible that physical takings may also apply when considering a retreat scenario.

Regulatory takings are more difficult to elucidate, especially in instances when a permit or regulation reduces allowable uses, diminishes private property values, or requires the owner to provide a public benefit such as public access. Some state laws specifically prohibit an agency from issuing a permit in a manner that takes private property without just compensation. Nevertheless, takings issues may arise whenever an agency denies a permit, imposes a permit condition, or otherwise restricts the use of private property. This fact could be critical as efforts to address the impacts of climate change and sea level rise become more pronounced. SLR will most definitely have a variety of effects on different locations and different scales. Some communities that are unprotected today will demand the right to protect the shore and private property; in other areas, the cumulative impacts of past erosion, increased frequency and intensity of storms, and sea level rise may outweigh the benefits of increasingly costly and repetitive remedial actions. One thing is certain though, under the current U.S. legal framework, as private property boundaries shift as a result of shoreline change, land could be lost from the private into the public domain, and it is this loss that has the potential to become a source of major conflict as the threat escalates.

The possible introduction of regulatory measures anticipating shoreline change and restricting the options of coastal property owners will no doubt be subject to challenges in court. The majority of these actions

will be based on state and federal constitutional provisions prohibiting a governmental taking of property through burdensome land use and environmental regulations (Higgins, 2008). The assumption is that these changes in regulation will essentially mean the rights of property owners will be subordinate to the government's ability to protect the rights afforded to the public (Titus, 2000). This is, of course, a controversial legal position for coastal resource managers to adopt, despite some apparent justification. As the impacts of shoreline change continue to be realized, coastal infrastructure will become increasingly susceptible to threats, with residential and commercial structures, roads, and bridges becoming more prone to flooding. The effectiveness and integrity of existing seawalls and revetments will be reduced due to the change in environmental conditions that exceed the original engineering design capacity. All these impacts imply that coastal states must develop and adopt policies to manage coastal resources and protect life and property from climate change even if such policies infringe on existing property rights.

#### *3.2.3.1.4 PUBLIC NUISANCE*

Damage that occurs as a result of shoreline change can, in part, be attributed to human actions (Higgins, 2008). This interpretation allows the common law action for public nuisance to be evoked since the law essentially aims to protect public rights/privileges from tortuous injuries and allow claimants to seek recovery for damages suffered (Drabick, 2005). A public nuisance can be defined as an unreasonable interference with a right common to the general public (Kalo, et al., 2007). In determining the degree of nuisance caused by the interference, courts must consider: (1) whether the conduct involves significant interference with public health, safety, peace, comfort or convenience; (2) whether a statute or other law makes the conduct unlawful; and (3) whether the conduct is continuous or has a long-lasting effect, and whether the actor knows the conduct to have a significant effect on the public's rights (Higgins, 2008). Both public officials and private citizens are more commonly using public nuisance claims for damages for loss of coastal property or infrastructure, particularly based on present costs of preventing future

harms (Drabick, 2005).

An example of the use of public nuisance law is *Scott v. City of Del Mar* (1997), when the California Court of Appeals ruled that private coastal armoring encroaching upon the public's land constitutes a nuisance, and that forcible removal is not recoverable as inverse condemnation. The court stated that "the legislature has the power to declare certain uses of property a nuisance and such use thereupon becomes a nuisance per se," (Kremer, 1997). The court upheld such a legislative definition when the City of Del Mar, using its police power, removed a seawall that was declared a public nuisance. This ruling, and the overarching tenant of public nuisance claims law, provides an avenue for governments to simply define coastal protection actions such as armoring in vulnerable locations as a nuisance and remove them without being subjected to takings laws (Higgins, 2008).

### **3.2.3.3 ADDITIONAL LEGAL TOOLS**

One other piece of legislation that is critical when assessing the policy options associated with adaptation to shoreline change is the National Environmental Policy Act (NEPA). Congress passed NEPA in 1969 with the express purpose of ensuring that federal agencies properly evaluated the potential impacts to the human and physical environments of a proposed action, and evaluated reasonable alternatives and mitigation measures, before authorizing that action (Anderson, 1973; Austin, Carter, Klein, & Schang, 2004). A second, and perhaps more vital, mandate of NEPA is the requirement that every federal agency to disclose any identified environmental effects to the public and solicit public comment on the proposed action. NEPA, therefore, ensures a measure of transparency in the decision-making process, accountability for environmental consequences, and access to administrative processes and the courts, both for people directly affected by federal decisions and for the public at large (Karkkainen, 2002).

Managing shorelines in response to shoreline change will require human adaptations across multiple

scales that must be supported by public policy over the next few decades (Moser, 2005). This will ensure that social systems, in the form of communities, institutions and economies, as well as natural systems, such as wetlands, fisheries and coastlines, can continue to function effectively in the face of climate-induced changes (National Assessment Synthesis Team, 2000; Zhang, Douglas, & Leatherman, 2004). Existing laws and management mechanisms must play a key role in the strategic planning process at each scale. Evaluating proposed alternative options in the light of existing legal framework can also help clarify potential areas of conflict or consensus, while helping to set long-term strategic approaches necessary for adapting to these threats.

### **3.2.4 SOCIAL JUSTICE AND RESOURCE ALLOCATION**

Natural resource allocations often involve balancing economic, environmental, legal and technical consideration and are therefore among the most complex and critical decisions made in the policy arena, throughout all levels of governance, down to the individual scale. The increasing demand for natural resources due, in part to population increases especially on the coast, has resulted in the call for, and implementation stricter policies. These policies generally restrict the use of, and access to, many of most widely used resources. The allocation of coastal resources among competing interests, although never an easy decision, is often defined by three factors: 1) the state and renewable properties of resource itself, 2) a cost benefit analysis of the political fallout of the decision and 3) expert opinion of best management practices. However, these allocation decisions are always made in the face of complex overlapping social, political and economic systems, often without a complete understanding of the elaborate and wide-reaching consequences of such decisions.

It is with this in mind that, and with more and more resource allocation decisions having to be made especially in the face of increasing resource scarcity, the issue of justice has become more prevalent. The

underlying principle of justice is that fairness matters and how resources are allocated among individuals, groups and users also matters (P. J. S. Jones, 2009; Rawls, 1971). In fact, the frequency and intensity of claims that natural resource management decisions have been unfair to one group over the other is testimony to the widespread conviction that the principles of justice are gaining traction and influence within the broader societal context (Mutz, et al., 2002). Perceptions of fairness are not only driven by *outcomes* (distributive justice) but are also influenced by the fairness of the *process* used to reach those outcomes (procedural justice).

#### **3.2.4.1 DISTRIBUTIVE JUSTICE**

Distributive justice is concerned with how resources are allocated amongst diverse users and how fair that distribution is. When considered primarily as an ethical issue, distributive justice has been related to three main principles regarding what society owes individuals *in proportion to*: 1) the individual's needs, contribution and responsibility; 2) the resources available to society (including market and financial considerations); and 3) society's responsibility to the common good (Deutsch, 1975; Dogan, 2010). Many studies have demonstrated that a range of factors can influence allocation decisions including situational characteristics, cultural beliefs, relational characteristics and individual attributes (Hegtvedt, 1992; Leventhal, Karuza, & Fry, 1980; Reis, 1984). Although many approaches to the issue of a fair distribution have been discussed in modern literature there are two major approaches that are most relevant to resource allocation, that of equity theory and relative deprivation.

##### **3.2.4.1.1 EQUITY THEORY**

Equity theory essentially attempts to explain relational satisfaction in terms of perceptions of fair/unfair distributions of resources within interpersonal relationships (Adams, 1965). One of the main premises of

equity theory is that an individual will consider himself fairly treated if he perceives the ratio of his inputs to his outcomes to be equivalent to his peers. Adams (1965) stated that individuals realize inequity as discomfort, even if they are the benefactors. This discomfort generally results in behavior aimed at restoring equity such as altering inputs or outcomes or cognitively distorting them or by attempting to distort the comparator's perceptions of inputs or outcomes.

This theory has been operationalized through the proportionality rule, which is designed to test if individuals receive equal relative gains from the relationship under examination.

$$\frac{\text{Outcome A} - \text{Input A}}{\text{Input A}} = \frac{\text{Outcome B} - \text{Input B}}{\text{Input B}}$$

Outcomes have been defined as the perceived benefits from a social interaction or exchange, including material benefits, social status, and intrinsic rewards. Therefore, along the same lines, inputs are the perceived contributions, including material contributions, seniority, education, skills, and effort, to the same interaction or exchange (Messick & Cook, 1983; Peyton Young, 1995).

However, this large assortment of inputs and outputs raises many questions. The issue of how to build consensus regarding relevant input and output variables is obviously key to the potential success of the proportionality rule. However, in addition to what variables to include, the debate about how to measure these variables is ongoing. Possible variables include a large range of market and non-market parameters that are not only measured differently, on different scales, but are also highly incompatible in terms of comparability (Champ, Boyle, & Brown, 2003). Although the vast majority of economic variables will be comparable due to the fact that they are measured in dollar figures the same cannot be said for non-market variables. Most individuals would find it confusing and difficult to measure the value of community spirit in terms of dollars and cents. Attempts to force non-market variables on to an economic scale for measurement have been met with condemnation and controversy (Costanza, 2000).

Equity theory is based around four main propositions:

- Proposition 1:
  - Individuals will try to maximize their outcomes (where outcomes equal rewards minus costs).
- Proposition 2
  - a: Groups can maximize collective reward by evolving accepted systems for equitably apportioning resources among members. Therefore, groups will evolve such systems of equity, and will attempt to induce members to accept and adhere to these systems.
  - b: Groups will generally reward members who treat others equitably, and generally punish (increase the costs for) members who treat others inequitably.
- Proposition 3:
  - When individuals find themselves participating in inequitable relationships, they become distressed. The more inequitable the relationship, the more distressed the individuals feel.
- Proposition 4:
  - Individuals who discover they are in an inequitable relationship attempt to eliminate their distress by restoring equity. The greater the inequity that exists, the more distress they feel, and the harder they try to restore equity.

Although with metrics and variable selection, equity theory has some obvious weaknesses that should be considered when relating it to most coastal issues. One assumption of the theory is that people always attempt to maximize individual gains. This implies that altruism does not exist within a society. Another important assumption of equity theory is that an equitable distribution is a fair distribution, however, when considered within the context of the other allocation norms, environmental and economic conditions, and a social framework, this assumption does not always hold. One final issue with the utilization of equity theory is that it uses a uni-dimensional concept of fairness that emphasizes only the fairness of distribution, ignoring procedure (Leventhal, 1977).

Following the criticisms of equity theory, including that equity cannot always be considered “fair”, three allocation norms were suggested by Deutsch (1975) of 1) equity (proportional to inputs), 2) need (ones with greatest need get more), and 3) equality (everyone gets the same). These allocation norms provided a greater flexibility and utility for relative deprivation and allowed operationalized across multiple disciplines. However, there are many standards of fairness against which we, as individuals, compare outcomes to depending upon which allocation norm resonates (Tyler, Boeckmann, Smith, & Huo, 1997). Defining when each norm should be used is difficult due to the differing values that the full array stakeholders and cultures present in society identify with (Otto, Baumert, & Ramona Bobocel, 2011; Reiff, 2009).

Deutsch (1975) linked preferences for particular norms to the goals that individuals are pursuing at a certain period of time. He identified three main goals as a guiding framework to predict such preferences suggesting that

1. People pursuing economic productivity as a goal will primarily embrace the equity norm
2. People trying to foster enjoyable and harmonious social relationships will tend towards the equality norm
3. People trying to foster personal development and personal welfare will use the need allocation norm as the basic for fairness

#### *3.2.4.1.2 RELATIVE DEPRIVATION*

Three main formulations of relative deprivation have been presented over time frustration-aggression, social equity, and the J curve of revolutions (Crosby, 1976; Davis, 1959). According to Davis' (1959) formulation, an individual who lacks a desired good or opportunity (*X*) experiences a sense of injustice whenever he perceives that individuals similar to himself possess *X*. Davis's theory implies strongly that

the individual who covets  $X$  feels entitled to possess  $X$  himself. The necessary determinants of felt deprivation, then, according to Davis, are that the individual who lacks  $X$  must (a) perceive that a similar other has  $X$ , (b) want  $X$ , and (c) feel entitled to  $X$ . When any one of these elements is lacking, deprivation does not occur.

Runciman added a fourth condition to Davis's three determinants when he stated that the individual must think it is feasible to obtain  $X$  (Runciman, 1966). This fourth determinant provided a distinction between unrealistic hopes, or daydreams, on the one hand, which do not lead to felt deprivation, and reality-based aspirations, on the other hand, which do lead to feelings of deprivation. In contrast to Runciman, Gurr (1970) stated that an individual experiences deprivation, or a sense of grievance, only when he thinks that it is not feasible to obtain  $X$  (Gurr, 1970). He determined that relative deprivation was a function of the following equation:

$$\text{relative deprivation} = \frac{\text{value expectations} - \text{value capabilities}}{\text{value expectations}}$$

"Value expectations" are those goods and opportunities that the individual wants and to which he feels entitled, based on comparisons with similar others (including himself in the past). "Value capabilities" are those goods and opportunities that the individual possesses or thinks that he can possess. Gurr (1970) identifies three patterns of deprivation. The first, "aspirations of deprivation," occurs when value expectations rise while value capabilities remain constant. "Decremental deprivation" occurs when value expectations remain constant and value capabilities decline. "Progressive deprivation" occurs when value expectations rise while value capabilities decline.

Based upon the three main formulations of Davis, Runcimann, and Gurr, and in an effort to simplify the concept, Folger *et al.* (1983) determined that relative deprivation requires a comparison of want (Folger, 1987; Folger, Rosenfield, & Robinson, 1983). Two main types of comparisons can lead to feelings of

deprivation, egoistic deprivation, which occurs when an individual compares himself to others, and fraternal deprivation, which occurs when an individual compares his own reference group to other groups (Tyler, 1994; Tyler, et al., 1997). Central to this characterization of relative deprivation is the choice of reference to which the comparison relates. Individuals with the same outcome objectives can potentially feel satisfied or dissatisfied depending upon that reference point. Folger *et al* (1983) went on to state that five preconditions were needed for relative deprivation to occur. The individual must:

- Want the resource,
- Feel entitled to resource,
- See someone else with resource (or perceive it),
- Decide resource is possible to get, and
- Lack personal responsibility for not having it.

#### *3.2.4.1.3 UTILITY OF DISTRIBUTIVE JUSTICE*

Allocations of resources amongst different user groups are always difficult, usually controversial and often borders on the impossible in terms of fairness. This is caused, at least in part, by differing social values and the variety of standards that people deem acceptable. People are rarely at a loss for an opinion when asked if an allocation of a resource is fair. These opinions are based upon existing moral frameworks that differ greatly depending upon situational factors as well as ethical ones (Rawls, 1971; Tyler, et al., 1997). These opinions also represent a series of tradeoffs that individuals are willing to make. Understanding people's reactions to, and preferences for, different allocation norms and distributive patterns can provide managers with critical insight in root causes of conflict and discontent.

### 3.2.4.2 PROCEDURAL JUSTICE

Procedural justice can be broadly defined as the perceptions of the degree to which decision-making is viewed as just and fair (Rawls, 1971). It is based upon the hypothesis that for participants involved in a decision-making process, the procedures used to arrive at decisions are significant determinants of satisfaction, and consequently separate from the effect of outcomes (distribution) (Lawrence, Daniels, & Stankey, 1997). Research suggests that if those affected by a decision perceive the process to be procedurally just then they have a much greater level of satisfaction with the outcome, irrespective of what that decision means to them as individuals (Murphy, 2009). So, for example, procedures that are perceived as fair by participants might reduce dissatisfaction with unfavorable outcomes, while procedures perceived as unfair might reduce satisfaction with what are otherwise judged as objectively fair outcomes (Tyler & Lind, 1992).

Procedural justice studies from social psychology, which have been performed largely in the context of judicial decision making, have identified some of the factors that contribute to acceptance of decisions made by authorities: voice, being treated with respect by authorities and other participants, perceived lack of bias on the part of authorities, fair treatment of all parties by authorities, and decisions that are responsive to information and that are correctable in the face of new information (Tyler, 1994; Tyler & Lind, 1992). A broader framework for evaluating the justice of procedures was developed by Leventhal (1980) that provides a multifaceted approach to understanding the variety of issues and dimensions that must be considered (Table 4).

One of the key components that shape individual's views regarding the fairness of a procedure is the distribution of control between stakeholders and decision-makers. Two types of control are relevant here: 1) *process control*, which refers to the extent and nature of a stakeholder's control over the presentation of evidence, and 2) *decision control*, which refers to the extent and nature of a stakeholder's control over the

actual decisions made. Often in the case of resource allocation issues, the level of decision control that stakeholders can exert is minimal, which reinforces the importance of process control when considering how to encourage participation in management.

*Table 4. Leventhal's criteria of procedural justice*

<i>Criterion</i>	<i>Description</i>
Control/representation	How much opportunity people had to present their problem or case to the decision makers
Consistency	Equal treatment across people and over time
Impartiality – bias suppression	Lack of bias, honesty, an effort to be fair by suppressing self interest
Accuracy	The use of good, accurate information
Correctability	Opportunity for review of complaints
Ethicality	Moral and ethical values are extended to all

### *3.2.4.2.1 THE ROLE OF PROCEDURAL JUSTICE IN MANAGEMENT*

Recent literature dealing with institutional organization and management has identified four main functions as critical components to effectiveness: conceptualization, development, implementation and review (Davidson, et al., 2009; Lertzman, 2009). It is within each of these functions that components of procedural justice can be defined and pursued. Davidson et al. (2009) identified four elements of good practice that should be applied to each management function in turn:

- Legitimacy of process and participants
- Respectful treatment between people during discussions
- Acknowledgment of people's tendency to make comparisons about natural resource allocations and make decisions based upon self interest
- Prioritization of trust rather than threat /sanctions (reciprocal between individuals involved)

These elements have an obvious crossover with the criteria initially developed by Leventhal and can essentially be mapped onto the Representativeness, Consistency, Impartiality and Ethicality criteria, providing further evidence for the applicability of procedural justice concepts within the management arena, and in fact, that these principles are already in use in certain settings. Natural resource managers should be able to apply lessons learned in one discipline to their own in order to realize the benefits. However, due to the controversial nature of natural resource management and the less rigorously defined boundaries of costs and benefits compared to a self-contained business venture, there are assumptions associated with this approach that must be acknowledged in order to fully determine its usefulness.

In theory, natural resource management is assumed to be value neutral. This is because a management process is tasked with achieving goals and objectives as directed by its societal context. The job of management is to operationalize normative values of society that are reflected in laws, policies, plans, and accepted behaviors (Lockwood, et al., 2010). However, due to agency agendas and identities, the trained incapacities of staff, and the power relations of all the actors involved, it is rarely the case that value neutrality is achieved on the part of the decision controllers (Amend & Gasson, 1996; Gomez-Mejia, Balkin, & Cardy, 2008; Holling & Meffe, 1996). Acknowledgement of this potential issue is a must for transparency and legitimacy. Another major assumption that underlies procedural justice is that a decision making process can be removed from outside influences and act in isolation to achieve a more acceptable procedure. A management process is usually conceived in order to provide for sustainable use of resources and the distribution of benefits within society. This is a goal that can only be achieved by working across ecosystems and institutions. Therefore, despite the fact that the desire to change the way decisions are reached may be a noble objective, without appreciating the larger context of the institutional structure, its real world application may be limited (Hegtvedt & Johnson, 2009). This argument raises the question of how the benefits of a single procedure, no matter how just, can be realized across the communities involved, and if the process itself can be just as important in terms of opportunities as any decisions made.

### 3.2.4.2.2 LIMITATIONS OF PROCEDURAL JUSTICE

Although it is tempting to claim that following a set of pre-determined rules for a procedure, with an acknowledgement of a few assumptions, will enable a more productive managerial environment and lead to more effective resource use, it must be recognized that there are costs associated with this approach as well as benefits. Irvin & Stansbury (2005) presented advantages and disadvantages for community participation in government decision-making (Table 3) and draw the conclusion that evidence for effective participation in environmental management is in short supply. They state that this is probably in part due to the problems inherent in measuring the success of environmental policies that may take decades to be seen to be influencing the environment. One key aspect that adds context to this discussion is the matter of urgency (Antal & Hukkinen, 2010; Cockerill, Daniel, Malczynski, & Tidwell, 2009; Hamilton, 2006; Smith & Tyler, 1996). If the issue under discussion is not considered salient to participants then the quality of the process becomes immaterial.

**Table 5. Advantages and disadvantages of community participation in government decision making (recreated from (Irvin & Stansbury, 2005).**

	Advantages to community	Advantages to government
Decision Process	<ul style="list-style-type: none"> <li>Education (learn from and inform government representatives)</li> <li>Persuade and enlighten government</li> <li>Gain skills for activist citizenship</li> </ul>	<ul style="list-style-type: none"> <li>Education (learn from and inform citizens)</li> <li>Persuade citizens; build trust and ally anxiety or hostility</li> <li>Build strategic alliances</li> <li>Gain legitimacy</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>Break gridlock: achieve outcomes</li> <li>Gain some control over policy process</li> <li>Better policy and implementation decisions</li> </ul>	<ul style="list-style-type: none"> <li>Break gridlock: achieve outcomes</li> <li>Avoid litigation costs</li> <li>Better policy and implementation decisions</li> </ul>

	Disadvantages to community	Disadvantages to government
<i>Decision Process</i>	<p>Time consuming and possibly disengaging</p> <p>Pointless if decision is ignored</p>	<p>Time consuming</p> <p>Costly</p> <p>May backfire, creating more hostility toward government</p>
<i>Outcomes</i>	<p>Worse policy decision if heavily influenced by opposing interest groups</p>	<p>Loss of decision-making control</p> <p>Possibility of bad decision that is politically impossible to ignore</p> <p>Less budget for implementation of actual projects</p>

## CHAPTER 4. CONCEPTUAL FRAMEWORK

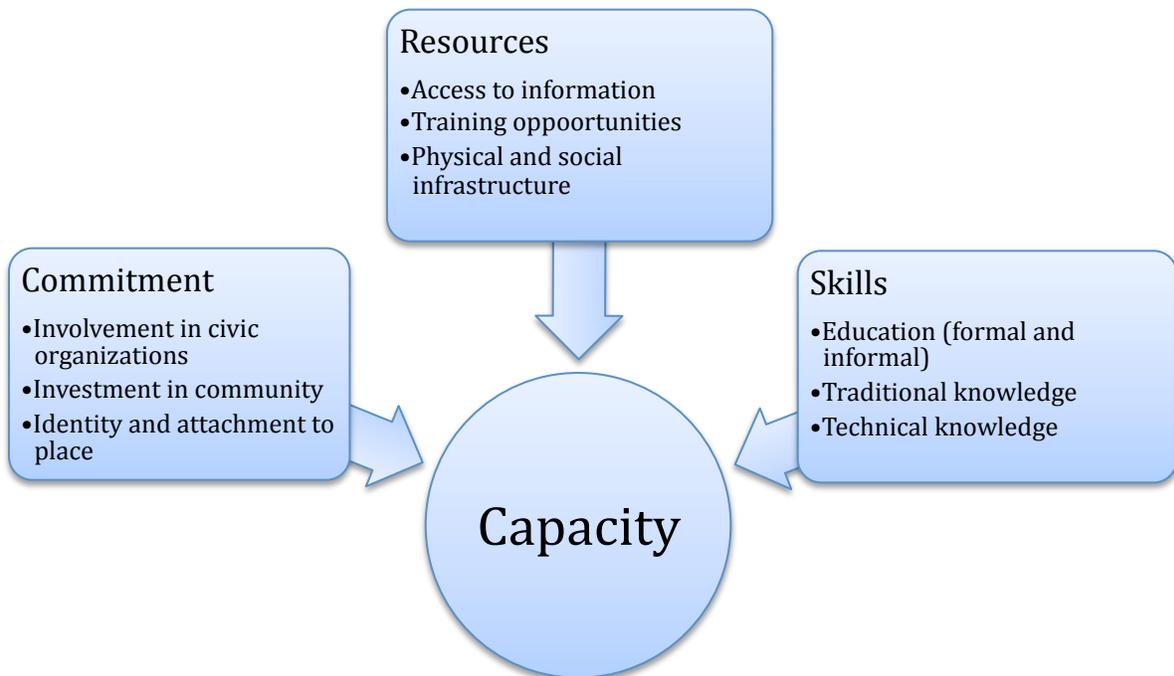
### 4.1 A SELF-ORGANIZATION CONTINUUM

Self-organization represents a series of inherent characteristics that provide individuals the aptitude to coalesce for short and long term post disturbance benefits. As previously described, the realization of self-organization is concerned with a ‘process’ that people go through in order to be better placed to deal with an event in time. Utilizing the presumption that a spectrum of abilities to organize across different scales exists within society allows a mechanism for categorizing individuals into meaningful subgroups to be developed. Using the broad, over-arching definition presented here as a theoretical foundation, it is possible to identify three descriptors, or attributes, that could be used to develop an index that could represent such a continuum: 1) the ability to work with others, 2) the inclination to plan for the future, and 3) the closeness of relationships with members of a self defined community.

These attributes represent the current and potential degree of self-organization that exists within an individual or a group rather than the components of a process. Separating existence and process at this stage, using existence to create an index of self-organization and process to conceptualize and test the utility of the construct, it is possible to avoid the issue of a tautology. Based on the consensus within the literature, individuals with high levels of all three descriptors can be defined as having a high ability to organize in order to cope with potential changes brought about by natural and human induced environmental transformations. This provides the basis for preliminary hypothesis development designed to test differences between the groups generated by the index for each of the self-organization items identified.

## 4.2 SELF-ORGANIZATION COMPONENTS

For the purposes of this study, each of the four components that have been identified as key pieces of the self-organization process has been operationalized using three key characteristics. These characteristics, derived from the literature discussed in Chapter 3, are described in the following conceptual diagrams using a series of measurable parameters (Figures 12-15). It is acknowledged that each parameter could be measured in a variety of different ways across a range of scales, depending upon the coastal issue under investigation. It is therefore important to develop question items that are specific and meaningful to the issue under examination.



*Figure 12. Conceptual operationalization of capacity*

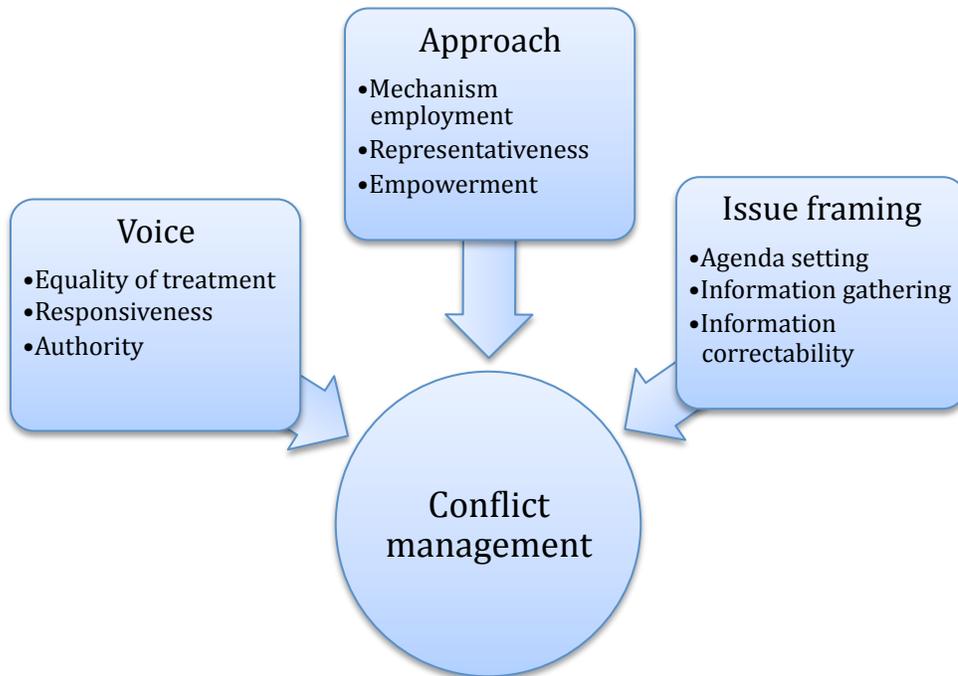
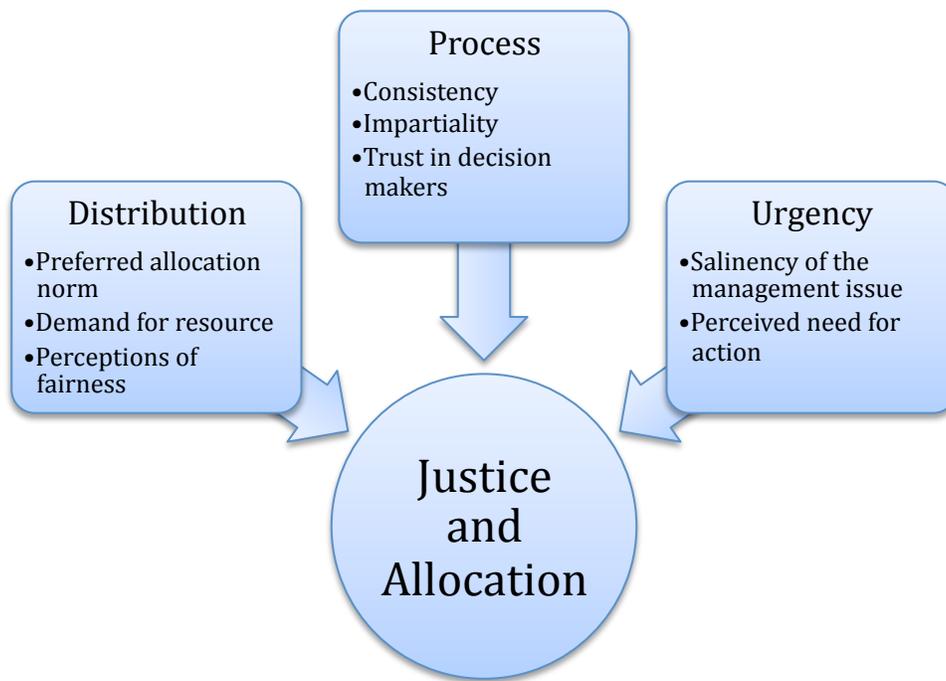


Figure 13. Conceptual operationalization of conflict management



Figure 14. Conceptual operationalization of governance

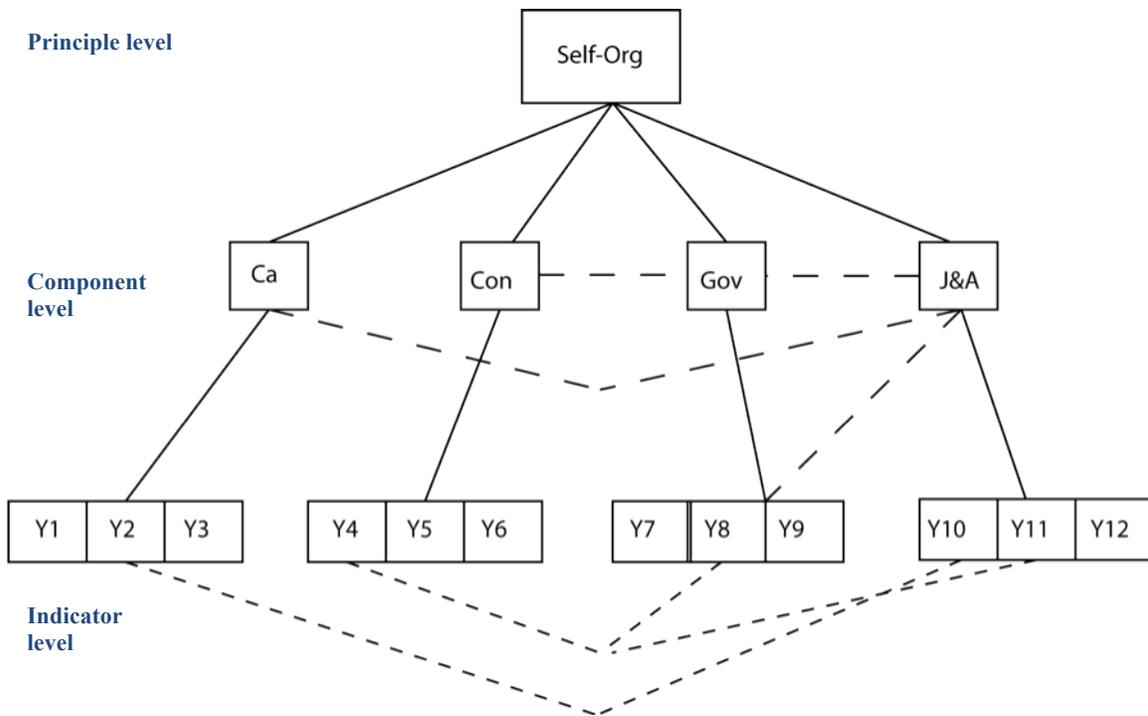


*Figure 15. Conceptual operationalization of justice and allocation*

#### 4.3 PRACTICALITIES OF OPERATIONALIZATION

It was important to the validity of this study that the variables utilized in the methodological application of the self-organization principle were, to every extent possible, uncorrelated and independent. This was especially important since the variables under investigation have been narrowed from a broader concept pool. This suggests that some debate over variable selection would be valid, especially if the suggested model only explains a small amount of overall variance. This variation in variable selection is evident throughout the literature for every social construct incorporated in all of the conceptual models that have been presented in this dissertation. The variable selection for this study therefore focused on measurable constructs that could be collected en masse from one population without the need for multiple sampling strategies or numerous data collection periods.

The point must be made that some natural, and therefore, unavoidable overlap existed between concepts like governance and justice due to the nature of the concepts themselves rather than any issues with the variable conceptualization. As with many social science constructs, theories are inter-related and overlapping. Potential covariance between each level of the overall model of self-organization that has been developed (shown as dotted lines) is shown in Figure 16. However, for this study individual hypotheses were developed and tested using the self-organization continuum as the treatment effect. This limited the impact of possible covariance on potentially significant results at the most disaggregated level (Y1-Y12). No attempts were made to control for this possible covariance at the indicator level.



**Figure 16. Potential covariance within the overall model of self-organization**

Capacity: Y1 – Commitment, Y2 – Resources, Y3 – Skills  
 Conflict Management: Y4 – Voice, Y5 – Approach, Y6 – Issue framing  
 Governance: Y7 – Regulatory quality, Y8 – Accountability, Y9 – Rule of Law,  
 Social justice and allocation: Y10 – Distribution, Y11 – Process, Y12 – Urgency

The issue of covariance became more relevant when considering the option of aggregating the indicators Y1-Y12 to form composite indicators. As previously discussed (See Chapter 2.1.4.1) composite

indicators, although controversial, have potential to be useful as overall benchmarks to compare communities, regions or nations on the same scale (Barnett, et al., 2008; Cutter, et al., 2003). The possibility existed to aggregate individual indicators to component level and ultimately to principle level. However, covariance was then much more relevant to the validity and reliability of the model. The generation of an inter-item correlation matrix through a reliability test would provide a sound basis for which to include or exclude indicators in order to eliminate high correlations (Cronbach, 1951).

#### 4.4 PROPOSITIONS AND HYPOTHESES

The consideration that self-organization represents a series of inherent characteristics that provide individuals the aptitude to coalesce for short and long term post disturbance benefits, and that this aptitude will be found on a continuum of ability within society, allowed a series of propositions to be generated at the component level (Figure 18).

*Proposition One: As level of self-organizational aptitude increases, levels of capacity will also increase*

This proposition was derived from Magis (2010) who argued that there are likely threshold levels necessary for an individual to accomplish certain ends and Goodman et al (1998) who emphasized the role of participation in decision making and action as a critical constituent of benefit derivation.

*Proposition Two: As level of self-organizational aptitude increases, the importance of, and investment in, conflict management will likely increase*

Conflict management is concerned with understanding, analyzing and managing conflicts both before and after they occur. Therefore, as Warner (2000) and Mushove & Vogel (2005) argued, involvement and participation, and by extension investment, in the process of conflict management provides mechanisms to cope with changes in circumstances instead of being isolated and vulnerable by a refusal to engage in the process.

*Proposition Three: As level of self-organizational aptitude increases, the demand for a higher standard of overall governance will also increase*

Using the definition suggested by Brondizio *et al* (2009), governance is a social function centered on steering human groups towards mutually beneficial outcomes and away from mutually harmful outcomes. Therefore it can be argued the engagement in good governance, or a higher standard of governance, would provide a greater opportunity to garner positive outcomes for those involved. This would manifest itself in better coping mechanisms in the face of change.

*Proposition Four: As level of self-organizational aptitude increases, the importance attached to a just approach to resource allocation will also increase*

The underlying principle of justice is that fairness matters and how resources are allocated among individuals, groups and users also matters (P. J. S. Jones, 2009; Rawls, 1971). Therefore this proposition is based on the idea that as competition for resources intensifies so does the importance attached to the process of resource allocation. As individuals strive to coalesce in order to recognize collective benefits the preference for fairness also increases (Mohai, Pellow, & Roberts, 2009; Mutz, et al., 2002).

From these propositions, a series of hypotheses were formulated. Separate hypotheses were developed for each of the indicator items Y1-Y12 (Figure 16). The basic premise for these hypotheses was that

individuals with higher existence (aptitude) level of self-organization on the conceived index, even if self-classified, should exhibit a range of behaviors that differ from individuals who were classified lower on that scale on all of the items under examination. The overarching null hypothesis therefore states that (Ho): *No difference will be found for any indicator between respondents with high or low aptitude level of self-organization.*

For the capacity component items three alternative hypotheses were developed, one for each indicator:

- Ha1(a): Respondents with high aptitude for self-organization will have a greater commitment to their community than respondents of a lower level
- Ha1(b): Respondents with high aptitude for self-organization will have greater access to resources than respondents of a lower level
- Ha1(c): Respondents with high aptitude for self-organization will have a higher perceptions of their personal skill set than respondents of a lower level

For the conflict management component items three alternative hypotheses were developed, one for each indicator:

- Ha2(a): Respondents with high aptitude for self-organization will voice their concerns more readily than respondents of a lower level
- Ha2(b): Respondents with high aptitude for self-organization will demand a higher degree of stakeholder incorporation in the approach to decision making than respondents of a lower level
- Ha2(c): Respondents with high aptitude for self-organization will demand a greater level of participation into defining the issue frame than respondents of a lower level

For the governance component items three alternative hypotheses were developed, one for each indicator:

- Ha3(a): Respondents with high aptitude for self-organization will be more critical of current regulatory quality than respondents of a lower level
- Ha3(b): Respondents with high aptitude for self-organization will be more critical of the level of accountability shown by management authorities than respondents of a lower level
- Ha3(c): Respondents with high aptitude for self-organization will prefer a greater level of autonomy than respondents of a lower level

For the justice and allocation component items three alternative hypotheses were developed, one for each indicator:

- Ha4(a): Respondents with high aptitude for self-organization will favour the “need” allocation more highly than respondents of a lower level
- Ha4(b) Respondents with high aptitude for self-organization will demand a more just process than respondents of a lower level
- Ha4(c): Respondents with high aptitude for self-organization will have a greater sense of urgency to act than respondents of a lower level

## CHAPTER 5. SHORELINE CHANGE

### 5.1 IMPACTS OF SHORELINE CHANGE

A series of underlying geophysical processes help to define the more easily detectable biophysical effects of shoreline change and sea level rise on a coastal region (FitzGerald, Fenster, Argow, & Buynevich, 2008; Leatherman, 2001; Valiela, 2006). These effects tend to be localized and, although dramatic in places, relatively predictable. These processes can result in one or more of the following biophysical responses:

- Land loss by inundation of low-lying lands
- Land loss due to erosion (removal of material from beaches, dunes, and cliffs)
- Barrier island migration, breaching, and segmentation
- Wetland accretion and migration
- Wetland drowning (deterioration and conversion to open water)
- Expansion of estuaries
- Saltwater intrusion (into freshwater aquifers and surface waters)
- Increased frequency of storm flooding (especially of uplands and developed coastal lands).

The social and economic implications of these biophysical effects are broad reaching and difficult to forecast. Societal response to shoreline change is expected to be highly variable and complex across multiple scales (Moser, 2005) . This is due in part to the inherent variety of character displayed by human beings across different socio-economic and demographic ranges, as well as the institutional mechanisms that have been socially established to represent various social values. Social values are certain qualities and beliefs that are shared by a specific culture or group of people. These traits can include but are not

limited to religious, economic, political, and cultural factors (Eagly & Chaiken, 1993). Based upon these limited number of core values, individuals maintain a certain attitude or disposition to respond positively or negatively toward some aspect of the perceived world (Ajzen, 1989; Ajzen & Fishbein, 1972) The term attitude then references not only the act of perception but also the evaluative meaning ascribed to an object in the process. The entire set of attitudes held by a person is therefore a subset of their beliefs, values, and ethical orientations at any given time (Rokeach, 1986)

In the case of shoreline change, values range from the “keep nature in its place” mentality on one end of the spectrum, to the romantic-transcendental preservation ethic on the other (Antal & Hukkinen, 2010). Differences in people’s attitudes towards climate change and sea level rise, as well as possible actions that can be taken, point to a variety of issues including varying degrees of problem awareness, perceptions of risk and urgency, differences in value-based lenses, cognitive frames and integrative complexity, varying motivations, abilities, and constraints to taking actions (Moser & Dilling, 2004). These differences are compounded by the fact that coastal resources provide a wide range of ecological goods and services that are of high social and economic value (Moberg & Folke, 1999). In many cases, the same resource, such as wetland areas, can have high intrinsic value from a biodiversity standpoint while simultaneously having a high extrinsic value by protecting local infrastructure and supporting important industries such as commercial or recreational fishing, or as a location for a marina or a bridge. Due to the increased pressures on coastal resources, management strategies involving a complex set of regulations and use restrictions are often employed to balance the needs of the ecosystem with that of society (The World Bank, 2006).

The dilemma managers face is that environmental and social goals are often developed independently without due consideration for the tradeoffs inherently linked to competing, conflicting objectives (Weinstein, et al., 2007). This is reflected in the “Management Dilemma”, in which there are no solutions to one problem that do not at the same time violate some other management goal or constraint. By not

specifically addressing this management dilemma, which often results in various forms of conflict between stakeholders, managers are left trying to engage in combat conservation. An understanding of these tradeoffs and how stakeholder groups will be affected, and the direction and magnitude of possible conflicts, would provide insight into how best to adapt to shoreline changes. The management choices can no longer be environment versus development, but must strive to achieve more subtle combinations to reach eco-societal goals or norms (Weinstein & Reed, 2005).

As sea levels continue to rise, coastal infrastructure, including residential and commercial structures, roads, and bridges, will become increasingly susceptible to flooding. Moreover, the effectiveness and integrity of protection measures such as existing seawalls and revetments will be reduced, since the change in environmental conditions may exceed the original engineering design capacity. All these impacts imply that coastal states must develop and adopt policies to manage coastal resources and protect life and property from shoreline change even if such policies infringe on existing property rights. Understanding societal responses to this reality, preferences for solutions, and the impact of these potential changes on communities and their coping mechanisms, form a credible vehicle for an examination into the self-organization component of social resilience as it has been conceptualized in this document.

## **5.2 POTENTIAL POLICY OPTIONS**

In the interest of raising awareness of the issue of shoreline change, in particular sea level rise, and presenting viable adaptations, the Intergovernmental Panel on Climate Change (IPCC) identified three options for decision-makers to consider when developing policies on responding to this coastal threat (IPCC, 1996). Each option requires a series of tradeoffs in the distribution of costs and benefits, both among society and between society and the natural environment. However, it must be noted that these

options become more or less feasible depending upon the biophysical parameters of the coastline, the social implications of such decisions, societal reaction to any one of the potential decisions, and the legal structure of the State in which the decision is being made. Aspects that must be considered include parameters such as length and type of affected shoreline, the degree of shoreline development, the percentage of the state population that lives in coastal areas, and the types and relative importance of potentially affected industries (Moser, 2005). The inherent unpredictability of human nature makes planning and decision making exceptionally difficult for all levels of government. The options that the IPCC have presented are protection, accommodation, and planned retreat.

***The Protection*** policy aims to protect the land from the sea so that existing land uses can continue as ‘normal’. Protection is generally accomplished by constructing hard structures or employing soft engineering measures. The first shortfall of a protection policy is that it is generally costly and has limited or finite long-term effectiveness. For example, erected protective barriers may be toppled by storm surge and other extreme weather conditions (e.g. Hurricane Katrina in New Orleans, 2005). This policy essentially attempts to control or operate against natural processes, but this approach may trigger effects detrimental to long-term ecological, social or structural sustainability.

For instance, seawalls may be effective as flood protection, but along an open coast with long wave fetch, wave reflection and scour at the base of a seawall can cause loss of beach in front of the seawall (Kraus & McDougal, 1996). Even along a sheltered coastline, local waves in a storm surge may lead to the failure of a protection structure (The National Academies, 2007). Groynes are effective where there is significant long-shore drift, but they can be subject to bypassing and do not address cross-shore transport losses (Coch, 2009; Hillyer, Stakhiv, & Sudar, 1997). In addition, hard structures usually require regular maintenance schedules, which are often costly. “Soft” engineering methods such as beach nourishment or artificial breakwaters are used increasingly amongst developed countries and offer opportunities to avoid some of the problems associated with hard structures (Hamm et al., 2002). However, these techniques do

require better technical knowledge and continued monitoring for effective performance and are also often very costly.

Despite the shortcomings of the protection policy, it may still be the most viable sea level rise adaptation policy depending on the values of properties along the coastline, protection of cultural heritage, and some coastal resources vital to local and national economies.

**The Accommodation** policy implies that people continue to occupy the land but make some adjustments to properties and activities. The policy involves adjustments such as redesigning of structures (e.g., elevating buildings and strengthening foundations) to minimize the impacts of flooding; investment in zoning and land use policies that encourage only low capital investments on vulnerable lands. Soft approaches are vital to the accommodation policy, and efforts like dyke opening, wetland renewal, dune rehabilitation and beach nourishment to enhance natural resilience, drainage modifications for built up areas that might become inundated and growing flood or salt-tolerant crops are particularly key options. Storm warning, preparedness, and evacuation schemes have also been highlighted as vital to this option (Boateng, 2008).

Accommodation allows wetlands and other natural coastal features to migrate inland through wash-over and therefore avoids the environmental issues that are likely to occur with shoreline protection. It reduces risks without the expense of full protection, but it does not eliminate risk (The H. John Heinz III Center for Science Economics and the Environment, 2000b). Due to the residual risks, accommodation methods alone may not be suitable for densely populated cities and centers of economic activity. However, the measures could potentially be implemented at a community level with greater effectiveness.

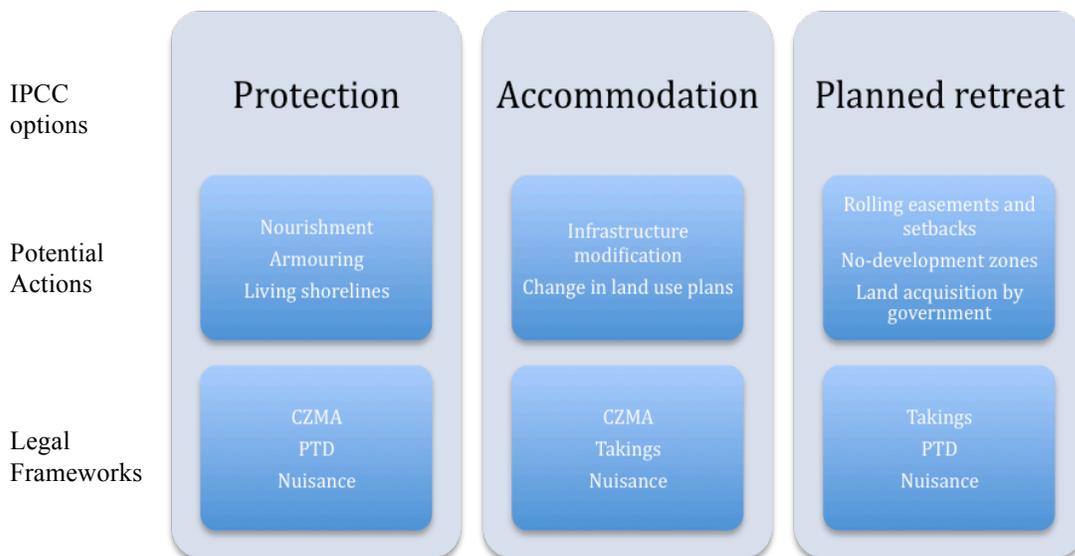
**Retreat** involves either only a partial or perhaps no attempt to protect the land from the sea. In an extreme case, the coastal area is abandoned and coastal landforms and ecosystems are allowed to shift landward.

This policy option is recommended for highly vulnerable coastlines, where the market cost and/or technical difficulty of protecting the coast far exceeds the benefits of providing protection. To be effective, vulnerable populations and infrastructure need to be shifted away from hazardous zones. The potential benefits of this policy include savings on the cost of defenses, habitat and wetland conservation and maintaining aesthetic value of the coast. The opportunity cost of obtaining these benefits includes loss of land, properties and cultural heritage as well as payments of high compensation.

An effective organized retreat plan, rather than simply a ‘do nothing’ option, requires planning and organization within a strong governmental framework (Tol & Verheyen, 2004; Yohe & Neumann, 1997). It also implies that land is available elsewhere to support displaced populations. Implementation requires legislation and regulations that prevent development and possibly settlement on vulnerable coastal lands and properties. It may involve public education, taxation, insurance and zoning policies (Leatherman, 1990). In fact, in areas where reliable data on historical rate of shoreline recession are available, a setback distance may be fixed based on predicted rate of recession into the future. The success of this policy depends on the ease with which vulnerable communities can be resettled inland. In developed countries this appears conditional on the willingness of government and local authorities to pay compensation (Winckel, Vrijling, & van de Graaff, 2008).

Under the current legal frameworks presented in Chapter 3, the three proposed IPCC options are all controversial and difficult for federal and state governments to implement, as well as potentially highly expensive, for state and federal governmental bodies to implement. Specific actions that may be implemented under these options and which legal frameworks are implicated by those actions can be linked together (Figure 17). These linkages allow each option to be examined in turn, and the legal and social implications to be discussed. For instance, the protection option would be implemented through one or a combination of actions such as beach nourishment, coastal and estuarine armoring, or a living shorelines approach. Armoring can be used as an example to demonstrate the complexity of these

linkages in legal terms. As discussed earlier, armouring of the shoreline often leads to a loss of more fragile ecosystems such as beaches, as well as a loss of public access to the shoreline. Loss of the ecosystem violates several of the provisions accounted for under the Coastal Zone Management Act which places preservation and protection of the Nation’s resources on the same level as wise use of the coastal zone. A loss of public access to the resource violates the most basic principles of the Public Trust Doctrine, which establishes the right of the public to enjoy public lands. Attempts to protect private property through armouring could fall afoul of public nuisance laws if infrastructure encroaches on public land, and depending upon state-specific CZMA provisions, may also violate additional state regulations. Therefore, even just employing one technical fix as a part of one IPCC option, publically or privately, can be shown to breach three of the fundamental laws of the land.



*Figure 17. IPCC policy options, actions and implicated legal frameworks*

Both the accommodation and planned retreat options offer similar complexities with violations of takings law being difficult to avoid. The implications of such breaches are simple enough to see with litigation looming against state and federal agencies as well as individuals. In an age of economic downturn, and in the face of rapid environmental change, allowing large percentages of resource management budgets to be

tied up in courts across the land may be considered unacceptable both publically and politically. One other piece of legislation that is critical when assessing the policy options associated with adaptation to shoreline change and SLR is the National Environmental Policy Act NEPA. Congress passed NEPA in 1969 with the express purpose of ensuring that federal agencies properly evaluated the potential impacts to the human and physical environments of a proposed action, and that they evaluated reasonable alternatives and mitigation measures, before authorizing that action (Anderson, 1973; Austin, et al., 2004). A second, and perhaps more vital mandate of NEPA, is the requirement that every federal agency disclose any identified environmental effects to the public and solicit public comment on the proposed action. NEPA, therefore, ensures a measure of transparency in the decision-making process, accountability for environmental consequences, and access to administrative processes and the courts, both for people directly affected by federal decisions and for the public at large (Karkkainen, 2002). NEPA also provides a framework for ensuring community consultation when assessing the policy options proposed by the IPCC.

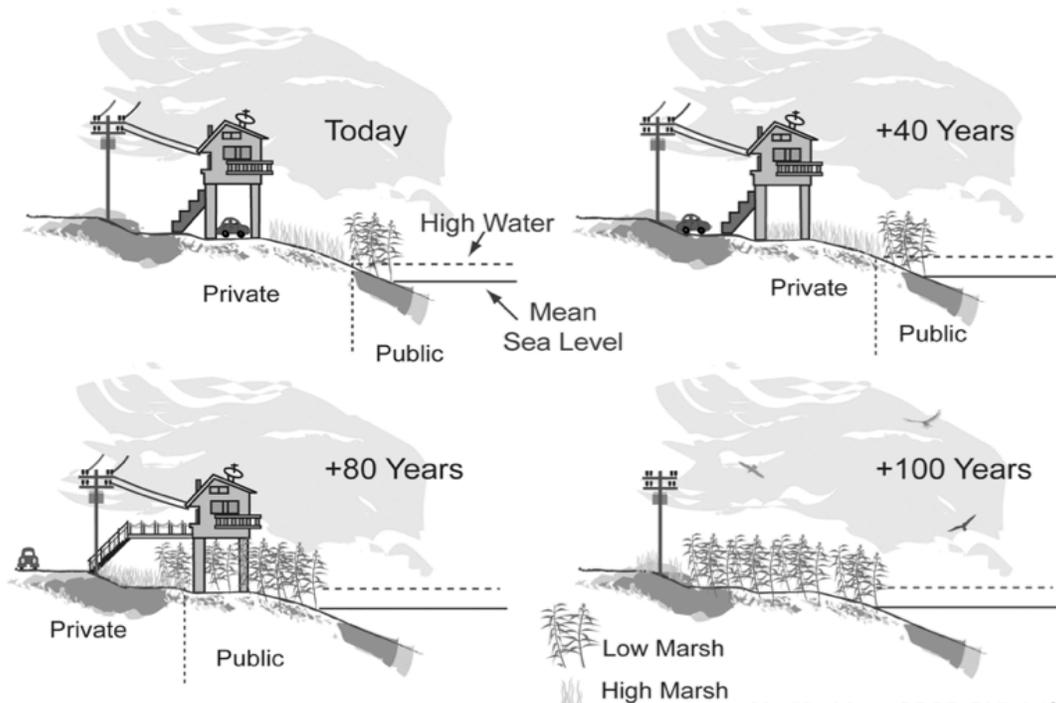
In terms of comparing these options, it could be argued that planned retreat will be more socially disruptive than the protection or accommodation options in the short term. However, in the long run, attempts to protect infrastructure against the rising tide may be more disruptive due to its unsustainable nature, not only monetarily (Landry, Keeler, & Kriesel, 2003), but also in terms of technical fixes (Polome, Marzetti, & van der Veen, 2005). One possible solution to shoreline change that has been strongly advocated for, but remains controversial, despite being extensively employed in many states is beach nourishment and beach stabilization. However, it must be noted that if public funds are used for the nourishment project, then that land falls under the PTD irrespective of previous ownership.

### 5.3 LOCALIZED APPROACHES

One alternative that is gaining traction among coastal states such as South Carolina and Maryland is the establishment and enforcement of rolling easements that provide a formal mechanism for the recognition of the fact that the line between private and state-owned property will shift with rising sea levels. Rolling easements are a specific type of easement placed along the shoreline to prevent private property owners from holding back the sea but allow any other types of use and activity on the land. As sea level rises, the easement automatically moves or "rolls" landward, and can be considered a form of organized retreat (Figure 18). The easement means that shoreline stabilization structures cannot be erected, and therefore sediment transport remains undisturbed allowing tidal habitat to migrate naturally. Unlike setbacks, which prohibit development near the shore and can often result in takings claims if a property is deemed undevelopable due to the setback line, rolling easements place no restrictions on development. The landowner is free to build on their property with the understanding that they will not be able to prevent shoreline change by armouring the shoreline. If sea-level rise threatens the structure, the owner is faced with the decision to either relocate the structure or allow it to succumb to the encroaching sea. Since there are no restrictions on possible land uses, rolling easements have minimal impacts on property values, usually reducing property values by one percent or less (Titus 1998), a concern that is often highlighted as a critical variable in the demand for more permanent shoreline protection mechanisms.

Shoreline change will have a variety of effects in different locations. Some communities that are unprotected today will demand the right to protect the shore and private property; in other areas, the cumulative impacts of past erosion, increased frequency and intensity of storms, and sea level rise, may outweigh the benefits of increasingly costly and repetitive remedial actions. One potential solution open to lawmakers remains the strengthening of the Coastal Zone Management Act to provide adequate

protection for states from litigation under doctrines such as the Takings clause. By mandating specific action requirements in terms of comprehensive land use plans and climate change mitigation strategies, the federal government can create an environment where open policy discussions about solutions can occur. Another approach would be to mandate that environmental impact assessments be conducted in areas of high concern. This would trigger the process under the National Environmental Policy Act and encourage active participation of stakeholders in the decision-making process. Understanding society's preferences for specific management alternatives will help determine potential sources of conflict as well as the embeddedness of existing social values.



**Figure 18. A pictorial of a rolling easement (Source: United State Global Change Research Program)**

This pictorial demonstrates how a rolling easement might work. Since the coastal marsh is allowed to migrate inland freely it would reach the footprint of the house in 40 years. After 80 years the footprint of the house would have extended onto public property since the marsh would have colonized the land and created a need for use modification. After 100 years the house would be removed completely allowing a return to nature.

## CHAPTER 6. STUDY METHODOLOGY

### 6.1 OVERALL APPROACH

The overall premise of this study was that if the degree of self-organization present in individuals was important when dealing with the issues of shoreline change, then those who are organized would be more capable of coping with the effects long term. In order to fully examine self-organization and its utility with respect to shoreline change this study was divided into two main parts. The first section examined potential differences between individuals with high and low organization based on the conceptual frameworks items (see Chapter 4) of self-organization presented utilizing a self-organization index to create meaningful sub-groups. The initial deconstruction of the overall model of self-organization, coupled with the fact that each item was tested separately, lent weight to the possibility of aggregating these items into composite indices after the initial analysis was completed. Conceptually, indices were created at the component level, and then depending on validity testing and internal reliability, an overall index score of self-organization could be developed. This overall index would provide a simple, single figure score for managers to be able to compare selected units of social scale (individuals, communities, counties, states, etc.) over time once baseline data were collected.

The second section used a combination of 5-point Likert scale items and the Potential Conflict Index (PCI) to determine if differences on policy option preferences for dealing with shoreline change existed between individuals with high and low organizational ability. Determining individual preferences for the policy options presented by the IPCC was an important step in allowing local knowledge, attitudes and perceptions to be incorporated into future planning strategies. The three IPCC policy options formed the basis for this section along with an additional “do nothing” alternative (see Chapter 5).

## 6.2 A SELF-ORGANIZATION INDEX

The self-organization index was based on an index developed and validated by Salz et al. (2001), which allowed the categorization of recreationalists into meaningful subgroups based on the four social world characteristics of orientation, experiences, relationships and commitment (Ditton, Loomis, & Choi, 1992; Unruh, 1979). The Salz et al. index utilized theory and an *a-priori* method to generate the index items. For each characteristic, Unruh (1979) described four subworld types of participants: strangers, tourists, regulars, and insiders. Based on these descriptions, Salz and colleagues developed four survey questions that corresponded to Unruh's four characteristics. Each question contained four possible response options, with each option corresponding to one of the four recreation specialization levels (least, moderately, very, highly). Question response options consisted of statements describing a participant's connection to an activity relative to that particular characteristic and were ordered from least specialized (response option = 1) to most specialized (response option = 4). As designed, the least-specialized participants would select option 1, and the most-specialized participants would select option 4. The sum of the four responses (e.g., least specialized:  $1+1+1+1 = 4$ , highly specialized:  $4 + 4 + 4 + 4 = 16$ ) was used to locate recreationalists along the recreation specialization continuum. Salz et al. (2001) used item analysis to examine the internal consistency of their composite index. Bivariate comparisons of the four social worlds items and Cronbach's alpha supported inclusion of all four items in their recreation specialization index. The nature of the inter-item predictability also supported the internal validity of the specialization index.

For the self-organization index, three survey questions have been developed using the identified overarching themes of collaboration, planning, and relationships. Each question contained 4 possible options, with each option corresponding to levels of organization (low, moderate, high, very high). This allowed respondents to be placed along an organization continuum running from a minimum of 3 (lowest organization) to 12 (highest organization). To determine organization level for a respondent, the answers for all three questions were summed to determine a cumulative score. A respondent scoring between "3"

and "6" is considered to be of "low self-organizational ability." Likewise, respondents with scores between "7" and "8," "9" and "10," and "11 and "12" are considered "moderate," "high," and "very high" ability, respectively. The index was tested for internal consistency and validity using bivariate comparisons and Cronbach's reliability analysis (Cronbach, 1951).

The variables that were designed to cover the three overarching themes of self-organization highlighted in the literature are:

1. The inclination to plan for the future (acting in advance to deal with an expected difficulty)

Q. Please indicate how you would best describe your *inclination to plan* for your future

- 1) Very slight. I live in the present; I do not plan for the future at this time.
- 2) Moderate. Planning for the future has some importance to me and I think about it.
- 3) Fairly strong. I recognize the importance of planning for the future and I am taking steps to do just that.
- 4) Very strong. I am actively planning for the future.

2. The closeness of relationships with members of a self defined community– relationships, networks (relationships)

Q. Please indicate how you would best describe your *relationships* with other members of the community you live in.

- 1) Superficial. I really don't know many of the people where I live at all.
- 2) Very limited. I know some people by sight and sometimes talk with them, but I only know some of their names.
- 3) One of familiarity. I know the names of people in my community, and often speak with them.
- 4) Close. I have personal and close relationships with people in my community. These friendships often revolve around doing things together.

### 3. The ability to work with others (collaboration)

Q. Please indicate how you would best describe your own *ability* to work with other people on a difficult problem

- 1) Non-existent. I find it impossible to work with others when faced with a difficult problem
- 2) Very limited. I find it hard to work with others; it requires effort on my part.
- 3) Moderate. I find it fairly easy to work with others when it is required
- 4) Good. I find it easy to work with others. I am very much a team player.

## 6.3 QUESTION ITEMS

Taking into account the overall model of self-organization presented in Figure 18, specific question items were devised in order to operationalize each component: capacity, conflict, governance and social justice and allocation. In addition to concept specific questions, respondents were asked about demographic parameters including age, gender, race, education and household income in order to provide a description of the respondent population. Situational parameters including resident status, length of residency and nativity provided context and anchoring for the respondents as well as for the concepts being tested. All question response options were ordered from strongly disagree (response option = 1) to strongly agree (response option = 5) along a 5-point Likert scale, although when relevant a sixth option of “don’t know” was added. For all of the items presented here it was important to clearly define the terms such as “shoreline change” in order to anchor the respondents.

### 6.3.1 CAPACITY

#### *Y1 – Commitment*

Commitment was operationalized initially in terms of community ties and so drew heavily on the situational parameters. Additional questions including property ownership and current involvement in civic organizations provided further context of commitment to a specific community. In terms of specifically operationalizing this component for the model, four main items were asked of each respondent as shown below. These questions were designed to cover the three aspects of commitment that were highlighted in the literature review portion of this study.

1. I feel a sense of belonging to this community
2. I think that it is important to be involved in local organizations
3. I do not think it is important to invest my time in local events
4. Local issues do not concern me

The current level of involvement in a range of typical civic organizations was gauged using the following question:

**Are you currently involved in any of the following organizations in your community? (Please circle all that apply)**

- |                                 |                                    |
|---------------------------------|------------------------------------|
| 1. The Chamber of Commerce      | 2. The Economic Development Office |
| 3. A local tourism organization | 4. A local political organization  |
| 5. A local environmental group  | 6. A local school board            |
| 7. A church group or program    | 8. A local historical organization |
| 9. Other (please list) _____    |                                    |

#### *Y2 – Resources*

The definition of resources used for this conceptualization drew upon the range of social resources discussed as central to Hobfoll's Conservation of Resource Theory (see Chapter 2) (Hobfoll, et al., 1990).

Therefore, personal characteristics like knowledge levels and experience, along with financial capabilities were encompassed in this indicator. One assumption that is made at this point is that respondents who were involved in civic organizations or who participate in a shoreline management process will have a greater level of knowledge, and therefore more resources, at their disposal. For the model, this component was operationalized using the following five items.

1. Local authorities have all the resources necessary to be able to manage the shoreline effectively in my county (financial, authoritative, legal)
2. My community would be capable of protecting our shoreline if only we were allowed to do so
3. Information regarding changing shorelines is easily accessible in my county (e.g. flood maps, erosion charts, land-use plans)
4. Current North Carolina laws inhibit my community's ability to protect our shoreline from change
5. The raw materials necessary to respond to shoreline change are difficult for me to obtain

### *Y3 – Skills*

The skills indicator was conceptualized using not only formal and informal education as foundation but also incorporating concepts of leadership and communication that have been shown to developing coping strategies (Kelly, 2004; Yohe & Tol, 2002). A separate question designed to determine what the highest level of education respondents have achieved was included in the instrument. The ability to interpret management actions and legal mandates concerning shoreline change was also considered. For the model, this component was operationalized using the following four items:

1. It is easy for me to become competent with techniques and technologies available for dealing with shoreline change

2. I do not understand the federal and state laws that define what I can do to protect my personal property from changes to the shoreline
3. I can explain the scientific arguments for and against shoreline change to other members of my community
4. I think I could be a leader in my community if it comes to dealing shoreline change issues

One item “My community would be capable of protecting our shorelines if only we were allowed to do so” is relevant to both the resources and skills indicators of the capacity component. In order to avoid compounding this variable in the data analysis, and essentially double counting the results, the item was only used as an item for the resources indicator.

The level of formal education achieved by the respondent was determined by using the following question:

**Which category best describes the highest level of education that you have completed?**

- |  |   |                              |
|--|---|------------------------------|
| <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> </ol> | <p>Did not complete high school</p> <p>High school diploma/equivalency</p> <p>Associate’s/ two year degree</p> <p>Bachelor’s/ four year degree</p> <p>Graduate degree</p> | <p>_____ Grade completed</p> |
|--|---|------------------------------|

**6.3.2 CONFLICT MANAGEMENT**

*Y4 – Voice*

The voice indicator posed several problems in terms of its placement within the overall model. As demonstrated in the literature review section of this document, voice can be conceived as an element of procedural justice, which would place it in the justice and allocation component. However, there is also

an argument that suggests “voice” has a conceptual home within a governance framework, especially under the context of democracy. For the purposes of this study, with the recognition that some covariance might exist between latent concepts involved with this indicator should be controlled for during data analysis, voice was housed in the conflict management component. It was operationalized using the following four items:

1. It has been easy for members of my community to raise issues of shoreline management with local authorities
2. I seek out formal opportunities to voice my concerns about shoreline management
3. I feel like community members are not listened to regarding how to deal with shoreline change issues
4. People in my community feel like they have been successful in getting their concerns about shoreline management heard by local authorities

#### *Y5 – Approach*

The approach indicator focused on how involved respondents feel they were incorporated into the process. Involvement and empowerment have been suggested as proxies for conflict management due to the fact that they increase ownership of the final decision (Leahy & Anderson, 2008; Murphy, 2009). Opposite mechanisms on the conflict approach spectrum were also used as key variables for this indicator (Thomas & Kilmann, 1974; Warner & Jones, 1999). For the purposes of this study, it was operationalized using the following four items:

1. The people involved in decision making want to make sure that the majority of people are in agreement on how to proceed with shoreline management
2. I feel as if I have had a particular management approach to shoreline change forced upon me

3. There should be more opportunities for community members to be involved in decisions about shoreline management
4. It is easy to become formally involved in the discussion regarding shoreline management in my community

#### *Y6 – Issue framing*

The issue-framing indicator provided an opportunity to examine the range of opinions on shoreline change represented in this study. It was also used to determine the transfer of information between the community members and decision makers (Lewicki, et al., 2003). For the purposes of this model, it was operationalized using the following five items:

1. People in my community spend a lot of time discussing what shoreline change actually is
2. There are many opinions about what alternatives we as a community have when it comes to managing of shoreline
3. I do not believe the information presented by the people in charge of shoreline management
4. I want more opportunities to correct inaccurate information about shoreline change
5. There are few opportunities for people in my community to add new information into the decision making process about shoreline change

### **6.3.3 GOVERNANCE**

#### *Y7 – Regulatory quality*

This indicator provided the opportunity to gather information on respondent's perceptions of the effectiveness and credibility of shoreline policies that are currently in place. It was conceptualized as an

avenue to investigate social values regarding property rights and public trust. For the purposes of this model, it was operationalized using the following four items:

1. Local authorities are implementing regulatory decisions with respect to shoreline management that I do not agree with
2. Current laws that deal with shoreline change are contradictory
3. Overall, protecting public property and beaches should be of higher priority to management agencies than protecting private property
4. The laws that are in place for shoreline management are not sufficient to deal with the issue of shoreline change

#### *Y8 – Accountability*

In the backdrop of a traditionally conceived democratic state, the most tangible, and probably most important, accountability relationships are those that exist between the general public and holders of public office and, within offices, between elected politicians and civil servants (Linberg, 2009; Mulgan, 2000). Accountability has also been used as a metric to discuss the extent to which governments pursue the needs of the general public, i.e. accountability as responsiveness (Finn, 1993). The term can also be applied to dialogue between citizens irrespective of any authority or subordination between the parties involved (Ostrom, 2010). For the purposes of this model, it was operationalized using the following five items:

1. I feel like shoreline change issues are not honestly discussed by the local authorities
2. Local authorities are responsive to the concerns of my community when it comes to shoreline management
3. Local authorities responsible for shoreline management take into account the input I provide

4. Local authorities are serious about involving community members in the process of shoreline management
5. Residents of my community have no responsibility to participate in the process of shoreline management decision making

#### *Y9 – Rule of law*

The legal framework under which a society is governed creates important boundaries for self-organization. It is, therefore, important to determine how respondents view that legal framework and the power differentials that are created by the current system. The rule of law indicator was conceptualized to do just that with the premise that it would only be possible to get a broad overview rather than specifics regarding particular Acts and Laws. For the purposes of this model, the rule of law indicator was operationalized using the following four items:

1. I think the state authorities have much more power to decide on shoreline management approaches than the federal government does
2. Authorities in my county are dictating the local approach to shoreline management
3. I believe I should be allowed to protect my personal property from the effects of shoreline change by whatever means I feel necessary
4. I feel that new federal laws to deal with shoreline change must be put in place

### 6.3.4 JUSTICE AND ALLOCATION

#### *Y10 – Distribution*

The distribution indicator focuses upon multiple scales of resource allocation and preferred allocation norms (Deutsch, 1975; Otto, et al., 2011). For the purposes of this model, it was operationalized using the following four items:

1. People who cannot afford to protect their property from shoreline change should receive more help from state and federal authorities than those who can afford to
2. We all pay taxes, so we are equally deserving of some financial assistance to protect our property from shoreline change
3. People with more expensive houses should contribute more to protect their own property from shoreline change
4. The state of North Carolina is not getting sufficient federal funds to deal with shoreline change compared to other states

#### *Y11 – Process*

The process indicator was the most difficult indicator to conceptualize in terms of maintaining independence. As demonstrated in Figure 16, there is natural co-variation with both the voice and the accountability indicators as well as an undeniable overlap with the governance component. Therefore, a broader overview of the process has been taken when conceptualizing this indicator. For the purposes of this model, it was operationalized using the following six items.

1. Local authorities will not listen to anything members of my community have to say because they have already made up their minds on how to manage the shoreline

2. I do not trust the people in charge of local management decisions to act in the best interest of the public when it comes to shoreline management issues
3. The decision-making process of how to deal with shoreline change is unfair
4. Everyone's opinion is of equal importance when it comes to deciding the best alternative for shoreline management
5. The people who are least able to recover financially from shoreline change are adequately represented in the decision making process
6. People with more expensive properties should have a greater say in the process of shoreline management than those with less expensive properties

#### *Y12 – Urgency*

Gauging the saliency of the issues of shoreline change and sea level rise was a key component of this study. Determining the issues' resonance among respondents provided context for exist levels of participation and conflict surrounding allocation of resources (Chaskin, 2001; Meyer, 1994) For the purposes of this model, the urgency indicator was operationalized using the following five items:

1. Natural changes to our shorelines will not impact my community's way of life in the foreseeable future
2. My family is already planning for shoreline change
3. More needs to be done to protect my coastal county from shoreline change
4. It is important to me personally that we do more to deal with the issue of shoreline change
5. I feel as if I will be fully able to deal with any issues that shoreline change will bring in the future

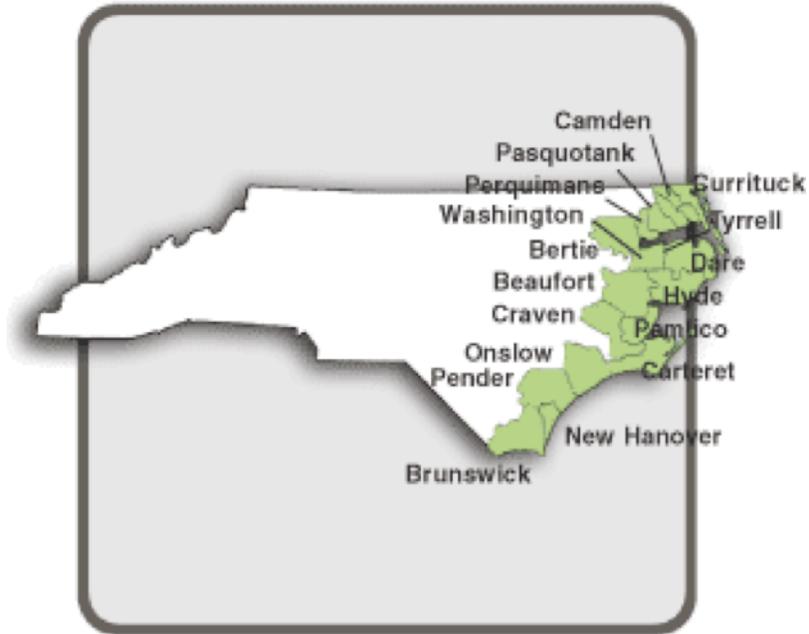
## 6.4 STUDY LOCATION

This study was conducted in the eastern part of the state of North Carolina, which not only lays claim to over 300 miles of coastline but also contains the largest estuarine system of any state along the Atlantic coast of the United States, encompassing approximately 6,000 miles of tidal shoreline (Feldman, 2008). Assessments of North Carolina's estuarine regions have categorized the coastal region in two principle geological zones: the Northern Coastal Province (NCP) and the Southern Coastal Province (SCP) (Riggs & Ames, 2003). The NCP, located between Cape Lookout and Raleigh about 160 miles northwest of the cape, includes the Outer Banks and most of the land bordering the Albemarle and Pamlico Sounds. It is characterized by gentle slopes, three major and three minor inlets, and long barrier islands with a moderately low sediment supply, compared to barrier islands worldwide (Riggs & Ames, 2003). The SCP encompasses the remainder of the state's coastal zone typified by steeper slopes, an even lower sediment supply, short barrier islands, and numerous inlets (Climate Change Science Program, 2009). One key descriptor that helps to illuminate the risk of shoreline change to the coastal regions of North Carolina is that approximately 30% of the Albermarle-Pamlico Peninsula is at an elevation less than 1m above sea level (Poulter, et al., 2009).

Shoreline change has the potential to have significant socioeconomic impacts across a large geographical range and North Carolina in no exception. Sea level rise could have major impacts on agriculture, fishing, development, tourism, transportation, water supplies, and wastewater. As beaches narrow and buildings become threatened, property values and coastal tourism are expected to decline (Bin, Dumas, Poulter, & Whitehead, 2007). Estimates show that a rise of 80 cm by 2080 could result in property losses of \$6.9 billion in four NC counties alone (Dare, Bertie, Carteret and New Hanover) and another \$3.9 billion in lost recreation benefits (2% discount rate, 2006 USD) (Bin, Crawford, Kruse, & Landry, 2008; Bin, Kruse, & Landry, 2008). In recognition of the threat, North Carolina currently requires any new

development to be set back from the ocean by 30-60 times the average annual erosion rate, or a minimum of 60 feet depending on the project (Climate Change Science Program, 2009; Poulter, et al., 2009). Setbacks are also in place along estuarine shorelines, with a required minimum of 30 ft and restrictions on development with 75ft of the shoreline (Feldman, 2008). There is currently state legislation in place that bans most permanent shoreline armouring and the construction of hard structures on the oceanfront although the recently passed NC Senate Bill 832 does allow the construction of a limited number of terminal groins at inlets or “on an isolated segment of shoreline where it will not interrupt the natural movement of sand” (General Assembly of North Carolina, 2009).

Due to the nature of the issue at hand and the potential far-reaching consequences of shoreline change, the respondent universe for this data collection effort had the potential to be the entire population of North Carolina, as well as second homeowners and semi-permanent visitors to the state. This would have included, at a minimum, a sample frame of approximately 9,535,483 individuals (United States Census Bureau, 2010). However, since the goal of this study was to understand the perceptions of coastal residents, the population of interest was narrowed to that geographic area. Current estimates showed the coastal population of North Carolina to be approximately 980,728 (United States Census Bureau, 2010) across twenty coastal counties and encompassing 169 ZIP codes (Figure 19).



County	Population	ZIP Codes	County	Population	ZIP Codes
Beaufort	47,759	9	Hertford	24,669	6
Bertie	21,282	8	Hyde	5,209	5
Brunswick	107,431	13	New Hanover	195,085	16
Camden	9,980	4	Onslow	177,772	14
Carteret	66,469	17	Pamlico	13,144	10
Chowan	14,793	2	Pasquotank	40,661	3
Craven	103,505	12	Pender	52,217	7
Currituck	23,547	14	Perquimans	13,453	4
Dare	33,920	14	Tyrrell	4,407	1
Gates	12,197	7	Washington	13,228	3

Figure 19. Coastal counties of North Carolina: Locations and 2010 census populations (Source: [http://water.epa.gov/type/oceb/beaches/2006\\_nc.cfm](http://water.epa.gov/type/oceb/beaches/2006_nc.cfm))

## 6.5 METHODS

### 6.5.1 SAMPLE FRAME

This population size, however, still presented an unreasonable and unfeasible sample frame to work with. In order to develop a more practical sample frame, focus was placed on four coastal counties that were considered to be highly vulnerable to shoreline change with the greatest exposure to the Atlantic Ocean (Riggs & Ames, 2003). The chosen counties were geologically similar, close in proximity to each other, and all encompassed by the Outer Banks barrier island system (Table 6). It is acknowledged that

attempting to ensure a fully representative sample across the four chosen coastal counties was problematic. However, since the principal focus of this dissertation was conceptual model development and testing, the primary objective in selecting a sample was to obtain a large enough number of respondents for analysis. Consequently, a representative sample of residents across the four chosen counties in North Carolina was unnecessary. Nonetheless, in order to maximize the utility of the data collected and provide the option to analyze the results at multiple scales, a stratified random sampling strategy was employed. The sample frame was therefore be defined by ZIP codes with the four counties that boasted a direct coastal boundary. ZIP codes were coded with integer numbers and selected using a random number generator for inclusion. Three ZIP codes were selected for each county.

*Table 6. Distribution of sample frame across North Carolina coastal counties*

County	ZIP codes used	Sample population
Carteret	3	30,319
Pamlico	3	4,999
Hyde	3	9,802
Dare	3	19,242
<b><u>Total</u></b>	<b><u>12</u></b>	<b><u>64,362</u></b>

### 6.5.2 SAMPLE SIZE

Even though the data collected during this study was be analyzed as one population, the main concern over sample size is power. The power of a statistical test is the probability of correctly rejecting a false hypothesis. In more practical terms, it is the probability of detecting a change or difference in a specific variable in the sample when that change or difference actually occurs in the population. The minimum power usually considered acceptable for hypothesis testing is 0.80 (Kirk, 1982). This, in conjunction with confidence level of 90%, suggests a minimum number of usable returned surveys of 775 for the defined

population of 64,362. In order to achieve this, based upon similar research employing the same methods (Poole, Young, Paterson, & Loomis, 2010), a 30% response rate will be assumed (Table 7). The list of residential addresses across the four counties was obtained from a national mailing company that provides data and related services for direct mail campaigns. Due to this approach it is assumed that up to 10% of addresses obtained will be unusable due to factors beyond control, such as emigration or death of the intended respondent.

**Table 7. Total population and expected response rates**

	Sampling Totals
Estimated Population	64,362
Number of Contacts Purchased	2,860
Number of Usable Postal Addresses	2,600
Expected Survey Response Rate	30%
Usable Surveys Obtained	780

Since this was a random sample two main assumptions have been made, 1) the sub-sample at the county level will also be random and 2) non-deliverables will be randomly distributed throughout the population and amongst the four counties. The sample was stratified across the selected counties based on percentage of the total population of interest within the county that each ZIP code represented (Table 8).

*Table 8. Distribution of surveys throughout the four coastal counties of North Carolina*

County	ZIP	Population	Number of surveys distributed (Total = 2,860)
Carteret	28570	18,364	433
	28516	10,430	246
	28531	1,525	36
		<b>Total = 30,319</b>	<b>Total = 715</b>
Pamlico	28510	1,423	204
	28571	2,498	357
	28556	1,078	154
		<b>Total = 4,999</b>	<b>Total = 715</b>
Hyde	27960	948	166
	27855	5,972	324
	27824	1,561	225
		<b>Total = 8,481</b>	<b>Total = 715</b>
Dare	27949	6,088	241
	27948	9,201	364
	27959	2,771	110
		<b>Total = 18,060</b>	<b>Total = 715</b>

### 6.5.3 SURVEY DESIGN

The survey instrument consisted of 34 separate questions, formatted into a 12-page booklet (Appendix 2). Several questions had multiple parts in order to fully examine all the concepts under investigation. The majority of the questions in the survey instrument were closed-ended; however, respondents were be given the opportunity to express their opinions via open-ended questions as well. The survey instrument was developed from existing literature, from consultation with faculty of The Institute for Coastal Science and Policy, and from studies previously undertaken by the Human Dimensions Research Unit of East Carolina University (D. K. Loomis, Anderson, Hawkins, & Paterson, 2008; D.K. Loomis, Poole, & Paterson, 2009; Poole, et al., 2010).

#### 6.5.4 DATA COLLECTION

Data collection for this study took the form of a mail back survey distributed using the procedure recommended by Sallant and Dillman (1994). The Sallant-Dillman method is most commonly utilized when cold-contacting potential respondents. As with the Dillman Total Design Method, personalization and repeated contacts were used to increase the likelihood that a recipient will respond to the questionnaire. The major difference between the Sallant-Dillman method and the Dillman Total Design Method is the inclusion of a signed, pre-notice letter before a survey packet is distributed. This method provided an opportunity to not only remove erroneous addresses from the developed database but also to encourage initial respondent buy-in and maximize response rates.

The Total Design Method advocates a personalized approach to make sure that potential respondents feel that the research project is legitimate and that they are truly important to the success of the project. First, the recipient received a hand-signed letter notifying them that, in about a week, they would be receiving a survey in the mail. The letter stressed the importance of their participation and included contact information in the event they had questions or concerns prior to receiving the survey. One week later the recipients received the survey packet, which included the questionnaire, a business-reply envelope and a cover letter reminding the recipient of the purpose of the questionnaire. One week later, a follow-up reminder post card was sent to all initial survey recipients; this postcard also served as a thank you for those who had already replied. A second letter and questionnaire was sent out four weeks after initial mailing. Respondents were tracked through a unique identification number to guarantee that a potential respondent not receive unnecessary correspondences. Since this study was primarily concerned with model development conducting a non-respond bias test was considered unnecessary and therefore not performed.

### 6.5.5 DATA ANALYSIS

General demographic characteristics of the respondents were analyzed to provide a holistic picture of the collected dataset, and in order to place results from the hypothesis tests in context. This was achieved through the generation of descriptive statistics of demographic attributes of the respondents including gender, race/ethnicity, education level and household income. Tables and graphs were used to illustrate differences between the sub-groups of respondents depending upon their self-classification on the self-organization index for each conceptualized component of the overall model. Finally, potential conflict index graphs for all the presented policy options were generated for each for sub-group using the PCI questions included on the survey instrument.

#### 6.5.5.1 MODEL TESTING

Several steps were taken to test the validity of each index developed throughout this study, including the overall model. Firstly, frequency distributions were calculated for each of the items associated with a particular index in order to observe the distribution of answers across the range of responses per response option. One way to analyze bivariate relationships between items is to examine the percent of occurrences when two variables differ by a pre-determined amount (Babbie, 2010; Salz, Loomis, & Finn, 2001). In other words, the percent of occurrences where one index item did not sufficiently predict responses to another index item. The frequency distributions of responses allowed these relationships to be examined. Secondly for each index, direct bivariate relationships among all potential pairs of index items were examined to determine the degree to which the items were related (Babbie, 2010) by generating correlation coefficients for each pairing. Middle-range correlations (e.g., between 0.20 and 0.70) are considered desirable since very low correlations indicate that one or more of the items may not be appropriate for inclusion in the index and extremely high correlations indicate that one or more of the

items may be redundant and should be eliminated (Babbie, 2010; OECD, 2008). Lastly, all indices were tested for index item reliability using Cronbach's coefficient alpha (Cronbach, 1951).

Cronbach's alpha, measured on a scale of 0-1, is the most commonly used estimate of internal consistency of items on a scale. Initially the analysis was designed to measure of the internal consistency or reliability of a psychometric test score for a sample of individuals taking an exam (Cronbach, 1951). It has subsequently been applied other disciplines to measure the extent to which individual item responses correlate with each other. Cronbach's alpha estimates the proportion of variance that is systematic or consistent in a set of survey responses (Vaske, 2008). The general formula for computing alpha is:

$$\alpha = \frac{N}{N-1} \left[ \frac{\sigma_X^2 - \sum_{i=1}^N \sigma_{Y_i}^2}{\sigma_X^2} \right]$$

*Where: N=the number of items in the scale;  $\sigma_x^2$ =the variance observed total test scores;  $\sigma_{Y_i}^2$ = the variance of component i for person Y*

It is important to remember that Cronbach's alpha is not a measure of unidimensionality even though it is often used to describe items in this way (Cronbach, Lee, & Shavelson, 2004). A set of items can have a high resultant alpha and still be multidimensional in nature. This is often the case when separate clusters of items demonstrate high levels of intercorrelation with each other. In reverse, a set of items can return a low resultant alpha and be unidimensional if there is high random error within the system (Gigerenzer, 2004; Vaske, 2008). One other key component with relevancy to survey data collection is that the items on a scale are assumed to be positively correlated with each other due to the fact that they are measuring the same construct. This may mean that items that have alternate directionality due to survey technique and reduced response bias may need to be recoded before Cronbach's alpha is calculated (Cronbach,

1951). The use of this statistic will provide the basis for the inclusion or exclusion of specific items in an aggregated self-organization metric.

#### **6.5.5.2 HYPOTHESIS TESTING**

Many statistical tests, including analysis of variance (ANOVA), rely heavily on distributional assumptions such as the existence of a normal distribution. When these assumptions are not satisfied, the supposition is that these statistical tests will perform poorly, resulting in a greater chance of committing an error. Likert scale data, like the data collected during this study, typically violates the assumption of normality presumed necessary for ANOVA. However, an extensive body of literature argues that this violation of normality should be of little concern to the effectiveness of ANOVA on non-normal data due to the fact that the test itself is robust enough to cope with this (Glass, Peckham, & Sanders, 1972; Velleman & Leland, 1993).

Pearson (1931) presented empirical results that demonstrated, for 2-way ANOVA, the actual and nominal probabilities of a Type-I error were nearly equal when skewed distributions are sampled (Pearson, 1931). This work built upon earlier studies where Rider (1929) and Pearson (1929, 1931) found little effect of non-normality on the two-tailed t-and F-tests, respectively, provided that the degrees of freedom for residual variance were not in nature. Scheffé (1959) showed that  $\beta_2$ , the kurtosis, and, to a lesser degree,  $\beta_1$ , the skewness, of a distribution could be considered as the most important indicators of the extent to which non-normality would affect the usual inferences made in the ANOVA. He demonstrated that for the fixed-effects model, the distribution of  $t$  is independent of the form of the population for large  $n$  and hence the inferences about the mean,  $\mu$ , which are valid in the case of normality, must be correct for large  $n$  regardless of the form of the population (Scheffe, 1959).

With the acknowledgement that a fundamental discourse exists between scientific and mathematical disciplines, for the purposes of this study it was assumed that parametric statistics would be employable based on the foundation of a large sample size (Pearson, 1929; Rider, 1929). Hypotheses H1- H4 relate specifically to the deconstructed components of the self-organization model utilizing the self-organization continuum as a grouping variable. Mean scores for each group can be calculated for each component and then examined for significant differences using one-way ANOVAs. Tukey's post-hoc test was used to test for pairwise differences between groups.

Throughout this study, hypotheses were tested using an alpha level of 0.10. This level was specifically selected to balance the possibilities of making Type I or Type II errors. A Type I error occurs when a true null hypothesis is rejected and occurs when significant differences are reported when none actually exist. This type of error can pose large problems in cases where study results have serious implications for human well-being, such as in medical research, however they pose less of a serious threat to this study. A Type II error, in contrast, occurs when a false null hypothesis is not rejected causing a potential avenue of research to be dropped prematurely. Gregorie and Driver (1979) suggest that a 0.10 level be used to reduce the possibility of Type II error. Balancing the two errors can be a difficult objective. Since the more serious implications of this study are associated with the rejection of potentially viable research areas rather than human well-being, testing at an alpha value of 0.10 represents a reasonable compromise (Gregorie & Driver, 1987).

#### **6.5.5.3 POTENTIAL FOR CONFLICT INDEX**

Although testable hypotheses have not been developed for the variation in acceptability of the proposed IPCC policy options, it is presumed that different groups on the self-organization continuum would prefer different policies. Directionality of such differences is hard, perhaps impossible, to predict in advance.

These differences will be examined through the use of the Potential for Conflict Index (PCI). The PCI describes the ratio of responses on either side of a rating scale's center point (Manfredo, et al., 2003). The greatest potential for conflict, a PCI value of 1, occurs when a bimodal distribution between the response scale's 2 extreme values exists (Vaske, Needham, Newman, Manfredo, & Petchenik, 2006). A distribution with 100% at any one point on the response scale yields a PCI of 0 and suggests no potential for conflict. Computation of the PCI uses a frequency distribution and follows the formula:

$$PCI = \left[ 1 - \left| \frac{\sum_{i=1}^{nu} |X_{ui}|}{X_t} - \frac{\sum_{i=1}^{na} |X_{ai}|}{X_t} \right| \right] * \frac{X_t}{Z}$$

*Where:  $X_a$  = an individual's "acceptable" (or "favor" or "likely") score;  $n_a$  = all individuals with acceptable scores;  $X_u$  = an individual's "unacceptable" (or "oppose" or "unlikely") score;  $n_u$  = all individuals with unacceptable scores;  $Z$  = the maximum possible sum of all scores =  $n$ \*extreme score on scale (e.g.,  $Z = 2n$  for scale with 5 response options);  $n$  = total number of subjects.*

The results of the PCI were displayed as bubble graphs to visually and simultaneously describe a variable's form, dispersion, and central tendency. As Vaske et al 2006 state: "The size of the bubble depicts the PCI and indicates degree of dispersion (e.g., extent of potential conflict regarding the acceptability of a management strategy). A small bubble suggests little potential conflict; a larger bubble suggests more potential conflict. The center of the bubble, which is plotted on the Y-axis, indicates the mean response (central tendency) to the measured variable. With the neutral point of the response scale highlighted on the Y-axis, it is apparent that respondents' average evaluations are situated above or below the neutral point (i.e., the action, on average, is acceptable or unacceptable). Information about a distribution's skewness is reflected by the position of the bubble relative to the neutral point (i.e., bubbles at the top or bottom of the graph suggest high degrees of skewness)." In the hypothetical example displayed below, Options 1, 2, and 3 are all acceptable, although Option 2 suggests the least amount of

conflict would be associated with potential implementation (Figure 20). Option 4 represents a management alternative that is not only unacceptable in general to the respondents but also likely to result in high levels of conflict if implementation is attempted.

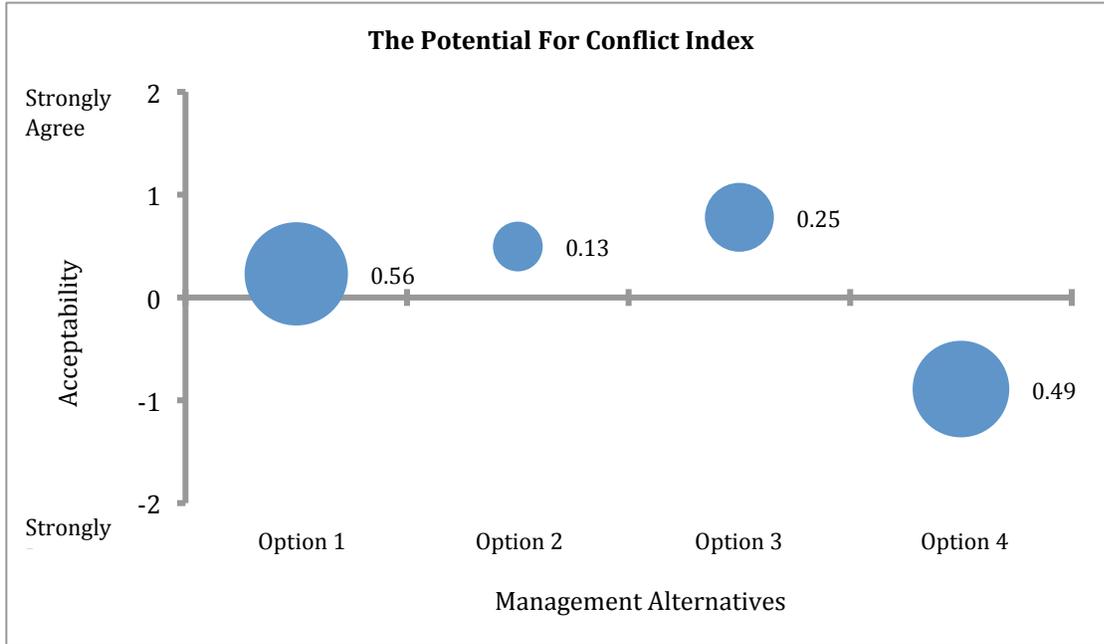


Figure 20. Hypothetical Potential for Conflict Index Graph Displaying Acceptability of Management Alternatives

Differences in PCI values were tested using the following formula:

$$d = \frac{ABS(PCI_a - PCI_b)}{\sqrt{(PCI_{aSD})^2 + (PCI_{bSD})^2}}$$

Where: The  $\sqrt{\quad}$  is the radical symbol for the square root of the sum of the squares, ABS = Absolute value,  $PCI_a$  = Observed PCI2 for the 1st sample or group,  $PCI_b$  = Observed PCI2 for a 2nd sample or group,  $PCI_{aSD}$  = Std. Dev. of simulated PCI2 distribution for 1st sample or group,  $PCI_{bSD}$  = Std. Dev. of the simulated PCI2 distribution for 2nd sample or group

## CHAPTER 7. RESULTS

### 7.1 RESPONSE RATES

Of the 2,860 mail surveys initially sent out, 545 proved to be non-deliverable due to irreconcilable problems with addresses. This was due in large part to unforeseen circumstances regarding a lack of mail receptacles on residential properties. Efforts were made to correct this oversight but to no avail. The effective sample size was therefore 2,315 individuals. In total, 659 useable surveys were returned the course of the two mailings for an overall response rate of 28.75% (Table 9).

*Table 9. Survey response rate.*

	N	%
Initial sample	2,859	-
Non-deliverables	580	20.29
Effective sample	2,279	-
Refusals	25	1.09
Total non-returned surveys	1,595	69.99
Total returned surveys	<b><u>659</u></b>	<b><u>28.92</u></b>

The distribution of returned surveys by county was also calculated (Table 10). Eight respondents removed the identification number on their surveys making it impossible to determine what county those surveys should have been associated with, therefore, the origin of these results were recorded as “unknown” but the responses were included in the overall data analysis.

*Table 10. Breakdown of survey response rate by county*

County	Carteret	Pamlico	Dare	Hyde	Unknown
Initial sample	715	715	714	715	-
Non-deliverables	79	103	242	156	-
Effective sample	636	612	472	559	-
Refusals	8	6	6	5	-
Total returned surveys	171	192	161	127	8
Percentage returned	<b><u>26.9</u></b>	<b><u>31.4</u></b>	<b><u>34.1</u></b>	<b><u>22.7</u></b>	

## 7.2 RESPONDENT PROFILE

Of all the completed surveys received, 96.2% of respondents identified themselves as permanent residents of a coastal county in North Carolina with the remaining 3.8% identifying themselves as seasonal residents. On average, the respondent population has lived in coastal North Carolina for over 24 years with 10% of individuals having spent over 60 years in the coastal county they currently reside in. Over 88% of respondents owned the house they were living in, with a further 4% living in family-owned accommodation. This figure greatly exceeds the typical homeownership across North Carolina, which has been measured as 68% (U.S. Census Bureau, 2010). In general, respondents had strong connections to the coastal county they were living in with 85% of individuals and 79% of families being either ‘strongly’ or ‘very strongly’ connected to the county on a 5-point Likert scale. Only 29.9% of all individuals who were surveyed did not work or volunteer in the coastal county they lived in providing evidence of strong social networks in-situ.

Initial demographic statistics of the respondent population show that, although the coastal residents surveyed ranged between the ages of 24 and 94, only 10% were less than 44 years of age. The average age of the respondents was 62 years. The respondents were predominately male (66.8%), and

the overwhelming majority (95.4%) listed their race as white. In general, the respondents were well educated with only 2% reporting not to have finished high school and 20% of individuals having completed a graduate degree. The majority of people (66.5%) surveyed reported their household income to be between \$25,000 and \$99,999 with a median income of \$50,000 to \$74,999. This exceeds the average income of North Carolina residents, which has been measured at \$24,745 (U.S. Census Bureau, 2010).

Due to the relatively homogenous nature of the overall respondent profile, and the degree to which some parameters varied when compared to North Carolina as a whole, the profile was compared to the demographics and census data from across the four coastal counties initialed sampled (Table 11). The results show that, although skewed towards male respondents, the respondent profile is generally more representative of the coastal region than of North Carolina as a whole, with the exception of Hyde County. Hyde County has a much more diverse racial makeup than the respondent sample, a lower median income, and lower percentage of high school graduates.

*Table 11. Demographic profile of respondents and the four sampled coastal counties in North Carolina*

Profile Parameter	Carteret	Pamlico	Dare	Hyde	North Carolina	Respondents
Race (% white)	90.0	77.1	94.2	65.9	72.1	95.4
Gender (% female)	50.6	49.1	50.4	44.3	51.3	33.2
Median Household Income (\$US)	46,155	40,561	53,889	38,265	45,570	50,000-74,999
Home Ownership (%)	73.5	81.6	71.3	82.6	68.1	88.0
High School Graduates (%)	87.6	82.7	91.8	76.6	83.4	97.9

### 7.3 SELF-ORGANIZATION INDEX VALIDATION

The self-organization index was created by first summing the scores for the three indicator items, 1) the ability to work with others, 2) the inclination to plan for the future, and 3) the closeness of relationships with members of a self defined community, with the sums ranging from a minimum of 3 to a maximum of 12. Initially, respondents were categorized into four levels of self-organization, mirroring the method used by Salz et al. (2001). Four levels were used in order to maximize potential differentiation between high and low levels of self-organization (Table 12). Due to the circular causality described in self-organizing systems, potential separation between individuals in the center of the spectrum may have been lost in simpler index.

*Table 12. Respondents distributed according to self-organization level with a four-level index.*

Self-Organization Level							
Least		Moderate		High		Very High	
<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>
9	1.4	113	17.8	277	43.6	236	37.2

When the index was conceived, the scores associated with each level of self-organization were divided into equal groups. As such, a respondent scoring between "4" and "6" was considered to be of "low self-organizational ability." Likewise, respondents with scores between "7" and "8," "9" and "10," and "11 and "12" were considered "moderate," "high," and "very high" ability, respectively. This approach extended the *a priori* foundation of the index development. The number of respondents classified into each self-organization level was the result of this foundation, rather than the opposite approach during which some preconceived distribution of

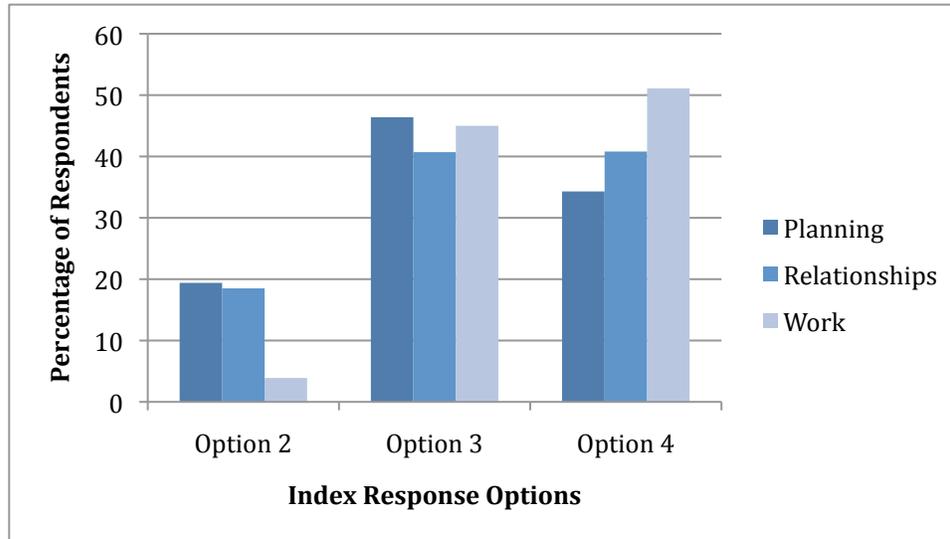
respondents would be forced into a manipulated set of index brackets (Salz, et al., 2001). However, when the data were analyzed the sample size of respondents in the lowest self-organization category was considered to be too small for the purposes of statistical analysis (Table 11). Therefore, respondents in the low and moderate categories were combined to yield three final self-organization groups of moderate, high and very high with groups ranging from 3-8, 9-10 and 11-12. The data from the two least self-organized groups were combined rather than completely excluded to ensure the full range of the measurable continuum was included in the data analysis. The utilization of three levels of self-organization provided groupings that were slightly variable in size (N = 122, 277 and 236, respectively) but ensured categories that were large enough to guarantee sufficient statistical power for further analysis (Table 13).

*Table 13. Respondents distributed according to self-organization level with a three level index.*

Self-Organization Level					
Moderate		High		Very High	
<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>
122	19.2	277	44.2	236	37.7

As described in the data analysis (See Chapter 6.5.1.1), several steps were taken to test the validity of the index. Firstly, frequency distributions were calculated for each of the three index items (Figure 20). On a scale of responses from “2” (combined least and moderate self-organized) to “4” (very high self-organization), the modal response for the planning and relationship items was “3”, and for the working with others was “4”. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 21, Table 14), demonstrated some predictive capability between the items. For each of the three variables

under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pair-wise comparisons, less than 12% of all respondents had responses that differed by more than 1 for each comparison (Table 14). This demonstrated a degree of internal validity had been achieved.



*Figure 21. Distribution of index response options according to the three index items for self-organization*

Secondly, bivariate relationships among the three index items were examined to determine the degree to which the items were related (Babbie, 2010). Correlation coefficients for the three pair-wise comparisons ranged from 0.23 to 0.39. These coefficients, although on the lower end of the suggested spectrum between 0.2-0.7, do sit within the acceptable range. This suggested that none of the items warranted exclusion from the index due to redundancy issues and each item was measuring a different aspect of self-organization (Table 14).

Lastly, the three-item index was tested for index item reliability using Cronbach’s coefficient alpha (Cronbach, 1951). The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.545$ . This result is slightly lower than desired, with 0.600 being the

recommended cut-off. Alpha values when a particular item was deleted were 0.378 for work, 0.410 for relationships, and 0.543 for planning, providing evidence to suggest that all three items should be used when constructing the final self-organization index.

*Table 14. Bivariate relationships among self-organization index items*

Index item pair	Correlation coefficient	% of responses differing by more than one
Plan and relationships	0.234	11.4%
Plan and work with others	0.263	1.4%
Relationships and work with others	0.386	1.1%

The results of the reliability and internal validity measures suggest that the final index may require some improvement before being used in future applications. Such improvements may include modifying item wording and/or selecting different self-organization themes for inclusion. Based on the results from the bivariate comparison and Cronbach’s alpha, all three items, planning, relationships and working with others, were used to create the self-organization index. This index was used in all subsequent analysis.

## 7.4 HYPOTHESIS TESTING

For the purposes of this study, each of the four components that have been identified as key pieces of the self-organization process, capacity, conflict management, governance and social justice, was operationalized using three key indicators derived from existing literature. Each identified indicator was then operationalized using a series of question items. Each item was measured on a 5-point Likert scale ranging from “strongly disagree to “strongly agree.”

Differences between self-organization levels for each of the items associated with each indicator

were examined using ANOVA. In order to avoid potential correlation, covariance, and type II errors, each indicator was initially analyzed separately before examining the potential for aggregating to higher levels of the conceptual model of self-organization presented in Figure 16 (Chapter 4.3). The effects of aggregation on the validity and reliability of the model was tested at each step within the model construction process.

#### 7.4.1 COMMITMENT

The commitment indicator was developed to determine if commitment to a coastal county was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific commitment items. The specific alternative hypothesis for commitment stated:

- Ha1(a): Respondents with high aptitude for self-organization will have a greater commitment to their community than respondents of a lower level

Initially, to ensure Cronbach's alpha was not violated, the survey questions related to the commitment indicator of this study were examined for directionality. To avoid issues with the statistic, questions 3 and 4 (see Chapter 6.3) that had been negatively framed for the purposes of the survey were recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 15). Significant differences were found between self-organization levels on all four of commitment items allowing the null hypothesis to be rejected. Tukey's post hoc tests were then used to evaluate the alternate hypothesis.

All the items used to operationalize the commitment indicator were significantly different at each level of self-organization and all displayed a linear increase between levels. The results of this analysis showed that all respondents were committed to their communities with all scores of the 5-point Likert scales being above 3. However, respondents with very high aptitude for self-organization consistently demonstrated more commitment to their community than respondents of a lower level demonstrating support for H<sub>1</sub>(a).

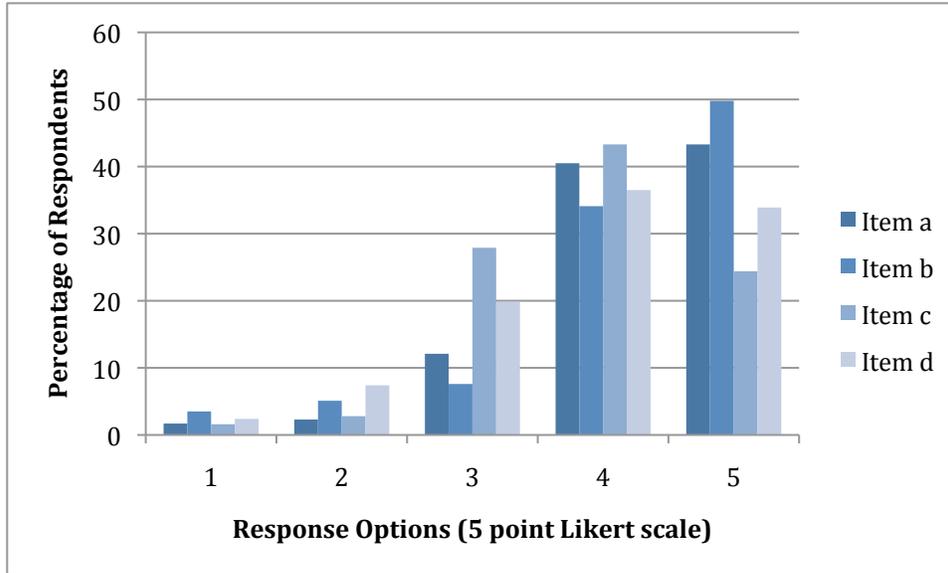
*Table 15. Analysis of variance of mean scores on commitment attributes according to self-organization level.*

<u>Commitment item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. I feel a sense of belonging to this community	<u>3.68</u>	<u>4.11</u>	<u>4.62</u>	57.993	0.000
b. I think it is important to be involved in local organizations	<u>3.74</u>	<u>4.15</u>	<u>4.57</u>	29.744	0.000
*c. I do not think it is important to invest my time in local events	<u>3.36</u>	<u>3.77</u>	<u>4.23</u>	47.085	0.000
*d. Local issues do not concern me	<u>3.33</u>	<u>3.91</u>	<u>4.25</u>	35.325	0.000

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the four index items (Figure 22). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for items A and B was "5", and for items C and D the mode was "4". The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 3.5% for all items.



*Figure 22. Distribution of index response options according to the four index items for commitment*

This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 22, Table 16), demonstrated some predictive capability between the items. For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pair-wise comparisons, less than 15% of all respondents had responses that differed by more than 1 for each comparison (Table 16). However, the results do suggest that item C may warrant further investigation since the biggest percentage differences were seen between pair-wise comparisons that included that item. Bivariate relationships among the four items were then examined. Correlation coefficients for the six pair-wise comparisons ranged from 0.26 to 0.45, which suggests no item exclusion was necessary (Table 16).

Under the premise that these four items could potentially be aggregated to form a single index of commitment they were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.662$ . The aggregation index was recreated using multiple combinations of three or two items but each alternate index returned lower reliability results than the use of all four items (Table 17).

**Table 16. Bivariate relationships among commitment index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.260	14.3%
A and C	0.312	5.2%
A and D	0.362	6.5%
B and C	0.247	4.2%
B and D	0.346	2.1%
C and D	0.452	10.7%

**Table 17. Inter item reliability Cronbach's alphas for commitment items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.522	AB	0.423
ABD	0.593	AC	0.489
ACD	0.644	AD	0.527
BCD	0.614	BC	0.390
		BD	0.517
		CD	0.621

Overall, the measures of reliability and validity demonstrated that a final aggregated index using all four items was the most reliable for the commitment indicator. This meant that the aggregation scores ranged between a minimum of 4 and a maximum of 20. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 18). The fact that aggregation scores increased significantly with each level of self-organization provided evidence that the null can be rejected and demonstrated support for Ha1(a). The aggregated means show a linear increase between each level of self-organization and also demonstrate a high level of commitment ranging between 14 and 17.7 out of a maximum of 20.

*Table 18. Analysis of variance of aggregated scores on commitment attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>14.10</u>	<u>15.98</u>	<u>17.67</u>	92.121	0.000

\*Means underscored by the same line are not significantly different ( $p>0.10$ ) using Tukey's test

One other element that was identified as important to provide further context of commitment to a specific community is the level of involvement in civic institutions. Initially, the percentage of respondents involved in a range of organizations was analyzed as a whole and broken down for each self-organization level (Table 19). The results for respondents with very high aptitude for self-organization demonstrated more involved in every civic organization. The means for the very high level were compared to the respondent population a Chi-square test and a significant result was returned ( $p=0.06$ ).

*Table 19. Percentage of respondents involved in local civic institutions overall and for those with the highest aptitude for self-organization*

Civic organization	% Involvement all respondents	% Involvement moderate SO	% Involvement high SO	% Involvement very high SO
The Chamber of Commerce	5.8	2.5	4.7	9.3
The Economic Development Office	1.1	0.8	0.4	2.1
A local environmental group	8.0	2.5	6.9	12.3
A church group or program	41.1	27.0	37.9	52.5
A local tourism organization	5.3	0.8	5.4	7.6
A local political organization	9.9	3.3	9.4	14.4
A local school board	1.5	0	0.7	3.4
A local historical organization	9.7	5.7	9.4	12.7
Other	16.2	11.5	16.6	18.2

### 7.4.2 RESOURCES

The resources indicator was developed to determine if access to a variety of resources (legal, financial, raw materials, etc.) was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific resource items. The specific alternative hypothesis for resources stated:

- Ha1(b): Respondents with high aptitude for self-organization will have greater access to resources than respondents of a lower level

To avoid issues with Cronbach's alpha, question 4 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 20). No significant differences were found between self-organization levels, providing evidence that the null hypothesis could not be rejected.

Although no significant differences were found for this indicator, the results differed greatly from the commitment indicator in that all the mean responses for each item were less than 3 on a 5-point Likert scale. The highest mean across all items was 2.82 and was recorded by the highest self-organization level for the item designed to ascertain if information regarding shoreline change was easily available. These results suggested that, as a whole, respondents felt they personally, their community, and the local authorities in their area had little access to the resources necessary to cope with shoreline change irrespective of their level of self-organization. No linear increase was seen across the different self-organization levels on this indicator.

*Table 20. Analysis of variance for mean scores on resource attributes according to self-organization level.*

<u>Resource item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. Local authorities have all resources necessary	<u>1.75</u>	<u>1.73</u>	<u>1.63**</u>	0.434	0.648
b. My community would be capable of protecting our shoreline	<u>2.21</u>	<u>2.05</u>	<u>2.25</u>	1.142	0.320
c. Information regarding changing shorelines is easily available	<u>2.62</u>	<u>2.70</u>	<u>2.82</u>	0.670	0.512
*d. Current North Carolina laws inhibit my ...community's ability	<u>1.65</u>	<u>1.67</u>	<u>1.54</u>	0.485	0.616
*e. The raw materials necessary are difficult to obtain	<u>1.82</u>	<u>2.01</u>	<u>2.02</u>	0.715	0.490

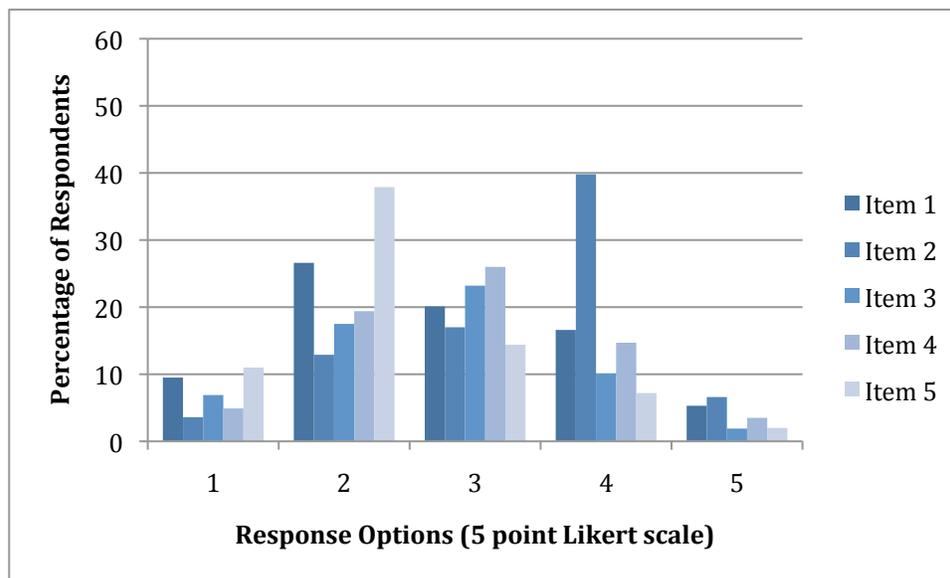
\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

Although no significant differences were found on the items tested for this indicator the decision was made to determine if these items could be combined to form a valid index anyway. This decision was made to ensure that the issue under examination did not compromise the theoretical foundation of the model as a whole. Shoreline change, as mentioned, is emotionally driven and controversial in many locations including coastal North Carolina, which may mask the importance of access to resources within the context of self-organization. The fact that the results for this indicator were skewed to the negative side of the Likert scale suggest this indicator may show a greater range across a different population of respondents.

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the five index items (Figure 23). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for items A and E was

“2”, for items C and D the mode was “3”, and for item B the mode was “4”. The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 12% for all items, although it ranged from 3.6-11%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 23, Table 21), demonstrated some predictive capability between the items.



*Figure 23. Distribution of index response options according to the five index items for resources*

For each of the five variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pair-wise comparisons, less than 11% of all respondents had responses that differed by more than 1 for each comparison (Table 21). This suggested that an index developed from all five items could be valid. However, the results do suggest that item E may warrant further investigation since the biggest percentage differences were seen between pair-wise comparisons that included that item. Bivariate relationships among the five items were then examined. Correlation coefficients for the ten pair-wise comparisons ranged from 0.28 to 0.49, which suggests no item exclusion was necessary (Table 21).

*Table 21. Bivariate relationships among resource index items*

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.280	5.5%
A and C	0.362	4.7%
A and D	0.277	4.7%
A and E	0.421	7%
B and C	0.359	6.5%
B and D	0.415	5.6%
B and E	0.381	7.3%
C and D	0.490	3.4%
C and E	0.440	8.8%
D and E	0.409	10.3%

Under the premise that these five items could potentially be aggregated to form a single index of resources they were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.753$ . The index was recreated using multiple combinations of four, three, or two items but each alternate index returned lower reliability results than the use of all five items (Table 22). All three measures demonstrated that a final aggregated index using all five items was the most reliable for the resources indicator. This meant that the aggregation scores ranged between a minimum of 5 and a maximum of 25. Acknowledging that no significant results would be expected due to the results of the single item analysis (Table 20), a one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 23). As expected this showed no significant differences, providing further evidence that the null hypothesis could not be rejected.

**Table 22. Inter item reliability Cronbach's alphas for resource items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABCD	0.695	ABC	0.597	AB	0.436
ABCE	0.696	ABD	0.586	AC	0.536
ABDE	0.688	ABE	0.615	AD	0.423
ACDE	0.720	ACD	0.644	AE	0.577
BCDE	0.737	ACE	0.665	BC	0.518
		ADE	0.617	BD	0.573
		BCD	0.683	BE	0.532
		BCE	0.649	CD	0.659
		CDE	0.703	CE	0.606
				DE	0.561

**Table 23. Analysis of variance of aggregated scores on resource attributes according to self-organization level.**

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>10.02</u>	<u>10.18</u>	<u>10.33</u>	0.136	0.872

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

### 7.4.3 SKILLS

The skills indicator was developed to determine if perceptions of personal skills were affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific skills items. The specific alternative hypothesis for skills stated:

- Ha1(c): Respondents with high aptitude for self-organization will have a higher perceptions of their personal skill set than respondents of a lower level

To avoid issues with Cronbach's alpha, question 2 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 24). Significant differences were found between self-organization levels on three of four items providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis using the three significantly different items. Results showed that respondents with very high aptitude for self-organization demonstrated a higher perception of their skill set than respondents of a lower level demonstrating support for Ha1(c).

The one item that was not significantly different for the skills indicator was designed to ascertain if respondents understood the federal and state laws associated with shoreline change. The mean values for all three levels of self-organization were less than 3 on a 5-point scale showing that the respondents as a whole felt that they did not understand the laws governing this particular issue. The other items used to operationalize the skills indicator were significantly different across the levels of self-organization and all displayed a linear increase between levels as was seen with the commitment indicator.

The results of this analysis showed that the respondents' perceptions of their skill levels increased with their levels of self-organization demonstrating support for Ha1(c). However, items C and D both returned results that were either lower than 3 or straddled the neutral point on the Likert scale. This suggests that overall perceptions of skills necessary for dealing with shoreline change within the community tend to be low, irrespective of significant differences (Table 24).

*Table 24. Analysis of variance of mean scores on skills attributes according to self-organization level.*

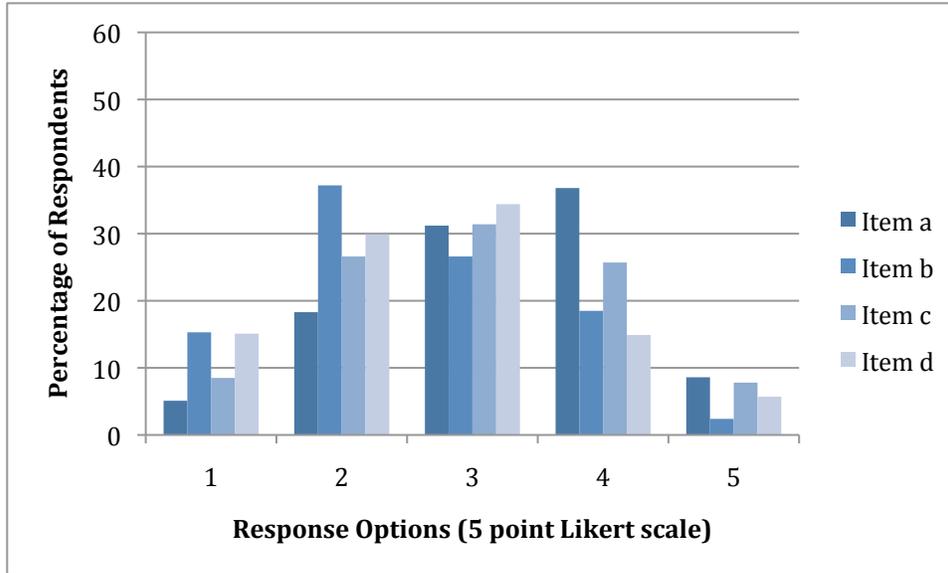
<u>Skill item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. It is easy for me to become competent with techniques	<u>3.02</u>	<u>3.27</u>	<u>3.39</u>	4.594	0.011
*b. I do not understand the federal and state laws	<u>2.55</u>	<u>2.58</u>	<u>2.54**</u>	0.092	0.912
c. I can explain the scientific arguments	<u>2.66</u>	<u>2.93<sup>a</sup></u>	<u>3.19<sup>a</sup></u>	8.629	0.000
d. I think I could become a leader in my ...community	<u>2.24</u>	<u>2.63</u>	<u>2.94</u>	16.215	0.000

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Validation tests were done using all four items even though there were no significant differences associated with item B. This was done to remove any initial assumptions that may have biased the results of the index validation. Frequency distributions were calculated for each of the four index items (Figure 24). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for items C and D was "3", for item A the mode was "4", and for item B the mode was "2". The proportion of responses in the strongly disagree category (i.e. response = 1) ranged from 5.1-15.1%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 24, Table 25), demonstrated some predictive capability between the items. For each of the four variables under consideration for inclusion in the index, possible responses varied from "1" to "4". For all pair-wise comparisons, less than 15% of all respondents had responses that differed by more than 1 for each comparison (Table 25). This suggested that perhaps an index developed from all four items could be valid.



*Figure 24. Distribution of index response options according to the four index items for skills*

Bivariate relationships among the four items were then examined. Correlation coefficients for the six pair-wise comparisons ranged from 0.03 to 0.47, which suggests at least one item should be excluded (Table 26). When the correlation coefficients were more closely examined it became obvious that item pairs that included item B were the lowest, suggesting that excluding this item would increase the validity of the index as a whole.

To further examine this possibility the items were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.596$ . The index was recreated using multiple combinations of three or two items to see if any item should be excluded. When item B was excluded the index item reliability increased to  $\alpha = 0.648$ , therefore only items A, C, and D were used to create the aggregation index (Table 26).

**Table 25. Bivariate relationships among skills index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.213	14.3%
A and C	0.320	5.2%
A and D	0.346	6.5%
B and C	0.229	4.2%
B and D	0.033	2.1%
C and D	0.468	10.7%

**Table 26. Inter item reliability Cronbach's alphas for skills items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.499	AB	0.323
ABD	0.418	AC	0.487
ACD	0.648	AD	0.508
BCD	0.501	BC	0.401
		BD	0.077
		CD	0.611

The three measures of reliability demonstrated that using three of the four items created the most valid index for the skills indicator. This meant that the aggregation scores ranged between a minimum of 3 and a maximum of 15. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 27). The fact that aggregation scores increased significantly with each level of self-organization provided evidence that the null can be rejected and demonstrated further support for Ha1(c). Although the aggregated means show a linear increase between each level of self-organization,

they demonstrate only a moderate of personal skills in general with means ranging between ranging between 8 and 9.6 out of a maximum of 15.

*Table 27. Analysis of variance of aggregated scores on skills attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>7.98</u>	<u>8.90</u>	<u>9.66</u>	15.89	0.000

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

One other element that was identified as important to provide further context to the skills indicator is the highest level of education reached by respondents. The results show that 68.3% of respondents had an associate's degree or higher with only 2.1% of all respondents not completing high school. Initially, the percentage of respondents obtaining each level of education was analyzed as a whole and broken down for each self-organization level (Table 28).

*Table 28. Level of education attained by respondents overall and for those with the highest aptitude for self-organization*

Education Level	Level obtained by respondent population (%)	Level obtained by moderate SO (%)	Level obtained by high SO (%)	Level obtained by very high SO (%)
Did not complete high school	2.1	3.4	1.1	2.2
High school diploma/equivalency	29.2	46.6	30.1	19.2
Associate's/two year degree	21.5	16.4	21.4	24.6
Bachelor's/four year degree	26.5	19.0	30.1	27.7
Graduate degree	20.7	14.7	17.3	26.3

The results were compared using a Chi-square test. The test showed that the respondents with very high self-organization did not consistently achieved a higher level of education than the population as whole ( $p=0.224$ ). However, statistical differences were found between each level of self-organization (Table 29), which demonstrated further support for the hypothesis skill sets available to individuals would be different at each level of self-organization.

**Table 29. Chi-squared test of education levels at levels of self-organization**

Self-Organization Level Comparison	Chi-Squared Result
Moderate – high	0.003
Moderate – Very high	0.000
High – Very high	0.034

#### 7.4.4 VOICE

The voice indicator was developed to determine if the willingness to voice concerns was affected by a respondent’s level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific voice items. The specific alternative hypothesis for voice stated:

- Ha2(a): Respondents with high aptitude for self-organization will voice their concerns more readily than respondents of a lower level

To avoid issues with Cronbach’s alpha, question 3 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 30). Significant differences were found between self-organization levels on three of the four items providing evidence that the null hypothesis should be rejected. Tukey’s post hoc test was used to evaluate the alternate hypothesis

using the three significantly different items. Results showed that respondents with very high aptitude for self-organization were significantly different from the other two levels, demonstrated greater willingness to voice their concerns than respondents of a lower level. This provided strong support for Ha2(a).

**Table 30. Analysis of variance for mean scores on voice attributes according to self-organization level.**

<u>Voice item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. It is easy for members of my community to raise issues	<u>1.73</u>	<u>1.98<sup>a</sup></u>	<u>2.23<sup>a</sup></u>	4.131	0.017
b. I seek out formal opportunities	<u>2.73</u>	<u>2.70<sup>a</sup></u>	<u>2.88<sup>a</sup></u>	3.049	0.048
*c. I feel like community members are not listened to	<u>1.84</u>	<u>1.80</u>	<u>1.97**</u>	0.906	0.405
d. People in my community feel like they ...have been successful	<u>1.61</u>	<u>1.77<sup>a</sup></u>	<u>2.02<sup>a</sup></u>	3.172	0.043

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different (p>0.10) using Tukey's test

<sup>a</sup> not significantly different (p>0.10) using Tukey's test

Although significant differences were found for this indicator, the results were again very low with all the mean responses for each item being less than 3 on a 5-point Likert scale. The highest mean across all items was 2.88 and was recorded by the highest self-organization level for the item designed to ascertain if respondents actually sort out formal opportunities voice their concerns over shoreline management decisions. These results suggested that, as a whole, respondents felt they personally, their community, and the local authorities in little opportunity to exercise their voice. Despite this general lack of voice, there was a linear increase across self-

organization levels was seen across the three items that were significant on this indicator. These results provide further support for the voice hypothesis (Ha2(a)).

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. As before, validation tests were done using all four items even though there were no significant differences associated with item C. Frequency distributions were calculated for each of the four index items (Figure 25). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for all items was “3”. The proportion of responses in the strongly disagree category (i.e. response = 1) ranged from 5.4-12.1%. For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pairwise comparisons, less than 10% of all respondents had responses that differed by more than 1 for each comparison (Table 31). This suggested that an index developed from all four items could be valid.

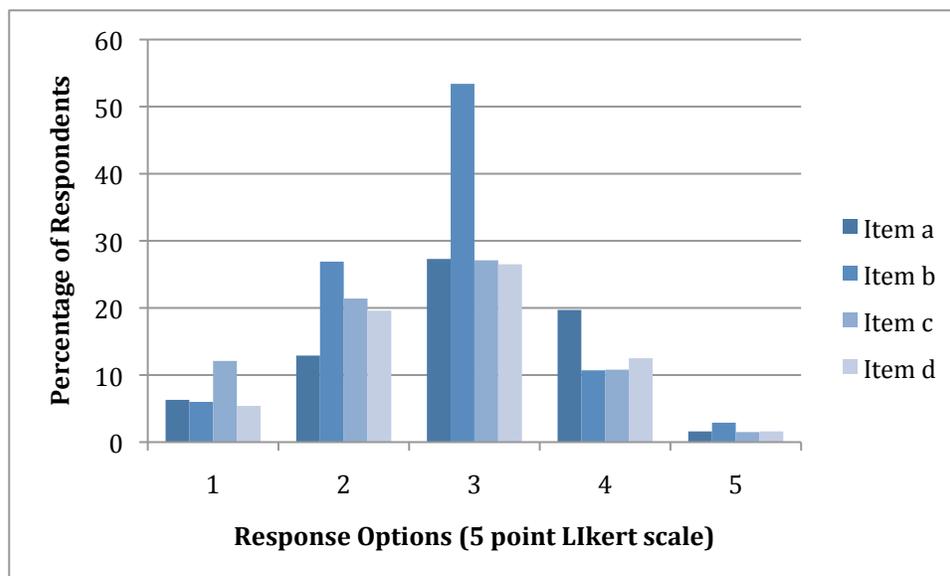


Figure 25. Distribution of index response options according to the four index items for voice

Bivariate relationships among the four items were then examined. Correlation coefficients for the six pair-wise comparisons ranged from 0.13 to 0.60. A correlation coefficient of 0.13 is lower than desired and suggested that some item exclusion may be necessary (Table 31). A closer examination of the coefficients suggested that item pairs that included item B were the lowest, suggesting that excluding this item would increase the validity of the index as a whole. However, the % comparisons of responses suggested the item pairs including C differed the most, suggesting that perhaps C should be excluded instead. This was considered to be a more preferable solution due to the fact that item B had returned a significant difference across self-organization levels in the initial ANOVA test.

**Table 31. Bivariate relationships among voice index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.205	3.6
A and C	0.417	9.6
A and D	0.600	2.3
B and C	0.132	9.9
B and D	0.191	6.1
C and D	0.472	4.3

To further examine this possibility the items were tested for index item reliability using Cronbach's coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.693$ . The index was recreated using multiple combinations of three or two items to see if any item should be excluded. When item B was excluded the index item reliability increased to  $\alpha = 0.750$ , therefore only items A, C, and D were used to create the aggregation index (Table 32).

**Table 32. Inter item reliability Cronbach's alphas for voice items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.515	AB	0.270
ABD	0.618	AC	0.596
ACD	0.750	AD	0.750
BCD	0.542	BC	0.208
		BD	0.261
		CD	0.644

The three measure of reliability demonstrated that using three of the four items created the most valid index for the voice indicator. This meant that the aggregation scores ranged between a minimum of 3 and a maximum of 15. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 33). The fact that aggregation scores increased significantly between the levels of self-organization provided evidence that the null can be rejected and demonstrated further support for Ha2(a). Although the aggregated means show a linear increase between the levels of self-organization, they demonstrate a low overall value for the voice indicator with means ranging between ranging between 5 and 6.5 out of a maximum of 15.

**Table 33. Analysis of variance of aggregated scores on voice attributes according to self-organization level.**

	Self-Organization Level			ANOVA	
	Moderate	High	Very High	F	Sig.
Aggregation score	<u>5.16</u>	<u>5.51</u> <sup>*a</sup>	<u>6.23</u> <sup>a</sup>	3.719	0.025

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.5 APPROACH

The approach indicator was developed to determine if the demand for stakeholder incorporation in the approach to decision making was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific approach items. The specific alternative hypothesis for commitment stated:

- Ha2(b): Respondents with high aptitude for self-organization will demand a higher degree of stakeholder incorporation in the approach to decision making than respondents of a lower level

Due to the directionality of the items no recoding was necessary for the analysis of this indicator. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 34). Significant differences were found between self-organization levels on two of the four items providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis using the three significantly different items. Results showed that respondents with very high aptitude for self-organization demanded a greater level of stakeholder incorporation in the approach to decision making than respondents of a lower level, demonstrating support for Ha2(b).

Although significant differences were found for this indicator, the results were less consistent across the 5 point Likert scale than seen with the other indicators. Item C demonstrated a strong support for Ha2(b), and was significantly different with a linear increase across self-organization levels. However, item D suggested that all respondents felt it was difficult to become involved in a formal decision process, despite a significant difference between very high self-organization respondents and the other two levels. The two items that were not significantly different, A and B, both suggested that respondents were not happy with the approach currently being employed

irrespective of self-organization level. This result may be more of a consequence of the issue of shoreline change rather than the role that self-organization might play in attitudes towards management approaches.

*Table 34. Analysis of variance for mean scores on approach attributes according to self-organization level.*

<u>Approach item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. The people involved in decision making want to make sure the majority of people are in agreement	<u>1.94</u>	<u>1.91</u>	<u>1.94**</u>	0.032	0.969
b. I feel as if I have had a particular management approach forced upon me	<u>2.42</u>	<u>2.53</u>	<u>2.69</u>	1.244	0.289
c. There should be more opportunities for community members	<u>3.29</u>	<u>3.65</u>	<u>3.73</u>	3.736	0.024
d. It is easy to become formally involved	<u>1.79</u>	<u>1.97<sup>a</sup></u>	<u>2.19<sup>a</sup></u>	2.987	0.051

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the four index items (Figure 26). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for item A was "2", for items B and D the mode was "3", and for item C the mode was "4". The proportion of responses in the strongly disagree category (i.e. response = 1) ranged from 0.3-7.7%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 26, Table 35), demonstrated some predictive capability between the items. For each of the four variables under consideration for inclusion in the index, possible responses

varied from “1” to “4”. For all pair-wise comparisons, less than 15% of all respondents had responses that differed by more than 1 for each comparison (Table 35). These results do suggest that item C may warrant further investigation since the biggest percentage differences were seen between pair-wise comparisons that included that item. Bivariate relationships among the four items were then examined. Correlation coefficients for the six pair-wise comparisons ranged from 0.28 to 0.40, which suggests no item exclusion was necessary (Table 35).

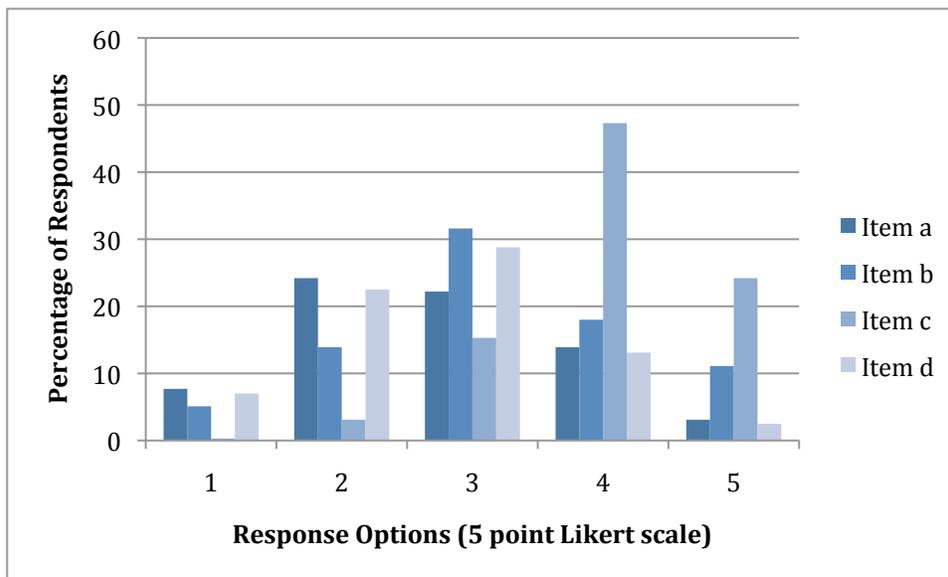


Figure 26. Distribution of index response options according to the four index items for approach

Table 35. Bivariate relationships among approach index items

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.286	9.6
A and C	0.281	12.5
A and D	0.393	2.2
B and C	0.395	14.6
B and D	0.360	3.7
C and D	0.242	5.8

Under the premise that these four items could potentially be aggregated to form a single index of approach they were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.660$ . The index was recreated using multiple combinations of three or two items but each alternate index returned lower reliability results than the use of all four items (Table 36). All three measures demonstrated that a final aggregated index using all four items was the most reliable for the approach indicator. This meant that the aggregation scores ranged between a minimum of 4 and a maximum of 20.

**Table 36. Inter item reliability Cronbach’s alphas for approach items**

Index item combination	Cronbach’s alpha	Index item combination	Cronbach’s alpha
ABC	0.585	AB	0.441
ABD	0.609	AC	0.440
ACD	0.571	AD	0.562
BCD	0.603	BC	0.566
		BD	0.524
		CD	0.396

A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 37). The fact that aggregation scores increased significantly between the levels of self-organization provided evidence that the null can be rejected and demonstrated further support for Ha2(b). The aggregated means show a linear increase between each level of self-organization but suggest a high level of conflict with the management approach currently being employed with means ranging between 9.4 and 10.5 out of a maximum of 20.

*Table 37. Analysis of variance for aggregated scores on approach attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>9.43</u>	<u>10.08*<sup>a</sup></u>	<u>10.53<sup>a</sup></u>	2.508	0.082

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.6 ISSUING FRAMING

The issue framing indicator was developed to determine if the demand for participation in defining the issue frame was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific issue-framing items. The specific alternative hypothesis for issue framing stated:

- Ha2(c): Respondents with high aptitude for self-organization will demand a greater level of participation into defining the issue frame than respondents of a lower level

To avoid issues with Cronbach's alpha, question 3 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 38). Significant differences were found between self-organization levels on four of the five items providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis.

The one item that was not significantly different for the issue framing indicator was designed to ascertain if respondents felt that there were limited opportunities to add new information into the decision making process on shoreline management. The mean values for all three levels of self-organization were greater than 3 on a 5-point scale showing that the respondents as a whole felt these opportunities were limited suggesting that they wished to play a greater part in issue framing than they were currently. The other items used to operationalize the issue framing indicator were significantly different across the levels of self-organization and all displayed a linear increase between levels as was seen with the commitment and the skills indicator.

**Table 38. Analysis of variance for mean scores on issue framing attributes according to self-organization level.**

<u>Issue framing item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. People in my community spend a lot of time discussing	<u>2.10</u>	<u>2.33<sup>a</sup></u>	<u>2.53<sup>a</sup></u>	4.166	0.016
b. There are many opinions	<u>2.83</u>	<u>3.16<sup>a</sup></u>	<u>3.27<sup>a</sup></u>	3.362	0.035
*c. I do not believe the information presented	<u>2.90</u>	<u>3.07<sup>a</sup></u>	<u>3.12<sup>a</sup></u>	2.593	0.076
d. I want more opportunities to correct ...inaccurate information	<u>3.14</u>	<u>3.38</u>	<u>3.38</u>	5.346	0.005
e. There are few opportunities to add new information	<u>3.24</u>	<u>3.33</u>	<u>3.36<sup>**</sup></u>	1.209	0.299

\*Items recoded for analysis

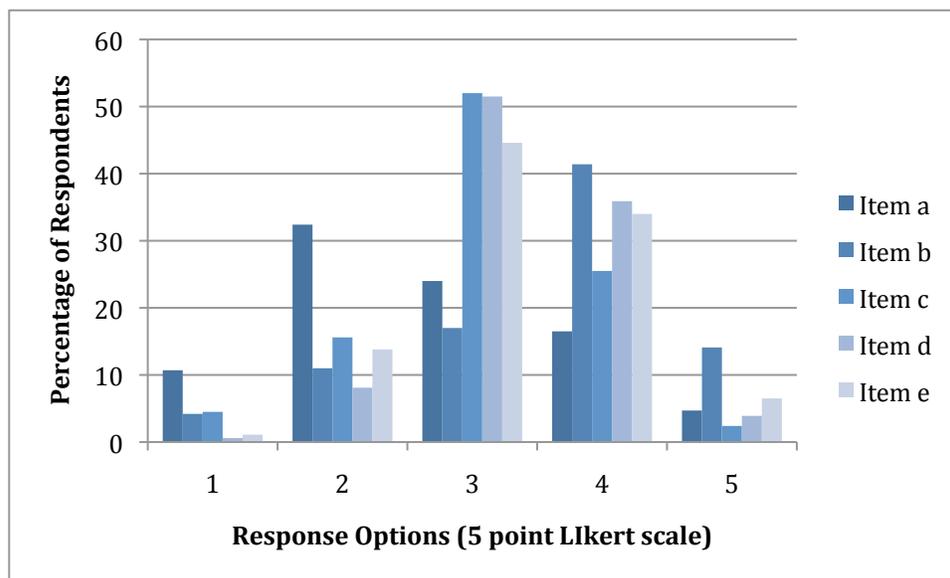
\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ )

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

The results of this analysis showed that the respondents interest in playing a role in framing the issue of shoreline change in their communities increased with their levels of self-organization

demonstrating support for Ha2(c). Items A, B, and C all returned results that were either lower than 3 or straddled the neutral point on the Likert scale. This suggests that overall perceptions of how the issue is currently framed, and the role that respondents play in the frame community tend to be low, irrespective of significant differences (Table 38)

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the five index items (Figure 27). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for item A was “2”, for item B was “4”, the mode for items C, D, and E was “3”. The proportion of responses in the strongly disagree category (i.e. response = 1) ranged from 0.6 to 10.7%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 27, Table 39), demonstrated some predictive capability between the items.



*Figure 27. Distribution of index response options according to the five index items for issue framing*

For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pair-wise comparisons, less than 15% of all respondents had responses that differed by more than 1 for each comparison (Table 39) with all but one result being less than 6%. This suggested that an index developed from all five items would have questionable validity. Bivariate relationships among the five items were then examined. Correlation coefficients for the ten pair-wise comparisons ranged from -0.42 to 0.49, which suggests at least one item should be excluded (Table 39).

*Table 39. Bivariate relationships among issue framing index items*

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.488	14.5
A and C	0.006	5.2
A and D	0.095	2.7
A and E	0.001	6.0
B and C	0.019	5.7
B and D	0.103	2.9
B and E	0.019	5.8
C and D	-0.328	6.0
C and E	-0.418	4.0
D and E	0.347	3.6

To further examine this possibility the items were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.308$ , which is very low. The index was recreated using multiple combinations of four or three items to see if any item should be excluded. When item C was

excluded the index item reliability increased to  $\alpha = 0.466$  which was the largest Cronbach's alpha when items were considered in groups for four or five (Table 40).

This suggested that only items A, C, D, and E should be used to create the aggregation index.

However, when combinations of only two items were examined, items A and B combined to form an index with an index item reliability of  $\alpha = 0.657$ . This, in conjunction with the negative Cronbach alphas returned by some of the analyses suggest that the items developed for this indicator were not as valid as would be expected.

**Table 40. Inter item reliability Cronbach's alphas for issue framing items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABCD	0.372	ABC	0.445	AB	0.657
ABCE	0.288	ABD	0.509	AC	0.017
ABDE	0.466	ABE	0.443	AD	0.152
ACDE	-0.131	ACD	-0.091	AE	-0.007
BCDE	-0.077	ACE	-0.325	BC	0.025
		ADE	0.255	BD	0.145
		BCD	-0.056	BE	0.014
		BCE	-0.227	CD	-0.885
		CDE	-0.617	CE	-1.503
				DE	0.499

The three measures of index reliability and validity for the issue framing index returned mixed results. Both the bivariate relationships and the Cronbach alphas suggested that items C and D had a negative impact upon the index suggesting they be removed. However, the highest reliability score was returned with only two items, A and B. The use of only two items vastly reduced the utility of this index as it was initially conceptualized, limiting the aggregation scores

range between a minimum of 2 and a maximum of 10. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 41). Not surprisingly this showed no significant differences, suggesting that aggregation of these items into a single index was actually detrimental to the overall measurement of this indicator considering the fact that 4 out of the 5 original items showed significant differences across levels of self-organization.

*Table 41. Analysis of variance for aggregated scores on issue framing attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>4.34</u>	<u>4.43</u>	<u>4.62</u>	0.543	0.581

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.7 REGULATORY QUALITY

The regulatory quality indicator was developed to determine if critiques of the current regulations were affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific regulatory quality items. The specific alternative hypothesis for regulatory quality stated:

- Ha3(a): Respondents with high aptitude for self-organization will be more critical of current regulatory quality than respondents of a lower level

Due to the directionality of the items no recoding was necessary for the analysis of this indicator. A one-way analysis of variance was then used to test for differences between the means of each

item according to self-organization level (Table 42). No significant differences were found between self-organization levels providing evidence that the null hypothesis could not be rejected.

Although no significant differences were found for this indicator the mean responses for each item tended to be low (less than 3 on a 5-point Likert scale), with the exception of item D. Item D, concerning with whether or not respondents felt that the laws currently in place with regards to shoreline change are sufficient, returned a mean above 3. This result, in combination with the low responses of the other items, suggested that that overall perception of regulatory quality is low amongst respondents irrespective of self-organization level.

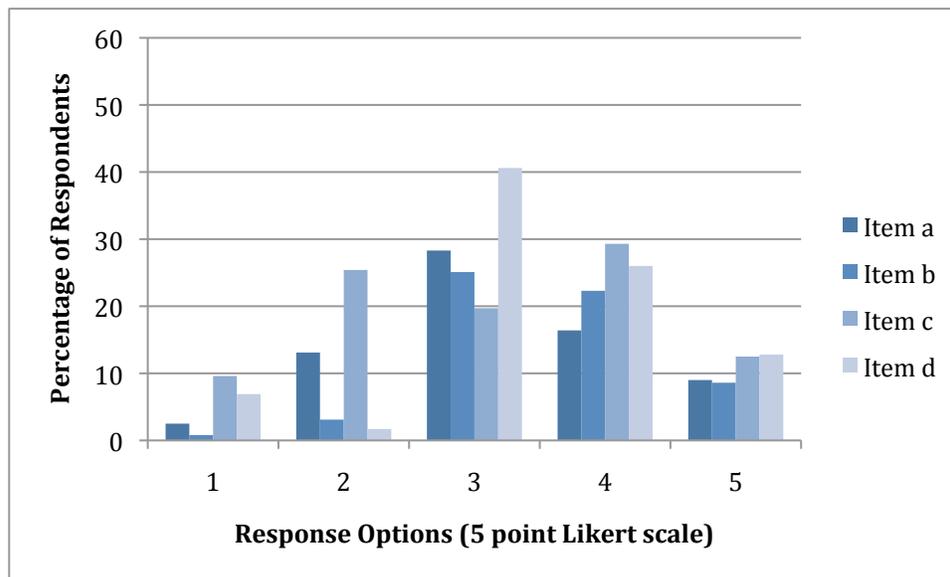
*Table 42. Analysis of variance for mean scores on regulatory quality attributes according to self-organization level.*

<u>Regulatory quality item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. Local authorities are implementing regulatory decisions I do not agree with	<u>2.19</u>	<u>2.25</u>	<u>2.31**</u>	0.177	0.838
b. Current laws are contradictory	<u>1.98</u>	<u>2.06</u>	<u>2.30</u>	1.473	0.230
c. Overall, protecting public property and beaches should be of higher priority	<u>2.96</u>	<u>3.03</u>	<u>2.94</u>	0.325	0.723
d. The laws that are in place are not sufficient	<u>3.18</u>	<u>3.33</u>	<u>3.13</u>	2.251	0.106

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

Acknowledging that since no significant differences were found a valid index would be unlikely in this situation the same approach was used with this indicator as with the resources indicator. Frequency distributions were calculated for each of the four index items (Figure 28). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for items A,

B, and D was “3” and for item C the mode was “4”. The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 10% for all items, although it ranged from 0.8 to 9.6%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 28, Table 43), demonstrated some predictive capability between the items.



*Figure 28. Distribution of index response options according to the four index items for regulatory quality*

For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. For all pair-wise comparisons, less than 15% of all respondents had responses that differed by more than 1 for each comparison (Table 43). This suggested that an index developed from all four items would have questionable validity as suspected. Bivariate relationships among the four items confirmed this suspicion. Correlation coefficients for the six pair-wise comparisons ranged from -0.070 to 0.40, which suggested one or more items might need to be excluded (Table 43). To further examine this possibility the items were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.316$ , which was very low. The

aggregation index was recreated using multiple combinations of three or two items. When item D was excluded the index item reliability increased to  $\alpha = 0.395$  (Table 44). This suggested that three items A, B, and C should be used to create the aggregation index. However, the lack of internal consistency in the scale (Cronbach's  $\alpha < 0.400$ ) was a concern. When combinations of only two items were examined, items A and B combined to form an index with an index item reliability of  $\alpha = 0.582$ . This, in conjunction with the negative Cronbach alphas returned by some of the analyses suggest that the items developed for this indicator were not as valid as would be expected.

**Table 43. Bivariate relationships among commitment index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.402	6.3
A and C	0.058	15.6
A and D	-0.070	13.8
B and C	0.006	13.6
B and D	0.034	12.7
C and D	0.055	14.2

**Table 44. Inter item reliability Cronbach's alphas for regulatory quality items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.395	AB	0.582
ABD	0.373	AC	0.108
ACD	0.045	AD	-0.128
BCD	0.075	BC	0.029
		BD	0.073
		CD	0.110

The three measures of index reliability and validity for the regulatory quality index returned mixed results. Both the bivariate relationships and the Cronbach alphas suggested that item D had a negative impact upon the index suggesting it should be removed. However, the highest reliability score was returned with only two items, A and B. The use of only two items vastly reduced the utility of this index as it was initially conceptualized, limiting the aggregation scores range between a minimum of 2 and a maximum of 10. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 45). Not surprisingly this showed no significant differences.

*Table 45. Analysis of variance Aggregated scores on regulatory quality attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>4.18</u>	<u>4.33</u>	<u>4.61*</u>	0.879	0.416

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.8 ACCOUNTABILITY

The accountability indicator was developed to determine if the level of acceptable accountability, i.e. the extent to which governments pursue the needs of the general public, was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific accountability items. The specific alternative hypothesis for accountability stated:

- Ha3(b): Respondents with high aptitude for self-organization will be more critical of the level of accountability shown by management authorities than respondents of a lower level

To avoid issues with Cronbach's alpha, question 5 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 46). Significant differences were found between self-organization levels on four of the five items providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis using the four significantly different items. Results showed that respondents with very high aptitude for self-organization were actually more supportive of the management authorities, suggesting that they felt as if accountability expectations were being met, than respondents of a lower level. These results provide sufficient evidence to reject the null but do not demonstrate support for the alternate as written.

Although significant differences were found for this indicator, the results were again very low with all the mean responses for each item being less than 3 on a 5-point Likert scale, with the exception of item E. The highest mean across all of the items associated with items A through D was 2.60 and was recorded by the highest self-organization level for the item designed to ascertain if respondents felt as if the management process was honestly conducted. The one item that did produce a high mean was focused on the personal accountability and responsibility of respondents to be involved in management decisions. These results suggested that, as a whole, respondents felt that there was little accountability and that local authorities were doing little to respond to community concerns. Despite this general lack of accountability, there was a linear increase across self-organization levels was seen across the four items that were significant on this indicator.

**Table 46. Analysis of variance for mean scores on accountability attributes according to self-organization level.**

<u>Accountability item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. I feel like shoreline change issues are not honestly discussed	<u>2.55</u>	<u>2.70</u>	<u>2.60**</u>	0.397	0.672
b. Local authorities are responsive to the concerns of my community	<u>1.92</u>	<u>2.17<sup>a</sup></u>	<u>2.47<sup>a</sup></u>	5.413	0.005
c. Local authorities responsible take into account the input I provide	<u>1.66</u>	<u>1.83<sup>a</sup></u>	<u>2.02<sup>a</sup></u>	2.551	0.079
d. Local authorities are serious about ...involving community members	<u>1.77</u>	<u>2.08<sup>a</sup></u>	<u>2.29<sup>a</sup></u>	4.478	0.012
*e. Residents of my community have no responsibility to participate	<u>3.37</u>	<u>3.60<sup>a</sup></u>	<u>3.73<sup>a</sup></u>	2.502	0.083

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the five index items (Figure 29). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for items A and E was “4”, and for items B, C and D the mode was “3”. The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 8% for all items, although it ranged from 2.2 to 7.2%. For each of the five variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. The pair-wise comparisons varied greatly, ranging from 0.8% to 20.6 of respondents who had responses that differed by more than 1 for each comparison (Table 47). The results do suggest that items D and E may warrant further investigation since the

biggest percentage differences were seen between pair-wise comparisons that included those items. This suggests that an index developed from all five items would be questionable validity.

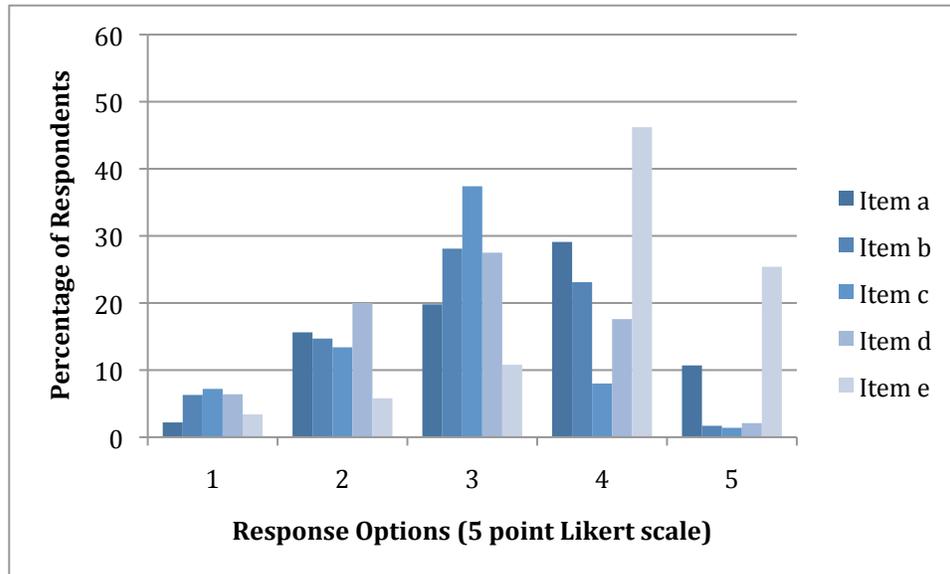


Figure 29. Distribution of index response options according to the five index items for accountability

Bivariate relationships among the five items were then examined. Correlation coefficients for the ten pair-wise comparisons ranged from 0.11 to 0.58. A correlation coefficient of 0.11 is lower than desired and suggested that some item exclusion may be necessary (Table 47). To investigate further if the five items could potentially be aggregated to form a single index of accountability they were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.664$ , which was higher than expected considering the pair-wise comparisons. The index was recreated using multiple combinations of four or three items to see if any item should be excluded. When item E was excluded the index item reliability increased to  $\alpha = 0.705$  which was the largest Cronbach’s alpha when items were considered in groups for four or five (Table 48). This suggested that only items A, B, C, and D should be used to create the aggregation index. However, when combinations of three items were examined, items B, C, and D combined to form an index with an index item

reliability of  $\alpha = 0.747$ , which provides strong evidence to limit the index further to just these three items.

*Table 47. Bivariate relationships among accountability index items*

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.265	0.8
A and C	0.260	4.0
A and D	0.276	0.8
A and E	0.107	16.7
B and C	0.475	4.6
B and D	0.577	2.2
B and E	0.144	19.7
C and D	0.426	3.0
C and E	0.108	20.6
D and E	0.194	19.8

The three measures of index reliability and validity for the accountability index returned conclusive results that showed all five items should not be used. Both the bivariate relationships and the Cronbach alphas suggested that multiple items should be removed from the final aggregated index. Although the use of only three items did reduce the utility of this index as it was initially conceptualized, it produced a more valid final product. This limited the aggregation scores range between a minimum of 3 and a maximum of 15. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 49). The fact that aggregation scores increased significantly with each level of self-organization provided further evidence that the overall null hypothesis should be rejected. However, post hoc tests using Tukey's test did not demonstrate support Ha3(b) as

expected, showing instead that higher levels of self-organized individuals were less critical of management efforts. The aggregated means did show a linear increase between each level of self-organization and also demonstrated a low level of overall accountability ranging between 5 and 7 out of a maximum of 15.

**Table 48. Inter item reliability Cronbach's alphas for accountability items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABCD	0.705	ABC	0.594	AB	0.410
ABCE	0.541	ABD	0.631	AC	0.420
ABDE	0.585	ABE	0.384	AD	0.425
ACDE	0.542	ACD	0.580	AE	0.191
BCDE	0.660	ACE	0.371	BC	0.643
		ADE	0.415	BD	0.735
		BCD	0.747	BE	0.258
		BCE	0.494	CD	0.600
		CDE	0.495	CE	0.198
				DE	0.333

**Table 49. Analysis of variance for aggregated scores on accountability attributes according to self-organization level.**

	Self-Organization Level			ANOVA	
	Moderate	High	Very High	F	Sig.
Aggregation score	5.35	6.08 <sup>a</sup>	6.75 <sup>a</sup>	5.659	0.004

\*Means underscored by the same line are not significantly different (p>0.10) using Tukey's test

<sup>a</sup> not significantly different (p>0.10) using Tukey's test

#### 7.4.9 RULE OF LAW

The rule of law indicator was developed to determine if critiques of the current legal frameworks were affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific rule of law items. The specific alternative hypothesis for rule of law stated:

- Ha3(c): Respondents with high aptitude for self-organization will prefer a greater level of autonomy than respondents of a lower level

Due to the directionality of the items no recoding was necessary for the analysis of this indicator. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 50). Significant differences were found between self-organization levels on two of the four items levels providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis using the two significantly different items. Results showed that respondents with moderate aptitude for self-organization were demanding a greater level of autonomy than respondents of a higher level. These results provide sufficient evidence to reject the null but do not demonstrate support for the alternate as written.

The results for the rule of law indicator show a mixed response. One of the significant items, item C, did show some support for Ha3(c) in as far as there was a significant difference between self-organization levels, however the increase was not linear across the levels as expected. The mean values for all three levels of self-organization on the remaining items were all less than 3 on a 5-point scale showing that the respondents as a whole felt that they disagreed with the laws and governance system currently in place, irrespective of self-organization level.

*Table 50. Analysis of variance for mean scores on rule of law attributes according to self-organization level.*

<u>Rule of law item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. I think the state authorities have much more power than the federal government	<u>2.98</u>	<u>2.67</u>	<u>2.91**</u>	1.817	0.163
b. Authorities in my county are dictating the local approach	<u>2.17<sup>a</sup></u>	<u>1.89</u>	<u>2.27<sup>a</sup></u>	3.283	0.038
c. I believe I should be allowed to protect my personal property	<u>3.36<sup>a</sup></u>	<u>3.05</u>	<u>3.22<sup>a</sup></u>	2.352	0.096
d. I feel that new federal laws must be put in place	<u>2.37</u>	<u>2.51</u>	<u>2.65</u>	1.353	0.259

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p > 0.10$ ) using Tukey's test

In order to determine if a valid index could be created from an aggregation process, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the four index items (Figure 30). On a scale of responses from "1" (strongly disagree) to "5" (strongly agree), the modal response for items A, C, and D was "4", and for item B the mode was "3". The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 15% for all items, although it ranged from 3.9-14.3%. This distribution, in combination with the percent of occurrences when two variables differ by a pre-determined amount (Figure 30, Table 51), demonstrated some predictive capability between the items. For each of the four variables under consideration for inclusion in the index, possible responses varied from "1" to "4". The pair-wise comparisons varied greatly, ranging from 7.5% to 24.7 of respondents who had responses that differed by more than 1 for each comparison (Table 51), with numerous comparisons returning a high percentage of differences. This suggested that an index developed from all four items would be questionable validity. Bivariate

relationships among the four items were then examined. Correlation coefficients for the six pairwise comparisons ranged from 0.11 to 0.58. A correlation coefficient of 0.11 is lower than desired and suggested that some item exclusion may be necessary (Table 51).

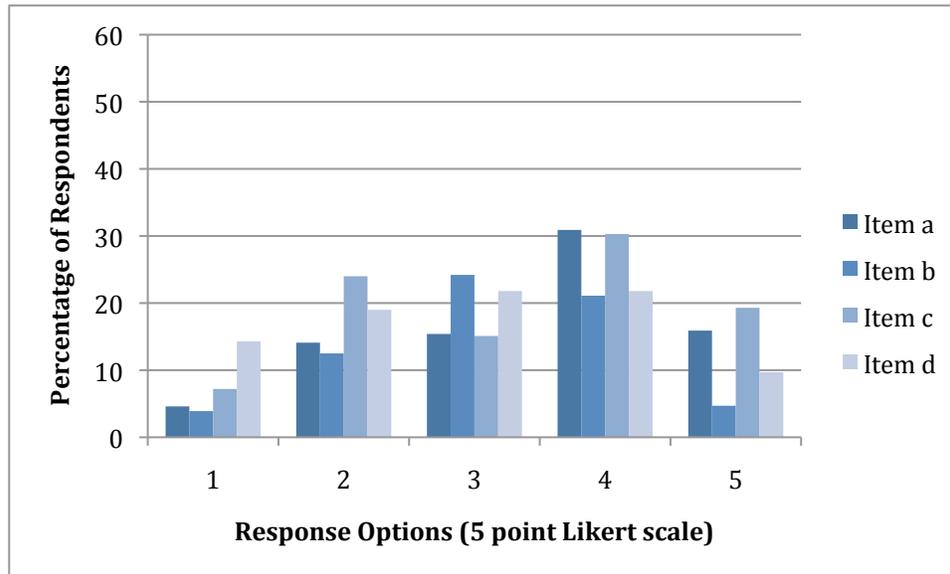


Figure 30. Distribution of index response options according to the five index items for rule of law

Table 51. Bivariate relationships among rule of law index items

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.280	7.5
A and C	0.088	24.7
A and D	0.170	22.1
B and C	0.153	18.4
B and D	0.257	15.6
C and D	0.044	17.9

To further examine this possibility the items were tested for index item reliability using Cronbach's coefficient alpha. The reliability of the final multiple-item index was measured with

an internal consistency of  $\alpha = 0.453$ , which was higher than expected considering the pair-wise comparisons. The index was recreated using multiple combinations of three or two items to see if any item should be excluded. When item C was excluded the index item reliability increased to  $\alpha = 0.485$  which was the largest Cronbach's alpha when items were considered in groups for three or two (Table 52). This alpha was lower than is typically recommended and suggested that the items developed for this indicator were not as valid as would be expected.

**Table 52. Inter item reliability Cronbach's alphas for rule of law items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.393	AB	0.447
ABD	0.485	AC	0.159
ACD	0.265	AD	0.300
BCD	0.368	BC	0.267
		BD	0.409
		CD	0.100

The three measures of index reliability and validity for the accountability index returned conclusive results that showed all four items should not be used. Both the bivariate relationships and the Cronbach alphas suggested that item C should be removed from the final aggregated index. This meant that the aggregation scores ranged between a minimum of 3 and a maximum of 15. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 53).

Significant differences were found when the results were analyzed ( $F = 3.067$ ) providing evidence that the overall null hypothesis should be rejected. However the post-hoc results show no linear pattern between the levels of self-organization. Since no linear increase or decrease was

found between groups there is limited support for Ha3(c). It does suggest that the items used to measure this component may have lacked reliability especially considering the ultimate Cronbach’s alpha ( $\alpha = 0.485$ ).

*Table 53. Analysis of variance for aggregated scores on rule of law attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>7.500<sup>a</sup></u>	<u>7.05</u>	<u>7.84<sup>a*</sup></u>	3.067	0.047

\*Means underscored by the same line are not significantly different ( $p>0.10$ ) using Tukey’s test

<sup>a</sup> not significantly different ( $p>0.10$ ) using Tukey’s test

#### 7.4.10 DISTRIBUTION

The distribution indicator was developed to determine if preferences for specific resource allocation norms were affected by a respondent’s level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific distribution items. The specific alternative hypothesis for distribution stated:

- Ha4(a): Respondents with high aptitude for self-organization will favour the “need” allocation more highly than respondents of a lower level

Due to the directionality of the items no recoding was necessary for the analysis of this indicator. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 54). A significant difference was found between self-organization levels on only one of the four items levels. Tukey’s post hoc test was used to evaluate the alternate hypothesis using the one significantly different item. Results did not

demonstrate support for Ha4(a) due to the fact that, although the item that returned a significant result was the one used to operationalize the need allocation, the means actually decreased between the self-organization levels and the expected linear pattern was not present. One interesting result involved item D, which was aimed at determining if respondents thought that North Carolina as a whole was getting sufficient federal assistance to help deal with shoreline change. Although no significant differences were seen across self-organization levels, all the means returned for this item were very low, suggesting in fact that respondents felt as if North Carolina was receiving sufficient assistance. This suggested that any conflict associated with shoreline management was not linked to federal funding but more to how those funds were being utilized.

*Table 54. Analysis of variance for mean scores on distribution attributes according to self-organization level.*

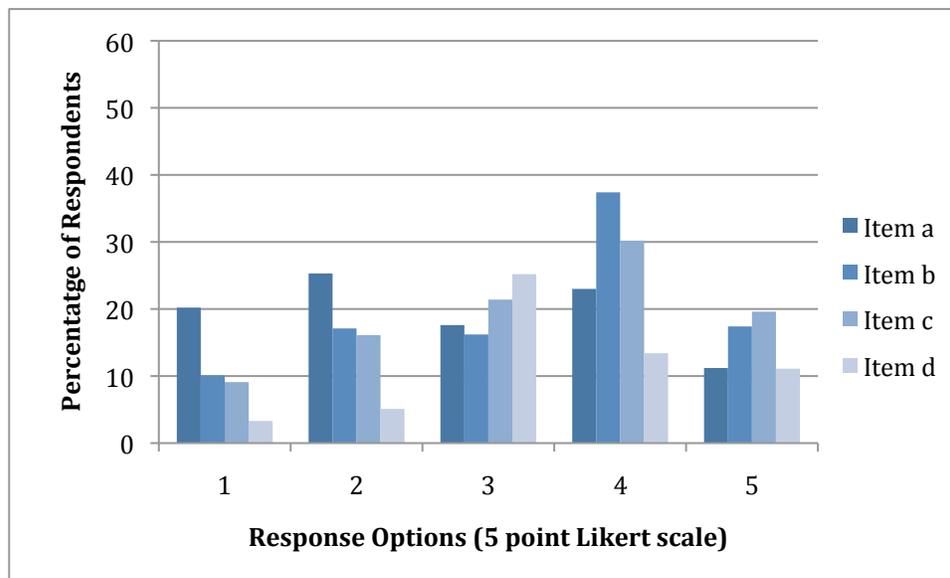
<u>Distribution item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
a. People who cannot afford to protect their property	<u>2.83</u>	<u>2.71</u>	<u>2.68**</u>	0.458	0.663
b. We all pay taxes, so we are equally deserving	<u>3.22</u>	<u>3.30</u>	<u>3.35</u>	0.431	0.650
c. People with more expensive houses should contribute more	<u>3.30<sup>a</sup></u>	<u>3.40</u>	<u>3.04<sup>a</sup></u>	4.435	0.012
d. The State of North Carolina is not getting sufficient federal funds	<u>1.83</u>	<u>1.93</u>	<u>2.07</u>	0.709	0.492

\*\*Means underscored by the same line are not significantly different ( $p>0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p>0.10$ ) using Tukey's test

Since only one item was significant, it is acknowledged that a valid index created from these four items would be unlikely, however the validation steps were carried out nonetheless. Frequency

distributions were calculated for each of the four index items (Figure 31). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for item A was “2”, for items B and C the mode was “4”, and for item D the mode was “3”. The proportion of responses in the strongly disagree category (i.e. response = 1) ranged greatly from 3.3-20.2% suggesting that an index created from all four items may lack validity. For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. The pair-wise comparisons varied greatly, ranging from 5.4% to 19.2% of respondents who had responses that differed by more than 1 for each comparison (Table 55). As suspected, this suggested that an index developed from all four items would be questionable validity.



*Figure 31. Distribution of index response options according to the four index items for distribution*

Bivariate relationships among the four items were then examined. Correlation coefficients for the six pair-wise comparisons ranged from 0.077 to 0.45, which suggested at least one item should be excluded (Table 55).

**Table 55. Bivariate relationships among distribution index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.449	5.4
A and C	0.184	16.1
A and D	0.191	11.5
B and C	0.077	16.3
B and D	0.125	8.7
C and D	0.085	19.2

The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.453$ , which was higher than expected considering the pair-wise comparisons. The index was recreated using multiple combinations of three or two items to see if any item should be excluded. No combination of three items increased the Cronbach alpha of the index (Table 56), suggesting that an index created from all four items may be the most reliable. When combinations of only two items were examined, items A and B combined to form an index with an index item reliability of  $\alpha = 0.616$  which suggested that the index should be created using only these two items.

**Table 56. Inter item reliability Cronbach's alphas for distribution items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABC	0.481	AB	0.616
ABD	0.466	AC	0.312
ACD	0.339	AD	0.312
BCD	0.237	BC	0.143
		BD	0.207
		CD	0.152

The three measures of index reliability and validity for the regulatory quality index returned conclusive results that items should be excluded from the final index for this indicator. Both the bivariate relationships and the Cronbach alphas suggested that item D had a negative impact upon the index suggesting it should be removed. However, the highest reliability score was returned with only two items, A and B. The use of only two items vastly reduced the utility of this index as it was initially conceptualized, limiting the aggregation scores range between a minimum of 2 and a maximum of 10. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 57). Not surprisingly this showed no significant differences since the items used to create the index were not significant before aggregation.

*Table 57. Analysis of variance for aggregated scores on distribution attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>6.04</u>	<u>6.000</u>	<u>6.02*</u>	0.015	0.985

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.11 PROCESS

The process indicator was developed to determine if perceptions of fairness with regards to the process of decision-making was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific process items. The specific alternative hypothesis for process stated:

- Ha4(b) Respondents with high aptitude for self-organization will demand a more just process than respondents of a lower level

To avoid issues with Cronbach's alpha, question 5 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 58). No significant differences were found between self-organization levels, providing evidence that the null hypothesis could not be rejected.

*Table 58. Analysis of variance of mean scores on process attributes according to self-organization level.*

Process item	Self-Organization Level			ANOVA	
	Moderate	High	Very High	F	Sig.
a. Local authorities will not listen to anything members of my community have to say	<u>2.23</u>	<u>2.37</u>	<u>2.22**</u>	0.582	0.559
b. I do not trust the people in charge of local management decisions	<u>2.74</u>	<u>2.85</u>	<u>2.65</u>	1.176	0.309
c. The decision making process is unfair	<u>3.27</u>	<u>3.19</u>	<u>3.20</u>	0.438	0.646
d. Everyone's opinion is of equal importance	<u>3.19</u>	<u>3.14</u>	<u>3.34</u>	1.868	0.155
*e. The people who are least able to recover financially are adequately represented	<u>3.20</u>	<u>3.32</u>	<u>3.29</u>	0.820	0.441
f. People with more expensive properties should have a greater say	<u>2.11</u>	<u>1.96</u>	<u>1.90</u>	2.120	0.121

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

Although no significant differences were found for this indicator, two items warrant more investigation. Both items D and F returned differences that approached a significant  $p = 0.100$  alpha level at  $p = 0.155$  and  $0.121$  respectively. These were both key items in understanding the

importance respondents attached to equality and fairness. The directionality of these two items suggest that the hypothesis for the process indicator was constructed correctly and perhaps a slightly different wording of these two items, or a larger sample size, may have moved these items into the significance range.

Acknowledging that since no significant differences were found a valid index would be unlikely in this situation the same approach was used with this indicator as with the resources indicator. Frequency distributions were calculated for each of the six index items (Figure 32). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for items A, B, C and E was “3”, and for items D and F the mode was “2”. The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 5% for all but one of the items. The exception was item F with over 30% of responses in the strongly disagree category.

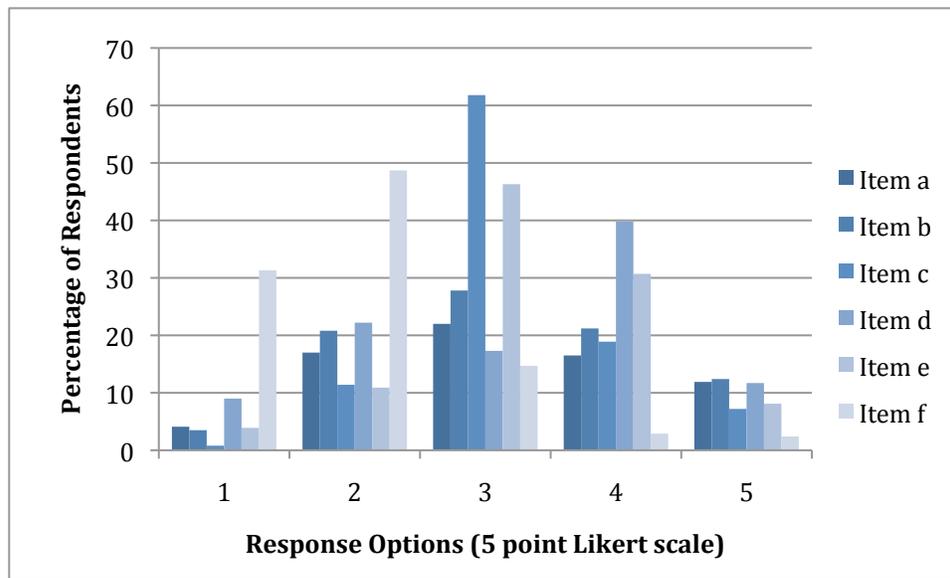


Figure 31. Distribution of index response options according to the six index items for process

For each of the six variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. The pair-wise comparisons varied greatly, ranging from 1.4% to 26.8% of respondents who had responses that differed by more than 1 for each comparison (Table 59). The biggest variation was seen with pair-wise comparisons that included item F. This suggested that an index developed from all six items would have questionable validity. Bivariate relationships among the six items were then examined. Correlation coefficients for the fifteen pair-wise comparisons ranged from -0.13 to 0.63, which suggests at least one item, if not multiple items, might need to be excluded (Table 59).

To further examine this possibility the items were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.417$ , which is low. The aggregation index was recreated using multiple combinations of five or four items. When item F was excluded the index item reliability increased to  $\alpha = 0.511$  (Table 60). This suggested that five items A, B, C, D and E should be used to create the aggregation index. However, the low internal consistency in the scale was a concern. When combinations of four items were examined, items A, B, C and E combined to form an index with an index item reliability of  $\alpha = 0.641$ , which provides strong evidence to limit the index further to just these four items.

*Table 59. Bivariate relationships among process index items*

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.626	1.4
A and C	0.308	2.9
A and D	-0.42	12.3
A and E	0.158	4.4
A and F	-0.118	25.9
B and C	0.400	2.9
B and D	-0.79	12.5
B and E	0.195	8.0
B and F	-0.135	20.5
C and D	-0.18	13.7
C and E	0.100	6.9
C and F	0.037	26.8
D and E	-0.044	8.4
D and F	0.14	22.2
E and F	-0.138	26.2

The three measures of index reliability and validity for the regulatory quality index returned conclusive results that items should be excluded from the final index for this indicator. This meant that the aggregation scores ranged between a minimum of 4 and a maximum of 20. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 61). Not surprisingly this showed no significant differences since the items used to create the index were not significant before aggregation.

**Table 60. Inter item reliability Cronbach's alphas for process items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABCDE	0.511	ABCD	0.510
ABCDF	0.406	ABCE	0.641
ABCEF	0.516	ABCF	0.525
ABDEF	0.319	ABEF	0.436
ACDEF	0.111	ABDE	0.446
BCDEF	0.130	ABDF	0.294
		ACDE	0.220
		ACDF	0.072
		ADEF	-0.074
		BCDE	0.251
		BCDF	0.084
		BCEF	0.255
		BCDF	0.084
		BDEF	-0.107
		CDEF	-0.051

**Table 61. Analysis of variance of aggregated scores on process attributes according to self-organization level.**

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>11.62</u>	<u>11.78</u>	<u>11.32*</u>	0.976	0.378

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

#### 7.4.12 URGENCY

The urgency indicator was developed to determine if perceptions of the saliency of the issue of shoreline change was affected by a respondent's level of self-organization. The null hypothesis, no difference will be found for any indicator between respondents with high or low aptitude level of self-organization was tested using the specific urgency items. The specific alternative hypothesis for urgency stated:

- Ha4(c): Respondents with high aptitude for self-organization will have a greater sense of urgency to act than respondents of a lower level

To avoid issues with Cronbach's alpha, question 1 (see Chapter 6.3) that had been negatively framed for the purposes of the survey was recoded into a positive frame for the purposes of analysis. A one-way analysis of variance was then used to test for differences between the means of each item according to self-organization level (Table 62). Significant differences were found between self-organization levels on only one of the five items providing evidence that the null hypothesis should be rejected. Tukey's post hoc test was used to evaluate the alternate hypothesis using the one significantly different item. These results show very limited support for Ha4(c).

Although only one item was significantly difference for this indicator the means returned are relatively high compared to several of the other indicators. In fact, all the means for the non-significant items were above 3 on a 5-point Likert scale. This suggests that, as a whole, the respondent population is concerned with shoreline change and view it as a matter of urgency. The one item that was significantly different across the levels of self-organization was associated with determining if respondents were already planning for shoreline change. All the means for this item were below 3 suggesting that although shoreline change is an issue with this group of coastal residents, planning for the change is not, although high levels of self-organized individuals were inclined to plan than the moderate level.

*Table 62. Mean scores on urgency attributes according to self-organization level.*

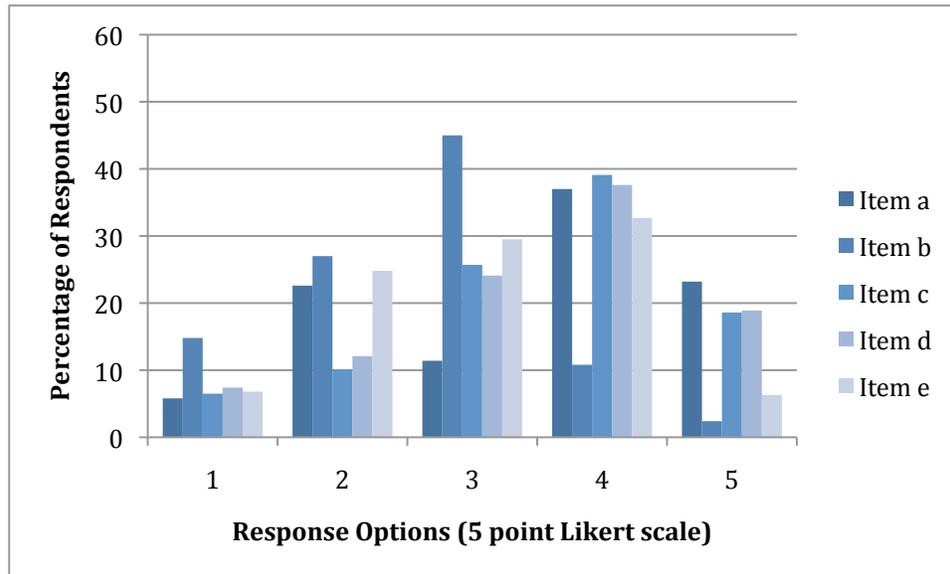
<u>Urgency item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
*a. Natural changes will not impact my community's way of life	<u>3.33</u>	<u>3.48</u>	<u>3.60**</u>	1.913	0.148
b. My family is already planning for shoreline change	<u>2.33</u>	<u>2.65</u>	<u>2.63</u>	5.050	0.007
c. More needs to be done to protect my coastal county	<u>3.46</u>	<u>3.51</u>	<u>3.59</u>	0.569	0.566
d. It is important to me personally that we do more	<u>3.40</u>	<u>3.49</u>	<u>3.47</u>	0.260	0.771
e. I feel as if I will be fully able to deal with any issues	<u>3.18</u>	<u>3.03</u>	<u>3.06</u>	0.924	0.398

\*Items recoded for analysis

\*\*Means underscored by the same line are not significantly different ( $p > 0.10$ )

In order to determine if a valid index could be created from an aggregation process, in spite of the lack of significant items, the same three validation steps used for the overall self-organization index were taken. Frequency distributions were calculated for each of the four index items (Figure 33). On a scale of responses from “1” (strongly disagree) to “5” (strongly agree), the modal response for items A was “2”, for item B the mode was “3”, and for items C, D, and E the mode was “4”. The proportion of responses in the strongly disagree category (i.e. response = 1) was less than 15% for all items, although it ranged from 5.8-14.8%. For each of the four variables under consideration for inclusion in the index, possible responses varied from “1” to “4”. The pair-wise comparisons varied greatly, ranging from 6.0 to 25.1% of respondents who had responses that differed by more than 1 for each comparison (Table 63). These results do suggest that item E may warrant further investigation since the biggest percentage differences were seen between pair-wise comparisons that included that item. Bivariate relationships among

the five items were then examined. Correlation coefficients for the ten pair-wise comparisons ranged from -0.39 to 0.66, which suggested that at least one or more of the items should be excluded (Table 63).



*Figure 33. Distribution of index response options according to the five index items for urgency*

To further examine this possibility the items were tested for index item reliability using Cronbach’s coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.405$ , which is low. The aggregation index was recreated using multiple combinations of four, three, or two items. When item E was excluded the index item reliability increased to  $\alpha = 0.703$  (Table 64). This provided strong evidence to limit the index to that four items A, B, C, and D.

**Table 63. Bivariate relationships among urgency index items**

Index item pair	Correlation coefficient	% of responses differing by more than one
A and B	0.262	16.7
A and C	0.327	9.8
A and D	0.356	12.7
A and E	-0.385	7.0
B and C	0.293	19.8
B and D	0.338	25.1
B and E	-0.095	7.8
C and D	0.659	6.2
C and E	-0.305	4.9
D and E	-0.311	6.0

**Table 64. Inter item reliability Cronbach's alphas for urgency items**

Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha	Index item combination	Cronbach's alpha
ABCD	0.703	ABC	0.553	AB	0.415
ABCE	0.076	ABD	0.580	AC	0.494
ABDE	0.108	ABE	-0.265	AD	0.526
ACDE	0.245	ACD	0.702	AE	-1.173
BCDE	0.312	ACE	-0.362	BC	0.447
		ADE	-0.331	BD	0.499
		BCD	0.701	BE	-0.198
		BCE	-0.132	CD	0.703
		CDE	0.097	CE	-0.832
				DE	-0.882

The three measures of index reliability and validity for the regulatory quality index returned similar results. Both the bivariate relationships and the Cronbach alphas suggested that item E had a negative impact upon the index suggesting it should be removed. This meant that the aggregation scores ranged between a minimum of 4 and a maximum of 20. A one-way analysis of variance was then used to test for differences between the means of the aggregated items according to self-organization level (Table 65). Not surprisingly this showed no significant differences. However, the relatively high means, ranging between 12.5 and 13.3 out of 20 did lend credence to the suggestion that shoreline change does resonate as an issue with the respondent population and that some urgency is attached to the issue.

*Table 65. Analysis of variance for aggregated scores on urgency attributes according to self-organization level.*

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>12.52</u>	13.10	<u>13.28*</u>	2.154	0.117

\*Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test.

### 7.4.13 INDICATOR SUMMARY

In summary, the hypothesis testing returned mixed results, suggesting that some indicators were more highly influenced by the degree of self-organization than others. Three of the indicators, resources, regulatory quality, and process, had no significantly different items across self-organization levels. Therefore, based on these results the null hypothesis for these indicators cannot be rejected. Unsurprisingly the aggregated indices for these three indicators were also not significant. Two indicators, distribution and urgency, only had one item each that was significantly different. Since only one item was significant it is difficult to claim that evidence existed to reject the null hypothesis for these indicators. However, there is an argument to suggest that the significant items, key components of the alternative hypotheses constructed for each indicator, provide sufficient evidence to warrant further examination and the inclusion of this indicators in future studies. The majority of the means associated with four of the five indicators mentioned, with the urgency indicator being the exception, tended to be either below 3 or straddling 3 on the 5-point Likert scale. This suggests that the issue of shoreline change may well be masking the indicators themselves.

Of the remaining seven indicators, only one, commitment, returned significant differences across all items. All five of these items were associated with a linear increase in mean value with each level of self-organization, providing strong evidence to reject the null hypothesis and accept the alternative  $H_{a1(a)}$ . The aggregated index was also significant for the commitment indicator. The other six indicators all returned significantly different items providing evidence to reject the null hypotheses associated with them (Table 66). The majority of the means associated with five of these six indicators, with the issue-framing indicator being the exception, also tended to be either below 3 or straddling 3 on the 5-point Likert scale.

*Table 66. Summary table of null hypothesis testing for indicators Y1-Y12*

Indicator	# of significant items	Null hypothesis testing
<b>Commitment</b>	<b>4/4</b>	<b>H<sub>0</sub> Rejected</b>
Resources	0/5	H <sub>0</sub> Not Rejected
<b>Skills</b>	<b>3/4</b>	<b>H<sub>0</sub> Rejected</b>
<b>Voice</b>	<b>3/4</b>	<b>H<sub>0</sub> Rejected</b>
<b>Approach</b>	<b>2/4</b>	<b>H<sub>0</sub> Rejected</b>
<b>Issue-framing</b>	<b>4/5</b>	<b>H<sub>0</sub> Rejected</b>
Regulatory quality	0/4	H <sub>0</sub> Not Rejected
<b>Accountability</b>	<b>4/5</b>	<b>H<sub>0</sub> Rejected</b>
<b>Rule of law</b>	<b>2/4</b>	<b>H<sub>0</sub> Rejected</b>
Distribution	1/4	H <sub>0</sub> Not Rejected but Insufficient Grounds to Support Ha4(a)
Process	0/6	H <sub>0</sub> Not Rejected
Urgency	1/5	H <sub>0</sub> Not Rejected but Insufficient Grounds to Support Ha4(a)

The potential to develop indices for each indicator was examined using the results of the ANOVAs as a foundation. Based on three different measures of reliability and validity, the best combination of items per indicator was selected (Table 67). The majority of indices were constructed from either all items or all but one of the items associated with each indicator. One indicator, issue framing, was most reliable when only two of five items were used to construct that particular index, which brings its validity in question. In terms of the reliability of the scales generated through simple aggregation of items, only two indicators, rule of law and regulatory quality, returned a Cronbach's alpha below acceptable levels ( $\alpha = 0.60$ ). This suggests that the items developed to examine the social constructs within each indicator were neither redundant nor completely unrelated. An ANOVA was used to test for differences between the aggregated

means of each indicator according to self-organization level, which provided a way of determining if the aggregation process was detrimental to the validity of the indicators.

*Table 67. Summary table of scale reliability for indicators Y1-Y12*

Indicator	# of items used for aggregation	Adjusted Cronbach's	Aggregation F	Pattern across SO levels post aggregation
<b>Commitment</b>	<b>4/4</b>	<b>0.662</b>	<b>92.121</b>	<b>Linear increase</b>
Resources	5/5	0.753	0.136	-
<b>Skills</b>	<b>3/4</b>	<b>0.648</b>	<b>15.89</b>	<b>Linear increase</b>
<b>Voice</b>	<b>3/4</b>	<b>0.750</b>	<b>3.719</b>	<b>Linear increase</b>
<b>Approach</b>	<b>4/4</b>	<b>0.660</b>	<b>2.508</b>	<b>Linear increase</b>
Issue-framing	2/5	0.657	0.534	-
Regulatory quality	2/4	0.582*	0.879	-
<b>Accountability</b>	<b>3/5</b>	<b>0.747</b>	<b>5.659</b>	<b>Linear increase</b>
<b>Rule of law</b>	<b>3/4</b>	<b>0.485*</b>	<b>3.067</b>	<b>Non-linear increase</b>
Distribution	2/4	0.616	0.015	-
Process	4/6	0.641	0.976	-
Urgency	4/5	0.703	2.154	-

\*Unacceptable Cronbach's alpha

Bold numbers denote significant difference between levels of SO when aggregated using Tukey's test

## 7.5 OVERALL MODEL OF SELF-ORGANIZATION

The overall model of self-organization was tested in multiple ways to determine the reliability of the items, indicators, and components. Initially, all twelve modified indices were tested to see if they could be aggregated to form a single index of self-organization using two validation techniques. Bivariate relationships among the twelve items were examined. Correlation coefficients for the multiple pair-wise comparisons ranged from -0.15 to 0.76, which suggested that at least one item should be excluded (Table 68).

*Table 68. Correlation coefficients for aggregated indicators Y1-Y12*

	Comfinal	Resfinal	Skillsfinal	Voicefinal	Appfinal	Issfinal	Regfinal	Accfinal	Roifinal	Disfinal	Procfinal	Urgfinal
Comfinal	1.000											
Resfinal	-0.005	1.000										
Skillsfinal	0.187	0.305	1.000									
Voicefinal	0.110	0.599	0.212	1.000								
Appfinal	0.070	0.493	0.254	0.572	1.000							
Issfinal	0.145	0.327	0.237	0.353	0.312	1.000						
Regfinal	0.030	0.532	0.252	0.487	0.672	0.302	1.000					
Accfinal	0.124	0.575	0.264	0.758	0.486	0.344	0.408	1.000				
Roifinal	0.050	0.375	0.238	0.405	0.566	0.249	0.508	0.388	1.000			
Disfinal	-0.023	-0.082	0.025	0.030	0.122	-0.004	0.034	0.008	0.197	1.000		
Procfinal	-0.059	0.221	0.141	0.171	0.403	0.140	0.540	0.058	0.336	0.022	1.000	
Urgfinal	0.170	-0.146	0.085	-0.011	0.004	0.081	-0.039	0.013	0.163	0.349	0.011	1.000

To investigate further if the twelve items could potentially be aggregated to form a single index of accountability they were tested for index item reliability using Cronbach's coefficient alpha. The reliability of the final multiple-item index was measured with an internal consistency of  $\alpha = 0.792$ , which was higher than expected considering the pair-wise comparisons. The index was recreated using multiple combinations of eleven items to see if any item should be excluded. Several of the combination of eleven items increased the Cronbach alpha of the index (Table 69) with the most reliable and valid index excluding the urgency indicator ( $\alpha = 0.811$ ). The exclusion of more than one item was not considered due to the fact that this would have severely compromised the overall model as it conceptualized.

**Table 69. Inter item reliability Cronbach's alphas for aggregated indicators**

Indicator excluded	Cronbach's alpha
Commitment	0.809
Resources	0.765
Skills	0.800
Voice	0.751
Approach	0.747
Issue framing	0.780
Regulatory Quality	0.755
Accountability	0.758
Rule of law	0.759
Distribution	0.800
Process	0.790
Urgency	0.811

The next step in overall model testing was to determine if it would be reliable to construct one overall model of self-organization as it was initially conceptualized, as a function of the four identified components: capacity, conflict management, governance, and social justice and allocation. Since each of the components was constructed from three indicator aggregations, the possibility of further aggregation was examined using index item reliability (Table 70). As a safe guard to confounded error due to aggregation issues (See Chapter 2.1.4.1) all the items that had been developed for each indicator that had been combined into the multiple aggregations were analyzed separately as well (Table 66).

**Table 70. Reliability analysis of overall model of self-organization**

Component	Indicators	Indicator Aggregation Cronbach's	Item Cronbach's (without aggregation)
Capacity	Commitment Resources Skills	0.332*	0.710
Conflict management	Voice Approach Issue Framing	0.688	0.801
Governance	Regulatory Quality Accountability Rule of Law	0.723	0.777
Social justice and allocation	Distribution Process Urgency	0.226*	0.605

\*Unacceptable Cronbach's alpha

As a result of the aggregated reliability analyses (Table 70) a reliability analysis was run using all 54 individual items developed for this study, irrespective of which component or indicator they were initially constructed for. This analysis returned an index item reliability of  $\alpha = 0.864$ .

For completion's sake, despite two low Cronbach alpha results from the capacity and the social justice components, a single figure of self-organization was developed from one final aggregation of all four components. This final index was also tested for inter item reliability ( $\alpha = 0.774$ ). However, the inter-item correlation matrix (Table 71) reinforced the correlation concerns raised in Chapter 4.3, which reduces the overall reliability of this final index as a whole. The results highlighted potential overlap between the conflict and governance components with an inter-item correlation of 0.798.

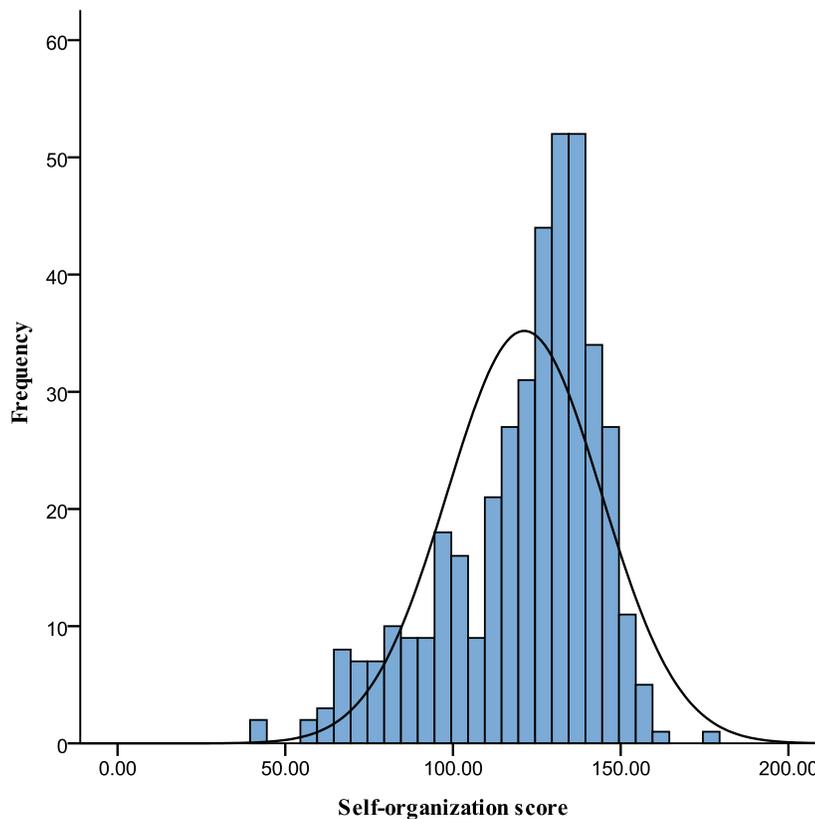
*Table 71. Inter-item correlation matrix for self-organization index*

Component	Capacity	Conflict	Governance	Social Justice
Capacity Aggregation	1.000			
Conflict Management Aggregation	0.600	1.000		
Governance Aggregation	0.598	0.798	1.000	
Social justice and Allocation Aggregation	0.086	0.237	0.305	1.000

Despite obvious limitations in the reliability of the overall model, the distribution of self-organization in the respondent population was examined to see if a metric like this would be a utility for managers. Using the most reliable aggregated indicator indices as a basis, with item exclusion where pertinent, the self-organization metric scores potentially ranged between a minimum of 43 and a maximum of 215 (Figure 34). The mean score for the population as a whole was 121.25 (standard deviation = 23.01). The means shifted when each level of self-organization

was examined using the self-organization index as the grouping variable with level 2, 3, and 4 returning means of 113.7, 120.2, and 127.0 respectively (Table 72). An one-way analysis of variance shows that the differences in these means were significant ( $p=0.000$ ) and also shows a linear progression across the levels of self-organization.

**Figure 34. Distribution of overall self-organization scores for the respondent population**



**Table 72. Analysis of variance for aggregated scores for the self-organization model**

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Aggregation score	<u>113.68</u>	<u>120.16</u>	<u>126.98</u>	9.050	0.000

\*Means underscored by the same line are not significantly different ( $p>0.10$ ) using Tukey's test.

## 7.6 PERCEPTIONS OF SHORELINE CHANGE

### 7.6.1 BACKGROUND PERCEPTIONS

In order to provide background information into perceptions of shoreline change as a whole and the growing importance of specific coastal events, respondents were asked two main questions. The first question was concerned with the causes of shoreline change overall and whether or not changes were natural or human caused. Initially, the results were analyzed as a single population. The results show that respondents felt shoreline change was a result of both natural causes and human actions in combination (Table 73). However, a larger percentage of respondents (18.7%) disagreed that changes to the shoreline were as a result of human actions as opposed to natural causes (2.6%).

*Table 73. Perceptions of the causes of changes to the shoreline*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Changes a result of human actions	7.7%	11.0%	19.2%	44.4%	17.7%
Changes a result of natural causes	1.3%	1.3%	5.3%	46.5%	45.6%

The second question was concerned with understanding public perceptions of growing threats to the coast. The results show that respondents believe that sea level rise is not considered to be as much of a potential threat to the shoreline as other events such as storm surge or erosion, with over 27% disagreeing to its importance (Table 74). When respondents' perceptions of coastal threats were examined using the self-organization index as the group variable a significant difference was found between level 2 and levels 3 and 4 for storm surge only (Table 75).

**Table 74. Perceptions of coastal events and their growing importance**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Coastal erosion	2.7%	8.1%	16.5%	40.2%	32.5%
Sea level rise	12.9%	14.2%	26.2%	26.9%	19.8%
Storm events	1.0%	5.1%	15.6%	35.1%	43.3%
Storm surge	1.7%	4.3%	14.6%	33.5%	45.8%

**Table 75. Perceptions of coastal events and their growing importance examined by self-organization level**

<u>Urgency item</u>	<u>Self-Organization Level</u>			<u>ANOVA</u>	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Coastal erosion	<u>3.79</u>	<u>3.93</u>	<u>3.98*</u>	1.364	0.257
Sea level rise	<u>3.19</u>	<u>3.32</u>	<u>3.28</u>	0.397	0.673
Storm events	<u>4.05</u>	<u>4.15</u>	<u>4.18</u>	0.797	0.451
Storm surge	<u>3.99</u>	<u>4.20</u>	<u>4.22</u>	2.454	0.087

\*Means underscored by the same line are not significantly different ( $p > 0.10$ )

## 7.6.2 POLICY PREFERENCES

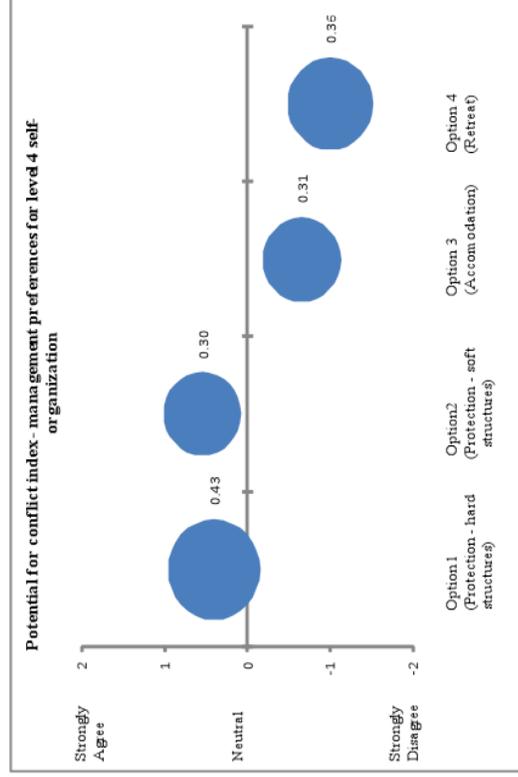
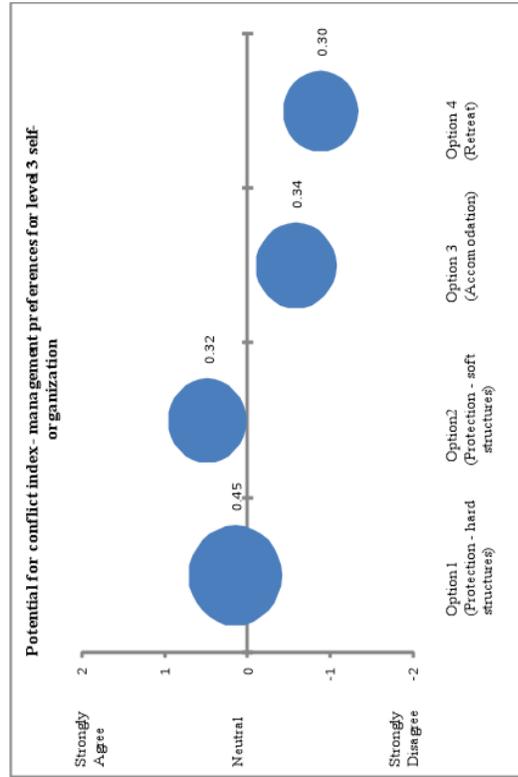
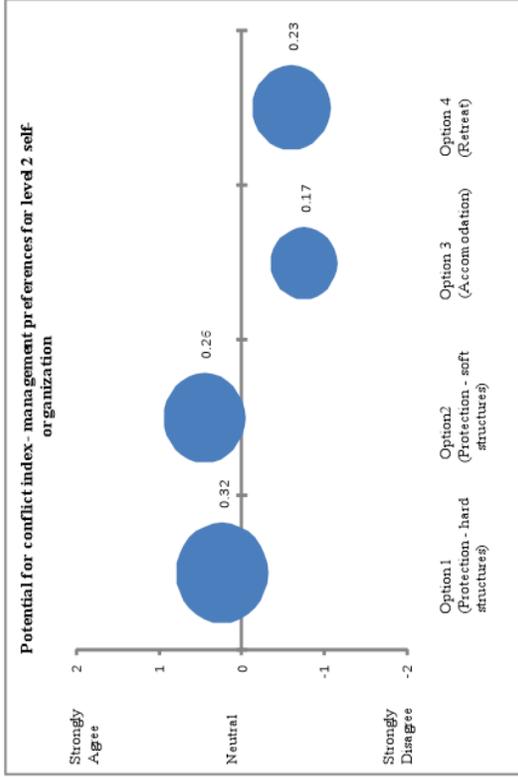
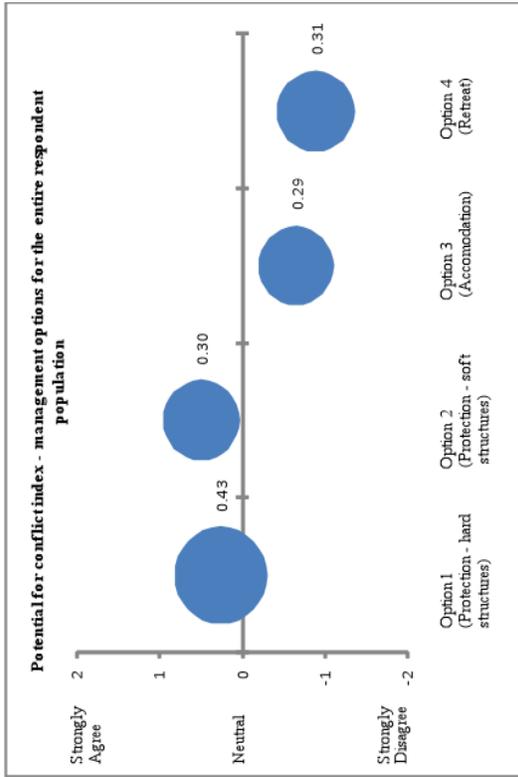
Four possible shoreline management options that corresponded with the policy alternatives suggested by the IPCC (protection, accommodation, retreat, and do nothing) were presented to the respondents. Graphical representations of Potential for Conflict Indices (PCI) were generated for the respondent population overall and then for each of the levels of self-organization (Figure 35) in order to easily compare preferences throughout the respondent population.

The results show that, in the case of shoreline protection in coastal North Carolina, the degree of self-organization becomes irrelevant when respondents are asked to consider management options. All of the PCI figures that were generated maintained the same basic pattern of acceptability irrespective of the level of self-organization under examination. The uses of both hard and soft structures to protect the shoreline from change were seen as acceptable for all self-organization subgroups. However, the options of introducing laws to encourage accommodation alternatives or a planned retreat were both considered unacceptable by all subgroups (Table 76). Overall, respondents viewed the retreat option as the least acceptable option with a mean of -0.89 on a 5 point Likert scale ranging from -2 to 2.

**Table 76. Scale means of shoreline change management policy options examined by self-organization level using the Potential for Conflict Index**

	Level 2	Level 3	Level 4
Protection (Hard structures)	0.23	0.14	0.40
Protection (Soft structures)	0.44	0.48	0.54
Accommodation	-0.76	-0.59	-0.65
Retreat	-0.61	-0.89	-1.00

Acceptability measured on a 5 point Likert scale from -2 (Very unacceptable) to 2 (Very acceptable)



**Figure 35. Potential for conflict indices for IPCC policy options**

In order to examine the policy option that was considered acceptable by all self-organization levels, respondents were asked to declare an acceptable degree of armouring, either hard or soft structures. Again there were no significant differences between self-organization subgroups (Table 77).

**Table 77. Analysis of variance for acceptable percentage of shoreline armouring according to self-organization level.**

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Hard structures	<u>33.90</u>	<u>33.03</u>	<u>38.53</u>	1.940	0.140
Soft structures	<u>43.20</u>	<u>42.16</u>	<u>45.66</u>	0.667	0.514

Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

Finally, respondents were asked to imagine that planned retreat was the only option available to them and to determine a level of property loss that would be acceptable to them before they moved. Again, no significant differences were seen between self-organization levels with all respondents suggesting that they would remain in-situ until a loss of 30-50% of property was realized (Table 78).

**Table 78. Analysis of variance for acceptable mean percentage property loss according to self-organization level.**

	Self-Organization Level			ANOVA	
	<u>Moderate</u>	<u>High</u>	<u>Very High</u>	<u>F</u>	<u>Sig.</u>
Mean % property loss	<u>2.56</u>	<u>2.46</u>	<u>2.62*</u>	1.940	0.145

Means underscored by the same line are not significantly different ( $p > 0.10$ ) using Tukey's test

\* On a percentage scale where 1= 10%, 2= 30%, 3 =50%, 4=70%, and 5 = 90%

In addition to preferences on policy options, respondents were asked to consider a range of options that could be used to secure the funding necessary to implement management actions. These options ranged from private to public sources. Only one result returned a significant difference across levels of self-organization, the option of using funds from local municipalities (Table 79), however this results was not linear in nature. These results demonstrate a lack of differentiation between funding sources since all the means for all the funding options were above 3 on a 5-point Likert scale. This would suggest that respondents are looking for financial assistance from any source possible in order to help protect their shoreline.

*Table 79. Analysis of variance for acceptability of sources of funding for management actions*

	Self-Organization Level			ANOVA	
	Moderate	High	Very High	F	Sig.
Local municipalities	<u>3.38<sup>a</sup></u>	<u>3.31</u>	<u>3.62<sup>a</sup></u>	4.266	0.014
Private funding sources	<u>3.56</u>	<u>3.61</u>	<u>3.79*</u>	1.937	0.145
Federal funding sources	<u>3.54</u>	<u>3.63</u>	<u>3.79</u>	1.705	0.183
Funds from property owners	<u>3.42</u>	<u>3.55</u>	<u>3.65</u>	1.326	0.266

\*Means underscored by the same line are not significantly different ( $p>0.10$ ) using Tukey's test

<sup>a</sup> not significantly different ( $p>0.10$ ) using Tukey's test

## CHAPTER 8. DISCUSSION

### 8.1 SELF-ORGANIZATION INDEX

Self-organization symbolizes a series of inherent characteristics that result in creativity, innovation and collective action, present at a range of social scales, which provides the basis for coping strategies in the face of change (Fuchs, 2003; Kauffman, 2002; Leydesdorff, 2003). Self-organizing systems are complex and difficult to define just as self-organization as a construct has shown to be difficult to measure.

However, a greater understanding of the role that self-organization might play in being able to determine the outcomes of the human-resource-management interaction provides an important incentive for this sort of study (Figure 7). Management actions taken in the face of controversial issues such as shoreline change have consequences in terms of the social structure of communities and the inherent existence of individuals (Abel, et al., 2006; Folke, et al., 2005; Ostrom, 2009). Being able to comprehend human responses to the resulting changes to that structure will provide management agencies with a deeper understanding into social impacts of decisions as well as insight into how to develop more efficient strategies in the face of an uncertain future.

The ability to sub-group individuals that have different responses and coping abilities in the face of disturbances could potentially be a vital tool in the decision-makers' tool kit. Managers are currently working in an unprecedented era of ever decreasing budgets and are faced with funders insisting that every resource allocation decision is justified to a degree that is unparalleled. The ability to characterize communities in terms of self-organization ability can provide that justification. With no attempt to cast moral judgment on which approach may be warranted, understanding the underlying self-organizational

ability of individuals could allow resources to be used to either support communities more capable of coping or those that are less capable of doing so.

Based upon the theoretical foundation presented earlier, constructs like collective action and co-management play key roles in an individual's and community's ability to self-organize. If deemed to be the correct management approach, policy makers may choose to support localized efforts that excel at abilities like self-organization in order to provide decision devolution opportunities. This might help to reduce the current levels of public dissatisfaction and distrust toward government that currently exists (Lockwood, et al., 2010; Murphy, 2009). In contrast, the opposite approach may be just as valid. Being able to identify communities that have lower levels of self-organization can allow key resources to be invested in social institutions or processes that may be vital in increasing the collective ability to cope with change (Ostrom, 2000; Sen, 1999). Although the index of self-organization presented in the study is not without fault, it is an initial attempt to create a method of sub-grouping the population in order to allow management decisions to be viewed through a uniquely functional framework.

One of the factors that confound the measurement of self-organization is the reported non-linear nature of the construct itself (Fuchs, 2003; Kauffman, 2002). The circular causality and the innate variability associated with self-organization means that the identification of themes and measurable parameters is also compounded by error (Reisig, et al., 2007). Overall, the results of this study returned a functional, if slightly lower than desired, index item reliability ( $\alpha = 0.545$ ) for the three item self-organization index (Cronbach, 1951; Cronbach, et al., 2004). This suggests that the items included in this study did not capture a significant percentage of the variation associated with understanding the self-organization level of an individual. Nevertheless, the items that were used did provide a foundational starting point for such an endeavor. These results highlight the challenges associated with the development of even a simple index for multifaceted concepts such as self-organization, and ultimately if possible, more complex constructions such as vulnerability and social resilience (Cutter et al., 2008; Cutter, et al., 2003).

Many factors could serve to either further compound or simplify these challenges if the index was reconstructed in a different location with a different population. As the respondent profiles demonstrates, the population that was sampled for this study was very homogenous especially in terms of ethnicity and social-economic status. This could have meant that factors that commonly create differences amongst individuals were not fully represented in this study. Cutter et al. 2000, showed that factors such as ethnicity, age, and income play a large role in determining social vulnerability in a variety of states across the USA including South Carolina, Georgia and Louisiana. There is little reason to doubt that this might be the case with the concept of self-organization, especially since it was originally developed as a principle of social resilience, the counter-point to vulnerability. Testing the index on a population that is much more heterogeneous may allow the nuances of self-organization to be more readily discernable.

Although, ultimately the reasons for a reduced Cronbach's are ultimately unclear in this study, it is unlikely that the result was due to sample size (N= 659) even though there was some variability in the sizes of the self-organization levels (n = 122, 277 and 236 for moderate, high, and very high, respectively). It is more likely that the inclusion of just three survey questions on the survey instrument was insufficient to fully examine the overarching themes identified as constructs of self-organization aptitude: collaboration, planning, and relationships. Each of these themes is a multi-faceted concept in its own right and the index may have suffered from attempting to simplify each theme into four survey-friendly responses. The development of additional survey questions, or the identification of more themes, must be recommended in order to increase the reliability and validity of the index as a whole. Additional themes such as institution capacity, perceptions of mutual benefits gained from self-organization across scales, and the action of self-regulation may provide interesting avenues for investigation (Onyx & Bullen, 2000; Ostrom, 1995, 2000) as would the nature of human behavior (Adger, 2003; Ajzen, 1989; Ajzen & Fishbein, 1972). A greater understanding of the interactions and connections between these themes would be necessary though to avoid compounding error and inter item correlations. In general

though, the functionality of this three-concept self-organization index does demonstrate the viability of such an approach in terms of sub-grouping a variable population by this specific aptitude.

## 8.2 HYPOTHESIS TESTING

The important test for the utility of the index from a management perspective was to determine if the ability to self-organize related to the capabilities of an individual and/or community to cope with changes brought about by natural and human-induced alternations to their environment. Initially, the results were examined at the individual hypothesis level before further examination of the four proposed propositions could be conducted.

The results of the hypothesis testing provided sufficient support to reject the overall null hypothesis that no difference would be found for any indicator between respondents with high or low aptitude level of self-organization. At least partial evidence existed to support nine of the twelve alternative hypotheses that were proposed (See Table 63 in Chapter 7). The commitment hypothesis, Ha1(a) that stated that ‘respondents with high aptitude for self-organization will have a greater commitment to their community than respondents of a lower level’ was fully supported by the results with all four items showing a significant linear increase from moderate to very high self-organization levels ( $p < 0.000$  for all four items). The additional factor in the commitment hypothesis was involvement in civic institutions, and with over 70% of respondents working and/or volunteering in their residential coastal county strong links obviously exist between the surveyed population and the surveyed counties. As hypothesized, involvement in the range of civic institutions increased with self-organization level lending credence to the suggestion that participation and action are critical constituents of benefit derivation in a community (Goodman, et al., 1998).

Three indicators, resources, regulatory quality, and process, (alternative hypotheses Ha1(b), Ha3(a), and Ha4(b), respectively) provided evidence that would not allow the overall null hypothesis to be rejected with no significant differences ( $p < 0.10$ ) returned for any items across the three levels of self-organization. Two of these indicators, distribution and process, along with the rule of law indicator, also generated the only non-linear pattern between the self-organization levels with all other indicators increasing in mean from lowest to highest self-organization level once aggregated. However, when more closely examined, two of the hypotheses, regulatory quality and process returned items that were almost significant at the  $p = 0.100$  level and that would have been significant at the  $p = 0.200$  level. The regulatory quality item, 'The laws that are in place for shoreline management are not sufficient to deal with shoreline change' returned a  $p$  value of 0.106 result and the process indicator returned two items with a  $p$  value of 0.155 and 0.121. This suggests that more investigation into these three items would be warranted and perhaps a slight increase in sample size may actually move these from not significant to significant at the  $p = 0.100$  value.

Although the alpha value was set at 0.10 for this study, the argument can be made for adjusting that value towards an even more lenient level of 0.20 or even a 0.30 value. Researchers have long acknowledged the variable nature of human behaviour and its drivers (Ajzen, 1989; Eagly & Chaiken, 1993), suggesting that Type II errors could be common when investigating multi-dimensional social constructs. With the understanding that research into self-organization does not have serious implications to human well-being in the same way as is expected in medical research, even a 30% error rate would not be indefensible. If a  $p = 0.3000$  level was used for this research then three of the twelve hypotheses would be fully supported, eight partially, and only one, the resources hypothesis, would be rejected. This suggests that, fundamentally, the items and the indicators being used for the model construction have a relatively high level of validity associated with them.

Despite this argument, it is acknowledged that, at this point in time, the scientific community would strenuously object to an alpha level of 0.30, for a variety of reasons including the widely held conventional belief of scientific rigour (Gregorie & Driver, 1987; Scheffe, 1959; Vaske, 2008). Therefore, using the original alpha value of  $p=0.10$ , four of the twelve hypotheses, skills, voice, issue-framing, and accountability, returned significant differences in all but one item. With the skills indicator the item that was not significant related to the respondent admitting to not understanding the federal and state laws that define what they can do to protect their personal property from changes to the shoreline. This item could well have elicited an embarrassment response from some individuals not wanting to admit a lack of understanding. The type of pride response has been shown to influence survey responses irrespective of the anonymity guarantee associated with a mail back survey of this type (Axford, Carter, & Grunwald, 1997; Dillman, Smyth, & Christian, 2009; Keeney, Vonwinterfeldt, & Eppel, 1990). Asking for such an admission of ignorance, even in the face of legal complexities and potentially contradictory legal positions appears unwise and suggests that, although the construct is an important one the item should be reworded in a less aggressive nature (Keeney, et al., 1990).

The three items that were not significant across the remaining three indicators dealt with issues of not being listened to, opportunities to add new information to the discussion, and honesty respectively. All of these constructs can be linked back to Leventhal's criteria of procedural justice (Leventhal, 1977; Tyler, et al., 1997). This would suggest that possibly the operationalization of this theory across these indicators was not fully achieved in this study. This does not minimize the importance of the theory to this study, or to modern day resource management in any way, but instead highlights the difficulty associated with ensuring relevancy between issue and theory (Reisig, et al., 2007). One factor that may have compromised the validity of some of these items was the fact that only 33% of the entire set of respondents had ever participated in any aspect of state or federal shoreline management. Therefore, being able to answer questions that related to procedural justice may have been challenging for the majority of people.

When the involvement in management was analyzed by self-organization level, differences were marked between the groups. Over 42% (n= 83) of individuals of the very high self-organization level had participated in at least some sort of management compared to only 18% (n= 21) of the moderate self-organization level individuals. Interestingly, when these items are considered in this way, the analysis provides indirect support for the propositions regarding governance and social justice even if only one of the items was actually originally associated with the hypotheses tested under those propositions. The fact that individuals with higher levels of self-organization were significantly more likely to be involved in the management process and governance actions represents an important find for this study. It demonstrates the importance of self-organization characteristics of a community when considering management approach and potential for co-management, a direction that more and more agencies are starting to look towards in difficult economic and social times (Borrini-Feyerabend, et al., 2005; Heylings & Bravo, 2007; Klooster, 2000).

The results for two of the remaining hypotheses, distribution and urgency, only returned one significant item each. The fact only one item was significant for the urgency indicator is the most surprising result of this study since all respondents suggested that natural changes to the shoreline would cause changes to their community's way of life. The results returned for perceptions of shoreline change also suggest a different mentality overall. Nearly 80% of respondents agreed or strongly agreed on a 5-point Likert scale that the coastal events of coastal erosion, storm events, and storm surge were growing issues. When examined by self-organization level, although no significant differences were found at the  $p=0.10$  level, a linear increase in the perception of the events' importance was visible. Sea level rise was the one event drew a more neutral response with only 46.7% agreeing or strongly agreeing, however, only 27.1% disagreed or strongly disagreed. This suggests that the respondents are viewing coastal issues as a growing concern, which would, in theory imply at least some urgency. However, this sense was not captured using the items that were developed for the urgency indicator. The one item that was significantly for the urgency indicator related to whether or not the respondent's family was planning for

shoreline change. Individuals with high and very high levels of self-organization were significantly different from the moderate level respondents ( $p=0.007$ ) although all respondents registered lower than a 3 on a 5-point Likert scale suggesting that as an overall population they are not planning for the effects of shoreline change at this time.

One major trend existed across the tested indicators that warrant further discussion. With the major exceptions being the commitment and urgency indicators, the general trend was that responses tended to be at the lower end of the 5-point Likert scales used to examine the indicators. This suggests that respondents in general feel that, irrespective of their self-organization level, the social processes that are currently in place provide mechanisms to assist with change are not strong enough. One obvious case in point is the resources indicator. Using the issue of shoreline change as a focus for the discussion on this indicator, a mean of only 2.03 on a 5-point scale across all five items demonstrates that respondents felt that resource availability, both financial and raw materials, was very limited at the individual, county, and state level. The resources indicator was conceptualized to operationalize three key characteristics, access to information, training opportunities, and physical and social infrastructure. The highest mean returned for any of the 5 items used to examine these characteristics was 2.71, which corresponded to the item asking if information regarding changing shorelines was easily available to the respondents. This suggests that managers are failing at even the most basic of tasks in terms of providing knowledge to those individuals who are, or will be, affected by a growing coastal threat. In the face of such limited resources, ability to self-organize in order to cope with change also becomes very limited. This trend of low results was seen across six other indicators in addition to the resources indicator and suggests that respondents are unhappy with the approach to shoreline management that is currently in place.

It is unclear if other coastal management issues would also return results that follow this trend although it is well recognized that coastal management is full of “wicked problems” (Jentoft & Chuenpagdee, 2009; Lachapelle, et al., 2003; Nie, 2003). This suggests that perhaps taking the time to hone the items and

indicators for a model of self-organization on a less controversial and emotional issue would be beneficial and may generate more valid results that could then be applied to issues such as shoreline change. The theoretical basis for self-organization upon which these indicators were developed suggests that a difference between levels of self-organization ability should influence attitudes toward the social processes and institutions under consideration here. The fact that this was not readily seen during this study suggests that some refinement is necessary particularly at the item scale. Despite this admission, the metrics developed to examine self-organization provide a sound foundation from which to broaden this initial attempt to measure the first principle of the multi-dimensional, complex construct of social resilience.

### 8.3 PROPOSITION TESTING

The aggregation of the indicators into components in order to test the propositions also provided mixed results. The reliability analysis performed on proposition one, *as the level of self-organizational aptitude increases, levels of capacity will also increase*, returned a low Cronbach's alpha of 0.332 once the indicators had been aggregated. However, when the items were tested separately with no aggregation in Cronbach's alpha was much higher ( $\alpha = 0.719$ ). This suggests that the process of aggregation is vastly reducing the reliability of the capacity component. Based on the fact that the resources indicator was rejected at a  $p=0.10$  level, a reliability analysis using just the commitment and the skills indicators. This analysis also returned a low Cronbach's alpha of 0.353. When a reliability analysis of the individual items of these two indicators, excluding the one skills item as before, was performed the alpha returned was 0.656.

This suggested that although the resources indicator did not provide evidence to reject the null hypothesis, the individual items used did contribute to explaining some of the variance associated with the capacity

component. Although the capacity component was more reliable without aggregation, it was also more reliable when all the individual items were used. The linear increase in means across nine of the twelve items used to test the capacity component provides strong evidence to support the general proposition even if aggregation reduced reliability for this component.

The reliability analysis performed on proposition four, *as level of self-organizational aptitude increases, the importance attached to a just approach to resource allocation will also increase*, also returned an even lower Cronbach's alpha of 0.226. When the items were tested separately, the Cronbach's alpha increased to 0.522 although this still represents a lower than desired result. As with proposition one, the results associated with this proposition were confounded by the fact that a non-significant indicator, in this case the process indicator, was included in the aggregation. The other two indicators, distribution and urgency, had only one significant item each suggesting that this component was always likely to be unreliable and therefore that the proposition would be difficult to support. The linear progression between self-organization levels was not as obvious for the items associated with the social justice and resource allocation indicators. In this case only two of the utilized ten items demonstrated a linear increase between levels. This suggests that insufficient evidence exists to support proposition four as operationalized in this study. However, as mentioned in the hypothesis testing section (8.2), some support was generated indirectly for this proposition when examining some of the data associated with procedural justice theory.

The remaining two propositions associated with conflict management and governance returned acceptable Cronbach alphas both when tested as aggregated indicators as well as non-aggregated items. In fact, the governance component was actually more reliable when aggregated than when tested as individual items ( $\alpha = 0.768$  and  $\alpha = 0.744$  respectively). For the conflict management indicator only two items out eleven did not demonstrate a linear progression between self-organization levels providing strong support for proposition two, *as level of self-organizational aptitude increases, the importance of, and investment in,*

*conflict management will likely increase.* Although this strong support was not mirrored by the items associated with proposition three, six out of ten items did conform to the linear progression suggesting that the proposition was at least partially supported.

The general results of the aggregation process at this critical junction of model development were not entirely positive. Ideally, once fully developed, a composite index should represent the fundamental multidimensional concepts that cannot be captured by a single indicator in a valid and reliable way. However, it has been shown that the process of aggregation can mask the details, hide underlying nuances of complex social constructs like self-organization, and actually reduce the reliability of the measurements being employed (Barnett, et al., 2008; Cutter, et al., 2003). Although this possibility was reinforced during this study, the utility of designing and developing a reliable composite index for self-organization should not be dismissed.

As previously noted with grass-roots projects, bottom-up management, and community involvement are initiatives that are all becoming more prevalent in governance approaches as the mentality of management shifts from client based approaches into stakeholders and beyond (Borrini-Feyerabend, et al., 2005; Court, et al., 2002; Crance & Draper, 1996). The ability for individuals and communities to self-organize will therefore be scrutinized more heavily than ever before. Defining, conceptualizing, and testing self-organization becomes a critical step in understanding the effectiveness of management initiatives as well as providing the basis increased monetary commitment this approach from donors and agencies. Without the ability to measure these constructs, self-organization, and by extension social resilience, become abstract frameworks of irrelevant jargon with no functional position in the scientific process.

## 8.4 OVERALL MODEL

Despite recognized complications brought on by aggregation and methodological difficulties concerning covariance, the overall model shows significant differences between levels of self-organization, and a linear progression across the levels of self-organization across the aggregated index ( $p=0.000$ ). This lends credence to the study as a whole, and to the approach used in the development of the model.

Although support for the four propositions, based upon the aggregation of indicators to components was mixed, the decision was made to aggregate all the indicators into the final model in order to complete the study. Excluding indicators based upon the results in the intermediate stage would have undermined the viability of the full model as it was initially conceptualized. The final aggregated index, with the acknowledgment of existing methodological issues, returned an acceptable inter-item reliability ( $\alpha = 0.783$ ). The index, was most reliable when 11 indicators were used (excluding the urgency indicator) returning an index item reliability of  $\alpha = 0.813$ . One factor that does reduce the reliability of the overall model further is the covariance that exists between some of the social constructs that have been used to define self-organization. This is especially obviously between the governance and the conflict management components (Table 67).

The results of overall model testing suggest that some individual items used to develop the full model of self-organization may have been associated with the wrong component, or at least demonstrated potential overlapping characteristics with other component. This was demonstrated further by the fact that testing the model using all 54 individual items returned a higher Cronbach's alpha ( $\alpha = 0.864$ ) than the most reliable aggregated index ( $\alpha = 0.813$ ) however it was constructed. This is not overwhelmingly surprising due to the reality that the index was originally derived from a theoretical basis and that many of the indicators were examining intertwined and complimentary social ideas. The utilization of individual items to construct the overall model instead of the indicators provided the opportunity to reduce any effects of

potential covariance may have affected the overall model, a factor that was compounded by the processes of multiple levels of aggregation (Barnett, et al., 2008).

This does raise the disciplinary debate of a theoretical construct approach versus the data driven approach as is more typical in biophysical sciences. The opportunity does exist, for instance, to perform a factor analysis in order to allow the data to self-categorize itself (Barnett, et al., 2008; Kauffmann, et al., 2010; Reising, et al., 2007). However, in order to maximize the management utility of a concept like self-organization it is important to be able to identify and classify specific components of a social construct, and test those components over and over. Due to the highly unpredictable and inconsistent nature of human beings, it is likely that a data-driven approach would generate a different set of results each time a possible model was developed and applied (Butler, et al., 2007; Coleman, 1988; Crance & Draper, 1996). This has been shown to be a complication in numerous disciplinary fields where modeling human nature is the norm and has been shown as relevant in the field of coastal management as well (Deci & Ryan, 2000; Finley, 2009; Fuchs, 2003). Therefore, in this case, although this line of enquiry may provide an interesting comparison between fundamentally different approaches, the theoretical construct, *a-priori* method appears to be the most sound.

Although these types of models and indices, constructed from existing literature and social observations, are inherently limited, they do offer a mechanism to simplify complex phenomena by allowing focus on selected aspects of the whole (Bailer-Jones, 2003; Hansen & Wernerfelt, 1989; Reckhow, 1994). In this case, modeling self-organization was only possible by taking it in isolation and disregarding the other identified principles of social resilience (construct idealization). This implies that additional models of the other principles of social resilience must also be developed in order to fully examine the entire phenomena. The major assumption associated with this step-by-step approach is that features of the overarching phenomenon that are not examined in the first model can be disregarded in the immediate future since additional models developed later will complement the initial effort by addressing those

features that were omitted for practical reasons (Bailer-Jones, 2003; Bennett, Cumming, & Peterson, 2005).

Irrespective how the results discussed at this point are ultimately derived, it must be recognized that the utility of both the self-organization index and the complimentary self-organization model can only be truly examined when applied to a specific coastal management issue, in this case, shoreline change.

Shoreline change, climate change, sea-level rise and potential inland retreat are all topics that evoke a large range of responses from the impulsive to the carefully considered across individuals, communities, states, and countries alike.

## **8.5 SHORELINE CHANGE**

The range of perceptions of shoreline change in its many forms was demonstrated by the variability of responses to even the simplest of questions regarding the causes of changes (Table 68) and the importance of coastal events (Table 69). This variability did reduce possible distinctions between the different levels of self-organization with no significant differences being found when examining the perceptions of coastal threats. However, there was a distinguishable linear pattern between the levels with three out of four means being highest in the very high level of self-organizational ability. Sea level rise was the only coastal threat that did not follow this linear pattern with the high level (level 3) identifying it as more of a growing threat to the shoreline than the other levels. As discussed in Chapter 5, sea level rise can be difficult to isolate from other coastal processes, which makes it less tangible an issue to some of the general public. This is probably compounded by the often contradictory and inflammatory media that has surrounded the issue of sea level rise in the U.S. in general, and North Carolina specifically, for many years, (e.g. <http://www.nc-20.com/>).

This lack of distinction between self-organization levels was also evident when potential policy options were examined using the Potential for Conflict Index. In terms of comparing the proposed IPCC options, it could be argued that planned retreat will be more socially disruptive in the short term than the protection or accommodation options. However, in the long run, attempts to protect infrastructure against the rising tide may be more disruptive due to its unsustainable nature, not only monetarily (Landry, et al., 2003), but also in terms of technical fixes (Polome, et al., 2005). These arguments demonstrate the importance of actually asking the general public about their preferences and providing avenues for social involvement in determining potential solutions.

All levels of self-organization felt that the options of accommodation and retreat were unacceptable, although the level of unacceptability and the degree of consensus did vary slightly (Figure 32). In contrast, respondents also felt that the option of doing nothing was also unacceptable (acceptability mean = -0.484,  $PCI_2 = 0.30$ ). These results provide a clear distinction of between the levels of acceptability of the different policy options presented by institutions such as the IPCC. When coupled with the legal parameters discussed earlier, such as the Coastal Zone Management Act and the Public Trust Doctrine, the actual feasibility of implementing at least some of these policies becomes vastly reduced without serious modification of both laws and public attitudes.

Existing legal frameworks will have a major influence over the short term and long term approaches that can be employed to help society adapt to inevitable shoreline changes. As demonstrated earlier, the discussion of how to adapt must move beyond the typical biophysical domain into the realm of the policy makers and the legal system. If the legal portion of the shoreline change debate is not made central to possible solutions and coping mechanisms then the probability of actually implementing adaptation options without facing litigation reduces rapidly. An integrated, complex, and proactive planning process is necessary to determine strategic goals and solutions that have the possibility of being effective both technically and legally.

The fact that the results of this study provide evidence of a range of different social values and attitudes towards shoreline change and the policies governing the issue across socially constructed boundaries emphasizes the volatile nature of human beings. The results also highlight the importance of gathering social data in multiple ways to enhance the representation of public opinions in resource management and planning. Public preferences essentially guide resource management and understanding the nuances of these preferences is critical to potential management success (Ostrom, 2000; Wilshusen, 2009). Public input, and the use of multiple methods to collect those data, provides an important avenue to make management more effective and efficient (Irvin & Stansbury, 2005; Lawrence, et al., 1997). Although laws and acts, such as NEPA, provide avenues and mandates for public engagement it is critical that perceptions and opinions are sorted using a variety of both formal and informal collection methods, including independent efforts such as were employed during this study. Models and indices such as the ones presented during this study provide an insight into the underlying psychology of public perceptions.

## CHAPTER 9. CONCLUSIONS

In conclusion, the results of this study do not overwhelmingly answer the ultimate question, ‘does an increase in the aptitude to self-organize actually result in preferred outcomes and benefits to the individual or community?’ However, the study does support that concept that people on the continuum of self-organization do have different strategies and approaches to cope with changes to their social and environmental structure. The utility of models such as these lays in the ability to determine if selective targeting of specific communities for mitigation assistance for potentially catastrophic events is warranted or justified (Cutter & Emrich, 2006a). Being able to systematically score individuals, communities, and regions on a common metric creates the option for managers to focus scarce resources and financial assistance in the most environmentally and socially relevant areas. This potential for comparison does raise the debate of how those resources should be allocated, a return to distributive justice, and whether it would be more sensible to help the least capable or if more can be achieved by focusing on the most capable (Reiff, 2009; Reis, 1984; Reisig, et al., 2007). However, models of this nature do allow specific areas of social behavior and cohesion to be developed in order to increase the overall capacity of the measurable unit (Barnett, et al., 2008; Batabyal, 1998; Bodin & Crona, 2009; Holling, 2001). In other words, specific actions such as encouraging community involvement in natural resource management issues may actually strengthen individuals and the community as a whole. Creating the opportunity for people to focus on themselves avoids the direct comparison debate while highlighting measurable and concrete actions that can be taken on many scales to increase the capacity to cope with change.

Self-organization, and by extension social resilience, offers an insight into understanding the differences between people and how they cope with changing environments and circumstances, including how they foster, engage in, and sustain, social relationships to endure and recover from the stress of those changes.

No consensus exists within the scientific community about self-organization or of the larger construct of social resilience. Although the factors identified in the model and indices development were consistent with broader resilience and social literature it is not exhaustive or conclusive. Further refinements in the model and the index are necessary as well as initial conceptualization of the remaining three principles of social resilience suggested by Folke et al 2005. The expansion of all the principles of social resilience will reignite the debate of weighting since it is unlikely that all factors and components are created equal. The process of developing a defensible weighting scheme is likely to be highly challenging.

A logical next step of this research is to examine how self-organization as measured by the self-organization model has changed over time and space in North Carolina and beyond in order to incorporate a predictive capacity to the model. This could be achieved by examining the local and historical context for the counties that were investigated. The existence of management plans and land use plans, and historical insight into how those plans were developed, would supply some of this context. It would also allow the issue of self-organization versus imposed organization by governmental forces to be examined.

Applying a theoretically constructed model such as this to a controversial and nuanced issue such as shoreline change has provided mixed results. However, this does not detract from the utility of such an effort. Ultimately, resource managers work in complex and unpredictable social, economic, cultural and political systems. Preferable ecosystem states and management regimes, whether defined at a local level by resource managers or at a higher, societal level, are constrained by a series of external factors. These factors, such as large social and economic trends, capacity of government, political will, enabling legislation, and migration, and competing ecosystem services or goals all represent potential barriers and stumbling blocks to success (Ranganathan, et al., 2008; Rechkemmer & von Falkenhayn, 2009).

Providing tools and approaches that can be used to increase the chances of that success are becoming more important in an era of increasingly restricted budgets and ever shifting environments. Models that

attempt to examine and explain human reactions to complex issues, although difficult to refine, have a functional place in the scientific and management approach.

Resource management is not about the preservation or conservation of natural ecosystems but more about defining the dynamic between people and the resources they depend upon. The process of defining that dynamic is iterative and must account not only for changing natural resource condition but also for changing social conditions. At a time when social attitudes and values are changing rapidly, there is a need for a shift in the way in which coastal resources are managed. The traditional approach, which disproportionately emphasizes understanding and managing for biophysical parameters, is no longer appropriate or capable when it comes to incorporating a broad spectrum of social values. Since it is the values and priorities of society that drive resource management, it is important to provide coastal managers with tools that create an understanding between the cause and effect of management actions, both on those values and on social structure as a whole. The ability to assess how people deal with potential policy changes that may affect their livelihoods, identities, cultures, and social networks has the potential to be one of those tools. In an era where the phrase, “we don’t manage fish, we manage people,” is often uttered we still have limited understanding of people, from their intentions and behavior to their attitudes and management preferences.

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## CHAPTER 11. APPENDIX A - IRB APPROVAL



**EAST CAROLINA UNIVERSITY**  
**University & Medical Center Institutional Review Board Office**  
1L-09 Brody Medical Sciences Building · Mail Stop 682  
600 Moye Boulevard · Greenville, NC 27834  
Office 252-744-2914 · Fax 252-744-2284 · [www.ecu.edu/irb](http://www.ecu.edu/irb)

### Notification of Exempt Certification

**From:** Social/Behavioral IRB  
**To:** [Shona Paterson](#)  
**CC:** [David Loomis](#)  
**Date:** 4/13/2012  
**Re:** [UMCIRB 12-000031](#)  
Social Resilience

I am pleased to inform you that your research submission has been certified as exempt on 4/13/2012. This study is eligible for Exempt Certification under category #2.

It is your responsibility to ensure that this research is conducted in the manner reported in your application and/or protocol, as well as being consistent with the ethical principles of the Belmont Report and your profession.

This research study does not require any additional interaction with the UMCIRB unless there are proposed changes to this study. Any change, prior to implementing that change, must be submitted to the UMCIRB for review and approval. The UMCIRB will determine if the change impacts the eligibility of the research for exempt status. If more substantive review is required, you will be notified within five business days.

The UMCIRB office will hold your exemption application for a period of five years from the date of this letter. If you wish to continue this protocol beyond this period, you will need to submit an Exemption Certification request at least 30 days before the end of the five year period.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

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IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418  
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418 IRB00004973  
East Carolina U IRB #4 (Behavioral/SS Summer) IORG0000418

**CHAPTER 12. APPENDIX B - SURVEY INSTRUMENT**

***SURVEY OF NORTH CAROLINA COASTAL RESIDENTS***



*Human Dimensions Research Unit  
Institute for Coastal Science and Policy  
East Carolina University  
Greenville, NC 27858-4353*

*In the following questions, please tell us a little about your history in North Carolina*

1. Are you a permanent or a seasonal resident of a coastal county in North Carolina? (Please circle only one)

- 1 Yes, I am a permanent resident
- 2 Yes, I am a seasonal resident

2. How long have you lived in the coastal county you currently reside in? \_\_\_\_\_ Years

3. Do you work (paid or volunteer) in the county in which you live? (Please circle all that apply)

- 1 Yes, I am employed in the county in which I live
- 2 Yes, I volunteer in the county in which I live
- 3 No, I do not work or volunteer in the county in which I live

4. How strong a connection do you and your family feel to this coastal county? (Please circle only one number for each item)

		<i>Very weak</i>	<i>Weak</i>	<i>Neutral</i>	<i>Strong</i>	<i>Very strong</i>
1 Your connection, personally.....	1	2	3	4	5	
2 Your family connection, overall .....	1	2	3	4	5	

5. Are you currently involved in any of the following organizations in your community? (Please circle all that apply)

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1 The Chamber of Commerce         | 6 A local political organization  |
| 2 The Economic Development Office | 7 A local school board            |
| 3 A local environmental group     | 8 A local historical organization |
| 4 A church group or program       | 9 Other (please list) _____       |
| 5 A local tourism organization    |                                   |

6. Do you own the property you currently live in ?

- 1 Yes, I own the property
- 2 The property is owned by someone else in my family
- 3 No, this is a rental property  
 What is the length of your rental agreement in months? \_\_\_\_\_

7. Please consider the following statements about your role in the community in which you live. Please indicate the extent to which you agree or disagree with the following statements (Please circle one number for each item)

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>
a. I feel a sense of belonging to this community .....	1	2	3	4	5
b. Local issues do not concern me .....	1	2	3	4	5
c. I think that it is important to be involved in local organizations .....	1	2	3	4	5
d. I do not think it is important to invest my time in local events .....	1	2	3	4	5

*The next few questions ask you to consider some of your perspectives on some personality traits. For each question below, please read the four choices and circle the one answer that fits you best for that question.*

9. Please indicate how you would best describe your inclination to plan for your future:

- 1 Very slight. I live in the present, I do not plan for the future at this time.
- 2 Moderate. Planning for the future has some importance to me and I think about it.
- 3 Fairly strong. I recognise the importance of planning for the future and I am taking steps to do just that.
- 4 Very strong. I am actively planning for the future.

10. Please indicate how you would best describe your relationships with other members of the community you live in:

- 1 Superficial. I really don't know many of the people where I live.
- 2 Limited. I know some people by sight and sometimes talk with them, but I only know some of their names.
- 3 One of familiarity. I know the names of people in my community, and often speak with them.
- 4 Close. I have personal and close relationships with people in my community. These friendships often revolve around doing things together.

11. Please indicate how you would best describe your own ability to work with other people on a difficult problem:

- 1 Non-existent. I find it impossible to work with others when faced with a difficult problem.
- 2 Limited. I find it hard to work with others, it requires effort on my part.
- 3 Moderate. I find it fairly easy to work with others when it is required.
- 4 Good. I find it easy to work with others, I am very much a team player.

*In the following questions, please tell us your thoughts about shoreline change in your community and county. Even if you do not currently live directly on the shore at this time, changes may still affect you in the future. Your opinions are, therefore, very important to us and can help make management more effective.*

*For the following questions "shoreline change" is defined as changes brought about by events like coastal erosion, sea level rise, and storm surge*

12. Please indicate the extent to which you agree or disagree with the following statements about the causes of shoreline change (Please circle only one number for each item).

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. Changes to the shoreline are the result of human actions.....1	2	3	4	5	5
2. Changes to the shoreline are the result of natural causes.....1	2	3	4	5	5

13. To what extent do you believe the following coastal events are growing issues? (Please circle only one number for each item)

	Not an issue	Slight issue	Moderate issue	Considerable issue	Highly significant issue
1. Coastal erosion..... 1	2	3	4	5	5
2. Sea level rise ..... 1	2	3	4	5	5
3. Storm events..... 1	2	3	4	5	5
4. Storm surge..... 1	2	3	4	5	5

14. We would like how you feel about the issue of shoreline change. Please indicate the extent to which you agree or disagree with the following statements (Please circle only one number for each item).

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a. Natural changes to our shorelines will not impact my community's way of life in the foreseeable future.....1	2	3	4	5	5
b. My family is already planning for shoreline change ..... 1	2	3	4	5	5
c. More needs to be done to protect my coastal county from shoreline change..... 1	2	3	4	5	5
d. I feel as if I will be fully able to deal with any issues that shoreline change will bring in the future..... 1	2	3	4	5	5
e. The laws that are in place for shoreline management are not sufficient to deal with shoreline change..... 1	2	3	4	5	5
f. It is important to me personally that we do more to deal with the issue of shoreline change.....1	2	3	4	5	5

15. Please consider the following statements about shoreline change. Please indicate the extent to which you agree or disagree with the following statements (Please circle one number for each item).

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>	<i>Don't know</i>
a. It is easy for me to become competent with techniques and technologies available for responding to shoreline change.....	1	2	3	4	5	dk
b. I do not understand the federal and state laws that define what I can do to protect my personal property from changes to the shoreline .....	1	2	3	4	5	dk
c. I can explain the scientific arguments for and against shoreline change to other members of my community .....	1	2	3	4	5	dk
d. People in my community spend a lot of time discussing what shoreline change actually is .....	1	2	3	4	5	dk
e. There are many opinions about what alternatives we as a community have when it comes to managing our shoreline .....	1	2	3	4	5	dk
f. I think I could be a leader in my community if it comes to dealing with shoreline change issues .....	1	2	3	4	5	dk

16. Please consider the following statements about protecting personal property from shoreline changes. Please indicate the extent to which you agree or disagree with the following statements (Please circle one only number for each item).

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>	<i>Don't know</i>
a. People who cannot afford to protect their property from shoreline change should receive more help from state and federal authorities than those who can afford to.....	1	2	3	4	5	dk
b. We all pay taxes, so we are equally deserving of some financial assistance to protect our property from shoreline change.....	1	2	3	4	5	dk
c. People with more expensive houses should contribute more to protect their own property from shoreline change .....	1	2	3	4	5	dk
d. The state of North Carolina is not getting sufficient federal funds to deal with shoreline change as compared to other states.....	1	2	3	4	5	dk



***In the following questions, please tell us how you feel about the local authorities in charge of shoreline management***

19. We would like to know how you feel about the local authorities involved in shoreline management in your community. Please indicate the extent to which you agree or disagree with the following statements (Please circle only one number for each item).

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>	<i>Don't know</i>
a. Local authorities have all the resources necessary to be able to manage the shoreline effectively in my county (e.g. financial, authoritative, legal).....	1	2	3	4	5	dk
b. Local authorities are implementing regulatory decisions with respect to shoreline management that I do not agree with .....	1	2	3	4	5	dk
c. I feel like shoreline management issues are not honestly discussed by the local authorities.....	1	2	3	4	5	dk
d. Local authorities are responsive to the concerns of my community when it comes to shoreline management .....	1	2	3	4	5	dk
e. It has been easy for members of my community to raise issues of shoreline management with local authorities.....	1	2	3	4	5	dk
f. Local authorities responsible for shoreline management take into account the input I provide.....	1	2	3	4	5	dk
g. Local authorities will not listen to anything members of my community have to say because they have already made up their minds on how to manage the shoreline ...	1	2	3	4	5	dk
h. I do not trust the people in charge of local management decisions to act in the best interest of the public when it comes to shoreline management issues .....	1	2	3	4	5	dk
i. Local authorities are serious about involving community members in the process of shoreline management.....	1	2	3	4	5	dk
j. People in my community feel like they have been successful in getting their concerns about shoreline management heard by local authorities .....	1	2	3	4	5	dk

20. Please consider the following statements about shoreline management. Please indicate the extent to which you agree or disagree with the following statements (Please circle only one number for each item)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a. I do not believe the information presented by the people in charge of shoreline management .....	1	2	3	4	5
b. I want more opportunities to correct inaccurate information about shoreline change.....	1	2	3	4	5
c. There are few opportunities for people in my community to add new information into the decision making process about shoreline change .....	1	2	3	4	5
d. Everyone's opinion is of equal importance when it comes to deciding the best alternative for shoreline management .....	1	2	3	4	5
e. The decision-making process of how to deal with shoreline change is unfair.....	1	2	3	4	5
f. The people who are least able to recover financially from shoreline change are adequately represented in the decision making process .....	1	2	3	4	5
g. People with more expensive properties should have a greater say in the process of shoreline management than those with less expensive properties.....	1	2	3	4	5
h. I seek out formal opportunities to voice my concerns about shoreline management.....	1	2	3	4	5

*Several possible management options have been suggested by policy makers deal with shoreline change brought about by processes such as coastal erosion, sea level rise and storm surge. These include:*

- 1. Protect the shoreline (construct infrastructure so that existing land uses can continue as 'normal')*
- 2. Accommodate the changes (people continue to occupy the land but make some adjustments to properties and activities)*
- 3. Retreat (make no attempt to protect the shore and possibly move away from the coast completely)*
- 4. Do nothing (continue to live by and use the coast as we are doing now with no changes)*

*In the following questions, please tell us how you feel about these options and your preferences for actions.*

21. Please consider the following shoreline management options. Please indicate the extent to which you support or oppose each option (Please circle only one number for each item).

	Strongly oppose	Somewhat oppose	Neither support or oppose	Somewhat support	Strongly support
a. Responding to shoreline change near you with <u>hard structures</u> such as seawalls or terminal groins.....	1	2	3	4	5
b. Responding to shoreline change near you with <u>soft structures</u> such as sandbags or salt marshes.....	1	2	3	4	5
c. The introduction of laws that require you make changes to how you use your property <u>solely</u> because of shoreline change.....	1	2	3	4	5
d. Relocating yourself and your family inland instead of attempting to protect the shoreline from changes.....	1	2	3	4	5

22. If hard structures were to be constructed to protect the coast near you, what percentage of the shoreline dedicated to such structures would be most acceptable to you? The line below represents 100%. Please mark on the line the percentage of managed shoreline would be most acceptable to you.



23. If soft structures were to be constructed to protect the coast near you, what percentage of the shoreline dedicated to such structures would be most acceptable to you? The line below represents 100%. Please mark on the line the percentage of managed shoreline would be most acceptable to you.



24. Imagine you begin to see your property being lost due to shoreline change and your only option is to move inland. What percentage of land loss would be acceptable to you before you moved?

- 1 10% property loss
- 2 30% property loss
- 3 50% property loss
- 4 70% property loss
- 5 90% property loss

25. To what extent do you find each of the following funding sources acceptable or unacceptable as ways of protecting your community from shoreline change due to natural processes? (Please circle only one number for each item)

	Very unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Very acceptable
a. Funding from local municipalities .....	1	2	3	4	5
b. Private funding sources .....	1	2	3	4	5
c. Federal funding sources .....	1	2	3	4	5
d. Funds collected from individuals with property on the shoreline .....	1	2	3	4	5

*In the following questions, please tell us how you feel about the process of shoreline management*

26. Please consider the following statements. Please indicate the extent to which you agree or disagree with the following statements (Please circle only one number for each item).

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know
a. I think state authorities have much more power to decide on shoreline management approaches than the federal government does.....	1	2	3	4	5	dk
b. Authorities in my county are dictating the local approach to shoreline management .....	1	2	3	4	5	dk
c. I feel that new federal laws to deal with shoreline change must be put in place .....	1	2	3	4	5	dk
d. Current laws that deal with shoreline change are contradictory .....	1	2	3	4	5	dk
e. The people involved in decision making want to make sure that the majority of people are in agreement on how to proceed with shoreline management.....	1	2	3	4	5	dk
f. I feel as if I have had a particular management approach to shoreline change forced upon me .....	1	2	3	4	5	dk
g. There should be more opportunities for community members to be involved in decisions about shoreline management.....	1	2	3	4	5	dk
h. It is easy to become formally involved in the discussion regarding shoreline management in my community ....	1	2	3	4	5	dk
i. I feel like community members are not listened to regarding how to deal with shoreline change issues ....	1	2	3	4	5	dk

*The following questions will help us improve our understanding of North Carolina coastal residents. The information you provide will remain strictly anonymous. Your name will never be associated with your answers.*

27. What is your age?

\_\_\_\_ Years

28. Are you:

1 Male

2 Female

29. What is the ZIP Code of your primary residence?

\_\_\_\_\_

30. Which category best describes your race? (Please circle only one).

1 American Indian or Alaskan Native

2 Asian

3 Black or African American

4 Native Hawaiian or other Pacific Islander

5 White

6 Other \_\_\_\_\_

31. Which category best describes the highest level of education that you have completed?

1 Did not complete high school \_\_\_\_\_ Grade completed

2 High school diploma/equivalency

3 Associate's/ two year degree

4 Bachelor's/ four year degree

5 Graduate degree

32. Which category best describes your annual household income (before taxes)?

1 Less than \$10,000

2 \$10,000 - \$24,999

3 \$25,000 - \$49,999

4 \$50,000 - \$74,999

5 \$75,000 - \$99,999

6 \$100,000 - \$124,999

7 \$125,000 - \$149,999

8 \$150,000 - \$199,999

9 \$200,000 or over



