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AN ANALYSIS OF THE CAPACITY OF COASTAL MANAGEMENT PRACTITIONERS TO DEVELOP COASTAL ECOSYSTEM-BASED MANAGEMENT PLANS

Tiffany Catherine Smythe
University of Rhode Island, smythecoastal@gmail.com

AN ANALYSIS OF THE CAPACITY OF COASTAL MANAGEMENT PRACTITIONERS TO DEVELOP COASTAL ECOSYSTEM-BASED MANAGEMENT PLANS

TIFFANY CATHERINE SMYTHE

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TIFFANY CATHERINE SMYTHE

APPROVED:

Dissertation Committee

Major Professor Robert H. Thompson

Richard Burroughs

Timothy Hennessey

Nasser H. Zawia
Dean of the Graduate School

UNIVERSITY OF RHODE ISLAND

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Abstract

Ecosystem-based management (EBM) is an integrated, collaborative resource management strategy that is widely touted as the preferred approach to coastal and environmental management. Yet coastal management decisions largely occur through a fragmented system of governance, whereby coastal management practitioners act somewhat autonomously to make land- and water-use decisions that can have tremendous impacts on entire ecosystems. There are relatively few examples of coastal ecosystem-based management in practice; one possible reason is that a truly EBM approach, considering both the social and ecological aspects of an ecosystem, places extreme demands on coastal management practitioners. To effectively develop coastal EBM plans, practitioners themselves must have a strong understanding of EBM and its application to the coastal ecosystem they are managing. Further, practitioners must collaborate across both jurisdictions and disciplines in order to develop coastal EBM plans and make decisions from an ecosystem perspective.

This study analyzes the capacity of coastal management practitioners to develop coastal ecosystem-based management plans. Specifically, it investigates three key research questions: 1.) What are the characteristics of practitioners' mental models of the coastal ecosystems for which they are planning?, 2.) How did practitioners collaborate with others to develop the coastal EBM plan?, and 3.) What is the relationship between practitioners' mental models and practitioners' social networks? These questions were applied to two case studies, the Greenwich Bay Special Area Management Plan in Rhode Island, and the Great South Bay Ecosystem-Based Management Plan in Long Island, New York, which were selected because anecdotal evidence suggested they might be considered best-case scenarios for coastal ecosystem-based management planning.

Practitioners who were participated in these collaborative EBM planning efforts were the focus of this study. Mental models analytical methods were used to investigate how practitioners conceptualize coastal ecosystems, and social network analysis methods were used to investigate how practitioners collaborated with others to develop these plans. A series of statistical correlation tests were then performed on the results of these two analyses to determine whether practitioners with comprehensive, balanced mental models collaborated with many other practitioners of different affiliations and areas of expertise. Results show significant differences between the two cases as well as a statistically significant correlation between the comprehensiveness of practitioners' mental models and the extent of a practitioner's influence within a network. Results point to a series of recommendations for improving collaborative EBM planning efforts, as well as to additional research needs in mental models and collaboration.

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Chapter 1. Introduction

1.1 Statement of the Problem

In 2010, President Obama's Interagency Ocean Policy Task Force released a series of recommendations designed to address the increasingly intractable problems facing the nation's oceans and coasts. The Task Force called for the application of "the principles of ecosystem-based management" in "a coordinated and collaborative approach" in order to most effectively address the challenges facing coastal and ocean resources (Interagency Ocean Policy Task Force, 2010, p. 1). Ecosystem-based management (EBM) is an integrated, collaborative resource management strategy that is widely touted as the preferred approach to coastal and environmental management (e.g. McLeod, Lubchenco, Palumbi, & Rosenberg, 2005; U.S. Commission on Ocean Policy, 2004). Yet coastal management decisions largely occur through a fragmented system of governance, whereby federal and state coastal and environmental managers, local planners, and other practitioners act somewhat autonomously to develop plans and make decisions that can have tremendous impacts on entire ecosystems (Crowder et al., 2006; see also Thomas, 2003).

Despite broad interest in and support for the use of an EBM approach, there are relatively few examples of coastal ecosystem-based management in practice (Leslie & McLeod, 2007; McLeod & Leslie, 2009). This presents a conundrum: why is there so little application of a management approach that is so widely recommended? One possible reason is that a true EBM approach, which considers both the social and ecological aspects of an ecosystem, places extreme mental demands on coastal management practitioners (DeLauer, 2009). While many scholars of EBM have emphasized the importance of high-quality ecosystem plans as a means of applying an EBM approach (Arkema, Abramson, & Dewsbury, 2006; Brody, 2003b, 2008), relatively little attention has been paid to the coastal management practitioners themselves who are charged with developing and implementing coastal EBM plans. To effectively develop coastal EBM plans, practitioners themselves must have a strong understanding of EBM and its application to the coastal ecosystem they are managing. Further, practitioners must collaborate across both jurisdictions and disciplines, despite the fragmented nature of coastal governance, in order to develop coastal EBM plans and make decisions from an ecosystem perspective (Cortner & Moote, 1999; Wondolleck & Yaffee, 2000).

This study analyzes the capacity of coastal management practitioners to develop coastal ecosystem-based management plans. It is focused on coastal management practitioners themselves, and not the plans in which they were involved in creating, as coastal management practitioners are the front-line, on-the-ground individuals who do the work of developing and implementing coastal EBM plans (see DeLauer, 2009). For the purposes of this study, “coastal management practitioners” is defined broadly as coastal managers, policymakers, planners, scientists, environmental advocates, citizens, or other key individuals who were actively engaged in the relevant coastal EBM planning processes. In approaching this subject, this study seeks to delve deeply into the on-the-ground practice of EBM in order to provide insight into the conundrum presented above: why so much acclaim, yet so little practice? In analyzing this problem, this study illustrates how both theorists and practitioners can enhance the application of this approach through the improvement of existing and the development of new collaborative coastal EBM planning efforts.

There is an extensive literature on the concept of ecosystem-based management and collaboration, which is discussed in this dissertation. This study adopts and expands upon the widely-cited definition set forth in the “Scientific Consensus Statement of Ecosystem-Based

Management," which is: "an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors" (McLeod, et al., 2005). The concept of EBM requires a diversity of perspectives and the incorporation of both ecological and social considerations, thus employing a systems perspective that addresses and embraces the complexity of human and natural systems (McLeod & Leslie, 2009).

There is also an extensive literature on collaboration and collaborative planning processes which is referenced in this dissertation; collaboration is an area of inquiry in its own right just as much as it is a tool through which to apply EBM. For the purposes of this study, collaboration is defined as "the process of facilitating and operating in multi-organizational arrangements to solve problems that cannot be solved or easily solved by single organizations. Collaborative means to co-labor, to cooperate to achieve common goals, working across boundaries in multi-sector relationships" (O'Leary, Gerard, & Bingham, 2006, p. 7). This study approaches collaboration largely from a social networks perspective, considering the internal workings of collaborative processes and the composition and structure of collaborative planning networks.

1.2 Dissertation Approach and Objectives

This study investigates the capacity of coastal management practitioners to develop coastal ecosystem-based management plans. It focuses on three key research questions:

1. *What are the characteristics of practitioners' mental models of the coastal ecosystems for which they are planning?*
2. *How did practitioners collaborate with others to develop the coastal EBM plan?*
3. *What is the relationship between practitioners' mental models and practitioners' social networks?*

These questions are applied to two case studies and investigated using two different methods. The two case studies that were selected for this dissertation are the Greenwich Bay Special Area Management Plan in Rhode Island, and the Great South Bay Ecosystem-Based Management Plan in Long Island, New York. These cases were selected because they may be considered best-case scenarios for coastal ecosystem-based management planning. Practitioners involved in the development of these plans would be expected to have well-developed mental models of coastal ecosystems, and to have actively collaborated with a diverse networks of practitioners of varying expertise representing a wide range of agencies, organizations, and user groups.

Mental models and social network analytical methods were then applied to both case studies, and coastal management practitioners who had been involved in developing these EBM plans were surveyed and interviewed in order to elicit their mental models and their social networks. These methods are uniquely suited to the investigation of practitioners involved in collaborative coastal ecosystem-based management planning efforts. Just as ecosystem-based management is a relatively recent approach that seeks to address and embrace the complexity of coastal ecosystems, the mental models analysis and social network analysis techniques used in this dissertation are recently-developed methods, designed to analyze and understand complex systems within the context of natural resource management.

Moreover, these two methods are appropriately paired in that they are complementary: practitioners' mental models shape their roles in the collaborative networks within which they work, and collaborative processes shape practitioners' mental models.

A mental model is an individual's internal representation of an external domain, problem or phenomenon; mental models are important because they shape how individuals make decisions and solve problems (Gentner & Stevens, 1983). Arguably, applying the EBM approach as it is characterized in the scientific literature requires practitioners to have comprehensive and balanced mental models of coastal ecosystems. Practitioners' mental models of coastal ecosystems were elicited and analyzed using methods developed by Morgan et al. (2002), and are compared and represented visually using innovative methods developed by the author. Social network analysis is a suite of methods for systematically analyzing and mapping relationships between individuals or organizations (Wasserman & Faust, 1994). Network analysis can be used as a means of understanding the internal workings of collaborative processes (e.g. Hartley, Gagne, & Robertson, 2008). Network analysis data were collected from coastal management practitioners and analyzed using a series of standard network analysis routines (Hanneman & Riddle, 2005) to provide insight into practitioners' collaboration with others.

Results of the mental models analysis and social network analysis were then used to address the above research questions. Multiple hypotheses are tested to provide additional insight into these questions with regard to key sub-groups of practitioners: project leaders; those affiliated with state coastal management programs; those whose expertise is in marine resource management; and those whose expertise is in the marine sciences. Mental models analysis is used to investigate the comprehensiveness and balance of practitioners' mental models. Social network analysis is used to investigate the extent to which practitioners were collaborating, and the extent to which they collaborated with others of different affiliations or different areas of expertise. The results of both of these analyses are then compared to determine whether practitioners with comprehensive, balanced mental models collaborated with many other practitioners of different affiliations and areas of expertise.

1.3 Overview of Chapters

This dissertation comprises eight chapters. Chapter 2 includes a literature review discussing the theory and practice of ecosystem-based management as well as the concepts of collaboration and networks of practitioners. Chapter 3 presents background and descriptive information about the two case studies, the Greenwich Bay SAMP and the Great South Bay EBM Plan. Chapter 4 summarizes the study methodology. It details the methods by which case studies and individual study participants were selected; provides background on both the mental models and social network analytical methods; explains the means by which mental models and social network data were acquired; and details the methods used to organize and analyze mental models and social network data to address the research questions. Chapter 5 presents the mental models analysis findings and discussion for both case studies in order to address research question 1: What are the characteristics of practitioners' mental models? Chapter 6 presents the social network analysis findings and discussion for both case studies in order to address research question 2: How did practitioners collaborate with others to develop the coastal EBM plan? Chapter 7 presents the results of comparing practitioners' mental models and social networks, and incorporates some broader discussion about the two case studies as a whole, in order to address research question 3: What is the relationship between practitioners' mental models and social networks? Chapter 8 concludes the dissertation with a summary and discussion of key findings and recommendations for future research.

Chapter 2. Coastal Ecosystem-Based Management and Collaboration in the Coastal Zone

2.1 Overview

Ecosystem-based management (EBM) has been increasingly touted by scholars and policy makers as the preferred approach to coastal and environmental management (Interagency Ocean Policy Task Force, 2010; McLeod, et al., 2005; U.S. Commission on Ocean Policy, 2004). Yet despite widespread support for this approach, there are relatively few examples of coastal EBM in practice(e.g. Leslie & McLeod, 2007; McLeod & Leslie, 2009). This may be because coastal management planning and decision-making occurs through a fragmented system of governance, whereby federal and state coastal and environmental managers, local planners, and other practitioners act somewhat autonomously to make decisions that can have tremendous impacts on entire ecosystems (Beatley, Brower, & Schwab, 2002; Crowder, et al., 2006; see also Thomas, 2003). EBM in practice is challenging because it relies heavily on coastal management practitioners to embrace complexity: practitioners must take a broad, comprehensive approach that considers all aspects of ecosystems, including human concerns (DeLauer, 2009). It also requires practitioners to collaborate across both jurisdictions and disciplines to develop ecosystem-based plans and make decisions from an ecosystem perspective (e.g. Cortner & Moote, 1999; Wondolleck & Yaffee, 2000). This chapter includes a discussion of the concept of ecosystem-based management and its application to the coastal zone, the concept of collaboration, and the governance context in which these management strategies are applied.

2.2 Ecosystem-Based Management in Theory

There is an extensive literature on ecosystem-based management, and definitions of ecosystem-based management – both generic and with regard to the marine environment –

vary and are debated throughout this literature (e.g. Arkema, et al., 2006; Grumbine, 1994; Hyun, 2009; McLeod, et al., 2005). Despite this diversity, there is a general consensus that EBM refers to an approach in which the interactions between ecological processes and socioeconomic factors are integrated into a comprehensive environmental management strategy. Ecosystem-based management explicitly acknowledges the relationships between and interdependency of natural resources and human society that take place across multiple temporal and spatial scales; and it represents a significant departure from the sectoral approach to coastal and environmental management, through which individual species, resources, and uses are managed individually through separate statutes and executive agencies (Arkema, et al., 2006; Grumbine, 1994; Hyun, 2009; McLeod, et al., 2005). One widely-cited definition of EBM is the "Scientific Consensus Statement of Ecosystem-Based Management" (McLeod, et al., 2005), which represents the consensus of over 200 scientists and policy experts. The Consensus Statement defines EBM as "an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors." McLeod et al.'s definition of EBM is adopted for this study, though is adapted and expanded significantly through the development of the Reference Coastal EBM Model (presented in Chapter 4) as the purpose of this study is to examine EBM's application to real-world coastal settings.

The term "ecosystem" is a relatively modern concept dating back to the early 20th century; it has been attributed to Sir Arthur Tansley and, later, was brought into wider use by Howard and Eugene Odum (e.g. Christensen et al., 1996). Interest in an ecosystem-based approach to management, described as such, appears to have developed in the 1990s, as reflected in the work of various scholars who sought to define the concept and associated principles (e.g. Christensen, et al., 1996; Grumbine, 1994; Yaffee et al., 1996). Whereas many of these earlier studies focus on or imply a terrestrial focus (e.g. Yaffee, et al., 1996), more recent scholars have applied this approach to the marine environment, discussing how an ecosystem approach can improve coastal and ocean management (e.g. McLeod & Leslie, 2009; McLeod, et al., 2005).

It is important to note that there is some divergence within the EBM literature on the use of the term “ecosystem-based management”. Alternative terms are “ecosystem management,” an “ecosystem approach to management,” and “ecosystem-based fishery management” (Arkema, et al., 2006; McLeod, et al., 2005). McLeod et al. (2005, p. 6) indicate that “ecosystem-based fishery management” has a slightly different but complementary meaning, whereas “the term ‘ecosystem management’ implies that it is possible to control and manage an entire ecosystem. In view of the fact that humans cannot control ocean currents or most animals within a marine ecosystem, it is scientifically more accurate to speak of ‘ecosystem-based management’ or an ‘ecosystem approach to management’.” In a study of EBM definitions used throughout the peer-reviewed scientific literature, Arkema et al. (2006) analyzed the use of these three different alternative terms and found no statistically significant difference among the terms with regard to 17 criteria of EBM (discussed below). Another alternative term put forth by Olsen et al. (2006) is “ecosystem-based governance.” Olsen et al. (2006) argue that the word “governance” is preferable to the word “management” because management implies day-to-day operations and decisions, whereas “governance” encompasses the values, policies, laws and institutions that set the stage for management. This study uses the term “ecosystem-based management” because it is the most commonly-used term, and because there is consensus on its use and meaning as indicated by McLeod et al. (2005) and Arkema et al. (2006).

Some scholars (e.g. Arkema, et al., 2006; Grumbine, 1994; Hyun, 2009) have acknowledged the range of EBM definitions in the literature and have sought to identify common themes and principles that emerge from these definitions. In his widely-cited 1994 paper, Grumbine summarized the history of EBM and then conducted a survey of papers in peer-reviewed journals to identify 10 “dominant themes” of EBM; whereas Grumbine took a land-based approach to EBM, he identified a series of themes which are relevant to both terrestrial and marine applications of this concept (see Table 1). Arkema et al. (2006) focused on marine EBM and used methods similar to Grumbine’s to identify three general and 14 specific criteria that scholars use to define EBM; the authors divided the specific criteria into three categories: ecological, human dimensions, and management. Table 1 lists the Arkema et al. (2006) criteria according to the authors’ “general” and “specific” categories and then places the criteria identified by Grumbine (1994) into the same categories.[1] Criteria are listed in the same row only when they are identifying essentially the same concept.

[1] Hyun (2009) performed a similar review of EBM principles; her EBM criteria were: sustainability; ecological scales and principles; ecosystem valuation; participation; adaptive management; international responsibility; monitoring; the precautionary approach; and interdisciplinary knowledge.

Table 1. Criteria used to define ecosystem-based management based on reviews by Grumbine (1994) and Arkema et al. (2006)

Criteria (Arkema et al. 2006)	Arkema et al. (2006)	Grumbine (1994)
General	Ecological health	Ecological integrity
	Sustainability	
	Inclusions of humans in ecosystem	Humans embedded in nature
Ecological	Complexity	Hierarchical context (systems perspective)
	Spatial	
	Temporal	
		Data collection
Human dimensions		Values
	Ecosystem goods and services	
	Economic	
	Stakeholder	
Management	Adaptive	Adaptive management
	Co-management	Interagency cooperation
		Organizational change
	Monitoring	Monitoring
	Science-based	
	Boundaries	Ecological boundaries
	Technological	
	Precautionary approach	
	Interdisciplinary	

As noted above, previous studies have offered comprehensive reviews of EBM definitions and principles. Drawing on this literature, the above criteria have been distilled down to a few key principles and reorganized, using an adaptation of Arkema et al. (2006)'s three categories, with the goal of emphasizing their practical application for coastal management practitioners who are working to apply an EBM approach in a real-world setting (see Table 2 below). The new categories which will shape the rest of this study are Ecological; Governance; and Human Uses. Management has been renamed Governance as this study adapts Juda and Hennessey (2001, p. 44)'s definition of governance as "formal and informal arrangements, institutions, and mores" that structure how resources are used and how decisions are made; they identify three primary mechanisms of governance: government, the marketplace, and nongovernmental institutions. Human Dimensions has been renamed Human Uses to clarify its focus on human activities and to distinguish it from governance processes. Discussion of these three categories of EBM principles follows below.

Table 2. Principles of ecosystem-based management discussed in this study

Ecological	Ecological integrity/ecological health
	Complex systems: linkages and connections
	Scientific data and monitoring
	Temporal and spatial scales and boundaries
Human Uses	Humans as part of the ecosystem*
	Ecosystem services/valuation
	Economic considerations
	Social and cultural values *
Governance	Stakeholders*
	Adaptive management
	Interdisciplinary approach
	Cooperation/collaboration

**Items feasibly span both human use and governance categories; see further discussion below.*

2.2.1 Ecological Principles of Ecosystem-based Management

There is a general consensus within the literature that the fundamental goal of EBM should be to accomplish ecosystem health, ecosystem integrity, or sustainability. However, there is some question about what terms like "sustainability" and "ecosystem integrity" mean and how they can be operationalized, particularly with regard to the role of humans in the ecosystem. For example, Grumbine (1994) argues that "protecting native ecosystem integrity over the long term" is the overall goal of EBM and describes the importance of protecting ecosystem types and maintaining evolutionary processes. By contrast, Lackey (1998) criticizes the ideas of ecological health or integrity as inherently biocentric, and argues that EBM "should maintain ecosystems in the appropriate condition to achieve desired social benefits;

the desired social benefits are defined by society, not scientists" (Lackey, 1998, p. 25). It should be emphasized that these broad and ambiguous principles are both debated in the literature and are, arguably, of little utility to coastal management practitioners; as Arkema et al. (2006) acknowledge, these broad concepts may not be useful for implementation and managers may struggle to determine how best to measure progress toward these goals.

Other key ecological principles that emerge from the EBM literature are consideration of complex systems and linkages; the incorporation of scientific data and monitoring; and consideration of scales and boundaries. EBM scholars tend to agree that an ecosystem-based management approach must acknowledge the complexity of ecosystems – that is, the many different components of ecosystems and the linkages among those components (e.g. Arkema, et al., 2006; Grumbine, 1994; Yaffee, 1998b). Some scholars describe these concepts broadly whereas others offer more specific examples of the types of linkages and connections which should be considered: for example, Arkema et al. (2006) identify examples of such linkages as food web structure, predator-prey relationships, habitat associations, and other biotic and abiotic interactions.

There is also widespread agreement in the EBM literature that EBM also requires scientific data and ongoing monitoring in support of an ecosystem approach to management (e.g. Arkema, et al., 2006; Christensen, et al., 1996; Grumbine, 1994). Ecosystem structure, functions, processes and interactions cannot be understood without data that can explain those interactions; and progress toward EBM goals cannot be tracked without the ability to monitor environmental indicators (Christensen, et al., 1996; Grumbine, 1994). While some authors frame the need for scientific data in ecological terms, others frame it as a management need shaped by public values (e.g. Lackey, 1998). Finally, many scholars place an emphasis on a consideration of multiple temporal and spatial scales, noting that ecosystem processes take place at multiple such scales – both immediate and long-term, and on a wide range of spatial scales (e.g. Arkema, et al., 2006). Ecosystems are nested (Olsson & Folke, 2001); while there is some debate about which scale is most appropriate for applying an EBM approach, there is widespread agreement that scale is an essential consideration (e.g. Christensen, et al., 1996; Grumbine, 1994).[2] The matter of scale is related to that of defining ecosystem boundaries for EBM plans or projects. Defining boundaries can be difficult given the nested nature of ecosystems, and so other scholars have raised the questions of whether the concept of an "ecosystem" should be applied literally, through the delineation of boundaries, or considered metaphorically due to the difficulties of defining ecosystem boundaries.[3] Again, however, these concepts are discussed in the literature in broad terms that may not help coastal management practitioners operationalize these ideas in order to develop coastal EBM plans.

2.2.2 Human Use Principles of Ecosystem-based Management

There is a general consensus within the EBM literature that humans are part of the ecosystem and must be considered as part of an EBM approach, though scholars vary widely in their portrayal of how human concerns should be incorporated into this approach to management. This results in a blurring of the distinction between human uses (e.g. fishing) and governance processes (e.g. the management and regulation of fish stocks and fishing activity) – an important distinction that shapes the real-world practice of coastal management. It is

[2]In the coastal environment, ecosystems may be considered to range from the watershed scale (Olsson & Folke, 2001) up to the Large Marine Ecosystem (Juda & Hennessey, 2001; Olsen, et al., 2006).
[3] For example, Juda (2003) points out that "ecologically-defined space," or space defined by ecosystem attributes, is fundamentally at odds with "politically-defined space," or space defined by administrative or jurisdictional boundaries. Hennessey (1994) further contends that EBM should be considered be a metaphor or heuristic – a general guiding principle for management, but not a concept that can be applied literally.

possible that this distinction is lost because much of this literature is written by university scientists who may have relatively little experience with coastal management practice. To address this distinction, Arkema et al. (2006)'s categorizations of EBM principles have been modified. This section discusses a general discussion of humans in ecosystems and focuses specifically on the EBM principles which relate most directly to human uses of ecosystems: social and cultural values; ecosystem services/ecosystem valuation; and economic considerations; governance considerations are discussed below.

EBM scholars' views of how humans should be incorporated into an EBM approach vary widely. Some EBM scholars have a rather biocentric view of EBM; for example, Grumbine (1994, p. 31) writes that EBM should "accommodate human use and occupancy within these [ecological] constraints." Others portray humans role in the ecosystem only in negative terms, as the cause of threats or impacts to ecosystems(e.g. Altman et al., 2011). By contrast, others place special emphasis on the role of humans as part of the ecosystem and highlight how successful EBM requires consideration of environmental conservation as well as social and economic development goals and values (e.g. Lackey, 1998; Szaro, Sexton, & Malone, 1998). Some of the more recent EBM literature has more explicitly explored the dynamic and inextricable connections between ecological and social systems, often describing them as "linked" or "coupled social-ecological systems" (e.g. McLeod & Leslie, 2009; Olsson, Folke, & Hughes, 2008). From the perspective of coastal management practitioners, much of this discussion may seem moot. It is arguably impossible to consider applying EBM without considering people – we all live in, and interact with, elements of ecosystems on a daily basis; and nearly all human activities both rely on and impact the ecosystems in which they take place.

Many EBM papers identify either ecosystem services/ecosystem valuation, or economic considerations, as key principles of an EBM approach. However, this is an area where there seems to be considerable diversity within the literature. Some papers make no mention of any of these ideas; others focus more on ecosystem services – i.e. how "humans use and value natural resources" – but distinguish this from economic development (Arkema, et al., 2006, p. 527). Others explicitly recognize identify the link between environment and economy: Szaro et al. (1998, p. 4) emphasize the connection between "environmental and economic sustainability," and Weinstein et al. (2007, p. 47) note that "societal support for ecosystem-based management will erode away" unless management goals encompass both "both ecology and commerce management" to sustain society's economies.

Consideration of ecosystem valuation is closely related to that of social and cultural values. Many EBM scholars note that an emphasis on social and cultural values is part of what distinguishes EBM from other, more biocentric approaches to managing ecosystems (e.g. Hyun, 2009; Lackey, 1998). Even those authors who employ a more biocentric view of EBM acknowledge the role of values: Grumbine (1994, p. 31) writes that EBM takes place within a "complex sociopolitical and values framework" and notes that some may underestimate the "complexities of blending diverse human values into management." Lackey (1998) stresses this aspect of EBM, emphasizing that all management priorities are driven by society's values.

As with other aspects of the EBM literature, scholars discuss these principles in broad, conceptual terms that may provide little guidance for coastal management practitioners seeking to apply these concepts through the development of EBM plans. In practice, the ways in which humans value ecosystems and ecosystem services are likely closely related to the particular ways in which they use and experience them. Whether people rely on ecosystem resources as part of their work, recreation, spiritual lives, or the communities in which they live, these uses very likely shape human values and, in turn, the decisions and management regimes they support; see further discussion below.

2.2.3 Governance Principles of Ecosystem-based Management

Much of the execution of the EBM approach is in governance – defined above to include both the formal and informal arrangements that structure how resources are used and how decisions are made (Juda & Hennessey, 2001). As Burroughs (2011) has noted, while the principle of EBM has widespread support, it is not evident in most governance activities and will require change, which may take place at varying rates and through varying approaches. The EBM literature identifies several governance principles of EBM: stakeholders; adaptive management; an interdisciplinary approach; and cooperation and collaboration. It should also be noted that some of the human use principles discussed above – the role of humans in the ecosystem and social and cultural values – are closely related to governance, as governance processes are arguably value-driven and are about managing human activities.

Some scholars have emphasized that EBM requires the active involvement of stakeholders, both because EBM involves considering alternatives for human-environment interactions, but also because EBM is a place-based approach that reaches across traditional boundaries. As Szaro et al. (1998, p. 2) write, “Ecosystem management is an approach that attempts to involve all stakeholders in defining sustainable alternatives for the interactions of people and the environments in which they live. Leslie and McLeod (2007, p. 542) describe meaningful engagement of stakeholders as one of the challenges of implementing EBM, and note that stakeholders are “agents within dynamic networks that are linked to the environment at multiple spatial scales.” It is interesting to note that Arkema et al. (2006)

describe stakeholder involvement as one of the human dimensions criteria of EBM, and do not include it in their "management" category. While the ways in which stakeholders use and interact with the ecosystem should be considered (as described above in Human Uses), stakeholders themselves, as people, are important participants in the governance process and must have an integral role in developing and implementing management plans.

Discussion of adaptive management is ubiquitous throughout the EBM literature (e.g. Arkema, et al., 2006; Christensen, et al., 1996; Grumbine, 1994). Through an adaptive management approach, management actions are viewed as learning processes or experiments as they are systematically evaluated with the goal of improving future actions (Arkema, et al., 2006; Grumbine, 1994). Christensen notes that an adaptive management approach acknowledges that existing knowledge is incomplete and subject to change, and that an adaptive approach to EBM requires scientists to have ongoing interaction with managers and the public such that scientific information is shared and that scientists can respond to managers' and stakeholders' questions and research needs (Christensen, et al., 1996).

The EBM literature also places great emphasis on the need for an interdisciplinary approach (e.g. Arkema, et al., 2006; Leslie & McLeod, 2007). Specifically, EBM requires integrating knowledge of not only ecosystem structure, functions, and processes, but knowledge of the human systems and governance systems that comprise an ecosystem and the systems by which it is managed. Feasibly, this can include disciplines such as – but not limited to - ecology, biology, hydrology, geology, engineering, economics, sociology, ethics, law, and the policy sciences. Szaro (1998, p. 4) notes: "While the scientific foundation of ecosystem management rests with applied ecosystem science, scientists, including ecologists, must accept that there is far more involved than applied science alone. The concept encompasses humans and their socioeconomic culture as part of ecosystems." Leslie and McLeod (2007, p. 545) emphasize the need for interdisciplinary scientific capacity, calling for monitoring of ecological as well as economic, social, and institutional indicators as well as indicators "of the magnitude and degree of linkages and feedbacks between social and ecological systems."

An interdisciplinary approach, by definition, requires cooperation and collaboration between those with differing expertise. Given the fundamental mismatch between ecosystem boundaries and political/jurisdictional boundaries as well as the dominant sector-based approach to management, EBM also requires inter-institutional cooperation and collaboration. This subject is explored in many different ways in the EBM literature; some write broadly about the need for organizational change (e.g. Grumbine, 1994) while others focus almost entirely on the institutional (Cortner, Wallace, Burke, & Moote, 1998) or political (Cortner & Moote, 1999) challenges of EBM. As collaboration is a key component of this study in its own right, it is discussed in detail below.

2.2.4 Studies of and Advocacy for the Practice of Ecosystem-Based Management

There have been relatively few studies investigating the practice of EBM, particularly in marine and coastal environments. This suggests that there are relatively few examples of the full development and implementation of EBM plans or strategies in coastal and marine environments (Guerry, 2005; Leslie & McLeod, 2007; McLeod & Leslie, 2009). Most studies of EBM identified for this research are evaluations of ecosystem-based management plans and processes (e.g. Brody, 2003a, 2003b, 2008; Yaffee, et al., 1996).[4] Recent studies of marine

[4] For example, Yaffee et al. (1996) surveyed and interviewed managers at 105 different "ecosystem management sites" in the U.S. about their project goals, outcomes, and obstacles, and identified common themes and recommendations. Nearly all sites identified for this study were terrestrial or

EBM initiatives have included Arkema et al. (2006, p. 531), who evaluated the goals and management activities of eight marine ecosystem-based management plans in the United States and Australia according to their criteria of EBM as outlined above; they identified a gap between the literature and practice, specifically that "scientists characterize EBM differently than agencies planning to manage coastal and marine ecosystems," and that "management objectives and interventions tend to miss critical ecological and human factors emphasized in the academic literature." In another example, McLeod and Leslie (2009) performed five in-depth case studies of the implementation of marine EBM in the U.S., in most cases focused on the planning processes or projects themselves. The only study located for this review that has focused on coastal management practitioners themselves is DeLauer (2009)'s examination of the cognitive demands of EBM on decision-makers. However, despite the relative lack of practice of EBM, there are a variety of handbooks, toolkits, and other such products which have been developed for coastal management practitioners to encourage implementation (e.g. Environmental Law Institute, 2009; NatureServe, 2010).[5] These products illustrate that there is a broad level of effort to promote the application of an EBM approach.

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riverine, and represent projects active through 1995. Brody (2003a, 2003b, 2008) evaluated local ecosystem plans, focusing on the role of local land-use planners and officials and municipal comprehensive plans in implementing EBM.

[5] The "Ecosystem-Based Management Tools Network" is an alliance of organizations that promotes the development and use of tools for applying an EBM approach (NatureServe, 2010). The Environmental Law Institute's "Ocean and Coastal Ecosystem-Based Management Handbook" provides guidance as well as examples of EBM in practice to address "five specific challenges to EBM implementation and governance" – EBM vision and planning; ecosystem science and information; accountability and adaptive management; cumulative impacts; and tradeoffs (Environmental Law Institute, 2009, p. i). This handbook also incorporates numerous examples of marine EBM approaches in various U.S. locations, though they acknowledge that there are no perfect examples of EBM in practice and that each of these examples has strengths and weaknesses.

2.3 Coastal Ecosystem-Based Management in Practice

2.3.1 The Reality of Coastal Governance

It is notable that, despite the extensive scholarly literature on EBM as summarized above, the strong political support for EBM (e.g. Pew Oceans Commission, 2003; U.S. Commission on Ocean Policy, 2004) and the numerous efforts to promote implementation, none of these sources provide much concrete "how- to" guidance or advice for those seeking to develop an EBM plan or approach. Whereas there is extensive discussion about broad EBM principles like "ecosystem health" and "people as part of the ecosystem," these principles arguably mean little without defining exactly how these ideas should be applied to a real-world setting. To a large extent, this is understandable; if EBM is indeed a place-based management approach, then there is no one "cookie-cutter" plan or set of guidelines that would could be applied to multiple locations. All ecosystems are different. Even within the coastal realm, estuarine ecosystems differ from shelf ecosystems; even the two estuaries which are the focus of this study – Greenwich Bay in Rhode Island and the Great South Bay in New York – are notably different, in that the Great South Bay is a lagoon separated from the Atlantic Ocean by a barrier beach, whereas Greenwich Bay feeds into a larger estuary, Narragansett Bay. Yet there still appears to be a significant disconnect between the enormous number of articles and the small number of implementation efforts.

The relative lack of EBM practice suggests that this approach to management is not easily accomplished within the existing governance framework that shapes coastal and environmental management. The implementation of EBM in the coastal zone is particularly complex, and some scholars have suggested that this complexity, and the burden that this places on decision-makers, may explain the relative lack of implementation (e.g. DeLauer, 2009). The coastal zone, which encompasses both coastal lands and adjacent waters, is characterized by a convergence of resources, interests, activities, and regulatory jurisdictions. Coastal ecosystems are among the more vulnerable regions in the nation, due to a variety of stressors ranging from development pressure to coastal hazards to global climate change (Beatley, et al., 2002; U.S. Commission on Ocean Policy, 2004). Moreover, coastal ecosystems are among the most populous areas, house some of the nation's most lucrative industries, and contain some of the nation's most valuable property (Beach, 2002; Beatley, et al., 2002; Colgan, 2003; U.S. Commission on Ocean Policy, 2004). Coastal communities are also among the more socially complex areas, given their widespread popularity as seasonal residences and tourism destinations (Colgan, 2003; Thompson, 2006).

While the EBM literature emphasizes an integrated approach to coastal management, coastal governance remains fragmented in practice (Beatley, et al., 2002; Cicin-Sain & Knecht, 1998). In a paper discussing the application of EBM to ocean governance, Crowder et al. (2006) indicate that at least 20 different federal agencies have a hand in management. President Obama's Interagency Ocean Policy Task Force was formed in 2010 to address this very issue (Interagency Ocean Policy Task Force, 2010). Consideration of coastal lands adds an additional layer of complexity. Through the tradition of local land use control, local planners and officials have primary jurisdiction over coastal land use, and make land use decisions through methods such as developing comprehensive plans and zoning ordinances or issuing building permits (Platt, 2004). Such decisions may both individually and collectively have profound impacts on entire ecosystems (Brody, 2003b) and on the ability of state or regional government agencies to achieve environmental management goals (Burby & May, 1998; Norton, 2005). Federal, state and regional coastal and environmental managers also make management decisions through methods such as establishing laws and regulations, developing regional plans, or issuing site-specific permits (Beatley, et al., 2002). Representatives from universities and non-governmental organizations may also influence such decisions by conducting research or advocating for a particular outcome (Beatley, et al., 2002). All such decisions may have significant impacts on coastal ecosystems, yet are typically made independently, not in the integrated manner advocated in the EBM literature.

2.3.2 Ecosystem-Based Management and the Practice of Coastal Zone Management

The EBM approach suggests that coastal planning and management decisions should be made through a coordinated process, integrating jurisdictions and disciplines. In the United States, it would seem that the federal Coastal Zone Management Act (CZMA), 16 U.S.C. §1451 *et seq*., and the resultant state coastal programs established under the CZMA, would be an important program through which to implement such collaborative ecosystem-based processes. Whereas the CZMA is a federal program, it relies on the states for implementation because the type of planning and management it addresses has traditionally been considered the purview of state and local governments (Kalo, Hildreth, Rieser, Christie, & Jacobson, 2002). In turn, states have the flexibility to use a range of different institutional arrangements – direct permitting agency, networked program, or local implementation – through which state agencies and local governments can work together to execute these plans (Davis & Thompson, 2004). In this regard, the CZMA can be viewed in theory as an effort to promote intergovernmental cooperation for the management of coastal ecosystems (e.g. Godschalk, 1992).

However, in practice, many state coastal programs have limited practical ability to control local decisions (Davis & Thompson, 2004). Some scholars have studied the role of local decision-makers in implementing state coastal and environmental management goals, and have found that local governments may have limited commitment to such goals (Brody, 2003b; Burby & May, 1998; Norton, 2005). In studying the effectiveness of local ecosystem plans, Brody emphasizes the importance of local land-use decision-makers in implementing EBM (Brody, 2003a, 2003b, 2008). In studies of how coastal communities deal with natural hazards, Burby and May (1997, 1998) describe the inattention of local governments to environmental problems as the "commitment conundrum," noting that local governments can be reluctant to participate in intergovernmental partnerships for addressing environmental management goals. Norton (2005) found that local governments in coastal North Carolina often fail to address resource protection in part because they can be resistant to state-mandated environmental protection and growth management goals.

These studies illustrate how the effectiveness of an EBM initiative is dependent upon coastal management practitioners themselves, their understanding of and commitment to the concept of EBM, and their capacity to conceptualize and apply an EBM approach. Yet it is possible that practitioners have limited capacity to conceptualize and apply EBM. Coastal management practitioners include a broad range of individuals with widely varying training, experience, and expertise. This group may include coastal or marine resource managers whose training and experience is somewhat interdisciplinary, encompassing the natural, social and policy sciences. Alternatively this group may include marine scientists whose training and expertise may be quite extensive, but who are narrowly focused on a subject area such as fish ecology or benthic geology. This group may also include individuals who may not even think of themselves as coastal management practitioners – marine-based business owners, recreational users, or even citizens – all of whom may participate so actively that they effectively become coastal practitioners. Even the most experienced of these practitioners may find it challenging to conceptualize and apply EBM. DeLauer (2009) highlights the complexities of the EBM approach and notes that EBM places a series of implicit cognitive, interpersonal, and intrapersonal demands on decision-makers; she proposes that the relative lack of EBM implementation may be due to these extraordinary mental demands. Moreover, front-line practitioners face practical limitations of time and resources that fundamentally shape their work products (e.g. Lipsky, 1983). These inherent limitations underscore the importance of practitioners collaborating to share knowledge and pool resources in order to apply an EBM approach.

2.4 Collaboration, Networks and Ecosystem-based Management

2.4.1 The Importance of Collaboration to Ecosystem-based Management

There is widespread agreement throughout the EBM literature that to implement an EBM approach, decision-makers must collaborate across jurisdictions with other decision-makers, as ecosystems typically span political boundaries (Brody, 2003a; Cortner & Moote, 1999; Wondolleck & Yaffee, 2000). Scholars also note that EBM requires an interdisciplinary approach: decision-makers must also collaborate across disciplines and professions, in order to have access to the right information and understand the full range of environmental, social, and economic interactions characterizing an ecosystem (Brody, 2008; Szaro, et al., 1998).

Within the fields of political science and organizational behavior, collaboration is often distinguished from cooperation, coordination, and other similar concepts. Collaboration is typically defined broadly to include a range of joint activities and partnerships which are most often voluntary efforts to solve problems. Bardach (1998, p. 8) defines collaboration as "any joint activity by two or more agencies that is intended to increase public value by their working together rather than separately." Wood and Gray (1991, p. 146) note that "collaboration occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain." For the purposes of this study, collaboration will be defined according to O'Leary et al. (2006, p. 7) as "the process of facilitating and operating in multi-organizational arrangements to solve problems that cannot be solved or easily solved by single organizations. Collaborative means to co-labor, to cooperate to achieve common goals, working across boundaries in multi-sector relationships."

Other scholars incorporate collaboration into the environmental planning and management literatures. Yaffee (1998a) identifies collaboration as one of four behaviors facilitating cooperation across political and administrative boundaries.[6] Cortner and Moote (1999) identify collaborative decision-making as integral to the practical, equitable implementation of the EBM approach. In a comprehensive review of EBM initiatives, Yaffee and others (1996) found that collaboration is the single most important element of a successful approach to EBM because of the inherently transboundary nature of ecosystems. Brody (2003a, 2003b, 2003c) identifies collaboration as essential to the implementation of EBM at the local level, and uses what he describes as "inter-organizational" collaboration as one of five criteria for assessing the quality of local ecosystem plans.[7]

The concept of collaboration highlights the importance of institutions to the implementation of EBM. Some scholars have emphasized the institutional aspects of EBM, noting that its implementation is dependent on new and innovative institutional arrangements (e.g. Cortner & Moote, 1999; Cortner, et al., 1998; Imperial, 1999a, 1999b). Cortner et al (1998) note that collaboration is necessary precisely because there are institutional barriers

[6] Yaffee describes a "rough taxonomy of cooperative behaviors" comprising four behaviors - awareness, communication, coordination, and collaboration.
[7] The other four criteria used by Brody (2003c) were: (1) factual basis for the plan; (2) goals and objectives guiding implementation; (3) policies, tools, and strategies for action; and (4) clearly defined implementation.

and many unknowns about how best to implement an EBM approach. While the term institutions has been defined in various ways, this study adopts Cortner et al.'s (1998, p. 160) definition which includes "both formal institutions, such as administrative structures, and also informal institutions, such as customs and practices."

There are two types of collaboration that are particularly important for the application of an EBM approach: collaboration between agencies and organizations, and collaboration among individuals of different disciplines. There is an extensive literature on interagency collaboration. The increased reliance of public managers on collaborative decision-making processes is reflected in a growing literature on collaborative public management (e.g. McGuire, 2006). While collaboration may be widespread, it is characterized by a range of challenges. Bardach (1996) notes that interagency collaboration may be impeded by a variety of technical, legal, bureaucratic, and political barriers, and that incentive to move past these barriers may be impeded by agency staff members' desire to protect their agency's "turf." Wondolleck and Yaffee (2000) describe the challenges of collaborative EBM planning efforts, which may involve both government agencies and other groups, as including the lack of opportunities and incentives; conflicting goals and missions; inflexible policies and procedures; and constrained resources. They also call attention to the role of individuals in facilitating collaborative processes, noting that mistrust, group attitudes, conflicting organizational cultures, and a general lack of support for collaboration can impede such processes.

Collaboration among those of different disciplinary backgrounds or with different areas of expertise is also essential for applying an EBM approach. Collaborative public processes involving diverse groups have been shown to facilitate social learning: Schusler et al. (2003) found that public deliberation can increase social learning among participants if it incorporates, among other things, diversity among participants and the incorporation of multiple sources of knowledge. While scholars have explored the challenges of interdisciplinary collaboration among researchers and university scientists (e.g. Lele & Norgaard, 2005), there appears to be relatively little investigation of the challenges of such collaboration among practitioners. The literature on social networks provides additional insight into the internal workings of collaborative processes and the importance of diversity; see further discussion below.

2.4.2 Networks: A Strategy for Facilitating Collaborative Ecosystem-Based Management

Social networks are one mechanism through which collaborative processes take place, and some have argued that analysis of networks can provide insight into the "internal deliberations" of collaborative processes (Hartley, et al., 2008).[8] Social networks have been identified as a means of promoting collaboration despite the fragmentation of authority among government agencies (Bardach, 1998; Schneider, Scholz, Lubell, Mindruta, & Edwardsen, 2003). A recent literature has developed around the concept of governance networks in particular (alternatively described as public networks or networked government), through which government agencies and non-governmental organizations work together to manage resources and make decisions (e.g. Agranoff, 2007; Goldsmith & Kettl, 2009). In addition, numerous scholars have used social network concepts and analytical methods to investigate natural resource governance problems and processes (e.g. Bodin & Crona, 2009; Ernstson, Sorlin, & Elmqvist, 2008; Isaac, Erickson, Quashie-Sam, & Timmer, 2007). This body of research provides some context for understanding how the structure of a network, as well

[8] Social network analysis methodologies are detailed in Chapter 4, Methods.

as the position and attributes of individual actors within the network, may facilitate collaboration.

Numerous studies of social networks in natural resource governance settings have shown that networks can enhance collaborative governance processes in a variety of ways. Social networks can enable the mobilization of diverse resources, which in turn supports a resilient network that can adapt to change and solve complex problems (e.g. Bodin & Crona, 2009; Newman & Dale, 2005). Social networks can also facilitate the development of new and the exchange of existing knowledge and information, which is essential for managing complex systems like ecosystems (e.g. Bodin & Crona, 2009; Crona & Bodin, 2006; Isaac, et al., 2007). Networks have also been found as effective for understanding communication patterns and the exchange of advice among resource users and professionals (e.g. Crona & Bodin, 2006; Isaac, et al., 2007; Ramirez-Sanchez & Pinkerton, 2009), or within somewhat more formalized governance networks (e.g. Hartley, 2010).

However, several network scholars have pointed out that social networks vary widely in structure and composition and that not all networks are well-suited to effective collaboration (e.g. Bodin & Crona, 2009; Bodin, Crona, & Ernstson, 2006; Newman & Dale, 2005). Ernstson et al. (2008) point out that network structure can constrain collaborative ecosystem management because networks can allow for some collective actions while limiting others. Bodin and Crona (2009) conducted a comprehensive review of recent network studies which examined processes through with multiple actors were involved in addressing natural resource governance problems, and found that network structure can have a significant effect on actors' ability to exchange resources and information or solve problems; they further note that there is no one ideal network or set of network attributes and that favoring one network attribute might reduce the effectiveness of another.

Network attributes which may have an influence on the effectiveness of collaboration include the network structure as a whole as well as the position of individual actors within the network. Bodin and Crona (2009) cite a number of studies which found that network density – the number of actors in a network, and the number of ties between them – is important for collaboration in that it increases opportunities for communication, trust, and ultimately collective action. However, they also note that the utility of density diminishes at high values because it leads to reduced capacity for collective action (Oh, Chung, & Labianca, 2004) and homogeneity of information and ideas (Bodin & Crona, 2009; Bodin & Norberg, 2005). In network terms, homogeneity may also be described as a tendency toward homophily (or love of the same), which reduces diversity and limits access to some resources (Krackhardt & Stern, 1988).

Bodin and Crona (2009) also describe some key attributes of individual actors within the network, and note that "bridging ties" - actors who connect diverse subgroups within the network – are important to the collaborative management of complex, boundary-spanning systems such as ecosystems because these individuals facilitate the exchange of information and knowledge, and can even help develop trust and collective action among otherwise unconnected groups (Bodin, et al., 2006; Bodin & Norberg, 2005). Such individuals bring together actors, resources, and opportunities who were not otherwise connected (Granovetter, 1973). Newman and Dale (2005) highlight that these bridging ties have high social capital because they create diversity within a network, which they argue is critical for developing collaborative solutions to complex environmental problems. Ernstson et al. (2008)

further underscore the importance of diversity for accomplishing collaborative ecosystem management, noting that user groups and other actors with diverse and valuable knowledge must not be relegated to peripheral positions in a network.

No studies have been identified for this research through which the concept of social networks has been applied to structured EBM planning processes *per se,* though some scholars have used networks to explore the application of an ecosystem approach (e.g. Ernstson, et al., 2008; Hartley & Read, 2009; Vance-Borland & Holley, 2009). An especially relevant study is that of Schneider et al. (2003), who studied informal collaborative networks, comprising both governmental and non-governmental partners, in regions with EPA National Estuary Programs. By comparing networks in National Estuary Program areas with those in other areas, the authors found that actors in large, diverse, boundary-spanning NEP networks demonstrated cooperative attitudes, trust in their colleagues and the decision-making process, and confidence that their collaborative efforts could bring about environmental improvement. Schneider et al. (2003)'s study also highlights how collaborative networks can span government both vertically and horizontally, and can also span disciplinary and ideological differences.

2.5 Expectations of a Collaborative Coastal Ecosystem-Based Management Planning Process

Given the ecosystem-based management, collaboration, and networks literature summarized here, an exemplary coastal EBM planning process would be expected to have a number of attributes. Coastal EBM planning processes would be expected to include a large and diverse network of coastal management practitioners, including both professionals and stakeholders, representing a range of different agencies and organizations and a range of different areas of expertise. Given that EBM necessitates a comprehensive, integrated approach which addresses not only ecological considerations but also human uses of the ecosystem and the governance context, practitioners involved would be expected to have comprehensive mental models, illustrating their understanding of all three of these aspects of coastal ecosystems. In addition, some practitioners would also be expected to have balanced mental models of coastal ecosystems, giving equal weight to the ecological, governance and human use aspects of an ecosystem (see Chapter 4 for detailed discussion of mental model comprehensiveness and balance). While all practitioners would not be expected to have perfectly comprehensive, balanced mental models, key practitioners would be expected to provide some leadership in this area. Project leaders and those affiliated with state coastal management programs would be expected to have comprehensive and balanced mental models, because of their role in leading these coastal EBM efforts (see Chapter 3 for details about case studies); and marine resource managers – practitioners whose background, training and job title suggest that they are better equipped to address resource management problems from an integrated perspective - would also be expected to have comprehensive and balanced mental models. Conversely, marine scientists, who are traditionally more narrowly focused, would be expected to be involved but to have less comprehensive, balanced mental models.

As noted above, collaboration has been found to be the single most important factor in successful EBM planning. Given this, coastal EBM planning processes would also be expected to be characterized by active collaboration among this diverse group of practitioners. Active participation would be expected of all government agencies and entities which have a role in managing or influencing the ecosystem in question; such collaboration would also be expected to include stakeholders such as resource users and citizens. Collaboration networks would be expected to be dense, but not too much so (so as to avoid homogeneity), and shaped by “bridging ties” – influential individuals who create connections and facilitate the exchange of information and ideas between diverse groups who are not otherwise connected. In particular, plan leaders, those affiliated with the state coastal management program, and marine resource managers would be expected to be among the most active and influential collaborators, whereas marine scientists would be expected to be involved but to be less active, influential collaborators.

Chapter 3 describes the selection of the two case study coastal EBM planning processes, and Chapter 4 describes the methods by which these two cases were analyzed to determine whether they have any of these attributes. The remaining chapters report study results and discussion of these findings.

Chapter 3. Background and Descriptions of the Two Case Studies

3.1 Overview

Two case studies were selected through which to investigate the development of coastal ecosystem-based management plans: the Greenwich Bay Special Area Management Plan in Rhode Island, and the Great South Bay Ecosystem-Based Management Plan in Long Island, NY. The rationale for selecting these two cases is detailed in Chapter 4, Methodology. This chapter includes background and descriptions of the two case study locations and planning efforts. This background and context is important for understanding many of the study results, and so is referred to throughout the dissertation.

3.2 Case Study A: The Greenwich Bay Special Area Management Plan

Case Study A is focused on Greenwich Bay, a small, shallow estuary that feeds into the west side of Narragansett Bay in Rhode Island (see Figure 1). Ecosystem-based management planning for Greenwich Bay has been pursued through the development of the Greenwich Bay Special Area Management Plan (Greenwich Bay SAMP). The Greenwich Bay SAMP process began in early 2002; the SAMP itself was finalized and adopted into law in May 2005, and updated in late 2008 (RI Coastal Resources Management Council, 2008). It is currently implemented as part of the RI Coastal Resources Management Council's federally-approved coastal management program under the Coastal Zone Management Act of 1972, as amended (CZMA) (16 U.S.C. §1451 *et seq*.).

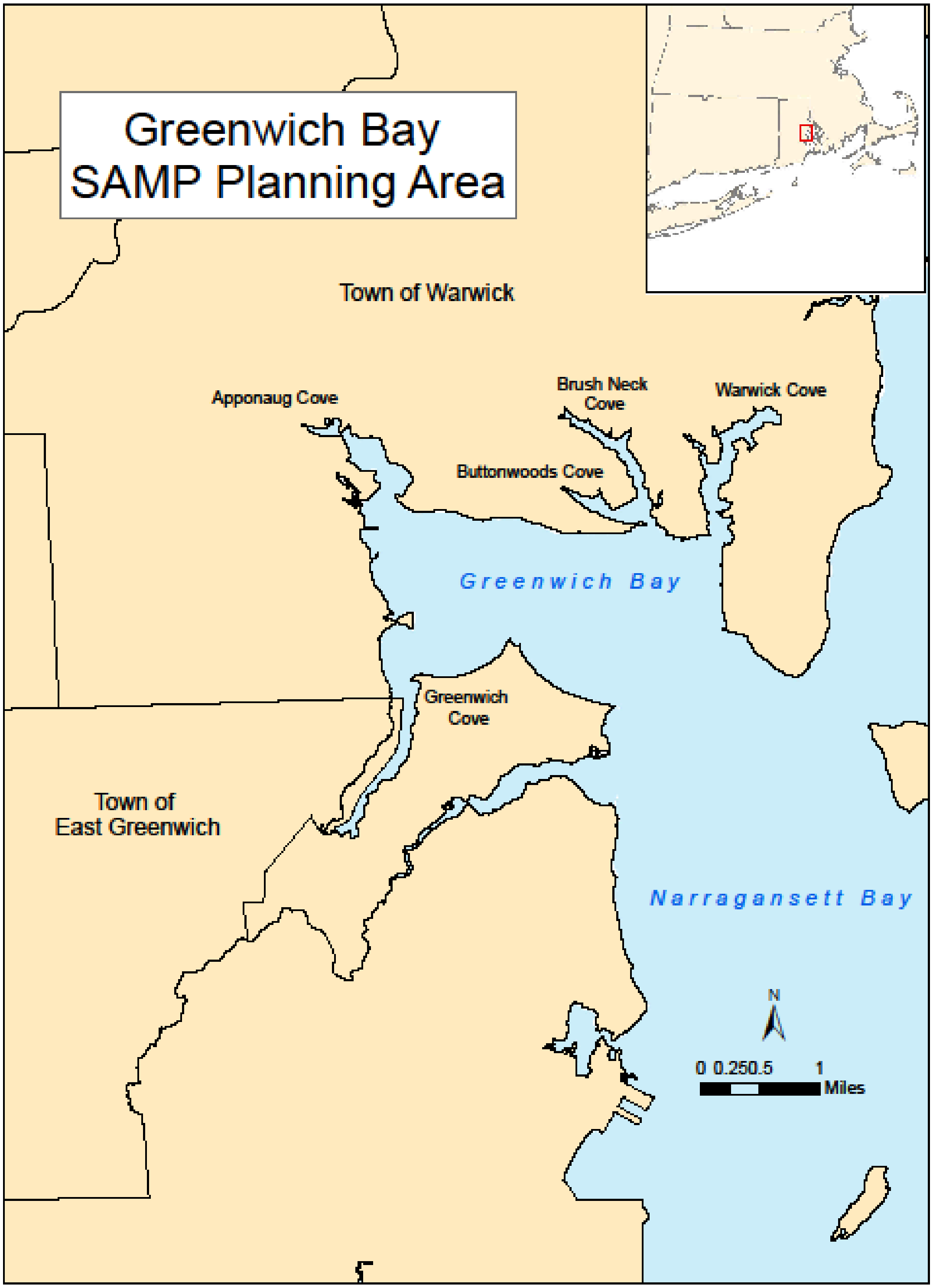

Figure 1. Map of Greenwich Bay SAMP planning area

3.2.1 Description of Study Area

The Greenwich Bay SAMP area comprises Greenwich Bay and its watershed, which are located to the west of Narragansett Bay in Rhode Island. Greenwich Bay is a 5-square-mile shallow, protected estuarine embayment that includes five protected coves: Greenwich, Apponaug, Buttonwoods, Brush Neck, and Warwick. Together, these coves comprise about 8% of Greenwich Bay's volume (Brush, 2002). On its western end, sources of freshwater input include Hardig Brook, which flows into Apponaug Cove, and the Maskerchugg River, which flows into Greenwich Cove; on its eastern end it is connected to Narragansett Bay, also an estuarine embayment. Habitats in Greenwich Bay include mud flats, freshwater and tidal wetlands, and open waters. Historically, Greenwich Bay also had extensive eelgrass habitat and supported a rich diversity of living marine life, including vibrant shellfish populations, most notably the northern quahog (*Mercenaria mercenaria*), known as hard clam on Long Island (RI Coastal Resources Management Council, 2008). Narragansett Bay's quahog fishery appears to have peaked in the 1950s and then again in the 1980s, but then declined in recent years; although biomass has been increasing since 2003, quahog landings remain low due to a variety of factors including water pollution-related closures and increased management measures. Today, Greenwich Bay is actively used by commercial quahoggers, and most quahog landings in Narragansett Bay are harvested in Greenwich Bay (RI Department of Environmental Management, 2010a). In addition to quahoggers, Greenwich Bay is actively used by recreational boaters, sailors, and beach goers. It is especially popular with recreational boaters, and has enough marinas, moorings and residential docks to accommodate 4,000 boats (RI Coastal Resources Management Council, 2008).

Greenwich Bay is abutted by two municipalities, Warwick and East Greenwich which together have nearly 26 miles of shoreline. Its 21-square mile watershed includes these two towns as well as the town of West Warwick. Historically, upland areas in the watershed had been used for farming, and later, for manufacturing mills and other industrial activities. In the late 19th and early 20th century, summer resort communities developed around Greenwich Bay's beaches; in the late 20th century, many of these summer cottages were turned into year-round homes, although on-site sewage disposal systems were not upgraded to accommodate this increased use (Kennedy & Lee, 2003; RI Coastal Resources Management Council, 2008). Today, the Greenwich Bay watershed is characterized largely by medium density suburban development patterns as well as some commercial development. While sanitary sewers are now available to much of the developed area of the watershed, many homes and businesses still use on-site sewage disposal systems, many of which are substandard or failing (RI Coastal Resources Management Council, 2008). Waterfront uses include beaches and parks, marinas and other water-dependent maritime businesses, and several waterfront restaurants.

Management problems facing the Greenwich Bay ecosystem include poor water quality due largely to fecal coliform and nitrogen inputs, declining finfish and shellfish populations and habitats, and conflicts between and among user groups. Many of these problems have been affecting Greenwich Bay since at least the early 1990s through shellfishing closures, beach closures, and other events (RI Coastal Resources Management Council, 2008). After years of temporary shellfishing closures caused by wet weather events, high fecal coliform counts following a severe storm event caused the permanent closure of Greenwich Bay to shellfishing in 1992 (RI Coastal Resources Management Council, 2008). This closure prompted the development of the Greenwich Bay Initiative (1993-1996), a collaborative research effort described below. Today, shellfishing is once again permitted in Greenwich Bay itself, though the five coves are permanently closed to shellfishing, and conditional closures of Greenwich Bay itself following wet weather events are still common (RI

Department of Environmental Management, 2010b). Greenwich Bay also experiences hypoxic and anoxic events, some of which result in fish kills; several small-scale ones were documented in the 1990s and early 2000s, and an unusually large one took place in August 2003, after development of the Greenwich Bay SAMP was already under way (RI Coastal Resources Management Council, 2008; RI Department of Environmental Management, 2003).

3.2.2 Management Context and Existing Institutional Arrangements

Management of Greenwich Bay and adjacent lands is shared among various federal, state, and local/regional entities. Key management agencies include the RI Coastal Resources Management Council (CRMC), a centralized state permitting agency which administers Rhode Island's federally approved coastal management program under the CZMA. CRMC is based in Wakefield, RI in close proximity to the state's coastal region and is the agency that led the Greenwich Bay SAMP planning process. Rhode Island is one of few states in the nation which has a centralized permitting agency to administer its program. CRMC is also unusual in that it is has a professional staff of coastal management professionals but is administered by a Council of members, appointed by the governor, who represent the public and state and local governments. The Council makes agency decisions on plans, policies and standards, and permit applications (RI Coastal Resources Management Council, 2011). The CRMC's management plan, the RI Coastal Resources Management Program (RICRMP), is an extensive regulatory program with jurisdiction over coastal waters as well as shoreline features, and areas contiguous to shoreline features, extending inland 200 feet from the inland border of that shoreline. CRMC also engages in ongoing planning and management of the state's coastal region, and implements regulations to address in-water and coastal structures and uses; most freshwater wetlands within the vicinity of the coast; coastal flooding and hazard mitigation; and public rights-of-way (RI Coastal Resources Management Council, 2010).

CRMC also develops Special Area Management Plans (SAMPs) to manage discrete areas of Rhode Island's coastal region. A SAMP is a coastal management tool identified in the CZMA and recommended as an integrated, regional approach to addressing complex multi-jurisdictional coastal management issues (NOAA Office of Ocean and Coastal Resource Management, 2007). The CRMC is one of the more active coastal management programs in the U.S. in developing SAMPs, and one of very few programs which implements SAMPs as regulatory tools (Fugate, 2011). The CRMC describes SAMPs as "ecosystem-based management strategies that are consistent with the Council's legislative mandate to preserve and restore ecological systems" and further notes that they are strategies to address "specific regional issues" (RI Coastal Resources Management Council, 2009). To date, the CRMC has developed six SAMPs, and is currently updating one and developing one more (RI Coastal Resources Management Council, 2009).[9]

Other key management entities for the Greenwich Bay area include the RI Department of Environmental Management (DEM). DEM is a state regulatory agency charged with implementing a wide range of programs to manage fish and wildlife, water resources, freshwater wetlands, and parks and recreational facilities. Relevant programs to the Greenwich Bay SAMP include DEM's water resources program and marine fisheries programs. DEM's Office of Water Resources oversees water quality and related permits, freshwater wetlands, and water quality-related shellfishing closures (RI Department of Environmental

[9] The other SAMPs that have already been developed are the Salt Ponds SAMP; the Narrow River SAMP; the Providence Harbor SAMP; the Pawcatuck River SAMP; the Greenwich Bay SAMP; and the Ocean SAMP. The Metro Bay SAMP, currently undergoing development, is an update of the Providence Harbor SAMP. The other one currently under development is the Aquidneck Island SAMP (RI Coastal Resources Management Council, 2009).

Management, 2009), and the Marine Fisheries Division oversees all state-managed finfish, shellfish, and crustacean fisheries (RI Department of Environmental Management, 2011). It should be noted that water quality-related beach closures in Rhode Island are handled by a different state agency, the RI Department of Health (RI Department of Health, 2011). The towns of Warwick and East Greenwich, both of which abut Greenwich Bay, are also key players in the management of the Bay and surrounding lands, as is the Warwick Sewer Authority, which was established by state law to manage Warwick's public sanitary sewers (RI Pub. Law. 254 Sect. 17).

3.2.3 The Greenwich Bay SAMP

As noted above, the Greenwich Bay SAMP planning process came about in response to numerous management problems facing Greenwich Bay, and built upon ongoing research and monitoring work that had begun nearly a decade earlier through the Greenwich Bay Initiative. The Greenwich Bay Initiative (1993-1996) was a collaborative effort involving federal, state, and local government agencies, university researchers, fishermen, environmental advocacy organizations and others to study the Bay and identify potential solutions to water quality problems (Kennedy & Lee, 2003; RI Coastal Resources Management Council, 2008). It also built on the CRMC's history of developing SAMPs, most of which have been developed in collaboration with the University of Rhode Island Coastal Resources Center/RI Sea Grant (CRC/RISG), a research and outreach program of the University of Rhode Island (URI) (Lee, 2011).

In 2002, CRMC secured a federal grant to develop a SAMP for Greenwich Bay. Public meetings associated with the plan began in 2003. To guide the development of this plan, CRMC and CRC/RISG established both a Technical Advisory Committee and a Citizens Advisory Committee. The Technical Advisory Committee (TAC) comprised 48 different individuals from

28 different organizations including state and local government, universities, environmental advocacy organizations, and other organizations with specific expertise in different aspects of Greenwich Bay (e.g. habitat, water quality, recreation); the TAC met on a regular basis (often as sub-groups based on the subject matter) - a total of 14 times between January 2003 and January 2004 – to review SAMP chapters and related content. The Citizens Advisory Committee (CAC) comprised 18 citizens from 16 different local neighborhood associations, trade associations and businesses, and met over 20 times between October 2003 and October 2004 (RI Coastal Resources Management Council, 2008). All meetings were open to the public such that a much broader constituency of stakeholders than the membership of these groups could engage in the planning process (Kennedy, 2011).

At the same time as these meetings were being held, CRMC and CRC/RISG drafted chapters of the Greenwich Bay SAMP document and made them available for review by the TAC and the CAC. This review process happened throughout 2003 and 2004 as chapters were being drafted (RI Coastal Resources Management Council, n.d.). The final document was approved in May 2005 following an extended public comment period, and at that point became a regulatory tool as part of the state's federally approved coastal management program (RI Coastal Resources Management Council, 2005, 2008).

The final Greenwich Bay SAMP is a 500-page document that includes extensive technical findings on Greenwich Bay's natural resources, human uses, and regulatory context. It also details an implementation strategy, including a series of detailed policies, standards, recommendations, and priority actions. The plan's goals, as articulated in its first chapter, address environmental quality ("improve Greenwich Bay's water quality," "maintain high quality fish and wildlife habitat") as well as the socioeconomic aspects of the Bay ("improve recreational opportunities," "enhance water-dependent economic development").

Interestingly, the first goal that is listed in the document addresses political and institutional capacity ("develop leaders and stewards to coordinate and implement actions") (RI Coastal Resources Management Council, 2008). SAMP chapters address topics including habitat and living marine resources; water quality; historic and pre-historic cultural resources; "economic assets" (which includes water-dependent businesses such as marinas); recreation; and natural hazards. Much of the content in these chapters clearly address ecosystem interactions; for example, the connections between upland development on Greenwich Bay's water quality and eelgrass and shellfish populations are emphasized; the impacts of degraded water quality on living marine resources as well as human activities such as swimming and shellfishing are made clear; and the Bay's connection to and interactions with Narragansett Bay are given consideration (RI Coastal Resources Management Council, 2008).

Arguably, the Greenwich Bay SAMP's water quality chapter may be considered one of the more significant parts of the plan, given that it was developed collaboratively with the RI DEM and that water quality concerns were among the major motivations for developing this plan. The 134-page chapter represents about one quarter of the entire document and includes extensive technical data on Greenwich Bay and its watershed; water quality problems including bacterial contamination, low dissolved oxygen levels, eutrophication and nutrient loading; and extensive discussion of current efforts to address these issues as well as CRMC's new regulations and recommended actions. It also incorporates a great deal of scientific research and technical findings, including the development of a Greenwich Bay ecosystem model to understand the relationship between nitrogen inputs and the Bay's conditions (Brush, 2002; see also Appendix E of RI Coastal Resources Management Council, 2008). The chapter also presents nitrogen budgets for Greenwich Bay, and had been considered by DEM for potential use as an alternative to a Total Maximum Daily Load (TMDL, or maximum amount of a pollutant a water body can receive and still meet water quality standards) for nutrients/dissolved oxygen in Greenwich Bay (RI Coastal Resources Management Council, 2008; Travers, 2011).[10]

The Greenwich Bay SAMP places great emphasis on collaboration and on-the-ground decision-making. This is most evident in the first two chapters of the document. Chapter 1, "Goals and Objectives," articulates a series of goals as described above, including one to develop capacity in those who will "coordinate and implement" the necessary management actions (RI Coastal Resources Management Council, 2008, p. 7). It then goes on to enumerate a series of priority actions, and to identify which agencies should take the lead on implementing these actions: for example, one of the priority actions is to "develop local capacity to help implement SAMP goals and objectives"; itemized actions under this heading specify clear tasks, such as "support state policies incorporated in the SAMP, for example through a coastal overlay zone," and assigns responsibility for these actions to the towns of Warwick and East Greenwich (RI Coastal Resources Management Council, 2008, p. 7). It also indicates that this achieving this overall goal is a means of achieving "consistent decision-making" among agencies through "collaboration and coordination" (RI Coastal Resources Management Council, 2008).

The second chapter is entitled "The Framework for Collaboration to Implement the Greenwich Bay SAMP." This chapter places great emphasis on the importance of collaboration to both the development and implementation of the plan, and identifies a series of action items which should be accomplished by specified agencies and organizations in order to

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[10] TMDL plans are required by law under section 303(d) of the Clean Water Act (33 U.S.C. §1251 *et seq.*) for impaired water bodies. In Rhode Island, DEM identifies impaired water bodies and develops and implements TMDLs (RI Department of Environmental Management, 2009). The Greenwich Bay SAMP had been considered for formal adoption as a TMDL for nutrients/dissolved oxygen, but was ultimately not adopted as such as it did not meet all of EPA's requirements (RI Coastal Resources Management Council, 2008; Travers, 2011).

effectively implement the SAMP. This chapter notes the varying federal, state, and local laws and governing authorities that play a part in managing Greenwich Bay, and points out that these laws are not based on an ecosystem-based management approach. It also notes that SAMPs are intended to build upon existing laws by coordinating among existing management entities: "R.I. CRMC has developed this plan with the municipalities, other federal and state agencies, and the concerned citizens of the watershed to address the issues affecting Greenwich Bay and its communities in a coordinated and collaborative fashion" (RI Coastal Resources Management Council, 2008, p. 3). It then elaborates:

> Federal and state agencies, the municipalities, university researchers, nonprofit environmental organizations, and citizen groups have achieved a certain level of cooperation, particularly through the Greenwich Bay Initiative, in addressing Greenwich Bay issues. Moving forward, increased collaboration, coordination, and public involvement will be needed to implement actions in this plan, monitor progress, and adapt the plan to incorporate new solutions and address new problems. Through collaboration and coordination, consistent decision-making by all agencies and streamlined permitting can be achieved (RI Coastal Resources Management Council, 2008, p. 5).

This chapter concludes with a series of recommended actions for effectively implementing the SAMP. These actions include the establishment of the Greenwich Bay Implementation Team, which would include representatives from the two municipalities as well as a range of state government agencies; and a Greenwich Bay Public Forum (RI Coastal Resources Management Council, 2008). A Greenwich Bay Public Form was convened once in October 2007 in Warwick, but it should be noted that the Greenwich Bay Implementation Team was never convened. CRMC staff indicate that this is for many reasons, one of which is that its function seems redundant with that of the Rhode Island Bays, Rivers, and Watersheds

Coordination Team, which was established by the Rhode Island General Assembly in 2004 and has similar goals (Boyd, 2011).[11]

The Greenwich Bay SAMP was adopted into law in May 2005, following an extended formal public review and comment period. Once approved, it attained regulatory authority as part of Rhode Island's federally-approved coastal management program. Since then, several Greenwich Bay SAMP implementation activities have occurred. These include the establishment of a policy grandfathering in numerous commercial fishing docks in Greenwich Cove, and the development of a new vegetated buffer policies that are appropriate to the small-lot suburban development that characterizes the Greenwich Bay watershed; these changes were incorporated into the SAMP by amendment in September 2008 (RI Coastal Resources Management Council, 2008). CRMC is currently working to support these new vegetated buffer policies by developing a "Suburban Buffer Design Manual"; in addition to this, staff also indicate that they have been working on developing a Greenwich Bay SAMP status report, but that this is not yet available (Boyd, 2011).

3.3 Case Study B: Great South Bay Ecosystem-Based Management Plan, Long Island, NY

Case Study B is focused on the Great South Bay, a coastal lagoon ecosystem on the south shore of Long Island, New York (see Figure 2) that is one of a series of estuarine embayments referred to collectively as the Long Island South Shore Estuary Reserve. Current ecosystem-based management planning in the Great South Bay is being pursued primarily through the development of the Great South Bay Ecosystem-Based Management Plan (Great South Bay EBM Plan), which is the primary focus of this case study. Work on the Great South

[11] The Rhode Island Bays, Rivers, and Watersheds Coordination Team was established by the Rhode Island General Assembly in 2004 to facilitate interagency coordination with regard to the management of Narragansett Bay and its watershed. See http://www.coordinationteam.ri.gov/index.htm for further information.

Bay EBM Plan began in 2007 and to date has not formally concluded, though, as illustrated below, the bulk of this work took place during 2007-2008. Other ecosystem-based management work is ongoing in the Great South Bay as well; these efforts, including a planned SSER amendment to the New York State coastal management program, as well as some scientific research and restoration efforts in the Great South Bay, are also described below.

Figure 2. Map of Great South Bay EBM planning area

3.3.1 Description of Study Area

The Great South Bay is a 151-square mile coastal lagoon separated from the Atlantic Ocean by a series of barrier islands, including Fire Island, a popular recreational destination and national park. It is the largest shallow estuary in New York State. Much of it is open water, though significant habitats include eelgrass beds, salt marshes, mud flats, and barrier beaches. Six small groundwater-fed rivers provide freshwater flow into the Bay, and Fire Island Inlet represents the only direct connection between the Bay and the Atlantic Ocean (U.S. Fish and Wildlife Service, 1997). Historically, the Great South Bay was home to a rich diversity of marine finfish, shellfish, and other wildlife, and was one of the focal points of Long Island's commercial fisheries. From the late 17th century through the 1950s, a vibrant eastern oyster (*Crassostrea virginica)* fishery thrived there, and Blue Point oysters were a valuable and sought-after product (LoBue & Bortman, 2011). More recently, waterman fished the Great South Bay for hard clams (*Mercenaria mercenaria*), known as quahogs in Rhode Island (U.S. Fish and Wildlife Service, 1997). This fishery peaked in the 1970s and some sources claim that over half the clams eaten in the U.S. were harvested in the Great South Bay. By the mid-1990s, however, the hard clam fishery had declined to the extent that it was no longer economically viable (LoBue & Bortman, 2011). For these reasons, the Great South Bay has a rich maritime heritage, and Long Island's only maritime museum is located on the Great South Bay waterfront in Sayville.

The Great South Bay is bordered by three suburban municipalities, Babylon, Islip, and Brookhaven, all contained within Suffolk County. Historically, much of this area was used for agricultural purposes, such as duck farming (U.S. Fish and Wildlife Service, 1997). Today, the watershed is characterized by medium-density development, with residential and commercial areas interspersed with areas of open space (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a). The shoreline is developed with an array of water-dependent and other maritime-related non-industrial uses (Steadman, 1999). Currently, the Bay itself is used by recreational and commercial fishermen and recreational boaters, though commercial fishing in the Bay is thought to have declined dramatically since the mid-1990s (Conover, Cerrato, & Wise, 2005; U.S. Fish and Wildlife Service, 1997). Current management issues facing the Great South Bay include declines in some finfish and shellfish species and associated landings, most notably the hard clam, as well as loss of eelgrass and other important habitat (Conover, 2008; Conover, et al., 2005). There are multiple possible reasons for these declines, which include nutrient loading of the Bay; increases in invasive species; global climate change; and brown tide (a type of harmful algal bloom) (Conover, 2008).

3.3.2 Management Context and Existing Institutional Arrangements

As with all coastal locations, management of the Great South Bay and adjacent land is shared among various federal, state, and local/regional entities. Key management agencies include the New York State Department of State Division of Coastal Resources (DOS), which houses New York State's federally approved coastal zone management program (NY Exec. Law. Art. 42) under the federal Coastal Zone Management Act of 1972, as amended (16 U.S.C. §1451 *et seq.*). New York's coastal program is structured quite differently from that of Rhode Island. It is a networked program with a small central office based in Albany on the Hudson River, nearly 200 miles upstate from Long Island's south shore, in close proximity to state lawmakers and other state offices. New York's coastal program is charged with managing diverse and geographically disparate freshwater, estuarine, and ocean areas including the Great Lakes, the St. Lawrence River, the Hudson River, Long Island Sound, the Peconic Estuary;

and the south shore of Long Island. DOS does not directly regulate or issue permits for coastal activities. Rather, it outlines a series of coastal policies with which government agency activities must be consistent, and it offers incentives for coastal communities to refine these policies at the local level by developing Local Waterfront Revitalization Programs.

Another key agency is the New York State Department of Environmental Conservation (DEC), whose primary purpose is to protect New York's natural resources pursuant to New York's Environmental Conservation Law (ECL). Whereas the DEC has central offices in Albany and regional locations throughout the state, their regional office in Suffolk County on the north shore of Long Island also functions as the headquarters of the DEC's Bureau of Marine Resources. The DEC oversees a wide range of regulatory and permitting programs; those relevant to this study include tidal wetlands protection (NY ECL Art. 25), water quality (NY ECL Art. 17), floodplain management (NY ECL Art. 16), and management of marine fisheries and shellfisheries (NY ECL Art. 13, Title 3).

Numerous other entities which are unique to Long Island play key roles in the management of the Great South Bay and surrounding area. These include the Suffolk County government (by contrast, there are no true county governments in Rhode Island or other New England states), and the municipal governments of the towns of Babylon, Islip, and Brookhaven, each of which contains several incorporated villages (see New York State Department of State, 2009) . The town governments of Babylon, Islip, and Brookhaven are especially relevant to the management of the Great South Bay because, unlike most coastal areas of the U.S., these towns own most of the adjacent underwater lands in the Great South Bay and adjacent areas. These municipal ownership rights to underwater lands date back to colonial land grants and patents through which lands – including lands underneath harbors and bays – were conveyed to local governing bodies (Beck, Fletcher, & Hale, 2005; New York State Department of State, 1997). While these municipalities hold these lands in trust for the public, as is done in most other states in which submerged lands are owned and held in trust by state governments (Beck, et al., 2005; New York State Department of State, 1997), this unique arrangement would seem to elevate the role of municipalities with regard to the management of the Great South Bay.

The Long Island Chapter of The Nature Conservancy (TNC) also plays a unique role in the management of the Great South Bay in that it owns approximately 13,000 acres of its underwater lands (about 20% of the entire Bay). TNC obtained these lands, located in the center of the Bay, in 2002 from the Bluepoints Oyster Company, a private shellfishing firm which had private ownership of these lands since the early 20th century; the property had been privately-owned since the 17th century, when it was first conveyed into private ownership through a series of colonial grants and patents similar to those described above.[12] In 2002, the Bluepoints Oyster Company donated these underwater lands to TNC, which manages this area as a centerpiece of its marine conservation work (Beck, et al., 2005). To manage this property, TNC established the Bluepoints Bottomlands Council, a diverse advisory council comprising members from local, county, state, and federal government agencies; environmental advocacy organizations; universities; the private sector; and other stakeholders (Beck, et al., 2005). To date, TNC's management efforts for the Bluepoints property have included stocking spawner sanctuaries with the goal of restoring hard clam populations (LoBue & Bortman, 2011).

Management of the Great South Bay is also influenced by the National Parks Service, which manages Fire Island National Seashore. Fire Island National Seashore (FINS) is a national

[12] The Bluepoints Property and its conveyance to TNC is a complex and unusual legal story; see Beck et al. (2005) for a detailed discussion.

park located within the towns of Brookhaven and Islip on the barrier island separating the Great South Bay from the Atlantic Ocean. However, the jurisdiction of the FINS extends into the Great South Bay itself such that 12,606 acres of the Park is part of the Great South Bay (New York State Department of State, 1997).

Another unique management entity is the South Shore Estuary Reserve Council, which implements the South Shore Estuary Reserve Comprehensive Management Plan. The South Shore Estuary Reserve (SSER), created by statute in 1993 (NY Exec. Law Art. 46), is a unique management entity that is especially relevant to this case study. The SSER statute provides for the establishment of the SSER itself, a comprehensive management plan for the SSER, and the SSER council, whose purpose is to develop and implement this plan. The SSER Council comprises 23 voting members including representatives from state agencies, county and local government, environmental advocacy organizations, scientists, and user groups, and is advised, in turn, by a Citizen's Advisory Committee, a Technical Advisory Committee, a Management Advisory Committee and a Local Government Advisory Committee (NY Exec. Law Art. 46). The SSER Comprehensive Management Plan was adopted in 2001 after a seven-year planning process that involved numerous public meetings and extensive input from federal, state, and local government, stakeholders, and the general public (South Shore Estuary Reserve Council, 2001). It is currently implemented by the SSER Council and staffed by the SSER office (which is, in turn, staffed by DOS), which is based in Freeport on the Long Island south shore. DOS provided technical support to the Council through the development of the Comprehensive Management Plan and has continued to support its implementation (New York State Department of State Division of Coastal Resources, n.d.).

The SSER Comprehensive Management Plan is, arguably, an ecosystem-based management plan in its own right. It contains a wealth of data on the natural resources and human uses of the SSER, and explicitly identifies the need for “improved knowledge for ecosystem management” (South Shore Estuary Reserve Council, 2001, p. 86). The Comprehensive Management Plan includes chapters on the overall SSER region; water quality, living resources and habitats; public uses of the SSER; the SSER economy; education, outreach, and stewardship; and implementation (South Shore Estuary Reserve Council, 2001). Each chapter includes policy recommendations to be implemented by different state, county, or municipal government agencies; for example, Chapter 2, “Improve and Maintain Water Quality,” recommends the implementation of “best management practices to reduce the contamination of stormwater runoff by hazardous materials, fertilizers, herbicides and pesticides, household hazardous wastes, and wildlife and pet wastes,” which would largely need to be accomplished by “all towns in the Reserve” (South Shore Estuary Reserve Council, 2001, p. 18). The implementation chapter provides additional guidance for implementing these recommendations as well and identifies budgetary needs to pursue the implementation of the Comprehensive Management Plan (South Shore Estuary Reserve Council, 2001).

It should be noted that the SSER Comprehensive Management Plan does not have regulatory authority in its own right as it is not an amendment to the state’s coastal program, and the enabling statute does not give the SSER Council regulatory authority. Instead, the Comprehensive Management Plan is implemented by the Council through partnerships between the Council, DOS, and several federal, state, county, and local government entities (New York State Department of State Division of Coastal Resources, n.d.). For clarity, it should also be noted that the SSER Comprehensive Management Plan is a state estuary program and is not part of the EPA’s National Estuary Program (Environmental Protection Agency, 2011).

3.3.3 Ecosystem-Based Management Planning in New York State

The Great South Bay EBM planning effort that is the focus of this case study came about in response to recent New York state ecosystem-based management planning legislation. In 2006, the state of New York passed the New York Ocean and Great Lakes Ecosystem Conservation Act, which established the New York Ocean and Great Lakes Ecosystem Conservation Council (NYOGLECC) (NY Exec. Law Art. 14). Documents announcing this Act indicate that its establishment made New York the only state other than California to codify an ecosystem-based management approach into law (Senecah, Manno, Wise, & Conover, 2006). According to this statute, NYOGLECC comprises the heads of nine different state authorities.[13] It is chaired by the commissioner of the New York State Department of Environmental Conservation, and its Executive Director is the Deputy Secretary of State for Coastal Resources, who is also the head of the state coastal program housed in DOS (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009a). DOS Oceans program staff have also worked as staff to the Council (Capobianco, 2011).

NYOGLECC defines ecosystem-based management in a balanced, integrated manner, noting that it "recognizes that humans are integral parts of any ecosystem," "emphasizes the need to establish strong partnerships to address complex and often contentious issues," and "requires the integration of ecological, social, economic, and institutional perspectives" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c). The Council is charged with working toward the implementation of an ecosystem-based management approach in multiple ways; per Article 14, it is directed to integrate ecosystem-based management into

[13] The nine New York State authorities comprising NYOGLECC membership are: NYS Dept. of Agriculture and Markets; NYS Dept. of Economic Development; NYS Dept. of Environmental Conservation; NYS Dept. of State (which houses the coastal program); NYS Dept. of Transportation; NYS Energy Resource and Development Authority; NYS Office of General Services; NYS Office of Parks, Recreation, and Historic Preservation; and the State University of New York.

existing laws and programs; develop guidelines for agencies to employ an ecosystem-based management approach; and encourage research and information sharing to facilitate ecosystem-based management by engaging public and private universities, research, and non-profit institutions (NY Exec. Law Art. 14). NYOGLECC was also directed to report to the governor and the legislature on a plan to implement ecosystem-based management actions, and the development of a spatial data atlas to facilitate ecosystem-based management. Article 14 also calls upon NYOGLECC to demonstrate the application of ecosystem-based management at the local level through demonstration projects in two study areas: eastern Lake Ontario and Long Island's Great South Bay (NY Exec. Law Art. 14). (Demonstration projects are further discussed below.)

In late 2006, NYOGLECC convened its first official meeting (Senecah, et al., 2006). A 2007 press release announcing the state's formal adoption of an ecosystem-based approach to coastal management emphasized the importance of collaboration and everyday decision-making. The press release quotes former governor Eliot Spitzer: "ecosystem-based management will provide a comprehensive and collaborative approach to protecting and sustaining our valuable environmental assets" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007b). It also notes that the NYOGLECC will "integrate the following ecosystem-based management principles into daily decision-making: base decisions on local factors; use the most current scientific findings; adapt decisions to changing circumstances; use measurable objectives to direct and evaluate performance; recognize the interconnections among and within ecosystems; [and] involve those affected by decisions" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007b).

Since its inception, NYOGLECC has accomplished many of the objectives identified in Article 14. These include the development of draft agency guidelines for the development of ecosystem-based management (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009a) and the completion of a final NYOGLECC report, *Our Waters, Our Communities, Our Future: Taking Bold Action Now to Achieve Long-term Sustainability of New York's Ocean and Great Lakes* (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c), which summarizes progress to date and makes recommendations toward implementing ecosystem-based management in New York. This report also details progress to date on the demonstration of ecosystem-based management in two areas: the Sandy Creeks Watershed on the eastern shore of Lake Ontario, and the Great South Bay. Ecosystem-based management planning in the Great South Bay is discussed in detail below.

3.3.4 The Great South Bay Ecosystem-Based Management Plan

Arguably, elements of an ecosystem-based management approach have been applied in the Great South Bay since at least 2001 through the implementation of the SSER Comprehensive Management Plan (discussed above). However, the Great South Bay has recently been the focus of ecosystem-based management planning because it is identified in the NYOGLECC statute as one of two demonstration areas through which NYOGLECC could demonstrate the application of an ecosystem-based management approach at the local level. As described in the final NYOGLECC report (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c, p. 25), these demonstration areas were to serve as "learning laboratories for the Council agencies to collaborate on various approaches to EBM planning and implementation. The goal is to apply lessons learned as the Council begins to implement EBM statewide."

Plans for the Great South Bay EBM demonstration area focused primarily on the development of a Great South Bay EBM plan (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a), and also included restoration projects and scientific research in support of ecosystem-based management (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009b; New York State Department of State Division of Coastal Resources, 2010). According to a 2007 NYOGLECC newsletter, the Great South Bay EBM plan would "make recommendations for better aligning federal, state, and local programs, provide direction for implementing future actions, and identify research and monitoring needs to better protect and use the ecosystem widely" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a). It also indicates that this plan would "identify the steps necessary to achieve conservation and socioeconomic goals using methods to maintain ecological integrity and economic sustainability" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a).

Work on the GSB ecosystem-based management demonstration area began in 2007 through a partnership between DOS, DEC, and the Long Island chapter of The Nature Conservancy (TNC). TNC was engaged in this process because, as discussed above, they were already engaged in hard clam restoration projects and other conservation work in the Great South Bay, and because they own and manage a substantial amount of submerged land within the Bay (e.g. LoBue & Bortman, 2011; New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a). As this work was also intended to build upon the SSER Comprehensive Management Plan, the SSER Council was also engaged as a partner (New York Ocean and Great Lakes Ecosystem Conservation Council, 2007a).

On behalf of NYOGLECC, DOS contracted TNC to develop an ecosystem-based management plan for the GSB, and established a steering committee comprising staff from DOS, DEC, TNC, and the SSER office (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c). Work on this plan began in 2007, and from September 2007 through March 2008, a stakeholder process was conducted in support of the development of this project. The stakeholder process was led by a consulting firm based in upstate NY and took place in central Long Island in Great South Bay area communities; it comprised two large-group meetings as well as a series of focus group meetings for specific users or interest groups. Stakeholders invited to these meetings included representatives of federal, state, county, and local government; environmental advocacy groups; user groups; and private citizens. At these meetings, stakeholders were updated on progress to date, were presented with a draft document summarizing TNC's progress to date in developing the ecosystem-based management plan, and were invited to offer comments and ask questions (EcoLogic, 2008).

In 2008, TNC completed work on a draft document entitled *An Ecosystem-based Management Plan for the Great South Bay Demonstration Area* (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c). While this document is not yet completed and publicly available (Capobianco, 2011) and therefore was not reviewed for this study, other sources indicate that it is a "comprehensive technical report" containing recommendations for the management of the Great South Bay, and includes an assessment of the Great South Bay ecosystem, using TNC's "Conservation Action Planning process" (New York Ocean and Great Lakes Ecosystem Conservation Council, 2009c). In applying this approach, the draft technical report identifies key ecological resources, or "surrogates," found within the GSB that highlight connections between different parts of the ecosystem (e.g. bay and ocean) and that act as indicators of the overall ecosystem health of the Bay. The technical report focuses in particular on three ecological surrogates, representing different habitat types, and six species surrogates, including *Mercenaria mercenaria* (hard clam, referred to in Rhode Island as quahog). The technical report also identifies water quality, habitat protection, and climate change adaptation as management priorities for the GSB. Overall, this draft report has been described as "a strong science-based foundation" for the final GSB EBM plan, which is forthcoming (New York State Department of State Division of Coastal Resources, 2010).

DOS has indicated that revisions are currently being made to the draft GSB EBM plan, and has further indicated that the final product will comprise two separate documents – the TNC technical report, and a separate EBM planning document (New York State Department of State Division of Coastal Resources, 2010). DOS has explained that the reason for this delay, as well as the plan to disaggregate the draft plan into two separate documents, is because they have determined there is a need for more consultation with partner agencies and other stakeholders before finalizing the recommendations. At the time of this writing, completion and distribution of these documents is planned for some time in 2011 (Capobianco, 2011). Tasks to be completed before finalizing and distributing these documents include developing and refining recommendations in partnership with stakeholders, developing a plan for implementing recommendations, preparing a public summary document, and conducting a peer review of both the technical report and the plan (New York State Department of State Division of Coastal Resources, 2010).

While work on this plan has been under way, NYOGLECC has supported other, related projects in the Great South Bay in support of ecosystem-based management planning. This work has included a Great South Bay nitrogen loading study to identify nitrogen sources and different management scenarios (Kinney & Valiela, 2008, 2011) and hard clam restoration efforts, including the establishment of spawner sanctuaries (LoBue, 2010). Other efforts led by a team of scientists at Stonybrook University included the launch of a Great South Bay Observatory and the development of a Great South Bay ecosystem model (Cerrato et al., 2011). All of this work has informed, and continues to inform, the overall planning process and associated documents.

At present, additional EBM-related activities are taking place in the Great South Bay area. The SSER Council and DOS are preparing to continue their work on ecosystem-based management planning in the Great South Bay through the development of a South Shore Estuary Reserve amendment to the New York State coastal management program. Work to plan the development of this amendment began in 2010 and, at the time of this writing, is still in the early stages of planning (Capobianco, 2011). Whereas the SSER amendment will address a range of issues beyond those that are specific to the Great South Bay, DOS has indicated that new data and information gathered for the Great South Bay EBM work performed to date "can inform, support and advance the development of the SSE Amendment" and that TNC's technical report can be used as a "possible template" for gathering and analyzing scientific information throughout the entire Reserve (New York State Department of State Division of Coastal Resources, 2010). They have further indicated that recommendations made in the final Great South Bay EBM plan may be applicable to the entire Reserve, and that the SSER amendment to the state's coastal management program may provide an appropriate mechanism for acting on some of the recommendations (New York State Department of State Division of Coastal Resources, 2010).

Chapter 4. Methodology

4.1 Overview

This dissertation is a case study analysis of two coastal ecosystem-based management planning efforts. In each case, two different data collection and analysis methods were employed. Mental models analysis (Morgan, et al., 2002) was used to investigate coastal management practitioners' conceptualizations of the coastal ecosystems they are managing; and social network analysis (e.g. Scott, 1991; Wasserman & Faust, 1994) was used to investigate whether and how coastal management practitioners were collaborating with those of different affiliations and areas of expertise in order to apply an ecosystem-based management approach. This chapter details the rationale for selecting these case studies, the methods by which study participants were selected, and the mental models and social network data collection and analysis methods used in each case. It should be noted that the mental models and social network methods used here are designed to be replicable in a wide variety of other settings with minimal modifications to account for differences in ecosystem characteristics and institutional arrangements.

As noted above, the focus of this research is coastal management practitioners, not the coastal ecosystem-based management plans they were involved in developing. For the purposes of this study, "coastal management practitioners" encompasses all those who are or were integral parts of these planning processes. This broad definition of those engaged in planning processes has been shaped by the work of Throgmorton (1990), who explores how planning efforts are often informed by three planning-related communities: politicians, advocates, and scientists. As such, "coastal management practitioners" includes coastal managers, policymakers, planners, scientists, environmental advocates, citizens, or other key individuals. This includes staff from local, county, state and federal agencies and programs includes land use planners, permitting and enforcement staff, managers, bureaucrats, staff scientists and engineers, and appointed or elected officials. This also includes representatives of non-governmental research, planning, advocacy, or business organizations which may have an interest in coastal management decisions, as well as citizens who actively engage in these processes. See below for detailed discussion of how study participants were identified.

The methods presented in this chapter are uniquely suited to the investigation of practitioners involved in collaborative coastal ecosystem-based management planning efforts. Just as ecosystem-based management is a relatively recent approach that seeks to address and embrace the complexity of coastal ecosystems, the mental models analysis and social network analysis techniques used in this dissertation are recently-developed methods, designed to analyze and understand complex systems within the context of natural resource management. Mental models analytical methods investigate how the individual pieces together fragmented information to make sense of complex systems and phenomena; and social network analytical methods recognize networks of individuals as complex systems unto themselves. Moreover, mental models and social network analysis are complementary. Mental models analysis provides insight into how individuals think, while social network analysis provides insight into how individuals work together within collaborative planning networks. Arguably, the two influence each other: individuals' mental models shape the collaborative networks within which they work, and collaborative processes shape individuals' mental models. The details of these methods and the theory underlying them are included in this chapter.

4.2 Case Study Approach and Case Selection

This dissertation employed a case study approach and focused on two cases, both of which are focused ecosystem-based management initiatives applied to a discrete coastal region. A case study approach was determined to be the most appropriate method through which to explore this study's research questions because case studies allow for in-depth investigation of complex phenomena in a real-world context, such that the researcher can consider the "how" and "why" of coastal management practitioners' work (Yin, 2003). The two-case approach was used because this number provides the opportunity for comparative analysis, while still allowing for in-depth analysis of each individual case. As noted by Yin (2003, p. 53), two-case analysis allows for the possibility that common conclusions may be drawn from both cases, which may expand the "external generalizability" of study findings. In particular, two-case analysis allowed for consideration of whether certain types of relationships (i.e. between social networks and mental models) hold up in different settings. In addition, two case studies allowed for conducting more interviews per case, despite the fact that mental models interviews can be lengthy and demanding (Morgan, et al., 2002).

As detailed in Chapter 3, the two cases selected for this study are the Greenwich Bay Special Area Management Plan (Greenwich Bay SAMP), Rhode Island, and the Great South Bay Ecosystem-Based Management Plan (Great South Bay EBM Plan), Long Island, New York. These cases were selected because the goal was to choose cases that could potentially be considered best-case scenarios. Accordingly, cases were selected based on the following criteria: each one is/was (a) driven by explicitly stated ecosystem-based management goals; (b) focused on a discrete area of one state's coastal zone; (c) administered or connected in some way with the state's coastal management program; (d) is shaped by strong institutional and/or political support; (e) has resulted or will result in a plan and/or set of policies or guidelines to be used by decision-makers; and (f) is currently being developed and/or implemented. The goal was also to choose case studies from different states, so as to allow for comparison between different sites, approaches, and networks, and to choose case studies located in the northeastern U.S., so as to allow for site visits and in-person meetings with coastal management practitioners. It is important to note that to date there are very few site-specific ecosystem-based management initiatives currently taking place in the coastal zone, much less those which meet the above criteria. While a systematic survey of each state coastal management program has not been conducted for this study, extensive web research and review of conference proceedings, conducted at the outset of this study, revealed very few such initiatives.[14] The two cases were chosen not only because they met the above criteria, but also because they are among the very few programs currently under way.

Beyond the case study selection criteria outlined above, the Greenwich Bay SAMP and the Great South Bay EBM Plan were especially appropriate case studies to test this study's hypotheses because, as noted above, they are theoretically best-case scenarios for the application of the ecosystem-based management approach. Both planning efforts include explicit goals and statements about the importance of collaboration to achieving EBM as well as the importance of decision-making and/or the role of coastal management practitioners. Moreover, they both benefit from significant institutional and political support. As discussed below, the Great South Bay planning effort came about through a recently-passed New York

[14] Other site-specific coastal EBM initiatives outside the northeastern U.S. include the Humboldt Bay Ecosystem-Based Management Project (groups.ucanr.org/HumboldtBayEBM/). In addition to my general search for coastal EBM initiatives, I examined in greater detail the coastal management programs in the coastal northeast (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey). In 2006 Maine concluded two pilot EBM studies in Taunton and Muscongus Bays (www.maine.gov/) but little information was readily available. The current Massachusetts Ocean Plan (www.mass.gov) was not considered because it does not include coastal lands. Rhode Island has developed several SAMPs (see below); I've chosen the Greenwich Bay SAMP partly because it is the one that most explicitly addresses EBM. No other site-specific coastal EBM programs were identified. See below for further discussion.

State law coupled with support from the governor's office, and is overseen by a new interagency council (e.g. New York Ocean and Great Lakes Ecosystem Conservation Council, 2007b) (see Chapter 3 for further discussion); such political leadership for environmental initiatives is arguably uncommon. In the case of the Greenwich Bay planning effort as discussed below, Rhode Island is nationally recognized as a leader in SAMP development (Schwarz & Allard Cox, 2006) and is one of few, if any, coastal management programs to adopt SAMPs into law as regulatory tools as one of its strategies to implement EBM (Fugate, 2011) (see Chapter 3 for further discussion). Given these circumstances, plus the relative absence of EBM initiatives in other locations, these planning efforts could be exemplary: practitioners involved in these initiatives may be more likely to have more fully-developed mental models of EBM and stronger networks of coastal management practitioners through which to collaborate. It was thought that if this proved to be the case, then study results would provide useful guidance for other regions seeking to improve practitioners' capacity to implement EBM. If this proved not to be the case, then this study would provide insight into what is not working, so as to improve future efforts to implement EBM.

4.3 The Mental Models Approach

4.3.1 What are Mental Models?

The first component of this study involved examining the mental models of key coastal management practitioners to understand how they conceptualize the coastal ecosystems they are managing. This section includes a discussion of the concept of mental models and different methods of analyzing these models, as well as a discussion of the reference coastal ecosystem-based management model, which has been designed for this study and which provides a framework for this study's investigation of coastal management practitioners' mental models of coastal ecosystem-based management.

A mental model is an individual's internal cognitive representation of a real-world or hypothetical domain, problem, or phenomenon. Individuals piece together fragmented information and experiences to construct models through which to understand the world and make decisions (Gentner & Stevens, 1983; Jones, Ross, Lynam, Perez, & Leitch, 2011). Understanding these models can enable the development of more effective communication and decision-making (Morgan, et al., 2002; see also Thompson, 2004). The concept of mental models was initially suggested by psychologist Kenneth Craik (1943)and further refined by psychologist P.N. Johnson-Laird (1983), and has been applied as a means of exploring human understanding of various problems and phenomena across a range of disciplines (e.g. Gentner & Stevens, 1983). Mental models are sometimes discussed within the context of cultural models, a concept which emerges from the field of cognitive anthropology to characterized widely shared, "presupposed, taken-for-granted" models (Holland & Quinn, 1987, p. 4). More recently, mental models have been used in natural resources management to understand how individuals think about and make decisions about environmental resources and problems (e.g. Jones, et al., 2011).[15]

Mental models analysis has been used to provide insight into a variety of environmental management questions and problems. Hukkinen (1998)conducted a series of case studies of environmental decision-makers in locations around the world, examining both their mental models and the formal institutions within which they work. He noted that

[15] At the time of this writing, *Ecology and Society* journal is developing an in-progress edition entirely focused on mental models, entitled "Mental models in human-environment interactions: Theory, policy implications, and methodological explorations"; see http://www.ecologyandsociety.org/issues/view.php?sf=49.

environmental decision-makers deal with complex problems, and that not even the best science can support decisions because of scientific uncertainty and differing expert opinions; for this reason, decision-makers construct mental models to make sense of complexity and uncertainty, and use these models as the basis for making decisions. He further notes that there is a feedback loop such that institutional rules shapes decision-makers' mental models, and vice versa (Hukkinen, 1998). Morgan et al. (2002) evaluated mental models to improve risk communication, and Zaksek and Arvai (2004) replicated this approach in a study of wildfire risk and management. Thompson (2004, 2005) incorporated mental models into two studies, one analyzing barriers to environmentally sensitive land management, and the second showing how decision-makers' incomplete mental models of coastal hazards can lead to potentially problematic hazard mitigation decisions. Kolkman et al. (2005) presented mental models analysis as a tool to understand and improve integrated water management decision-making. Olsson et al. (2008) noted how a change in mental models was necessary for applying an adaptive management approach. Mathevet et al. (2011) studied stakeholders' mental models of water management, and Stone-Jovicich et al. (2011) studied mental models of water across social groups, both with the goals of helping improve water resource management and related participatory processes.

Other scholars have considered the connection between ecosystem-based management and individuals' mental models or related concepts. Glaser (2006) explored how the social dimensions of EBM are related to human's mental models, also described as "mind maps," of humans' relationship to the natural world; this study described eco-centric, anthropocentric, and complex systems models of human-nature relations and concluded that complex systems approaches are most effective for operationalizing the social dimensions of EBM. In a case study of a Massachusetts ecosystem-based ocean planning effort, DeLauer

(2009) examined marine EBM through a constructive developmental framework. In her study she acknowledged the "mental demands" of an EBM approach on decision-makers and their capacity to meet these demands, given the complex, multi-dimensional nature of coastal ecosystems (2009, p. 12). DeLauer (2009, p. 26) interviewed decision-makers involved in this effort and then drew upon constructive developmental theory from the discipline of developmental psychology to analyze the cognitive, interpersonal, and intrapersonal aspects of decision-makers' "mindsets." [16]

Coastal management practitioners have mental models of coastal ecosystems. To effectively develop and implement ecosystem-based management plans, coastal management practitioners should theoretically have well-developed mental models of all of the uses, interactions, and dynamics characterizing coastal ecosystems. In other words, they should recognize the numerous ecological, human, and governance elements of an ecosystem, as well as the myriad interactions between these elements, as discussed in Chapter 2. However, depending on their background, academic training, experience, and other factors, individual practitioners may have more- or less-fully developed mental models of EBM and its application to the coastal zone. For example, a municipal planner may have little awareness of the way an individual coastal land use may degrade coastal habitat and water quality. By contrast, a state fisheries scientist may not recognize how a new, restrictive fisheries regulation may have unintended impacts on the economies of coastal communities. In reality, all mental models are limited; individuals may have more- or less-fully developed mental models, or they may have mental models which are more developed in certain areas due to their background, training, or job responsibilities. As noted by Jones et al. (2011, p. 46), "Because of cognitive

[16] DeLauer does not use the term "mental models," but the component of her study that explores human cognition and EBM is very relevant to this study.

limitations, it is neither possible nor desirable to represent [in a mental model] every detail that may be found in reality. Aspects that are represented are influenced by a person's goals and motives for constructing the mental model as well as their background knowledge or existing knowledge structures." These mental models of coastal EBM arguably shape or even limit practitioners' ability to develop coastal EBM plans: coastal management practitioners with less fully-developed mental models of coastal EBM may have less capacity to develop effective coastal EBM plans; by contrast, practitioners with more fully-developed mental models may be better equipped to apply EBM to the coastal zone.

4.3.2 Approaches to Analyzing Mental Models

Mental models analysis may be conducted several ways. Some scholars have focused on cognitive mapping approaches in which participants are directly asked to explain, draw, or arrange their mental model using cards or other props (Jones, et al., 2011; Kearney & Kaplan, 1997); others seek to elicit the individual's mental model by conducting an interview and then extracting the model from the interview text (Jones, et al., 2011; Morgan, et al., 2002). This study employs the latter approach and follows the methodology laid out by Morgan et al. (2002). According to Morgan et al. (2002), the mental models methodology comprises several steps: (1) developing an "expert model"; (2) conducting mental models interviews; (3) coding and analyzing the interview transcripts; and (4) evaluating the gaps between the expert model and the mental models of the actual coastal management practitioners. This study incorporated this complete methodology with a focus on step #4, evaluating the gaps between the "expert model" and practitioners' mental models. In this study, the "expert model" is described instead as a "reference coastal EBM model," or simply "reference model," as it seemed clear that no one individual could be truly expert in all of the facets of coastal ecosystem-based management.

4.3.3 The Reference Coastal Ecosystem-Based Management Model

Morgan et al.'s (2002) methodology indicates that the "expert model" (here described as the reference coastal EBM model) be developed first. They describe this model as a summary and representation of the best available scientific knowledge of a given issue. This model is represented as an influence diagram, which Morgan et al. (2002, p. 20) explain as "a directed network drawn from decision theory, which allows representing and interpreting the knowledge of experts from diverse disciplines." In other words, the influence diagram graphically illustrates what a coastal manager should know and take into consideration to apply an ecosystem-based management approach in the coastal zone. In this diagram, nodes represent concepts or ideas, sub-nodes represent concepts or ideas supporting the main nodes, and arrows represent influences that explain the relationship between the different concepts or ideas (Morgan, et al., 2002). For this study, the reference coastal EBM model reflects the many factors that must be considered when applying an ecosystem-based management approach to a coastal region.

To develop the reference coastal EBM model, an extensive review of the ecosystem-based management literature was conducted to identify key principles or components which should be included in the model. This resulted in the identification of overarching EBM principles, as well as the categories used by Arkema et al. (2006) to organize these principles (see Chapter 2 for detailed discussion). The three EBM areas of focus – Ecological, Human Uses, and Governance – outlined and discussed in Chapter 2 – form the basis of the reference coastal EBM model; see Figure 3 below.

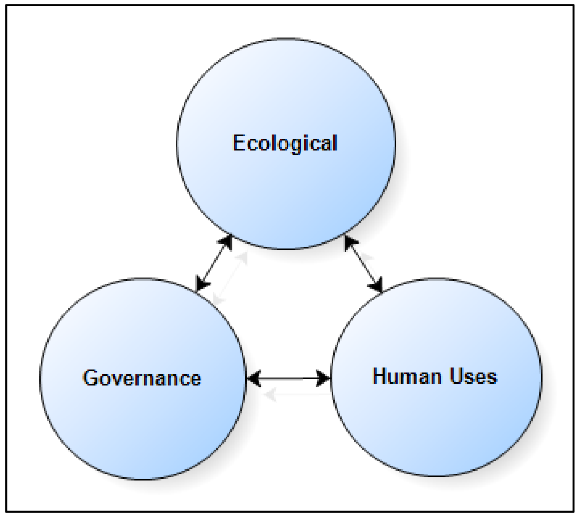

Figure 3. The three areas of focus of coastal ecosystem-based management

The key EBM principles from the literature, as discussed in Chapter 2, were then reviewed to determine how best to incorporate these into an applied coastal EBM model that is (a) focused on the development of an EBM plan, not on implementation over a period of time, and (b) concrete and specific enough to be relevant to coastal management practitioners working on real plans in real places. To address this problem, the overarching EBM principles were first reviewed to focus only on those relevant to plan development, not implementation.[17] This meant setting aside consideration of scientific monitoring and adaptive management, both of which would be addressed over time through plan implementation.[18] The remaining principles to be applied through plan development are shown below in Table 3.

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[17] This study does not include an evaluation of plan content. As noted in Chapter 2, scholars such as Brody (2003a, 2003b, 2008) have evaluated EBM plans by outlining a set of criteria with which to evaluate such plans. Such studies provide insight into what planners and scholars consider to be the ideal EBM plan.

[18] While adaptive management or monitoring could be included as goals and objectives in a plan, they would only become meaningful through implementation over time, and so were not considered here.

Table 3. EBM principles referenced in the Reference Coastal EBM Model

Area of Focus	**EBM Principle** (Arkema et al. 2006, Grumbine 1994)[19]	**How principle is addressed in Reference Coastal EBM Model**
Ecological	Ecological integrity/ecological health	Inclusion of ecosystem components as well as human activities that can affect their integrity/heath
	Complex systems: linkages and connections	Inclusion of linkages and connections between nodes in model
	Scientific data and monitoring	Scientific data: considered as an overlay to the entire model *Monitoring: NOT addressed (plan implementation, not development)*
	Temporal and spatial scales and boundaries	Spatial scales/boundaries: inclusion of upland and in-water components of ecosystem Temporal scales: considered as an overlay to the entire model
Human Uses	Humans as part of the ecosystem	Inclusion of human use and governance components
	Ecosystem services/valuation	Inclusion of human uses of ecosystem services
	Economic considerations	Inclusion of economic uses
	Social and cultural values	Inclusion of human uses and governance, which are reflections of values
Governance	Stakeholders	Inclusion of stakeholders in model; also addressed in network analysis component
	Adaptive management	*NOT addressed (plan implementation, not development)*
	Interdisciplinary approach	Inclusion of multiple subject areas/disciplines in model; also addressed in network analysis component
	Cooperation/ collaboration	Inclusion of agencies, organizations, and stakeholders; also addressed in network analysis component

The researcher then sought to identify concrete, applied, real-world ways to represent each principle in the model (see Table 3). This proved to be difficult to do; while these principles and the extensive body of literature on EBM provides a strong theoretical background for the concept of ecosystem-based management and makes a strong argument

[19] These EBM principles and these and other papers on EBM are discussed in detail in Chapter 2.

for its application in a variety of settings, they do not provide much insight into some basic, practical questions about the application of this approach: What are the elements of a coastal ecosystem? What are the elements of an EBM plan? Who, exactly, needs to be involved in the development of the plan? The Environmental Law Institute's *Ocean and Coastal Ecosystem-Based Management Implementation Handbook* (2009) is somewhat more applied and provides some guidance on these specific questions, and identifies six ocean and coastal "sectors" which require consideration: living resources; habitat; water quality and quantity; land use; ocean industries; and human health. The first three of these sectors were adopted as the key elements of the Ecological category of coastal EBM. Land use and ocean industries were also adopted as elements of the Human Uses category, though ocean industries was subdivided into two different categories – recreation and commercial (which includes fisheries and other industries) – as the term "ocean industries" does not suggest inclusion of recreational activities. "Human health" was not adopted as this is not a key concept that emerges from the EBM literature reviewed for this study (see Chapter 2).[20] This handbook does not identify governance "sectors," though it does devote considerable discussion to governance concerns, primarily government agencies and laws and regulations, as well as the importance of stakeholder engagement. For these reasons, I included two elements, "government" and "stakeholders," as elements of the Governance category. Figure 4 shows a somewhat expanded coastal EBM model reflecting these elements.

[20] Human health concerns were also overwhelmingly not discussed by interview subjects; only one participant who was affiliated with a state health agency raised such concerns.

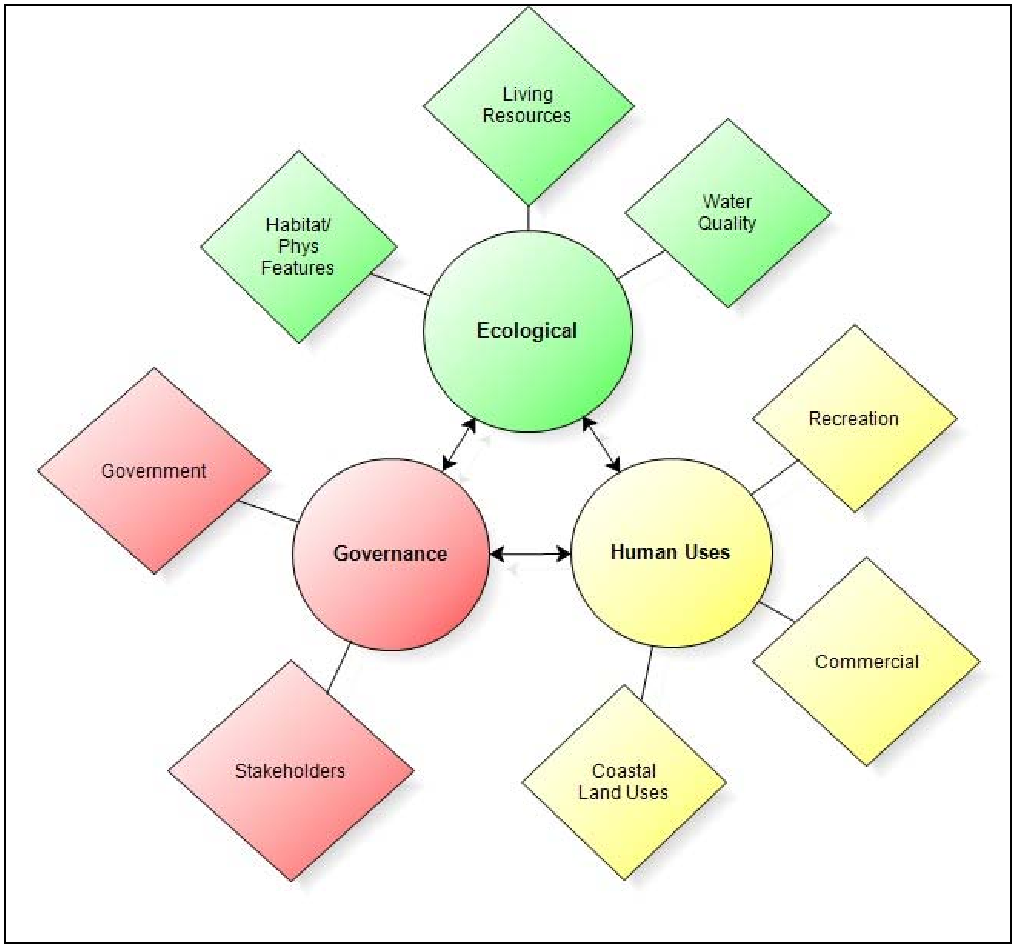

Figure 4. Basic structure of Reference Coastal EBM Model

Last, to flesh out the remainder of the coastal EBM model, the researcher reviewed available documents describing the actual conditions and governance contexts of the two coastal estuarine ecosystems that are the focus of this study: Greenwich Bay, RI and the Great South Bay, NY (see Chapter 3 for detailed discussion). The intent was to include sub-nodes representing the specific Ecological, Human Use and Governance elements of these ecosystems. For the ecological component of the model, this involved identifying the key living resources, habitat types, and water quality considerations; for the human uses component, this involved identifying the key upland and in-water uses; and for the governance component, this involved identifying the levels of government and stakeholder groups who should be involved in developing a coastal EBM plan. In all cases, the goal was to include all of the appropriate categories of resources and activities (e.g. shellfish, recreation), and to leave out any which obviously don't apply to these ecosystems (e.g. there is no commercial shipping in either of these estuaries). Figure 5 shows the resultant Reference Coastal EBM Model. A tabular list of the nodes in the model, which formed the code book for analyzing interviews, is included in the appendix.

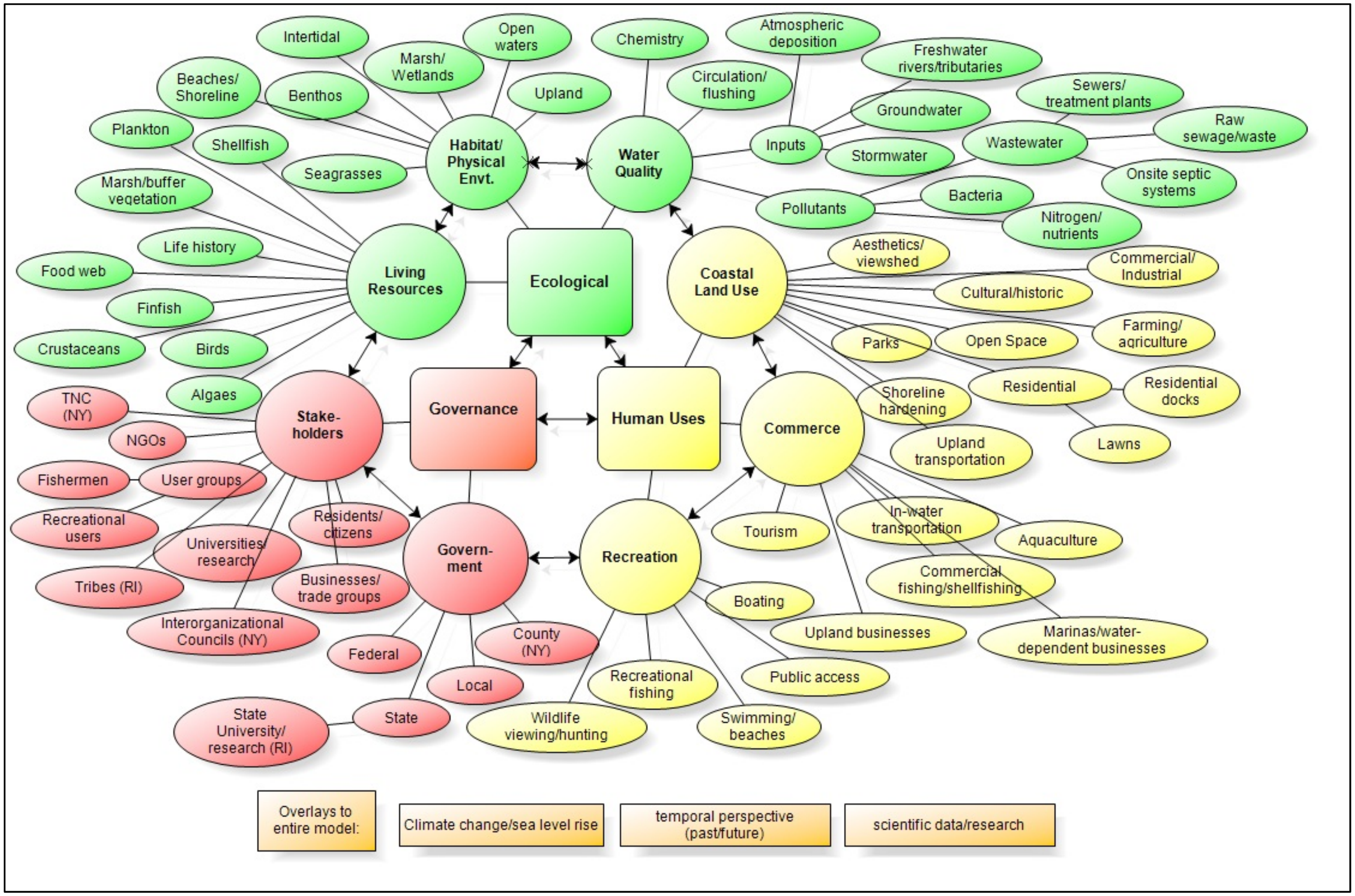

Figure 5. Reference coastal EBM model

One of the challenges in creating this model was that some important concepts did not fit into this paradigm of the three areas of focus, as they are either overarching considerations and/or could be considered with regard to each and every node in the model. In this sense they can be considered overlays to the model. These concepts are climate change/sea level rise; temporal considerations (both past and future); and scientific data/research. These are noted along the bottom of the model and are listed in the above table as “Overlays.”

It should be noted that there are some elements of the model that needed to be modified slightly for each of the two case studies; these are all under “Governance” and are clearly noted with references to RI or NY in parentheses. Specifically, in the Rhode Island case, federally-recognized Indian tribes had an interest in the planning area and were involved in the Greenwich Bay SAMP planning effort, and so needed to be acknowledged as a stakeholder; and "universities/research” in RI referred entirely to the state public university, the University of Rhode Island, and its role as contractor to the state coastal management agency, and therefore was included in the model as a subset of state government, not as a stakeholder (see Chapter 3 for further discussion). In the New York case, county government was included (there are no functional county governments in RI); in addition, the term “intergovernmental councils” was included as there are numerous Long Island-based inter-organizational councils of stakeholders, such as the South Shore Estuary Reserve Council, that don’t exist in RI and who were relevant to the Great South Bay EBM planning effort. Further, a special node needed to be created for The Nature Conservancy on Long Island, as they played an unusual role in this case as a paid contractor to the state coastal agency (see Chapter 3 for further discussion).

An additional challenge in creating this model was to reflect the linkages among ecosystem components; such linkages are emphasized in much of the EBM literature (see

Chapter 2). Arguably, if a truly ecosystem-based approach were applied, all of the nodes and sub-nodes in the model would be connected to all of the other nodes in some manner, whether directly or indirectly. Figure 6 below provides just one example of the ways in which Ecological, Governance, and Human Use could be linked together. Because illustrating each and every such linkage on the EBM model would make it unintelligible, the linkages among the different elements of the model are implied through the connections illustrated between the main areas of focus and sub-areas of focus.[21]

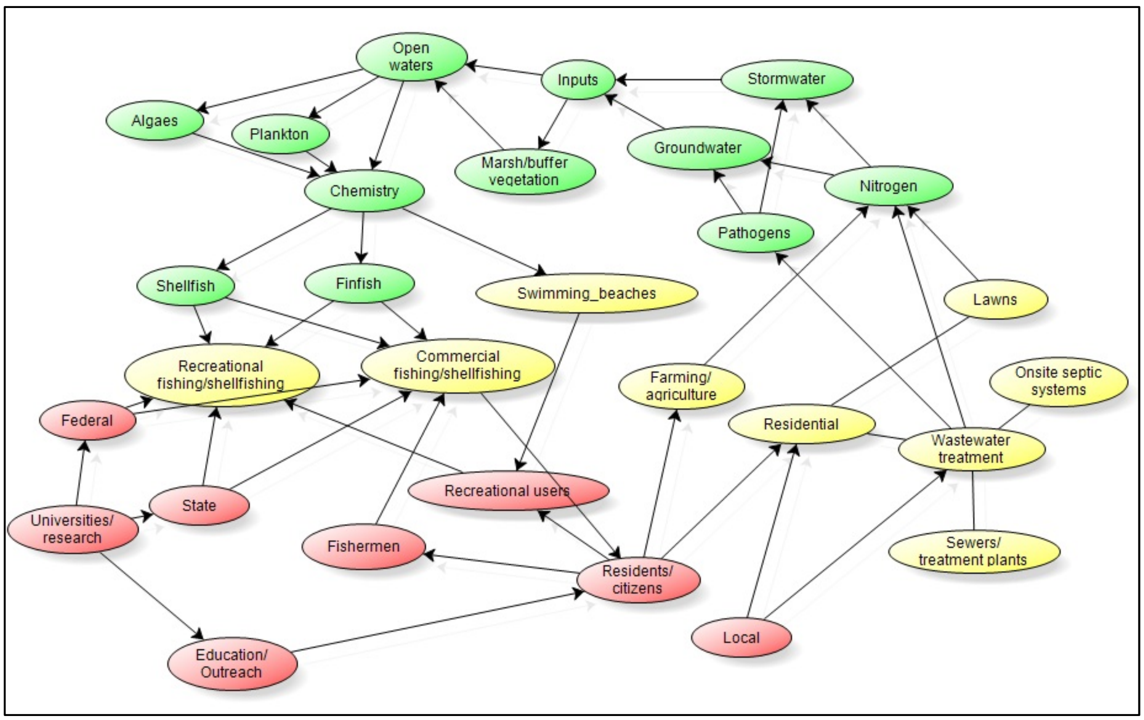

Figure 6. Example of linkages implied in Reference Coastal EBM Model

It is important to emphasize that there is unlikely to be any one individual whose mental model of coastal ecosystem-based management would fully resemble the coastal EBM model. It is difficult to imagine any one individual having a sufficiently broad *and* deep mental

[21] While practitioners' understanding of the linkages between nodes was not explicitly analyzed in this study, recognition of these linkages is an important aspect of the EBM approach.

model encompassing the myriad environmental, economic, social, and political/institutional aspects of a coastal ecosystem that are outlined in the reference model. It may be that the more fully-developed mental models are broad, in that they include all of the main nodes, or main concepts and ideas, but not all of the sub-nodes, or supporting ideas and information that indicates depth of knowledge in a particular subject.

4.3.4 Conducting Mental Models Interviews

Data collected for mental models analysis were collected through mental models interviews with coastal management practitioners engaged in the two cases (see below for detailed discussion of the selection of study participants). Mental models interviews are open-ended in nature and are designed to elicit the interview subject's way of thinking about a given subject with minimal prompting or guidance from the interviewer (Morgan, et al., 2002). Interviews conducted for this study were shaped by an interview guide which followed what Morgan et al. (2002) describe as a "funnel design," starting very generally and proceeding to increasingly focused questions or prompts. To guide these interviews, the researcher developed an interview guide and an accompanying interview matrix of topics and ideas (see Appendices). The interview guide was designed to elicit discussion about all facets of the coastal EBM expert model, and the matrix was designed to enable the researcher to keep track of whether the participant had volunteered an idea or whether it had been suggested by the researcher.

The interview guide (see Appendices) was designed in two parts. Part I was designed to be participant-led and started with two broad opening questions: (1) "*Tell me about your role in the Greenwich Bay SAMP [Great South Bay EBM Plan]*" and (2) "*Tell me about the main reasons for doing a Greenwich Bay SAMP [Great South Bay EBM Plan]*." This section of the interview guide also included a series of generic follow-up prompts, such as "Tell me more about [a subject the participant had mentioned]." The objective of these initial questions and prompts was to get the participant talking, and keep discussion going, without the interviewer introducing new concepts or topics. Part II of the interview guide was designed to be interviewer-led. This section included more specific questions or prompts, such as *"Tell me about recreational activities and how they were addressed in the Greenwich Bay SAMP [Great South Bay EBM Plan]"*. The purpose of these follow-up prompts was to draw the participant's attention to other topics included in the interview guide that had not yet been raised, and so these topic-specific prompts were only used as needed; the interviewer recorded when prompts were needed, so as to analyze the participants' responses accordingly. Part II also included five pointed closing questions which were designed to directly address how the participant defined EBM, who they thought was important to the process, and what they had learned through participating in this planning effort.

The interview matrix (see Appendices) was designed to accompany the interview guide. It included a list of the key topic and sub-topic areas represented in the expert model, and enabled the researcher to keep track of whether the participant had voluntarily mentioned a topic or whether he/she had been prompted. Topics which were covered in each interview encompassed the three spheres of EBM (ecological, governance, and human uses), and key subtopics of those areas, as described in Chapter 2.

Prior to conducting the mental models interviews, the interview instrument (see Appendices) was reviewed with numerous academic colleagues and then tested on three coastal management practitioners engaged in similar planning efforts (but not the ones being studied).[22] Testing allowed for significant fine-tuning of the interview instrument and enabled the researcher to address the clarity, flow, and overall length of the interview such that the final instrument flowed much better and captured the participants' mental models with no unnecessary redirection by the interviewer. The final interview instrument was designed for a 30-minute to 1-hour in-person or phone interview. All interviews were administered between March and May 2011 and took between 25 and 90 minutes (averaging about 45 minutes). Interviews took place in person except in just a few cases where an in-person interview was not practical, and all were recorded for note-taking and data analysis purposes. In accordance with the university's Institutional Review Board protocol for research on human subjects, informed consent was received from all participants prior to their participation in this study (see Appendices). See below for detailed discussion of selection of study participants.

4.4 The Social Network Analysis Approach

4.4.1 Social Network Analysis Concepts and Methods

The second component of this study involved analyzing collaboration between coastal management practitioners through the use of social network analysis methods. Social network analysis is a suite of methods of systematically analyzing and mapping relationships and interactions between individuals, groups, or organizations, and can be used as a method of analyzing collaborative processes. Some have identified network analysis as a tool to analyze and enhance EBM initiatives (e.g. Vance-Borland & Holley, 2009); see further discussion of networks and their use in understanding collaboration in Chapter 2. Formal network analysis involves quantitative analysis and mapping of interactions between individuals and organizations. In social network analysis, individuals or organizations are referred to as *actors*

[22] Two had worked on the Rhode Island Ocean Special Area Management Plan; one had worked on the Rhode Island Metro Bay Special Area Management Plan.

(or nodes) and the connections between those actors are referred to as *ties* (or relations) (Hanneman & Riddle, 2005). For the purposes of this study, only "actors" will be used to describe people, so as to avoid confusion with the discussion of nodes as part of mental models analysis (discussed below). Network data differ from conventional sociological data in that conventional data typically focus on actors' attributes, whereas network data focus on actors' ties; the purpose of social network analysis is to analyze actors' ties as well as the overall structure of the network (Hanneman & Riddle, 2005). Basic one-mode (actor-to-actor) network datasets resemble a matrix in which both row and column headings are the names of individuals, and the presence or absence of connections between those individuals are identified as ones and zeros in the body of the matrix (Hanneman & Riddle, 2005); see Table 4.

Table 4. Example of network dataset in matrix form (data are fictional).

	Thompson	Burroughs	Payne
Thompson	0	1	1
Burroughs	1	0	0
Payne	1	1	0

As illustrated in this table, ties between actors can be binary (presence/absence); alternatively, they can be valued (i.e. a rating or ranking of importance). Ties are also directed – as illustrated in the above figure, Payne indicates that he works with Burroughs, but Burroughs does not indicate that he works with Payne. Attribute data for actors in a network may also be recorded and incorporated into some types of analysis and/or visualized in a network graph. Given the unique qualities of network data, specialized software programs such as Ucinet (Borgatti, Everett, & Freeman, 2002) and Netdraw (Borgatti, 2009) are required in order to analyze and visualize these data (Scott, 1991; Wasserman & Faust, 1994).

The raw data needed to conduct social network analysis can be obtained by administering a relatively simple survey or interview in which respondents are asked to identify actors with whom they have a certain type of relationship (i.e. work together; socialize; exchange information or advice). In some cases, social network analysis is conducted on cases in which the network has a clear boundary and the names of those in the network are already known (e.g. a study of those in a classroom or office) (Wasserman & Faust, 1994). In many such cases, a survey may include a list of names and may simply ask respondents to identify and/or rank people on this list (e.g. Ernstson, et al., 2008). Alternatively, a survey or instrument may ask respondents to recall those with whom they have a given type of relationship (e.g.Isaac, et al., 2007).

Many types of social network analysis require that all actors in the network be surveyed as, by definition, a full network cannot be assessed based on a random sample of actors. However, this assumes that the network has a clearly-defined boundary and that it is very clear who is in the network (Hanneman & Riddle, 2005). Given the collaborative nature of the Greenwich Bay SAMP and the Great South Bay EBM Plan processes, the researcher sought to identify key actors in each effort by employing a modified snowball sampling strategy, modified from Hanneman and Riddle (2005), to bound each network and to identify study participants who had been actively and directly involved in these planning efforts. See below for details on this strategy and how it was employed to select study participants.

4.4.2 Social Network Analysis Survey

Because of the collaborative nature of the two planning processes and because the researcher wanted to allow respondents maximum flexibility and allow for unexpected findings, this study employed a more open-ended survey approach in which respondents were asked to identify names of people with whom they had worked. Two separate surveys were developed – one for the Greenwich Bay SAMP and one for the Great South Bay EBM Plan – but they both follow the same basic format to allow for comparability. The survey instrument was divided into several sections. Part I included a series of basic questions about the respondent's work and educational background. In Part II, the respondent was asked to *"tell us about the key people you worked with during the development of the Greenwich Bay SAMP (2002-2005) [Great South Bay EBM Plan (2007 – present)]."* The respondent was then directed to list up to 15 names of individuals, and to also indicate their affiliation and expertise.[23] In Part III, respondents were asked additional questions about their network; this series of questions was designed to assess people who were particularly important with regard to various their network; this series of questions was designed to assess people who were particularly important with regard to various types of issues: for example, one question was "*Who are the people you relied on the most to help you with matters related to natural resources or ecology (e.g. water quality, birds, other)*?" In Part IV, respondents were asked about people they had worked with on more recent iterations of their respective planning efforts. For the Greenwich Bay SAMP, this was current/ongoing implementation of the SAMP. For the Great South Bay EBM Plan, this was current plans to amend the New York State coastal management program to address some EBM-related goals for the Great South Bay and other Long Island south shore estuaries. An additional section was also added to the Great South Bay EBM Plan survey to allow respondents to indicate any other Great South Bay EBM-related projects they had worked on, as there have been several other such activities; see Chapter 3 for further discussion. In the final part, respondents were allowed to add comments. See the Appendices for a list of survey questions.

[23] Some reported more names than this by writing them in elsewhere on the survey.

Prior to administering the survey, a draft version of the instrument was reviewed with numerous academic colleagues and then tested on eight coastal management practitioners engaged in a similar planning effort (but not the one being studied).[24] This testing allowed for a significant amount of fine-tuning and a chance to make a series of changes to improve the survey's length, clarity, and flow. The final survey, which took approximately 15 minutes to complete, was preceded by an introductory informed consent statement which included a reminder that all input was confidential and that no names would be included in the final study. It was designed and administered through the use of Survey Monkey, a secure web-based application that enabled the researcher to email study participants the link so that they could complete the survey online. A hard copy of the survey was prepared as an alternative for those who preferred hard copy format. All surveys were administered between March and May 2011. In nearly all cases, study participants first completed a survey, and then participated in a mental models interview. See below for detailed discussion of selection of study participants and administration of surveys and interviews.

4.5 Selecting Study Participants

As mentioned above, study participants for both case studies were identified through a modified snowball sampling approach. Traditionally, snowball sampling is done by identifying initial contacts and then asking them to identify other contacts (Babbie, 2001). In this case, because survey data indicated individuals involved in the project, survey data were evaluated systematically to identify additional prospective study participants (see Figure 7). In both cases, an initial list of study respondents was assembled through the input of key informants who were affiliated with one of the lead agencies or organizations and who had been a

[24] Seven surveys were tested on coastal management practitioners who worked on the Rhode Island Ocean Special Area Management Plan; one was tested on a practitioner who worked on the Rhode Island Metro Bay Special Area Management Plan.

member of the core team who had led the planning process. These initial prospective study participants were contacted by an initial email and with follow-up emails or phone calls, as needed (see Appendix for a copy of the initial email invitation to study participants).

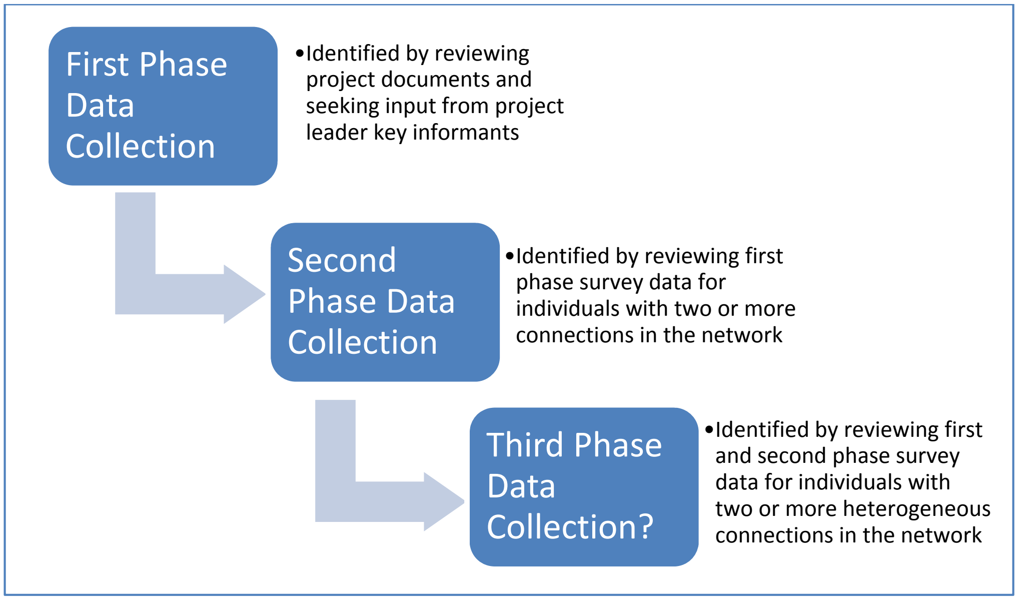

Figure 7. Method used for identifying prospective study participants.

Then, a second selection of prospective study participants was made based on an evaluation of the initial participants' responses to survey Part II, in which participants responded to the instructions, "*Please tell us about the key people you worked with during the development of the Greenwich Bay SAMP (2002-2005) [or Great South Bay EBM Plan (2007-present)]*." These data were aggregated into an initial network dataset. Using the software programs Ucinet (Borgatti, et al., 2002) and Netdraw (Borgatti, 2009), the author evaluated these initial network datasets for each case to determine which individuals, other than the initial participants, had two or more connections in their network. Whereas Hanneman and Riddle (2005) recommend surveying each additional person mentioned by initial study respondents, the researcher chose to focus on those with two or more connections because anecdotal evidence suggested that some actors who were being named might be false positives – i.e. they might have been named because they had worked with the study participants on other similar projects around the same time, but not on the case in question. The "two or more" rule, which is adapted from a similar strategy used by Ernstson et al (2008), provided a way to triangulate participation, prioritize study participants to pursue, and ultimately to create a boundary for the network based on corroboration. It also provided a practical way to prioritize additional study participants given the constraints of time and resources. See discussion and figures below for details on participants in each case.

Because anecdotal evidence from the first phase of data collection suggested that some of these prospective second phase study participants – even those with two or more connections - might still be false positives, initial email inquiries were sent to these individuals to ask them about their role in their respective cases: "*Did you consider yourself to be actively and directly involved in the development of the Greenwich SAMP [Great South Bay EBM Plan]? For example, did you attend numerous meetings (and if so, approximately how many)? And did you review and comment on, or contribute to, SAMP (GSB EBM Plan) documents?*" (See Appendices for a sample email query.)

Responses to these inquiries were recorded and used to help prioritize second phase data collection. Those who responded and indicated they had been "actively and directly involved" in their case were asked to complete a survey and participate in an interview. Those who responded and indicated they had only been minimally or tangentially involved were only asked to complete a survey. Examples of these individuals include those who indicated they had evaluated or commented on just one excerpt of a document, or those who indicated they had been working on scientific research that had informed the development of one part of the plan. Follow-up attempts were made by email and/or phone, as needed, for all individuals who did not respond to the initial inquiry and/or the invitation to participate in the study. See discussion and figures below for details on participants in each case.

At the conclusion of this second phase of data collection, new survey data were aggregated with the previously collected data into a revised network dataset and evaluated using Ucinet and Netdraw, as discussed above, to determine additional individuals who had two or more connections in the network. These individuals were then evaluated both qualitatively and quantitatively for a possible third phase of data collection. Their roles in their respective cases were evaluated qualitatively, based on input from study participants, to determine the nature of their involvement in their respective cases, and quantitatively, based on their connections in the network. Individuals were eliminated from consideration if: (1) qualitative input from other interview subjects clarified that they had minimal or no direct involvement or influence in the development of the ecosystem-based management plan in question, *and* (2) quantitative network data indicated they were connected solely with those of the same or similar affiliation (i.e. working in the same organization or within an isolated homogeneous subgroup). These rules were applied because this study was focused on identifying the core members of each collaborative planning network. In addition, the primary purpose of this study, as outlined in Chapter 1, was to understand how collaboration across jurisdictions and disciplines shapes individuals' mental models of coastal ecosystems. It was assumed that those who clearly had minimal and/or homogeneous connections in the network were not actively collaborating across jurisdictions and disciplines to influence other individuals' mental models. In the case of "isolates" – those with no connections in the network – it is clear that the actor is not influencing any other actors' mental models of coastal ecosystems. In the case of "pendants" - actors with just one connection in the network – it is also clear that this actor's thinking about coastal ecosystems is being filtered through only one other actor and is therefore not influencing other actors' mental models. Finally, in the case of those who had two connections within a homogeneous subgroup, it was clear that these actors were not actively collaborating across jurisdictions and disciplines and were therefore not influencing others' mental models.

In Case Study A, the Greenwich Bay SAMP, an initial list of prospective participants was assembled through the input of three key informants, two from the URI Coastal Resources Center/RI Sea Grant and one from the RI Coastal Resources Management Council, all of whom had been members of the core Greenwich Bay SAMP team. This resulted in a list of 21 prospective study participants. In only one case, one individual indicated they weren't really involved, and redirected the researcher to another individual within the same organization. Of these prospective study participants, 20 were available to complete a survey, and 19 were available to be interviewed. These survey responses were evaluated as described above, with the goal of identifying individuals with two or more connections in the network; this resulted in the selection of 19 additional prospective study participants. Of these, 17 responded to email inquiries. 14 indicated they had been actively involved, two indicated they had been only peripherally involved, and one indicated she had been uninvolved. All those who indicated some level of involvement were invited to participate in this study by completing a survey, and those who indicated they had been actively involved were invited to participate in a follow-up interview. As a result of this, 13 additional study participants completed surveys and ten participated in interviews. Only two individuals never responded to any inquiry at all, and three of the 17 individuals who responded to initial inquiries were invited to participate and did not do so.

Upon completion of this second phase of data collection, these data were aggregated and analyzed to identify additional individuals with two or more connections in the network.

Through this method, 12 additional names were identified as prospective study participants. However, all 12 names were eliminated based on application of the rules described above: two were deceased, one was known to have been involved only following the SAMP's completion, and the remaining nine were only connected to others in the network of the same or similar affiliation, and therefore had not been actively collaborating across jurisdictions and/or disciplines.[25] In total, 33 individuals from 18 different agencies, organizations, or programs participated in this study; 33 completed surveys and 29 participated in interviews. This represented an 85% response rate for surveys and an 81% response rate for interviews. Finally, before analyzing Greenwich Bay SAMP data, this dataset was reviewed to ensure inclusion only of individuals who had been directly involved in developing the Greenwich Bay SAMP. As a result, the input of one study participant who was both surveyed and interviewed was set aside, as this participant agreed to participate in the study but had only worked on the SAMP after it had been completed and adopted into law. Because of this, the final universe of study participants comprised 32 participants who completed surveys, and 28 who completed both surveys and interviews. Table 5 is a complete table summarizing the final universe of study participants whose input was analyzed for this study.

[25] An example of such a person would be someone who was support staff at a participant's organization – thus the participant worked occasionally with this person, but this person was not directly involved in the planning process.

Table 5. Final universe of study participants for case study A, Greenwich Bay SAMP

Category	Agency/Organization	Surveyed	Interviewed
Business operator/owner	Brewers Cove Marina	1	1
	RI Shellfishermen's Association	1	1
	Warwick Cove Marina	1	1
Citizen*	Brown University*	1	1
	Cedar Tree Point Association*	1	1
	Chepiwanoxet Neighborhood Association*	1	1
	Defenders of Greenwich Bay*	1	1
Environmental advocacy organization	Save the Bay	1	1
Federal govt.	Narragansett Bay Estuary Program (NBEP)	1	0
Local govt.	Town of East Greenwich	2	2
	Town of Warwick	2	2
	Warwick Sewer Authority	1	1
State govt.	RI Coastal Resources Management Council (CRMC)	8	6
	RI Department of Environmental Management (DEM)	2	2
	RI Department of Health (HEALTH)	1	1
	RI General Assembly	2	1
University – research	University of Rhode Island	2	2
University – outreach	URI Coastal Resources Center/ RI Sea Grant	3	3
	TOTAL	**32**	**28**

**Denotes affiliations of those who participated primarily as private citizens*

In Case Study B, the Great South Bay EBM Plan, an initial list of prospective participants was assembled through the input of two key informants, one from the New York State Department of State Division of Coastal Resources and one from the New York State Department of Environmental Conservation, both of whom had been members of the core team developing this plan. This resulted in a list of 13 prospective initial study participants. Of these prospective study participants, all 13 were available to complete a survey, and 12 participated in an interview.

These initial survey responses were evaluated as described above, to identify new individuals with two or more connections in the network; this resulted in the selection of four additional prospective study participants. Of these, four responded to initial email inquiries; three indicated they had been actively involved in the Great South Bay EBM Plan whereas one indicated he had been only peripherally involved. All four were invited to participate in this study by completing a survey, and the three who indicated they had been actively involved were invited to participate in a follow-up interview. As a result of this, four additional study participants completed surveys and three participated in interviews. Upon completion of the second phase of data collection, survey data were evaluated as described above to identify individuals with two or more connections in the network; through this, four additional names were identified as prospective study participants for a potential third round of data collection. However, all four names were eliminated based on application of the rules described above in that they were only connected to individuals with the same affiliation, and/or they were described by other study participants to have been only marginally involved in this case. In total, 17 individuals representing nine different agencies, organizations, or programs participated in this study; 17 completed surveys and 15 participated in interviews. This represented a 100% response rate for surveys and a 94% response rate for interviews.

As with the Greenwich Bay SAMP, before analyzing these data, data were reviewed to ensure inclusion only of individuals who had been involved in developing the Great South South Bay EBM Plan. Two individuals – a local government employee and a university researcher - who had been identified through the snowball sampling process and agreed to participate ultimately explained that they hadn’t directly worked on this plan. In addition, they reported no names on their survey, and no other individuals indicated they had worked with them. As a result, their survey and interview input was set aside and the final universe of study participants comprised 15 who completed surveys and 13 who completed both surveys and interviews. Table 6 summarizes the final universe of study participants whose input was analyzed for this study.

Table 6. Final universe of study participants for case study B, Great South Bay EBM Plan

Category	Agency/Organization	Surveyed	Interviewed
Environmental advocacy organization	Environmental Defense Fund	1	1
	Natural Resources Defense Council	1	1
	The Nature Conservancy - Long Island Chapter (TNC)	3	3
Local government	Town of Babylon	1	1
State government	New York State Department of Environmental Conservation (DEC)	3	2
	New York State Department of State Division of Coastal Resources (DOS)	4	3
	Long Island South Shore Estuary Reserve Program (SSER)	1	1
University	Stonybrook University	1	1
	TOTAL	**15**	**13**

Finally, for both cases, each participant was assigned a code such as “GB-11” (GB= Greenwich Bay; GSB=Great South Bay) in order to preserve their confidentiality. Individual participants will be referred to as such throughout this discussion.

4.6 Data Analysis: Mental Models

4.6.1 Overview

This section outlines the mental model analysis methods used to code, analyze, and interpret the interviews with coastal management practitioners. Table 7 presents a summary of the mental models terms and concepts that are explained in detail in this chapter. These methods were used to address research question 1: *What are the characteristics of practitioners' mental models of the coastal ecosystems for which they are planning?* Before beginning coding and analysis, mental models interviews were transcribed word-for-word using NVivo 8 (QSR International, 2010), a qualitative data analysis software program, with the assistance of Dragon Naturally Speaking (Nuance Communications, 2011) a voice recognition software program.

Table 7. Summary of key mental models terms and concepts used in this study

Reference coastal EBM model	Also described as simply the "reference model". Represents the best scientific knowledge or understanding of coastal EBM; adapted from Morgan et al. (2002)'s "expert model".
Areas of focus	Refers to the three key areas of the reference model: Ecological; Governance; and Human Uses.
Nodes	Refers to the concepts and sub-concepts that make up the reference model.
Mental model comprehensive-ness	A measure of the comprehensiveness of a practitioner's mental model of a coastal ecosystem, as determined by the presence or absence of reference model nodes in their interview transcript. Comprehensiveness is measured for each area of focus and then as a whole as a percentage based on the reference model. A practitioner's final comprehensiveness score, also expressed as a percentage, is an average of the scores for the three areas of focus. A perfectly comprehensive mental model would score 100%.
Mental model balance	A measure of the balance of a practitioner's mental model of a coastal ecosystem, as determined by the frequency with which each reference model node was brought up in their interview transcript. Balance is a measure of the degree to which the practitioner focused on each of the three areas of focus. It is measured for each area of focus as a percentage of the entire interview. A practitioner's total balance score is determined by calculating the difference between each of the three areas of focus scores and 0.333333; taking the absolute value of the difference; adding them together; and calculating the inverse. The result is expressed as a percentage, with 100% representing an equally balanced model.

4.6.2 Interview Coding

Interview transcripts were then coded using NVivo 8 software and rigorous qualitative data analysis coding methods. Coding is a method of working with qualitative data; codes are either descriptive or interpretive labels for topics of themes and are applied to units of text within a qualitative data source (Bazeley, 2007). In many cases coding employs a largely inductive approach, through which a coding system emerges as the researcher works through the data (Bazeley, 2007). As the purpose of this study was to understand how practitioners' mental models compared to the reference coastal EBM model (see above), coding was shaped almost entirely by the nodes comprising the reference model. First, a coding protocol was developed based on the reference coastal EBM model, whereby each node in the model became a code to be used in the coding process. For example, a study participant's reference to nitrogen would simply be coded as "nitrogen"; a reference to a state agency or regulation would be coded as "state government"; and so on.

Once an initial coding protocol was drafted, an exercise was conducted to test the coding procedure to ensure that it was consistent, comprehensive, and as objective as practicable. First, the researcher coded one particularly substantive interview, and recorded in a code book any case where coding required a judgment or a generalization; for example, references to commercial shellfishing were coded as both shellfish and commercial fishing, and references to boat discharge were coded as both pollutants (a sub-category of water quality) and recreational boating. These interviews and the draft code book were then shared with a second researcher who independently coded excerpts from that same interview. The results of these two independent coding processes were then compared and analyzed, and the code book was refined and improved to resolve any differences in interpretation or content that was being missed. This procedure was then repeated; the researcher coded a second substantive interview from the second case study, the second researcher independently coded these excerpts, and then the results were compared and reviewed. Please see Appendix for a copy of the code book.

Once the code book had been tested, the researcher proceeded with coding the entirety of each interview. The researcher's approach to coding tended toward the "fracturing" or "slicing" approach described by Bazeley (2007), in which phrases and sentences were broken down into their component parts with each part being assigned a separate code. In some cases, content was assigned multiple codes - for example, a reference to shellfishermen was coded as shellfish (the living resource); commercial fishing (the human use); and commercial fishermen (the stakeholders). In other cases, a couple of sentences might be assigned one overarching node and also have several nodes assigned to individual phrases within text: for example, a municipal sewering initiative which was being discussed as a way to properly treat waste and mitigate water quality problems was coded as both local government and sewers/treatment plants (a sub-category of water quality). The code book was maintained throughout the process to keep track of any items requiring judgment, so that coding was consistent across all interviews. In addition, topics or concepts were coded each and every time they were raised, in order to facilitate the quantitative analysis described below.

While most of the interview coding corresponded directly to the reference coastal EBM model, other content was coded for possible use in discussing findings. This included explicit discussion of the concept of ecosystem-based management itself; a description of any sort of intergovernmental relationship or exchange (i.e. between different state agencies, or between different levels of government); a topic that hadn't initially been identified in the coastal EBM model (i.e. education/outreach); or overarching topics that can be thought of as overlays to the entire reference model (i.e. climate change; historic perspective). Last, interviews were also coded to indicate which content had been prompted by a more specific follow-up interview question or prompt (see above).

4.6.3 Interview Analysis: Mental Model Comprehensiveness and Balance

While mental models have been widely studied, few rigorous mental model analytical methods were identified for this study that would provide for effective comparison between the practitioners' mental models. For this reason, an innovative method was developed to analyze, visualize, and compare participants' mental models based on the results of the coding process. The coding matrix query function in NVivo was used to export coding summaries for each of the interviews. For each respondent, these coding summaries indicated (1) presence/absence: whether a participant had identified each of the possible nodes, corresponding to each part of the reference model; and (2) number: the number of times a participant had brought up each of the nodes. The coding summaries also allowed for analysis of the proportion of each of these that had been prompted – that is, content raised by the participant only in response to a topic-specific question or prompt.

These data were then summarized within each of the three main areas of focus of the reference coastal EBM model- Ecological, Governance, and Human Uses - and were analyzed to investigate two aspects of practitioners' mental models: *comprehensiveness* and *balance*. Comprehensiveness and balance are important ways of understanding and comparing practitioners' mental models of coastal EBM because the literature describes EBM as an integrated, comprehensive approach that seeks to balance multiple uses and perspectives (e.g. Arkema, et al., 2006; Endter-Wada, Blahna, Krannich, & Brunson, 1998). This said, it is important to note that not all practitioners would be expected to have perfectly comprehensive, balanced mental models. Rather, these measures provide different ways of understanding and comparing different aspects of individuals' mental models. As described in

Chapter 2, some practitioners would be expected to have more comprehensive, balanced mental models than others. See below for further discussion.

The presence or absence of concepts that are part of the reference coastal EBM model provides insight into the comprehensiveness of practitioners' mental models. The number of times a concept was raised provides insight into the balance of practitioners' mental models – balance may reflect either a participant's problem orientation, or their focus on a discrete set of problems, or may reflect a bias toward topics that the practitioner believes are most important, or with which he or she is most familiar, or both. Information that was prompted – that is, nodes that were brought up only in response to a topic-specific question or prompt from the interviewer – may provide insight into topics that the participant acknowledges as valid, but that are either less familiar or less important.

To assess the comprehensiveness of practitioners' mental models, the presence/absence data were used. The number of concepts raised was compared with the number of concepts that had been identified in the reference coastal EBM model (see Figure 5). In cases where a participant named a more specific node (i.e. shellfish) within a sub-topic, they were also given credit for having identified the general overarching topic (i.e. living resources). Percentages were then calculated for each area of focus (Ecological, Governance, and Human Uses) to reflect the number of concepts discussed in proportion to the number of concepts identified in the reference coastal EBM model. These percentages were calculated both for the entire interview and for the portion of the interview that was unprompted. An overall percentage was then calculated to produce an overall comprehensiveness score, based on the entire interview, including both prompted and unprompted information. For example, one participant identified 17 of the 34 Ecological components, 12 of the 14 Governance components, and 18 of the 27 Human Use components. Based on this, the participant scored a 50% for the Ecological area of focus, 86% for the Governance area of focus, and 67% for the Human Use area of focus; his total Comprehensiveness score was 68%. If a participant had identified each concept identified in the model, he would have scored 100%. These data are presented in summary form and then in individual radar graphs in Chapter 5.

As noted above, mental model balance was assessed because of the emphasis of some EBM scholars on the need for an ecosystem approach to balance multiple uses and perspectives (e.g. Endter-Wada, et al., 1998). Again, while all practitioners were not expected to have equally balanced mental models, some practitioners would be expected to be more balanced than others, and balance provides a useful way of understanding and comparing individuals' mental models. While some level of imbalance is to be expected, arguably an individual with an extremely imbalanced mental model would be ill-equipped to help develop a collaborative ecosystem-based management plan as he or she may not be able to fully recognize all the elements of the reference model as well as the linkages between those elements.

To assess the balance of practitioners' mental models, the data reflecting number of coding references were used. Sub-totals of coding references were calculated within each area of focus (Ecological, Governance, and Human Uses), and percentages were calculated to reflect the proportion of the entire interview (as measured by total number of coding references) spent on each area of focus. These percentages were calculated both for the entire interview and for the portion of the interview that was unprompted. Percentages spent on each area of focus add up to 100%; if a participant had an equally balanced mental model, she would have scored 33.3333% in each of the three areas of focus. For example, one participant referenced Ecological concepts 45 times, Governance concepts 95 times, and Human Use concepts 88 times, comprising a total of 228 coding references for the interview. Based on this, the participant's Ecological score was 19.7%, Governance score was 41.7%, and Human Use score was 38.6%; together, these percentages total 100% representing the entire interview.

Last, a novel method was developed to create one overall score representing the balance of these practitioners' mental models. The difference between the percentage for each area of focus and 33.3333% was calculated. The absolute values of these three values were then added together, and the inverse was calculated, in order to represent the difference, in percentage, between a perfectly balanced mental model and the practitioners' mental model such that the higher the score, the more balanced the practitioners' mental model.[26] For example, the same participant identified above had a total balance score of 73%, calculated as follows: 1-|(0.197-0.3333)| + |(0.417-0.333333)| + |(0.386-0.333333)|. These data are presented in summary form and then in individual radar graphs in Chapter 5.

4.7 Data Analysis: Social Network Analysis

4.7.1 Data Preparation

This section describes social network analysis methods used to analyze survey data with the goal of addressing research question 2: *How did practitioners collaborate to develop the coastal EBM plan?* For each of the two case studies, survey data were first compiled and organized for each of the two cases to separate network data (actors' ties with other actors) from attribute data (qualities unique to each actor). Network data were based on survey

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[26] This calculation is represented mathematically as 1-|(E-0.333333)|+|(G-0.333333)|+|(H-0.333333)|, where E is the Ecological sub-area of focus score, G is the Governance sub-area of focus score, and H is the Human Uses sub-area of focus score.

respondents' lists of individuals they worked with on their respective planning effort. In both cases, nearly all study participants were able to identify one or more other individuals they worked with on the case in question. In the case of the Greenwich Bay SAMP, one respondent listed *only* organizations, not individuals, in response to the request for individuals' names. Seven other respondents included one or more organization names within their lists of individuals. All of these organization names were, by necessity, removed from the network dataset of individuals. In addition, two respondents included two first names, without sufficient other information to triangulate the individuals' full names or affiliations, and so these names were deleted from dataset. In the case of the Great South Bay EBM Plan, only one individual who indicated he had worked on scientific research supporting this plan was unable to identify any names of individuals he had worked with on the GSB EBM Plan. Five other respondents included one or two organization names within their lists of individuals. All of these organization names were, by necessity, removed from the network dataset of individual actors.

Attribute data were developed using survey responses which indicated attributes such as occupation, affiliation, and educational background. These responses were used to code each participant with a generalized affiliation and a generalized area of expertise. Generalized affiliations were either level of government (e.g. state government) or type of organization (e.g. environmental advocacy, business). Private citizens who were affiliated with various neighborhood organizations or institutions, but who had primarily participated as individuals, were simply coded as private citizens. Generalized areas of expertise for those working in coastal science and management sought to distinguish those working primarily as scientists from those working primarily as managers, and also acknowledged general area of expertise (e.g. marine science, environmental management). Other fields of expertise were coded more intuitively (e.g. planning; government; business). Users and business owners were coded for their type of business (e.g. fishing, marinas) and private citizens were coded as private citizens. Generalized expertise was based primarily on self-reported job title and responsibilities rather than educational background, as survey responses and interview content indicated that many individuals may have had narrow educational training (i.e. physical oceanography) but saw themselves as working in a broader context (i.e. marine resource management). Using Netdraw (Borgatti, 2009), generalized affiliation and expertise data were then used to create basic network graphs for each network, with actors coded for their generalized affiliation and generalized expertise (see figures in Chapter 6).

Network data were then analyzed using Ucinet 6 (Borgatti, et al., 2002). Network routines are detailed below and summarized in Table 8 below, along with other key social network analysis terms.

Table 8. Summary of key social network analysis terms and definitions used in this study (Hanneman & Riddle, 2005; Scott, 1991; Wasserman & Faust, 1994)

Term	**Definition**
Actors	Individuals who make up a network.
Ties	Relationships between the individual actors who make up a network.
Isolates	Actors with no connections within a network.
Pendants	Actors with only one connection within a network.
Degree centrality	A measure of the number of links an actor has to other actors in a network.
Out-degree	In degree centrality, for a given actor, the number of ties identified by that actor.
In-degree	In degree centrality, for a given actor, the number of others who identify that actor as part of their network.
Betweenness centrality	A measure of how frequently an actor lies along a path connecting a pair of other actors.
Percent homophily	An ego network analysis that determines, for a given actor, the proportion of ties who share an attribute, such as generalized affiliation, with the actor.
Krackhardt and Stern's E-I Index	An ego network analysis that determines, for a given actor, a measure of the actor's homophily based on an attribute such as generalized affiliation.
Network density	A measure of how many links exist within a network compared to the total number of links that could exist.
Network centralization	A measure of the extent to which the network is centered around one or more key individuals.

4.7.2 Overall Network Measures

First, each network was analyzed as a whole to understand the structure of the two networks so as to provide insight into the extent and nature of collaboration. Two metrics were calculated: *network density* and *network centralization*. Network density is a measure of how many links exist within a network compared to the total number of links that could exist, and can be used to understand network integration and cohesion (Scott, 1991). Network centralization is a measure of the extent to which the network is centered around one or more key actors (e.g. Wasserman & Faust, 1994) and provides insight into the extent to which centrality is distributed in a network – in other words, does the network rely on just a few very well-connected individuals, or is level of connection more evenly distributed? See Chapter 6 for findings and discussion.

4.7.3 Centrality Measures

Next, analytical routines were performed to determine the extent of collaboration in each network as determined by qualities of the ties between actors. Centrality is one measure of the importance of an actor in a network (Wasserman & Faust, 1994). Centrality may be considered an assessment of an actor's influence, as indicated by an actor's ties with other actors in a network. An actor's position in a network may provide him with both opportunities (i.e. to give or receive information, or to influence others) and constraints (i.e. limitations in sending/receiving information or influencing others) (Hanneman & Riddle, 2005). Centrality measures may provide insight into some aspects of collaboration by providing a measurement of individual actors' role in the network.

There are many different types of centrality and ways to measure it (e.g. Hanneman & Riddle, 2005; Wasserman & Faust, 1994); two were used for this study***.*** *Degree centrality* is a measure of the number of ties an actor has within the network (Wasserman & Faust, 1994). In Ucinet, Freeman degree centrality (Freeman, 1979) can be calculated; this calculation is based on the idea that the higher the number of ties an actor has, the more powerful or influential he or she may be (Hanneman & Riddle, 2005). These ties may include either ties identified by an actor (an actor's "out-degree"), or the number of others who identified that actor as part of their network (an actor’s “in-degree”). This type of centrality was determined to be relevant to this study because it provides insight into the extent to which each actor collaborated within the network, as well as the number of actors who might influence an actor’s mental model.

Another type of centrality is *betweenness centrality*, which is a measure of how frequently an actor lies along a path between other pairs of actors in a network. In other words, betweenness centrality is a measure, for any actor, of the number of people who depend on him or her to interact with others actors in the network (Wasserman & Faust, 1994). Betweenness centrality can provide important insight into the flow of information within a network, or overall power and influence within a network, as it provides insight into which key individuals are influencing others or controlling the flow of information between others (Hanneman & Riddle, 2005; Wasserman & Faust, 1994). This may also be considered a more meaningful way to interpret an actor’s position in a network, as having many connections doesn’t necessarily mean that an actor is important or influential; actors with high degree centrality do not necessarily have high betweenness centrality. Betweenness centrality was considered especially meaningful for this study as those with high betweenness could be especially important to a coastal EBM planning process, and can wield considerable influence by either limiting or facilitating the exchange of information between others in the network (Bodin & Crona, 2009). Degree centrality and betweenness centrality were both calculated for each actor within each of the two case studies; results are presented and discussed in Chapter 6.

Figure 8 is a simplified diagram of a hypothetical network that illustrates several of the network concepts discussed here. Each node in the diagram represents an actor in a network. Actor A is at the center of a smaller network within the broader network. This smaller network has 100% network density (discussed below), meaning that the maximum number of ties between actors are present. Actor C is at the center of another cluster which resembles a star. The star network illustrates degree centrality: actor C has a degree centrality of 7, meaning that he has seven ties within the network. Actor B plays a very important role in this network by linking the two smaller clusters. Whereas Actor B has very few ties in the network, he is a critical link between the two other smaller clusters, and thus would have a very high betweenness centrality score because he enables actors in one of the small clusters to access actors in the other small cluster.

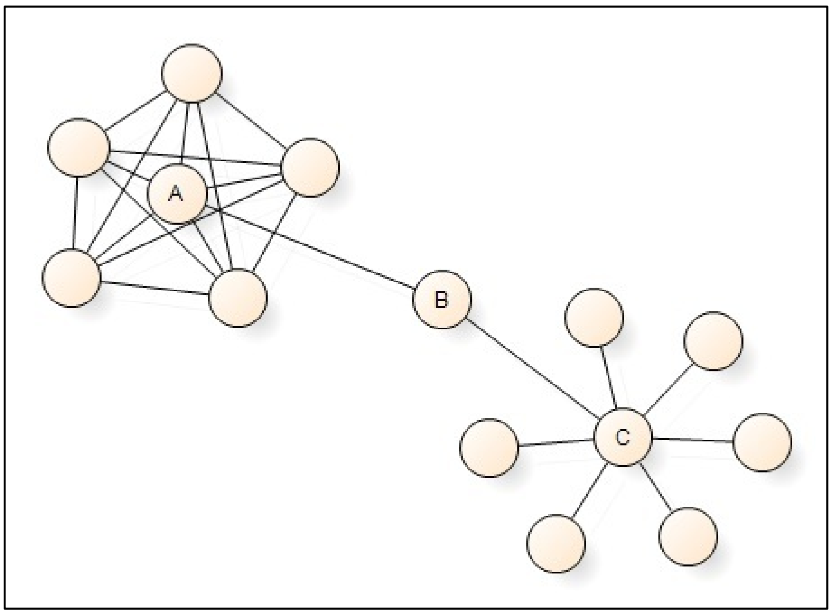

Figure 8. Hypothetical network illustrating degree centrality, betweenness centrality, and network density measures

4.7.4 Homophily Measures

Ucinet was also used to perform some ego network analyses on the network data for each of the two case studies. Complete network analysis and ego network analysis are different types of analysis; in the study of complete networks, analysis is focused on the entire network structure, and ties between actors within the network are studied within that context, whereas in the study of ego networks, analysis is focused on individual actors and those who immediately surround them (Hanneman & Riddle, 2005). Because this study's survey data collection involved each study participant recalling and identifying who he or she worked with, these data allowed for analysis of a complete network dataset and also provide some insight into the ego networks of individual actors.

In Ucinet, a series of homophily ego network measures can be calculated for each actor. Homophily refers to the general sociological principle that more contact occurs between similar people than between dissimilar people(McPherson, Smith-Lovin, & Cook, 2001). Ucinet homophily measures include *percent homophily* and *Krackhardt and Stern's E-I Index*, and are calculated based on a given attribute, such as affiliation or expertise, as a means of assessing similarity (Borgatti, et al., 2002). Ucinet's percent homophily calculation is a simple measure of the proportion of an actor's ties with those of the same attribute to the actor's total number of ties; a value of 100% would indicate perfect homophily (Borgatti, et al., 2002). [27] Krackhardt and Stern's E-I Index is a measurement of "external" and "internal" links, or in other words, ties with those in dissimilar groups and ties within one's own group. It is calculated as the number of external links (the number of ties with those of a different attribute) minus the number of internal links (the number of ties with those of the same attribute), divided by the total number of ties (Krackhardt & Stern, 1988). The resultant values range from +1 to -1 with +1 representing complete heterogeneity (no ties with actors of the same attribute) and -1 representing perfect homophily.[28] Both measures may provide insight into the extent to which

[27] For example, consider actor X, who is affiliated with state government, has ties with three other actors. Two are also affiliated with state government; one is not. Actor X's percent homophily is 2/3 or 67%.

[28] Krackhardt and Stern's E-I Index can be expressed mathematically as

$$\frac{E-I}{E+I}$$

study participants collaborated with a diverse range of individuals. These measures were calculated for each actor in both cases based on generalized affiliation and generalized expertise; results are presented in Chapter 6.

4.8 Comparative Analysis of Mental Models and Social Networks

Finally, a series of statistical correlation tests were performed to address research question 3: *What is the relationship between practitioners' mental models and practitioners' collaboration with others through their social networks?* Correlations were tested between a series of the values calculated above for each individual actor. Mental model comprehensiveness and mental model balance scores were both tested for correlation with degree centrality, betweenness centrality, and E-I Index scores. As noted above, a few individuals who participated in this study did not participate in a mental models interview; because these correlation tests rely on examining the relationship between mental models and social network measures, tests were only performed on the study participants for whom both mental models and network measures were available.[29]

First, Spearman's rank correlation test (Zar, 2010) was applied to each of the two case studies using SPSS (IBM, 2011)to determine whether there were statistically significant correlations between any of a series of mental models measures and social network analysis measures. This nonparametric linear correlation test was selected because of the small sample

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Where E represents ties with actors with a dissimilar attribute, and I represents ties with actors of the same attribute as Actor X. For example, consider actor X, who is affiliated with state government, has ties with three other actors; two are also affiliated with state government; one is not. Actor X's E-I Index is: (1-2)/3 = -0.33.

[29] In the case of the Greenwich Bay SAMP, 28 individuals participated in interviews and 4 additional participants only completed surveys; correlation tests were run on those who did both interviews and surveys (n=28). In the case of the Great South Bay EBM Plan, 13 individuals participated in interviews and 2 additional participants only completed surveys; correlation tests were run on those who did both interviews and surveys (n=13).

sizes of coastal management practitioners and because it is a simple and commonly used method for assessing correlation based on ranks. Second, the two case studies were combined into one universe of study participants (n=41) and both Spearman's rank and Pearson's correlation tests were applied to these data as a whole, again using SPSS (IBM, 2011). Pearson's linear correlation test was chosen as its requirements were satisfied by the larger sample size, and parametric tests are more efficient and powerful than nonparametric tests, which tend to require larger sample sizes in order to reject the null hypothesis (Howell, 2004).

Finally, to further examine the relationship between mental models and social network measures of particular interest, resampling statistical methods were used on the two different groups of study participants to provide further insight into whether there was any difference between the two cases. Resampling methods were used to test correlations, for each group of study participants, between (1) mental model comprehensiveness and degree centrality, and (2) mental model comprehensiveness and betweenness centrality. Resampling refers to a suite of non-parametric statistical methods in which samples are repeatedly redrawn or rearranged from a population of data. Such methods result in test statistics that are compared not to a theoretical probability distribution of values, but to an exact distribution of values which are calculated by rearranging and resampling from the actual data being tested. These methods have been established as effective for dealing with small sample sizes (Good, 2006). Pearson's correlation tests were run on each dataset using an Exact Test with Monte Carlo resampling in SYSTAT 13 (Cranes Software International, 2010). Results from these statistical tests are reported in Chapter 7.

Chapter 5. Mental Models Analysis

5.1 Overview

As described in Chapter 4, mental models analysis was applied to each study participant within each of the two case studies to provide insight into research question 1:

1.) *What are the characteristics of coastal management practitioners' mental models of the coastal ecosystem for which they are planning?*

This overarching question is investigated in this chapter through two sub-questions:

1a.) How comprehensive are practitioner's mental models of the coastal ecosystem for which they were planning?

1b.) How balanced are practitioners' mental models of the coastal ecosystem for which they were planning?

As described in Chapter 4, practitioners' mental models, elicited through interviews, were compared with the reference coastal EBM model, which is derived from the EBM literature and which considers three different area of focus: ecological; governance; and human uses. Comprehensiveness reflects whether or not a practitioner considered all of the basic elements within each area of focus; balance reflects the extent to which a practitioner focused on each of the three areas of focus. Comprehensiveness and balance are considered important elements of practitioners' mental models as the EBM literature indicates that EBM requires a comprehensive approach that seeks to balance multiple uses and the interests of diverse stakeholder groups (e.g. Arkema, et al., 2006; Endter-Wada, et al., 1998; U.S. Commission on Ocean Policy, 2004). However, as discussed in Chapter 4, all practitioners would not be expected to have perfectly comprehensive, balanced mental models; rather, comprehensiveness and balance provide two different ways of understanding and comparing practitioners' mental models. As described in Chapter 2, some practitioners would be expected to have more comprehensive, balanced mental models than others. The above questions are addressed in part through a series of hypotheses which are detailed below. This chapter addresses these questions through presentation and discussion of the mental models findings for both case studies.

As outlined in Chapter 1, the hypotheses which are tested here to address the above research questions focus on four sub-groups of the coastal management practitioners who participated in this study. These four sub-groups are: EBM plan project leaders; those affiliated with state coastal management programs; those whose generalized expertise is in marine resource management; and those whose generalized expertise is in the marine sciences. Project leaders are a logical focal point, as they would be expected to have both comprehensive and balanced mental models of the coastal ecosystems they were managing. Those affiliated with state coastal management programs would similarly be expected to have both comprehensive and balanced mental models because of the leadership role these programs played in these cases, and because of the inherently collaborative, intergovernmental approach of the federal Coastal Zone Management Program as discussed in Chapter 2. Those whose expertise (based on background, training and job responsibilities) is in marine resource management, whether they are working for a state coastal program or other entity, would similarly be expected to have comprehensive and balanced mental models because the nature of their work is to address multiple problems and balance multiple uses. Finally, those whose expertise (based on both training and job responsibilities) is in the marine sciences, who may be affiliated with universities or other entities, would NOT be expected to have balanced or comprehensive models because of the tendency of those trained in the sciences to have extensive expertise but in a very narrowly focused discipline. Hypotheses relating to these four sub-groups are tested in this chapter for the two different case studies.

Whereas this study is investigating the comprehensiveness and balance of practitioners' mental models, it should not be assumed that the ideal practitioner's mental model is completely comprehensive or completely balanced, or both. While the ecosystem-based management literature as summarized in Chapter 2 calls for a comprehensive and balanced approach to management, it is not necessarily the case that each and every practitioner involved in developing a coastal EBM plan needs to have a perfectly comprehensive, balanced mental model. It may be that a mix of practitioners of different affiliations, expertise, and types of mental models who are actively collaborating to develop an EBM plan would be an effective arrangement for developing such plans. Such collaborative arrangements are further discussed in Chapter 6 and Chapter 7.

5.2 The Mental Models of the Greenwich Bay SAMP Study Participants

As noted above, 28 of the 32 study participants participated in mental models interviews.[30] Chapter 4 describes the way in which these interview transcripts were coded and analyzed to assess (1) mental model comprehensiveness (as measured by the presence of coding references within each area of focus); and (2) mental model balance (as measured by the number of coding references within each area of focus). These findings are summarized and discussed below. Findings about mental model comprehensiveness are presented first, followed by findings about mental model balance. Discussion follows at the conclusion of this chapter.

[30] As described in Chapter 4, some study participants completed surveys but were not interviewed.

5.2.1 Research Question 1a: How Comprehensive Were Practitioners' Mental Models?

5.2.1.1 Overview and Summary Data

As described in Chapter 4, the results of coding study participants' interview transcripts were analyzed to address research question 1a, *How comprehensive were practitioners' mental models?* Comprehensiveness was assessed by determining whether or not the participant identified each component of the reference coastal EBM model – ecological, governance, and human uses; as described above, comprehensiveness is assessed because the EBM literature calls for a comprehensive approach that integrates consideration of both ecological and social systems into a management framework (e.g. Leslie & McLeod, 2007).

Table 9 shows the summary data reflecting the comprehensiveness of participants' models. In this table, participants are grouped by their generalized affiliation, and their generalized expertise is also shown. For these data, percentages for each area of focus (Ecological, Governance and Human Uses) represent a stand-alone score for the particular area of focus. This table also shows two values for each measure: one for the entire interview, and one for the unprompted portion of the interview (discussed below). The final two columns show overall Comprehensiveness scores, which are averages of the scores for the three areas of focus. Comprehensiveness scores are straightforward to interpret: the higher the score, the more comprehensive the participant's mental model. For example, throughout his interview, study participant GB-32 identified 76% of the total possible ecological components that are represented in the reference coastal EBM model; 93% of the governance components; and 69% of the human use components; his total score, representing the comprehensiveness of his entire mental model, was 80%.

Table 9. Summary data: Mental model comprehensiveness of Greenwich Bay SAMP study participants (n=28)

Study Parti-cipant	Generalized Affiliation	Generalized Expertise	Ecological		Governance		Human Uses		Total Comprehensiveness	
			%Total Interview	% Unprompt-ed	% Total Interview	% Unprompt-ed	% Total Interview	% Unprompt-ed	Avg. Total	Avg. Unpro mpted
GB-19	University-outreach	Marine res. mgmt.	0.85	0.65	1.00	0.93	0.88	0.50	0.91	0.69
GB-11	State govt.	Marine res. mgmt.	0.88	0.82	0.93	0.93	0.69	0.69	0.83	0.81
GB-10	Citizen	Resident	0.85	0.74	0.86	0.86	0.77	0.73	0.83	0.77
GB-31	Local govt.	Community planning	0.74	0.56	0.93	0.93	0.77	0.73	0.81	0.74
GB-13	Local govt.	Community planning	0.79	0.68	0.93	0.79	0.69	0.46	0.80	0.64
GB-32	Business operator/ user	Marinas/ boating	0.76	0.65	0.93	0.93	0.69	0.50	0.80	0.69
GB-24	Citizen	Resident	0.71	0.56	0.93	0.86	0.73	0.50	0.79	0.64
GB-12	State govt.	Marine res. mgmt.	0.65	0.59	0.93	0.86	0.77	0.73	0.78	0.73
GB-03	University-research	Marine sciences	0.71	0.68	0.93	0.86	0.65	0.50	0.76	0.68
GB-17	State govt.	Marine res. mgmt.	0.65	0.56	0.93	0.79	0.69	0.46	0.76	0.60
GB-28	Envtl. advocacy	Marine res. mgmt.	0.68	0.62	0.93	0.64	0.62	0.46	0.74	0.57
GB-18	University-outreach	Outreach/ Comm.	0.59	0.50	0.93	0.86	0.69	0.62	0.74	0.66
GB-29	State govt.	Envtl. mgmt.	0.71	0.68	0.93	0.93	0.50	0.42	0.71	0.68
GB-08	Citizen	Resident	0.62	0.56	0.93	0.93	0.58	0.46	0.71	0.65

GB-09	State govt.	Marine res. mgmt.	0.68	0.62	0.79	0.71	0.65	0.54	0.71	0.62
GB-25	Business operator/ user	Marinas/ boating	0.62	0.56	0.79	0.71	0.69	0.42	0.70	0.57
GB-14	State govt.	Policy/legal	0.62	0.56	0.93	0.86	0.54	0.46	0.69	0.63
GB-01	State govt.	Policy/legal	0.50	0.44	0.86	0.79	0.69	0.62	0.68	0.61
GB-05	State govt.	Marine res. mgmt.	0.65	0.56	0.86	0.71	0.54	0.38	0.68	0.55
GB-20	State govt.	Policy/legal	0.50	0.38	0.71	0.71	0.73	0.62	0.65	0.57
GB-21	Business operator/ user	Fishing	0.62	0.62	0.86	0.71	0.42	0.42	0.63	0.59
GB-02	Local govt.	Policy/legal	0.53	0.41	0.79	0.64	0.54	0.50	0.62	0.52
GB-16	University-research	Marine sciences	0.68	0.59	0.71	0.71	0.46	0.31	0.62	0.54
GB-23	Citizen	Marine res. mgmt.	0.65	0.53	0.64	0.57	0.54	0.42	0.61	0.51
GB-06	University-outreach	Marine res. mgmt.	0.62	0.53	0.64	0.57	0.50	0.42	0.59	0.51
GB-30	Local govt.	Sewage mgmt.	0.53	0.53	0.64	0.64	0.58	0.31	0.58	0.49
GB-26	Local govt.	Policy/legal	0.50	0.41	0.71	0.64	0.46	0.35	0.56	0.47
GB-27	State govt.	Policy/legal	0.59	0.38	0.71	0.64	0.35	0.23	0.55	0.42

As noted above, this table also shows two values for each area of focus: percent of total interview, and percent for the unprompted portion of the interview. The difference between these two values is important. The unprompted portion of the interview represents elements of the coastal EBM model that the participant brought up on his or her own, whereas the total interview includes elements of the model that the participant brought up in response to a topic-specific question or prompt. The unprompted values may represent either content that the participant is most familiar with or believes is most important; in a sense, it provides insight into the main issues or topics that the participant cared about. Throughout this study, this will be referred to as the practitioners' default model. By contrast, prompted content may include topics or issues that the participant recognizes as legitimate but which are not among the individual's top priorities; throughout this study, this will be referred to as the practitioners' complete model. In some ways, prompts are similar to questions or discussion that would take place in a collaborative process involving individuals of many different affiliations and areas of expertise; in this regard, including both unprompted and prompted information is an appropriate way to analyze these practitioners' mental models. See discussion section for further discussion. Throughout this chapter, graphs representing individual participants' mental models show both unprompted and total interview values, whereas summary findings, analysis and comparison of practitioners' mental models are based on the total interview scores (column highlighted in grey).

The overall average comprehensiveness score of Greenwich Bay SAMP study participants (n=28) is 71% based on analysis of total interviews. However there is a relatively wide distribution of scores, which range from 55 to 91%. When considering comprehensiveness scores for each of the three areas of focus, the average Greenwich Bay SAMP study participant's mental model was much more comprehensive in the Governance area of focus (84%) in comparison to both the Ecological (66%) and Human Use (62%) areas of focus. Figure 9 represents the comprehensiveness of the average Greenwich Bay SAMP study participant's mental model. In this figure the blue shaded area represents the total interview. If a participant had identified all of the components of the reference EBM model, the entire figure would be shaded blue to represent 100% of the model. The red line represents the unprompted portion of the interview. This visually illustrates how prompting caused participants to identify new content and thus convey a somewhat more comprehensive mental model.

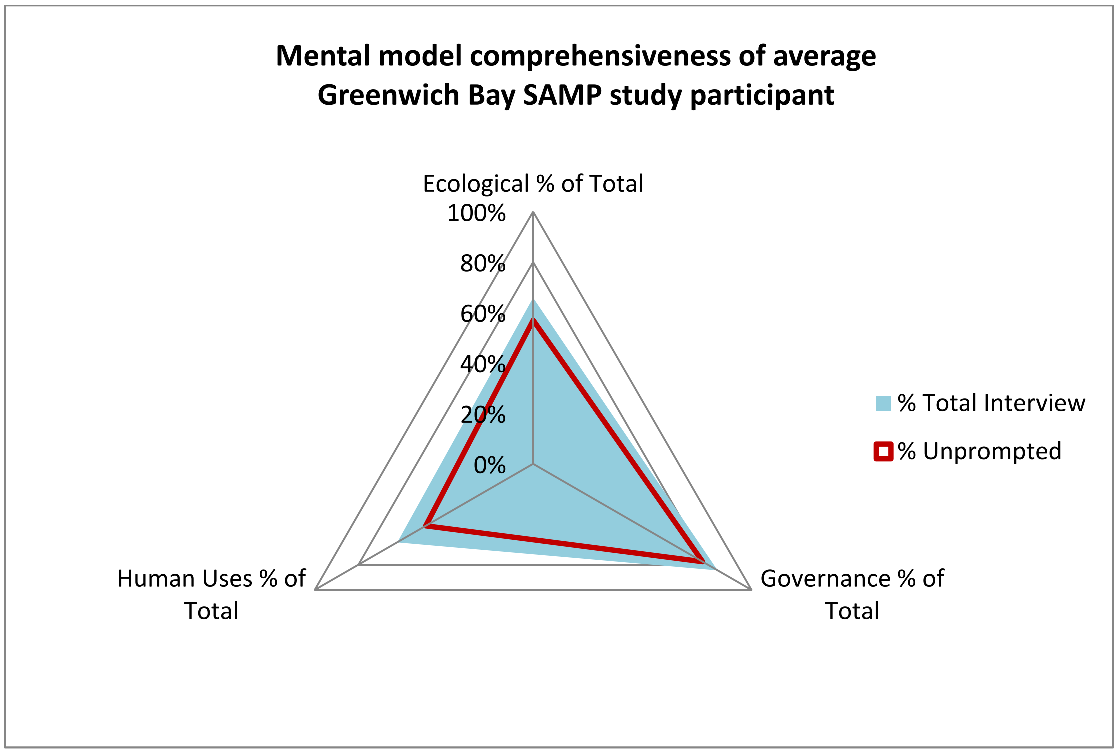

Figure 9. Mental model comprehensiveness of average Greenwich Bay SAMP study participant

As noted above, the difference between the unprompted portion of the interview and the entire interview is important. In nearly all cases, focused prompts and questions caused participants to discuss many other components of the reference coastal EBM model that they had not identified on his or her own. As shown in Figure 9, the average Greenwich Bay SAMP study participant's comprehensiveness score, based only on the unprompted portions of the interviews, is 61%, meaning that the average participant's mental model effectively expanded 10% in response to directed questions and prompts. Some participants were significantly more responsive to prompts than others; for example, as shown in Table 9, the mental model of participant GB-19 effectively expanded 22% in response to prompts.

However, the degree to which prompts caused practitioners to identify additional topics varied by area of focus. As shown in Figure 9, when prompted, the average participant's comprehensiveness score increased 6% for the Governance area of focus; 9% for the Ecological area of focus; and 13% for the Human Use area of focus. While the significance of prompts may in part be an artifact of the interview process – prompts give the interviewee guidance on what topics the researcher would like to discuss – Greenwich Bay SAMP findings indicate that prompts consistently caused participants to expand their focus on the Human Use area of focus. In the case of GB-19, her focus on human uses expanded 38%. This is notable and suggests that, for the most part, human uses were not as prominent a part of any of these participants' default mental models.

Grouping participants by their generalized affiliations and areas of expertise presents additional insight into the comprehensiveness of participants' mental models. Table 10 shows the average mental model comprehensiveness of Greenwich Bay SAMP study participants based on their generalized affiliation. Standard deviations are also shown here, and indicate that there is generally a great deal of variance within each sub-group. See below for discussion.

Table 10. Average mental model comprehensiveness of Greenwich Bay SAMP study participants grouped by generalized affiliation

Generalized Affiliation	Ecological		Governance		Human Uses		Total Average Comprehensiveness	
	% Total Inter-view	*St. Dev.*	% Total Inter-view	*St. Dev.*	% Total Inter-view	*St. Dev.*	% Total Interview	*St. Dev.*
Business operator/ user (n=3)	0.67	*0.08*	0.86	*0.07*	0.60	*0.16*	0.71	*0.08*
Citizen (n=4)	0.71	*0.10*	0.84	*0.14*	0.65	*0.11*	0.73	*0.10*
Envtl. advocacy (n=1)	0.68	*n/a*	0.93	*n/a*	0.62	*n/a*	0.74	*n/a*
Local govt . (n=5)	0.62	*0.14*	0.80	*0.13*	0.61	*0.12*	0.68	*0.12*
State agency employee (n=6)	0.70	*0.09*	0.89	*0.06*	0.64	*0.10*	0.74	*0.06*
State elected/ appointed official (n=4)	0.55	*0.06*	0.80	*0.11*	0.58	*0.17*	0.64	*0.07*
University (research/ outreach) (n=5)	0.69	*0.10*	0.84	*0.15*	0.64	*0.17*	0.72	*0.13*
Total participants (n=28)	**0.66**	***0.10***	**0.84**	***0.11***	**0.62**	***0.13***	**0.71**	***0.09***

Table 11 summarizes average mental model comprehensiveness of Greenwich Bay SAMP study participants based on generalized expertise. While generalized expertise corresponds, in some cases, to generalized affiliation, generalized expertise provides a more nuanced breakdown of the Greenwich Bay SAMP universe of study participants. Again, standard deviations are shown here and indicate that in many cases there are still wide distributions within these areas of expertise.

Table 11. Average mental model comprehensiveness of Greenwich Bay SAMP study participants grouped by generalized expertise

Generalized Expertise	Ecological		Governance		Human Uses		Total Average Comprehensiveness	
	% Total Inter-view	*St. Dev.*	% Total Inter-view	*St. Dev.*	% Total Inter-view	*St. Dev.*	% Total Interview	*St. Dev.*
Community planning (n=2)	0.76	*0.04*	0.93	*0.00*	0.73	*0.05*	0.81	*0.00*
Envtl. mgmt. (n=1)	0.71	*n/a*	0.93	*n/a*	0.50	*n/a*	0.71	*n/a*
Fishing (n=1)	0.62	*n/a*	0.86	*n/a*	0.42	*n/a*	0.63	*n/a*
Marinas/ boating (n=2)	0.69	*0.10*	0.86	*0.10*	0.69	*0.00*	0.75	*0.07*
Marine res. mgmt. (n=9)	0.70	*0.10*	0.85	*0.13*	0.65	*0.12*	0.73	*0.10*
Marine sciences (n=2)	0.69	*0.02*	0.82	*0.15*	0.56	*0.14*	0.69	*0.10*
Outreach/ comm. (n=1)	0.59	*n/a*	0.93	*n/a*	0.69	*n/a*	0.74	*n/a*
Policy/legal (n=6)	0.54	*0.05*	0.79	*0.09*	0.55	*0.14*	0.63	*0.06*
Resident (n=3)	0.73	*0.12*	0.90	*0.04*	0.69	*0.10*	0.77	*0.06*
Sewage mgmt. (n=1)	0.53	*n/a*	0.64	*n/a*	0.58	*n/a*	0.58	*n/a*
Total participants (n=28)	**0.66**	***0.10***	**0.84**	***0.11***	**0.62**	***0.13***	**0.71**	***0.09***

5.2.1.2 Findings: Hypothesis Testing Based on Mental Model Comprehensiveness

A series of hypotheses were drafted to provide further insight into research question 1a: *How comprehensive are practitioner's mental models of the coastal ecosystem for which they* *were planning?* This section presents the findings for study hypotheses that are based on mental model comprehensiveness.

A. Practitioners who are <u>EBM plan project leaders</u> have *more comprehensive mental models* than other practitioners.

This hypothesis was found to be true. GB-11, who is affiliated with the state coastal management program, and GB-19, who is affiliated with the university, were the two project leaders for the Greenwich Bay SAMP. GB-11 and GB-19 had the most comprehensive mental models of all study participants. They had an average comprehensiveness score of 87%, with scores of 83% and 91%, respectively. This is in comparison to the average score of 70% for all other participants (n=28). Figures 10 and 11 below show the mental model comprehensiveness of GB-11 and GB-19. It is interesting to note that GB-11's model changed very little in response to directed questions or prompts, whereas GB-19's model expanded significantly. It is also worth noting that GB-19 had the highest score for the Governance area of focus (100%) – the only participant to score 100% for any part of the model – as well as the highest score for the Human Uses area of focus.

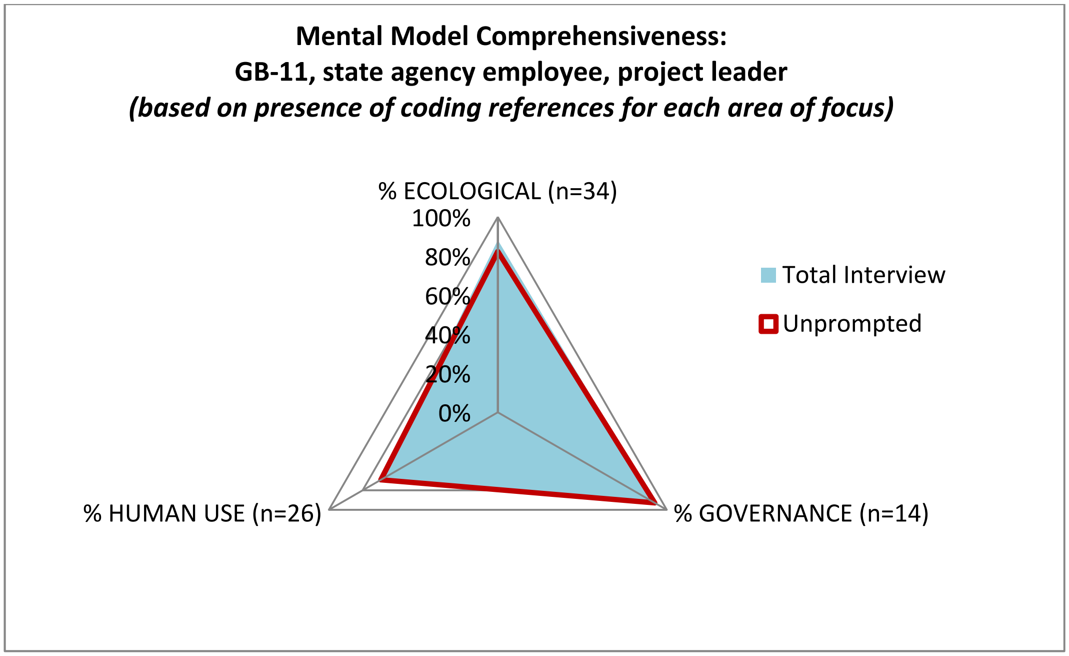

Figure 10. Mental model comprehensiveness of GB-11, state coastal manager, project leader

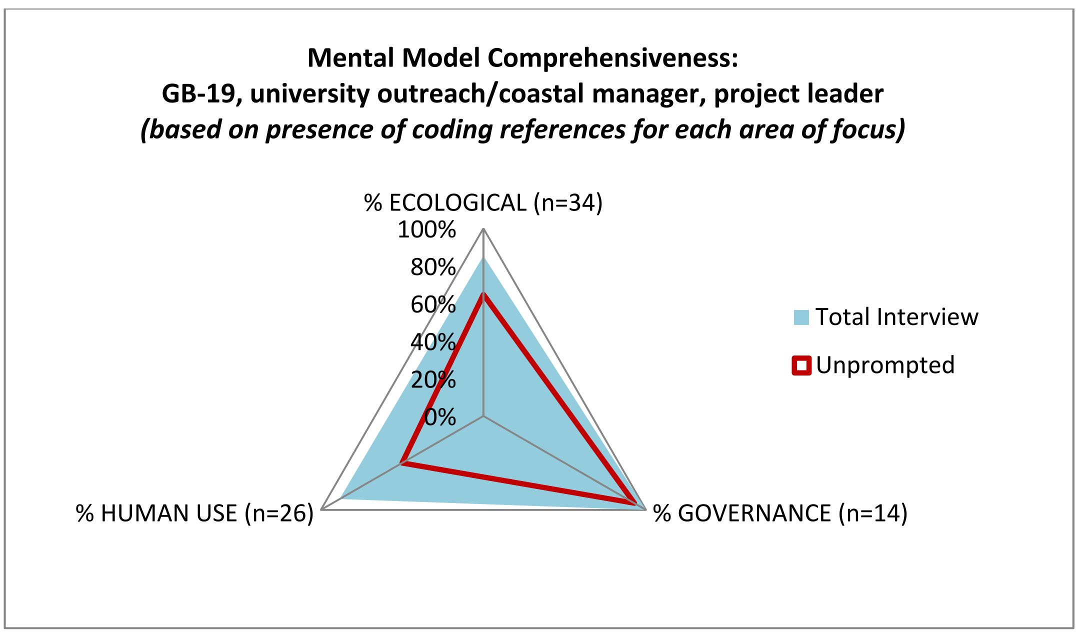

Figure 11. Mental model comprehensiveness of GB-19, university coastal manager and project leader

B. Practitioners who are <u>affiliated with state coastal management programs</u> have *more comprehensive mental models* than other practitioners.

Six participants who are affiliated with the state coastal management program were interviewed for this study: three professional staff (including the project leader) and three appointed officials. When all six are considered together, this hypothesis is found not to be true: their average comprehensiveness score is 70%, which is just slightly less than the average score for all other participants (n=22) of 71%. However, when agency employees are considered separately from the officials, this hypothesis is found to be true for the professional staff but not true for the officials. The three agency employees have an average comprehensiveness score of 77%, and the appointed officials have an average score of 63%. By comparison, the average for all participants was 71%. Further examination of these data reveals that the main point of divergence between these two sub-groups is in the Ecological area of focus: professional staff had an average comprehensiveness score of 74% whereas the officials had an average score of 53%. See below for further discussion.

C. Practitioners whose <u>generalized expertise is in marine resource management</u> have *more comprehensive mental models* than other practitioners.

This hypothesis was found to be true. There were nine study participants who participated in interviews whose generalized expertise was in marine resource management; their average overall comprehensiveness score was 73%, which is slightly higher than the average score for all other participants (n=19) of 70%. Further examination of these data show that the scores of the two project leaders (discussed above) greatly contribute to the average comprehensiveness score. When this score is calculated without the two leaders, the average drops notably to 69% - which is lower than other practitioners. By contrast, the average for all practitioners is 71%. See below for further discussion.

D. **Practitioners whose <u>generalized expertise is in the marine sciences</u> have *less comprehensive mental models* than other practitioners.**

This hypothesis was also found to be true. There were two study participants who participated in interviews whose generalized expertise was in the marine sciences. Their average overall comprehensiveness score was 69%, which is slightly less than the average for all other participants (n=26) of 71%. However, it should be emphasized that this is only slightly lower than the average score for the entire study (71%) and that numerous other participants had significantly lower comprehensiveness scores (see discussion below). In addition, there is an important difference between these two scientists. GB-03, a recently retired university scientist who has a longstanding history of working on state coastal management projects, scored 76%, whereas GB-16, a newer scientist who had worked on this project as a graduate student, scored 62%. Examination of these scientists' scores in each area of focus provides further insight: whereas the two scored nearly the same in Ecological, GB-16 had significantly higher scores in Governance and Human Uses. See further discussion below.

5.2.1.3 Unexpected Findings about Mental Model Comprehensiveness

While several of the above hypotheses were found true, these results mask the fact that there were numerous unexpected findings in the mental model comprehensiveness of Greenwich Bay SAMP study participants. For example, as illustrated in Table 10 above, some of the individuals with the most comprehensive mental models were private business operators/users or citizens. Citizens (73%) and marine-based business operators/users (71%) were two of the affiliations with the highest average comprehensiveness scores, and citizens had the highest average scores in the Ecological (71%) and Human Uses (65%) areas of focus. It is especially notable that citizens' mental models were more comprehensive than local government-affiliated practitioners (68%), state elected or appointed officials (64%) and university-affiliated individuals (72%). Certain key individuals stood out, as well; for example, citizen participants GB-10 and GB-24 had overall comprehensiveness scores of 83% and 79%, respectively, and business operator/user GB-32 scored 80%. See below for further discussion.

Another unexpected finding, which expands upon the above findings about those affiliated with the state coastal program, was that elected and appointed officials generally scored among the lowest comprehensiveness scores. GB-27, a state appointed official, was the lowest scoring study participant with a score of 55% overall (see Figure 12 below). However, most of these officials scored relatively high (greater than 70%) in the Governance sub-area of focus.

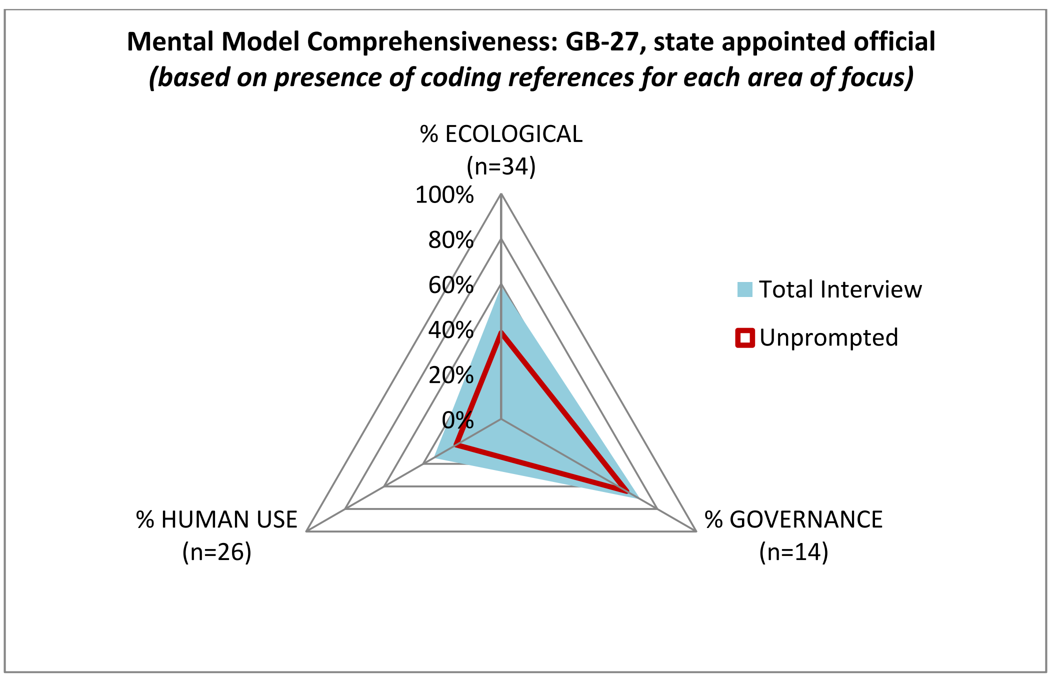

Figure 12. Mental model comprehensiveness of GB-27, state appointed official

Last, when examined by generalized expertise, community planners (n=2) were found to have the most comprehensive mental models, with an average score of 81%. Both community planners interviewed for this study were affiliated with local governments and had participated in the Greenwich Bay SAMP planning process on behalf of their towns; one, GB-31, had retired the year prior to this study. The planners had the highest average comprehensiveness scores in the Ecological (76%) and Human Uses (73%) area of focus out of all of the areas of expertise. See below for further discussion.

5.2.2 Research Question 1b: How Balanced Were Practitioners' Mental Models?

5.2.2.1 Overview and Summary Data

As described in Chapter 4, the results of coding study participants' interview transcripts were also analyzed to address research question 1b, *How balanced were practitioners' mental models?* Balance was assessed by determining the proportion of the practitioner's interview that was spent on each area of focus. As described above, mental model balance was assessed because much of the EBM literature suggests this the EBM approach requires balanced consideration of different resources, uses, and interests (e.g. Endter-Wada, et al., 1998). While it is not assumed that each practitioner would need to have an equally balanced model, balance scores provide insight into this aspect of practitioners' mental models. Proportion of the interview spent on each area of focus was quantified by counting the number of times each concept in the coastal EBM model was brought up, adding up subtotals for each of the three areas of focus, and then using these subtotals to calculate percentages of the total interview spent on each area of focus.

Table 12 shows the summary data reflecting the balance of participants' mental models. For these data, percentages for each area of focus (Ecological, Governance and

Human Uses) represent subtotals for the particular area of focus; the three subtotals add up to 100%. The final column, highlighted in grey, shows overall Balance Scores for each participant; participants are ranked by their Balance Scores, highest to lowest. As described in Chapter 4, the Balance Score was calculated by finding the difference between each of the subtotals and 0.333333; adding the absolute value of these numbers together; and then calculating the inverse such that the higher the Balance Score, the more balanced the participant's mental model. For example, GB-18 spent 34% of her total interview focused on ecological matters; 33% on governance; and 33% on human uses; her overall Balance Score is 99%. This table also shows unprompted scores for each area of focus, which represent the portions of the unprompted sections of the interview that were spent on each of the three area of focus; for example, for the unprompted portion of the interview, GB-18 spent more time on governance (37%) and less time on human uses (29%).

Table 12. Summary data: Mental model balance of Greenwich Bay SAMP study participants (n=28)

Study Participant	Generalized Affiliation	Generalized Expertise	Ecological		Governance		Human Use		Total Balance Score (%)
			% Total Interview	% Unprompted	% Total Interview	% Unprompted	% Total Interview	% Unprompted	
GB-18	University-outreach	Outreach/ Commun-ications	0.34	0.34	0.33	0.37	0.33	0.29	0.99
GB-20	State govt.	Policy/legal	0.34	0.25	0.36	0.50	0.30	0.25	0.94
GB-13	Local govt.	Community planning	0.33	0.39	0.38	0.40	0.29	0.22	0.91
GB-21	Business operator/ user	Fishing	0.31	0.33	0.39	0.36	0.30	0.31	0.89
GB-09	State govt.	Marine resource mgmt.	0.28	0.34	0.38	0.32	0.34	0.34	0.89
GB-12	State govt.	Marine resource mgmt.	0.35	0.35	0.27	0.28	0.38	0.37	0.87
GB-24	Citizen	Resident	0.28	0.29	0.41	0.43	0.31	0.28	0.85
GB-19	University-outreach	Marine resource mgmt.	0.40	0.45	0.34	0.37	0.26	0.18	0.85
GB-32	Business operator/ user	Marinas/ boating	0.36	0.44	0.38	0.31	0.26	0.25	0.85
GB-25	Business operator/ user	Marinas/ boating	0.26	0.31	0.40	0.38	0.34	0.31	0.84
GB-06	University-outreach	Marine resource mgmt.	0.41	0.44	0.31	0.29	0.27	0.27	0.84

GB-14	State govt.	Policy/legal	0.37	0.38	0.38	0.38	0.25	0.23	0.83
GB-17	State govt.	Marine resource mgmt.	0.30	0.38	0.42	0.47	0.27	0.15	0.82
GB-27	State govt.	Policy/legal	0.36	0.36	0.40	0.51	0.24	0.14	0.82
GB-10	Citizen	Resident	0.34	0.35	0.43	0.42	0.23	0.23	0.79
GB-05	State govt.	Marine resource mgmt.	0.45	0.49	0.32	0.30	0.24	0.21	0.77
GB-02	Local govt.	Policy/legal	0.31	0.34	0.46	0.42	0.23	0.24	0.75
GB-30	Local govt.	Sewage management	0.36	0.45	0.44	0.45	0.20	0.10	0.73
GB-28	Envtl. advocacy	Marine resource mgmt.	0.38	0.36	0.42	0.43	0.20	0.22	0.73
GB-01	State govt.	Policy/legal	0.20	0.15	0.42	0.47	0.39	0.38	0.73
GB-03	University-research	Marine sciences	0.33	0.36	0.48	0.48	0.19	0.16	0.71
GB-23	Citizen	Marine resource mgmt.	0.50	0.55	0.27	0.30	0.23	0.15	0.66
GB-31	Local govt.	Community planning	0.22	0.19	0.50	0.56	0.28	0.24	0.66
GB-26	Local govt.	Policy/legal	0.31	0.42	0.52	0.44	0.17	0.14	0.62
GB-16	University-research	Marine sciences	0.43	0.55	0.44	0.37	0.13	0.08	0.59
GB-29	State govt.	Envtl. mgmt.	0.42	0.42	0.46	0.47	0.13	0.12	0.59
GB-08	Citizen	Resident	0.21	0.15	0.54	0.61	0.25	0.23	0.58
GB-11	State govt.	Marine resource mgmt.	0.54	0.56	0.25	0.24	0.21	0.20	0.58

The average Greenwich Bay SAMP study participant's overall balance score was 78%. Given that a perfectly balanced score is 100%, this indicates that study participants' mental models were somewhat imbalanced. Study participants had a wide range of balance scores, ranging from 58% to 99%. Figure 13 shows the mental model of the average participant for this case. The blue shaded area represents the entire interview and indicates that the average participant was most focused on Governance, scoring 39.6%, and spent 34.6% of the total interview focused on Ecological content and 25.8% focused on Human Uses. The red line represents the portion of the interview that was unprompted, and shows that the average participant's balance also shifted slightly in response to prompts; whereas the average Governance score did not substantively change (less than 1%), the average participant shifted his or her focus away from Ecological (a decrease of 2.5%) toward Human Uses (an increase of 3.3%).

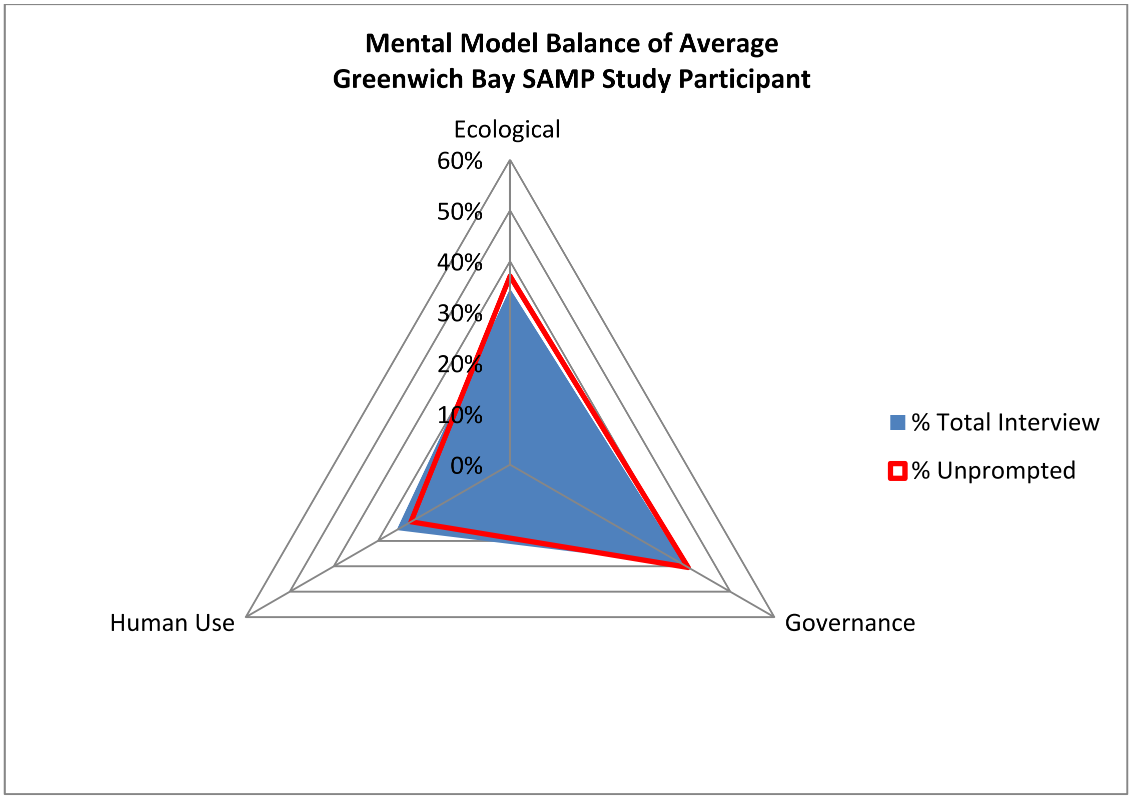

Figure 13. Mental model balance of average Greenwich Bay SAMP study participant

Whereas the average participant's mental model balance shifted only slightly in response to prompts, some participants were much more responsive to prompts than others. On average, participants' focus on any of the three areas of focus shifted in response to prompts such that they increased focus in one area and decreased it in another. In some cases, participants' focus shifted significantly – for example, GB-26's focus on Ecological decreased by 11%, GB-20's focus on Governance decreased by 14%, and GB-17's focus on Human Uses increased by 12%. In addition, as noted above, prompts caused the average participant to shift 3.3% toward a focus on human uses. The increased attention to Human Uses in response to prompts is consistent with the above finding regarding mental model comprehensiveness. See below for further discussion.

Evaluating Greenwich Bay SAMP study participants as sub-groups based on their generalized affiliation and generalized expertise provides additional insight into these data. Table 13 shows the average mental model balance of Greenwich Bay SAMP study participants based on generalized affiliation. Note that state government has been separated out into agency employees and elected/appointed officials, because of the differences in the two sub-groups' mental models. See below for discussion.

Table 13. Average mental model balance of Greenwich Bay SAMP study participants grouped by generalized affiliation

Generalized Affiliation	Ecological		Governance		Human Use		Overall Balance	
	% Total Interview	***St. Dev.***	**% Total Interview**	***St. Dev.***	**% Total Interview**	***St. Dev.***	**%**	***St. Dev.***
Business operator/ user (n=3)	0.31	*0.05*	0.39	*0.01*	0.30	*0.04*	0.86	*0.03*
Citizen (n=4)	0.34	*0.12*	0.41	*0.11*	0.25	*0.04*	0.72	*0.12*
Envtl. advocacy (n=1)	0.38	*n/a*	0.42	*n/a*	0.20	*n/a*	0.73	*n/a*
Local govt. (n=5)	0.30	*0.05*	0.46	*0.06*	0.23	*0.05*	0.73	*0.11*
State govt. - elected/ appointed (n=4)	0.32	*0.08*	0.39	*0.02*	0.29	*0.07*	0.83	*0.09*
State govt. - staff (n=6)	0.39	*0.10*	0.35	*0.08*	0.26	*0.09*	0.75	*0.14*
University (n=5)	0.38	*0.05*	0.38	*0.07*	0.24	*0.08*	0.80	*0.15*
All participants (n=28)	**0.35**	***0.08***	**0.40**	***0.07***	**0.26**	***0.07***	**0.78**	***0.12***

Table 14 below shows the average mental model balance of Greenwich Bay SAMP study participants based on generalized expertise. Evaluation of these data by generalized expertise allows for a more nuanced analysis as participants are divided into more sub-groups, many of which are different than the affiliation sub-groups used above. See below for discussion.

Table 14. Average mental model balance of Greenwich Bay SAMP study participants grouped by generalized expertise

Generalized Expertise	Ecological		Governance		Human Use		Overall Balance	
	% Total Interview	*St. Dev.*	% Total Interview	*St. Dev.*	% Total Interview	*St. Dev.*	%	*St. Dev.*
Community planning (n=2)	0.27	*0.08*	0.44	*0.09*	0.29	*0.01*	0.78	*0.18*
Envtl. mgmt. (n=1)	0.42	*n/a*	0.46	*n/a*	0.13	*n/a*	0.59	*n/a*
Fishing (n=1)	0.31	*n/a*	0.39	*n/a*	0.30	*n/a*	0.89	*n/a*
Marinas/ boating (n=2)	0.31	*0.08*	0.39	*0.02*	0.30	*0.06*	0.85	*0.00*
Marine res. mgmt. (n=9)	0.40	*0.09*	0.33	*0.07*	0.27	*0.06*	0.78	*0.11*
Marine sciences (n=2)	0.38	*0.07*	0.46	*0.03*	0.16	*0.04*	0.65	*0.08*
Outreach/ comm. (n=1)	0.34	*n/a*	0.33	*n/a*	0.33	*n/a*	0.99	*n/a*
Policy/legal (n=6)	0.31	*0.06*	0.42	*0.06*	0.26	*0.07*	0.78	*0.11*
Resident (n=3)	0.28	*0.07*	0.46	*0.07*	0.26	*0.04*	0.74	*0.14*
Sewage mgmt. (n=1)	0.36	*n/a*	0.44	*n/a*	0.20	*n/a*	0.73	*n/a*
All participants (n=28)	**0.35**	***0.08***	**0.40**	***0.07***	**0.26**	***0.07***	**0.78**	***0.12***

5.2.2.2 Hypothesis Testing Based on Mental Model Balance Findings

Similar hypotheses to those presented above for mental model comprehensiveness were developed to address research question 1b: *How balanced were practitioners' mental models?* Results are presented below.

A. Practitioners who are <u>EBM plan project leaders</u> have *more balanced mental models* than other practitioners.

This hypothesis was found to not be true. The average balance score for the two Greenwich Bay SAMP EBM plan project leaders, GB-11 and GB-19, was 72%, which is lower than the average score for all other participants (n=26) of 78%. When examining the scores of these two project leaders independently, it is surprising to see the difference between the two: GB-19, who is affiliated with a university outreach office, scored 85% – above average, and one of the higher scores of these study participants – whereas GB-11, who is affiliated with the state coastal program, scored 58% – the lowest score of the entire group. As shown in Figure 14 below, GB-11 was substantially more focused on the Ecological area of focus, even when prompted, at the expense of both Governance and Human Uses. By contrast, Figure 15 shows how GB-19 shifted her focus significantly (a change of 8%) when prompted toward a focus on Human Uses, such that her mental model became much more balanced. See further discussion below.

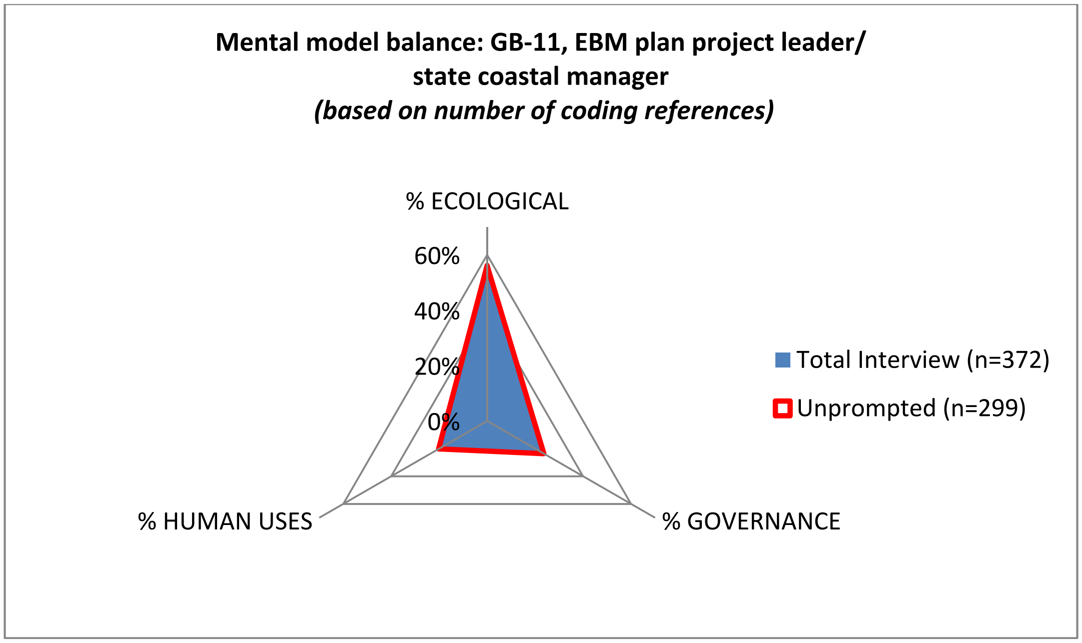

Figure 14. Mental model balance of GB-11, state coastal manager/EBM plan project leader

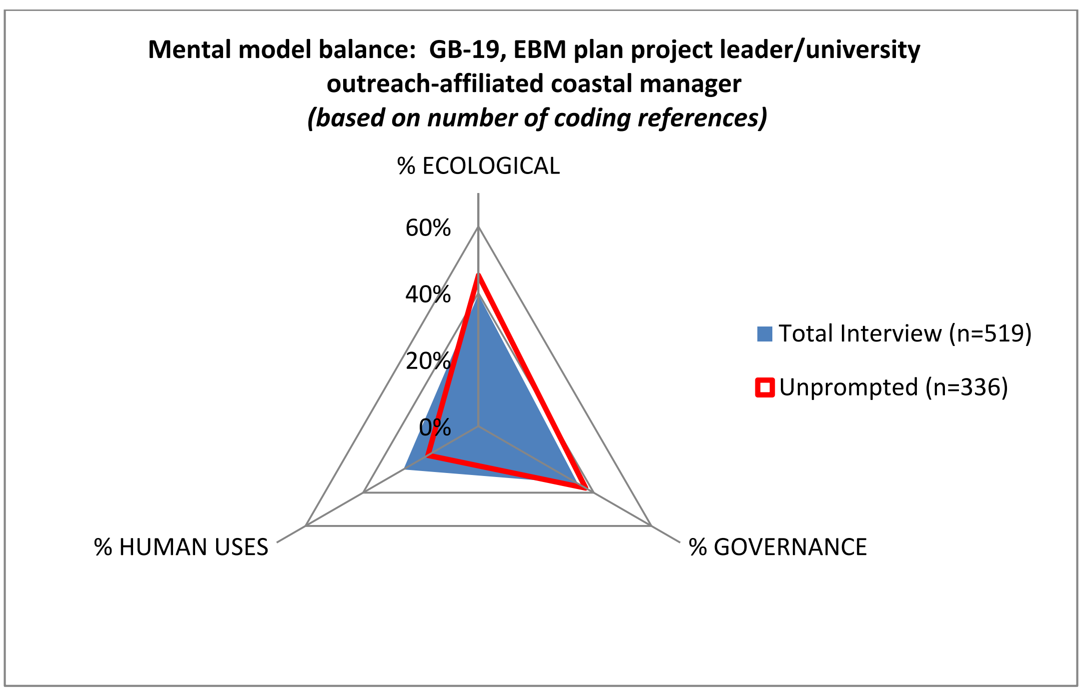

Figure 15. Mental model balance of GB-19, university coastal manager/EBM plan project leader

B. Practitioners who are <u>affiliated with state coastal management programs</u> have *more balanced mental models* than other practitioners.

This hypothesis was found to be true. There were six study participants who were affiliated with the state coastal program – three agency staff and three appointed officials. On average, these six participants had a balance score of 80%, which is slightly higher than the average for all other study participants (n=22) of 77%. However, it is interesting to consider these two groups separately: the agency staff (n=3) have a lower balance score of 76%, whereas the appointed officials (n=3) have a higher balance score of 83%. By contrast, the average practitioner had a balance score of 78%. On average, the agency staff were more focused on ecological matters, with an average score of 37% for the Ecological area of focus. By contrast, the appointed officials were more focused on governance matters, with an average score of 39% for the Governance area of focus. For example, Figure 16 shows the mental model of one such appointed official. See further discussion below.

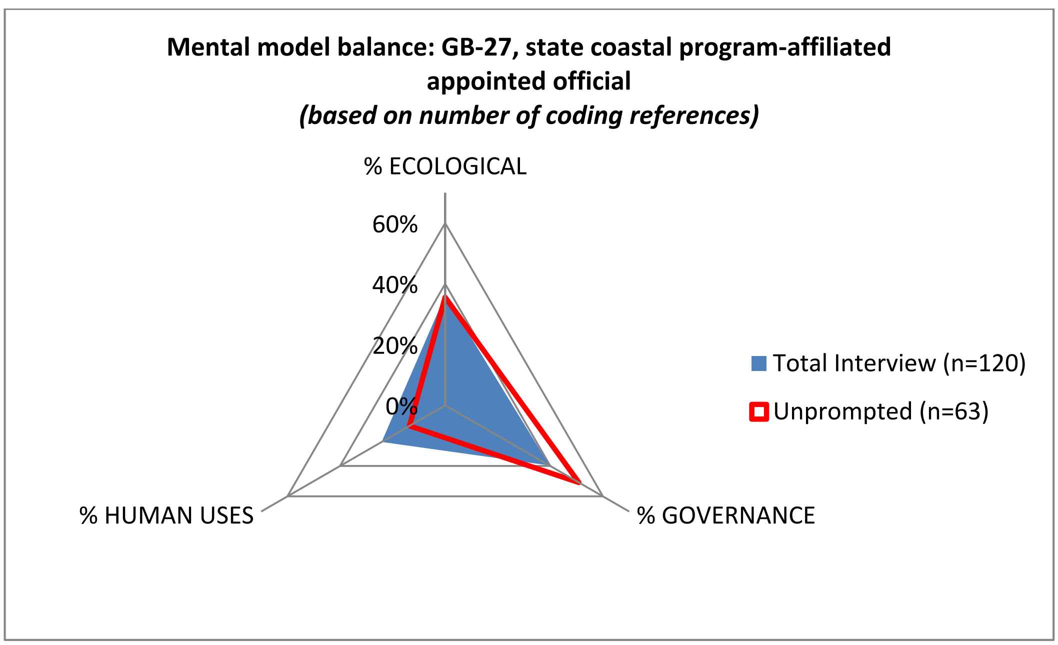

Figure 16. Mental model balance of GB-27, state appointed official

C. **Practitioners whose <u>generalized expertise is in marine resource management</u> have *more balanced mental models* than other practitioners.**

This finding was found to be true. The nine marine resource managers who were interviewed for this study had an average mental model balance score of 78%, which is higher than the average for all other study participants (n=19) of 77%. Marine resource managers' balance scores were, on average, weighted toward the Ecological area of focus, with an average score of 40%, at the expense of the Human Uses area of focus, with an average score of 27%.

D. **Practitioners whose <u>generalized expertise is in the marine sciences</u> have *less balanced mental models* than other practitioners.**

This hypothesis was found to be true. The average balance score for the two marine scientists who participated in interviews was 65%, which is notably less than the average score of 78% for all other participants (n=26). Notably, marine scientists' average scores were much more heavily weighted toward the Governance area of focus, with an average score of 46%, rather than Ecological (average score of 38%), as might have been expected.

5.2.2.3 Unexpected Findings about Mental Model Balance

As with mental model comprehensiveness, there were numerous unexpected findings with regard to the mental model balance of Greenwich Bay SAMP study participants. One finding that stood out is the mental model balance of marine-based business operators/users. With an average balance score of 86%, this group had the most balanced mental models of all study participants (see Table 13). This sub-group also had the highest average score for the Human Use area of focus (30%). Moreover, the low standard deviations associated with this group's scores indicate that there is relatively little variation among their mental models.

Similarly, the mental model balance scores of elected and appointed officials indicate that this group had relatively well-balanced models. The average balance score of the three appointed officials who were affiliated with the state coastal program was reported above; the average for all elected and appointed officials (n=6) was 78%, which is equal to the average and is notably higher than that of many other sub-groups based on affiliation or expertise. Last, the highest balance score was earned by GB-18, who is the only outreach/communications specialist interviewed for this study and who is affiliated with an office of the university that was hired to develop the SAMP. The average balance score for all three participants from this office, the URI Coastal Resources Center/RI Sea Grant, is 90% - substantially higher than any of the other averages based on sub-group.

5.3 The Mental Models of Great South Bay EBM Plan Study Participants

As described in Chapter 4, 13 of the 15 Great South Bay EBM Plan study participants completed mental models interviews which were analyzed for this study. As with the Greenwich Bay SAMP data, the results of coding these interview transcripts were analyzed to investigate the comprehensiveness and the balance of practitioners' mental models. This section includes findings and analysis for Great South Bay EBM Plan study participants' mental models. Discussion follows at the conclusion of this chapter.

5.3.1 Research Question 1a: How Comprehensive Were Practitioners' Mental Models?

5.3.1.1 Overview and Data Summary

As with the Greenwich Bay SAMP, comprehensiveness was assessed by comparing, for each participant, the number of elements of the reference coastal EBM model that the participant identified with the total number of elements. Table 15 shows the summary findings for the mental model comprehensiveness of all Great South Bay EBM Plan study participants. Participants are ranked in order of their overall comprehensiveness score, highest to lowest (values shown in the column highlighted in grey).

Table 15. Summary data: Mental model comprehensiveness of Great South Bay EBM Plan study participants (n=13)

Study Partici-pant	Generalized Affiliation	Generalized Expertise	Ecological		Governance		Human Use		Overall Comprehensiveness	
			% Total Inter-view	% Unprompt-ed	% Total Inter-view	% Unprompt-ed	% Total Inter-view	% Unprompt-ed	% Total Interview	% Unprompted
GSB-06	State govt.	Marine res. mgmt.	0.91	0.74	1.00	0.88	0.85	0.46	0.92	0.69
GSB-04	State govt.	Marine res. mgmt.	0.79	0.74	1.00	0.88	0.77	0.50	0.85	0.70
GSB-10	Local govt.	Envtl. mgmt.	0.76	0.65	0.88	0.81	0.69	0.38	0.78	0.61
GSB-11	Envtl. advocacy	Marine res. mgmt.	0.76	0.47	0.94	0.75	0.62	0.19	0.77	0.47
GSB-03	Envtl. advocacy	Marine res. mgmt.	0.79	0.38	0.81	0.38	0.58	0.15	0.73	0.30
GSB-09	State govt.	Marine res. mgmt.	0.76	0.71	0.88	0.81	0.54	0.35	0.73	0.62
GSB-02	State govt.	Marine res. mgmt.	0.65	0.65	0.88	0.88	0.65	0.38	0.73	0.64
GSB-15	Envtl. advocacy	Marine sciences	0.74	0.62	0.63	0.50	0.73	0.38	0.70	0.50
GSB-07	State govt.	Policy/legal	0.68	0.56	0.81	0.63	0.58	0.27	0.69	0.48
GSB-14	Envtl. advocacy	Marine sciences	0.62	0.59	0.88	0.81	0.50	0.50	0.66	0.63
GSB-08	State govt.	Marine res. mgmt.	0.79	0.76	0.50	0.38	0.58	0.31	0.62	0.48
GSB-05	University-research	Marine sciences	0.74	0.65	0.69	0.69	0.38	0.12	0.60	0.48
GSB-16	Envtl. advocacy	Marine sciences	0.41	0.32	0.44	0.44	0.38	0.38	0.41	0.38

The average comprehensiveness score for Great South Bay EBM Plan study participants (n=13) was 71%. Comprehensiveness scores ranged substantially, much more so than those of the Greenwich Bay SAMP study participants, from a low of 41% to a high of 92%. It is notable that the average comprehensiveness score for the unprompted portions of these interviews was 54%, indicating that on average, participants' comprehensiveness expanded 17% in response to directed questions or prompts. On average, Great South Bay EBM Plan study participants had the highest overall comprehensiveness score in the Governance sub-area of focus (79%), followed by Ecology (72%) and Human Uses (60%). Figure 17 shows the mental model comprehensiveness of the average Great South Bay EBM Plan study participant. Again, the blue shaded area represents the total interview and the red lined area represents the unprompted portion.

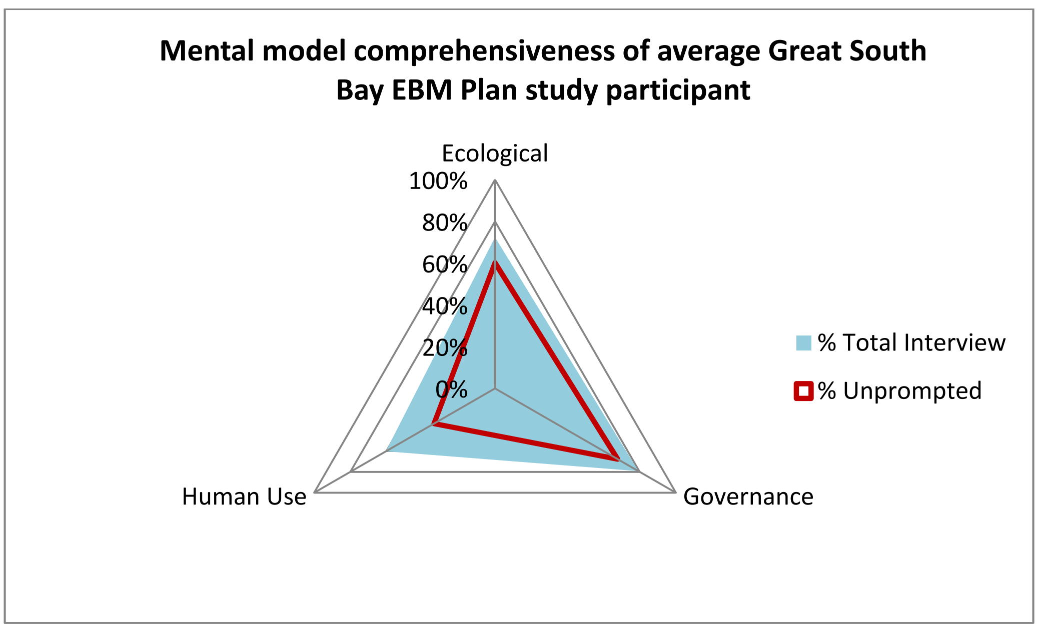

Figure 17. Mental model comprehensiveness of average Great South Bay EBM Plan study participant

Prompts were very important in eliciting the mental model comprehensiveness of Great South Bay EBM Plan study participants – much more so than for the Greenwich Bay SAMP participants. As noted above the average mental model expanded 17% in response to prompts; in one case, that of GSB-03, her mental model expanded 42% in response to prompts. Prompts were especially important at expanding participants' discussion of human uses: the average comprehensiveness score for Human Uses increased 26% in response to prompts. By contrast, comprehensiveness scores for Ecology increased 12% and for Governance increased 11%.

Comprehensiveness scores were also evaluated by sub-group based on generalized affiliation and generalized expertise. Table 16 shows average comprehensiveness scores based on generalized affiliation, in addition to standard deviations for each sub-group. There were many fewer generalized affiliations within the group of Great South Bay EBM Plan study participants than within the Greenwich Bay SAMP study participants. The standard deviations indicate that there is a great deal of variation within each of these subgroups.

Table 16. Average mental model comprehensiveness of Great South Bay EBM Plan study participants grouped by generalized affiliation

Generalized Affiliation	Ecological		Governance		Human Use		Overall Comprehensive-ness	
	% Total Inter-view	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***
Envtl. Advocacy (n=5)	0.66	*0.16*	0.74	*0.20*	0.56	*0.13*	0.65	*0.14*
Local govt. (n=1)	0.76	*n/a*	0.88	*n/a*	0.69	*n/a*	0.78	*n/a*
State govt. (n=6)	0.76	*0.09*	0.84	*0.18*	0.66	*0.12*	0.76	*0.11*
University-research (n=1)	0.74	*n/a*	0.69	*n/a*	0.38	*n/a*	0.60	*n/a*
All participants (n=13)	**0.72**	***0.12***	**0.79**	***0.18***	**0.60**	***0.14***	**0.71**	***0.12***

Table 17, below, shows average mental model comprehensiveness of Great South Bay EBM Plan study participants based on generalized expertise. While analyzing these data in this way does not provide an expanded number of sub-groups, as it did with the Greenwich Bay SAMP, it does divide the participants differently; for example, “marine sciences” includes participants from both universities and environmental advocacy groups.

Table 17. Average mental model comprehensiveness of Great South Bay EBM Plan study participants grouped by generalized expertise

Generalized Expertise	Ecological		Governance		Human Use		Overall Comprehensive-ness	
	% Total Inter-view	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***
Envtl. mgmt. (n=1)	0.76	*n/a*	0.88	*n/a*	0.69	*n/a*	0.78	*n/a*
Marine resource mgmt. (n=7)	0.78	*0.08*	0.86	*0.17*	0.65	*0.11*	0.76	*0.10*
Marine sciences (n=4)	0.63	*0.15*	0.66	*0.18*	0.50	*0.16*	0.59	*0.13*
Policy/legal (n=1)	0.68	*n/a*	0.81	*n/a*	0.58	*n/a*	0.69	*n/a*
All participants (n=13)	**0.72**	***0.12***	**0.79**	***0.18***	**0.60**	***0.14***	**0.71**	***0.12***

5.3.1.2 Hypothesis Testing Based on Mental Model Comprehensiveness

The same hypotheses that were tested for the Greenwich Bay SAMP study participants are tested here for the Great South Bay EBM Plan study participants to present additional insight into research question 1a: *How comprehensive were practitioners' mental models*?

A. Practitioners who were EBM plan project leaders had *more comprehensive mental models* than other practitioners.

This was found to be true. There were two EBM plan project leaders for the Great South Bay EBM Plan: GSB-04, who is affiliated with the state coastal management agency, and GSB-03, who is affiliated with the environmental advocacy organization which was contracted to develop this plan. On average, these two project leaders had a comprehensiveness score of

79%, which is greater than the average score of 69% for all other study participants (n=11). However, there are important differences between these two scores. GSB-04, with a score of 85%, had a significantly more comprehensive score than GSB-03, who had a score of 73%. This is due primarily to the fact that GSB-04 had a more expansive model with regard to Governance (with a score of 100%) and Human Uses (with a score of 77%); see figures 18 and 19 below.

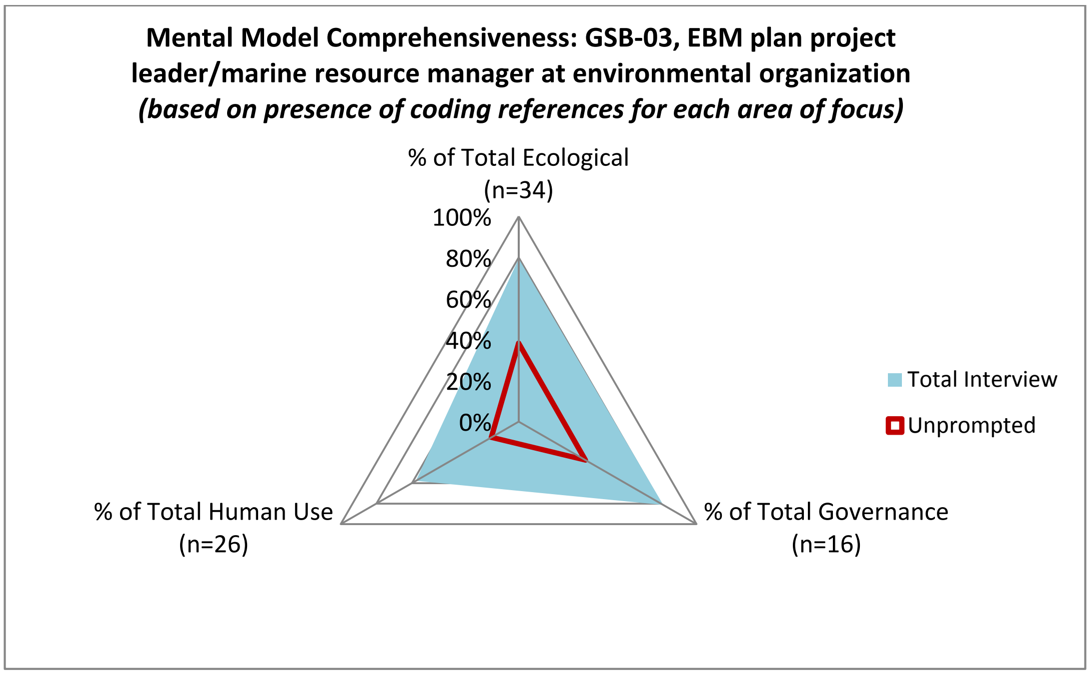

Figure 18. Mental model comprehensiveness of GSB-03, marine resource manager/EBM plan project leader

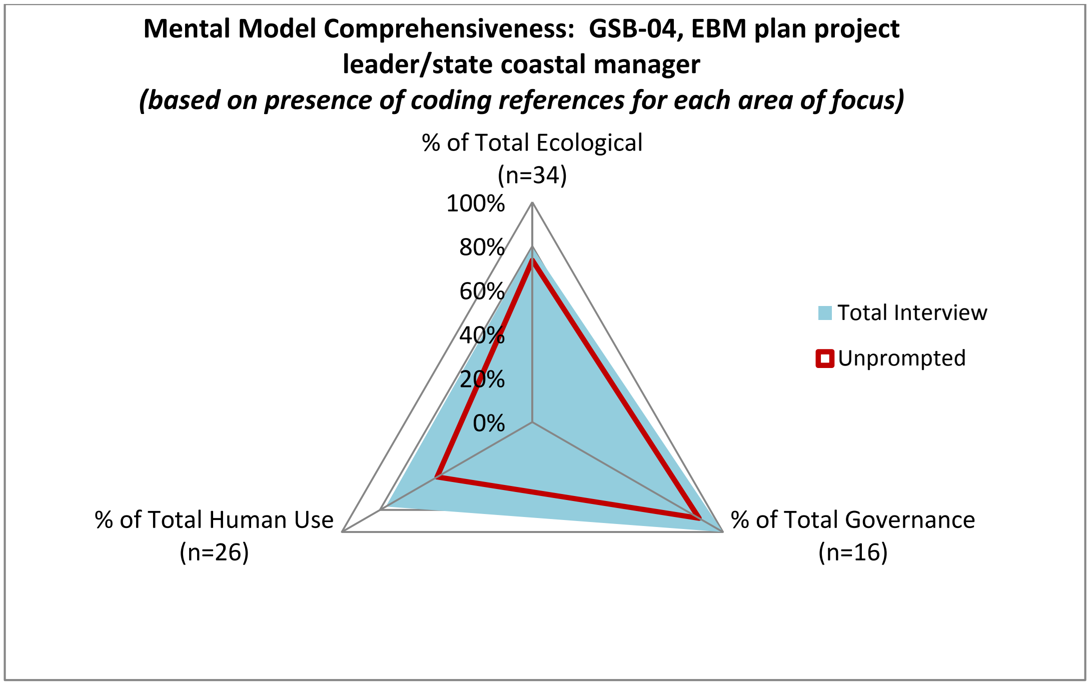

Figure 19. Mental model comprehensiveness of GSB-04, state coastal manager/EBM plan project leader

B. Practitioners who are <u>affiliated with the state coastal management program</u> have *more comprehensive mental models* than other practitioners.

This was also found to be true. Three practitioners who were affiliated with the state coastal management program were interviewed for this study; the average comprehensiveness score for those three practitioners was 76%, which is higher than the average score for all other participants (n=10) of 69%. This reflects generally high scores in the Governance area of focus (90%), and lower average scores in the Ecological (71%) and Human Use (67%) areas of focus. It should be noted that this number includes one of the EBM plan project leaders, who was one of the higher-scoring practitioners with regard to comprehensiveness; when the other two practitioners were considered by themselves, their overall average comprehensiveness score dropped down to 71%.

C. Practitioners whose <u>generalized expertise is in marine resource management</u> *have more comprehensive mental models* than other practitioners.

Hypothesis C was also found to be true. There were seven practitioners in this case whose generalized expertise is in marine resource management; they represented state agencies and programs located both in Albany and on Long Island, as well as some practitioners from environmental organizations. The average comprehensiveness score for these seven practitioners was 76%, whereas the average for all other practitioners (n=6) was 64%. This represents high average scores in the Governance area of focus (86%), the Ecological area of focus (78%) and the Human Use area of focus (65%). These same data are presented in Table 17 above, and show that with the exception of environmental management (n=1), this is the highest-scoring sub-group of this study.

D. Practitioners whose <u>generalized expertise is in the marine sciences</u> have *less comprehensive mental models* than other practitioners.

Hypothesis D was also found to be true. There were four marine scientists involved in this planning effort who participated in this study; their average comprehensiveness score, as shown in Table 17 above, was 59%, which is notably lower than the average for all other participants (n=9) of 76%. This is the lowest average of all of the sub-groups based on expertise. However, there is significant variation among these four scientists' scores – comprehensiveness scores range from 41% to 70% and reflect widely varying scores within the three areas of focus.

5.3.1.3 Unexpected Findings about Mental Model Comprehensiveness

As with the Greenwich Bay SAMP, analysis of the Great South Bay EBM Plan study participants’ mental model comprehensiveness revealed some unexpected findings. For example, government-affiliated coastal and environmental managers who participated in this study had more comprehensive models than other participants. Government-affiliated practitioners (n=7) had an average comprehensiveness score of 76% whereas the remaining practitioners (n=6), including those affiliated with environmental advocacy groups and a university, had an average score of 65%. The top-scoring practitioner was GSB-06, a marine resource manager based on Long Island and affiliated with another state agency who was part of the Great South Bay EBM Plan steering committee; see Figure 20 below.

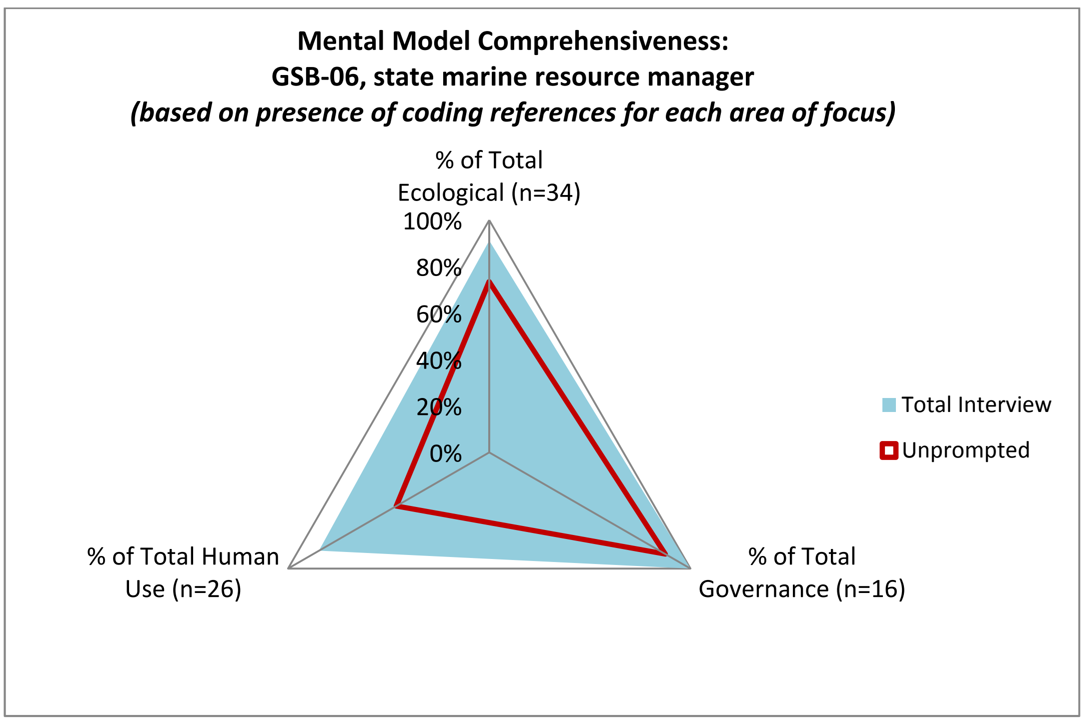

Figure 20. Mental model comprehensiveness of GSB-06, state marine resource manager

Second, practitioners who lived and worked on Long Island, in relatively close proximity to the Great South Bay, had more comprehensive mental models than those who lived and worked elsewhere. Eight of the thirteen participants were based on Long Island; their average comprehensiveness score was 73%, which is higher than the average for other participants (n=5) of 67%. When this was calculated only for marine resource managers or environmental managers based on Long Island, the comprehensiveness score was notably higher at 76%. These higher average scores were reflected in all three areas of focus, Ecological, Governance, and Human Uses. Last, the sub-group based on generalized affiliation with the highest average comprehensiveness score of 76% was local government. However, it should be noted that only one local government employee was interviewed for this study. See further discussion below.

5.3.2 Research Question 2b: How Balanced Were Practitioners' Mental Models?

5.3.2.1. Overview and Data Summary

As with the Greenwich Bay SAMP, the interview transcripts of Great South Bay EBM plan study participants were also used to address research question 1b: *How balanced were practitioners' mental models?* The method by which balance scores were calculated is described in Chapter 4 and is also summarized above in discussion of the Greenwich Bay SAMP data. Table 18 summarizes mental model balance findings for the Great South Bay EBM Plan study participants. Participants are ranked in order of their overall balance scores, which are included in the final column, highlighted in grey.

Table 18. Summary data: Mental model balance of Great South Bay study participants (n=13)

Study Partici-pant	Generalized Affiliation	Generalized Expertise	Ecological		Governance		Human Use		Overall Balance
			% Total Interview	% Unprompted	% Total Interview	% Unprompted	% Total Interview	% Unprompted	(Total Interview)
GSB-11	Envtl. advocacy	Marine res. mgmt.	0.36	0.39	0.40	0.43	0.24	0.17	0.82
GSB-15	Envtl. advocacy	Marine sciences	0.43	0.50	0.28	0.35	0.28	0.15	0.80
GSB-04	State govt.	Marine res. mgmt.	0.34	0.40	0.44	0.45	0.23	0.16	0.79
GSB-02	State govt.	Marine res. mgmt.	0.46	0.58	0.33	0.27	0.21	0.15	0.74
GSB-03	Envtl. advocacy	Marine res. mgmt.	0.47	0.52	0.26	0.38	0.28	0.10	0.73
GSB-16	Envtl. advocacy	Marine sciences	0.48	0.44	0.19	0.16	0.33	0.40	0.71
GSB-14	Envtl. advocacy	Marine sciences	0.46	0.46	0.35	0.37	0.19	0.17	0.71
GSB-06	State govt.	Marine res. mgmt.	0.51	0.60	0.29	0.29	0.20	0.11	0.64
GSB-10	Local govt.	Envtl. mgmt.	0.52	0.58	0.30	0.31	0.17	0.11	0.62
GSB-09	State govt.	Marine res. mgmt.	0.32	0.33	0.54	0.55	0.14	0.12	0.58
GSB-07	State govt.	Policy/legal	0.40	0.45	0.48	0.47	0.12	0.08	0.58
GSB-08	State govt.	Marine res. mgmt.	0.63	0.84	0.16	0.09	0.20	0.08	0.40
GSB-05	University - research	Marine sciences	0.69	0.69	0.22	0.27	0.09	0.03	0.29

The average balance score for Great South Bay EBM Plan study participants was 65% Given that a perfectly balanced mental model would have been 100%, this indicates that Great South Bay EBM Plan study participants had somewhat imbalanced mental models. Table 18 illustrates that there was an enormous range in participants' balance scores, ranging from a maximum of 82% to a minimum of 29%. This is a significantly greater range than that of the Greenwich Bay SAMP study participants. Figure 21 shows the average mental model balance for the average Great South Bay EBM Plan study participant. This figure shows that the average participant's mental model was inclined toward the Ecological area of focus (47%), with a moderate focus on Governance (33%) and a minimal focus on Human Uses (21%). This figure also shows that prompts were important in shifting the balance of practitioners' mental models. The average participant's focus shifted notably away from Ecological (decreasing by 5%) and toward Human Uses (increasing by 7%), thus indicating that when unprompted, these study participants were even more inclined toward the Ecological area of focus.

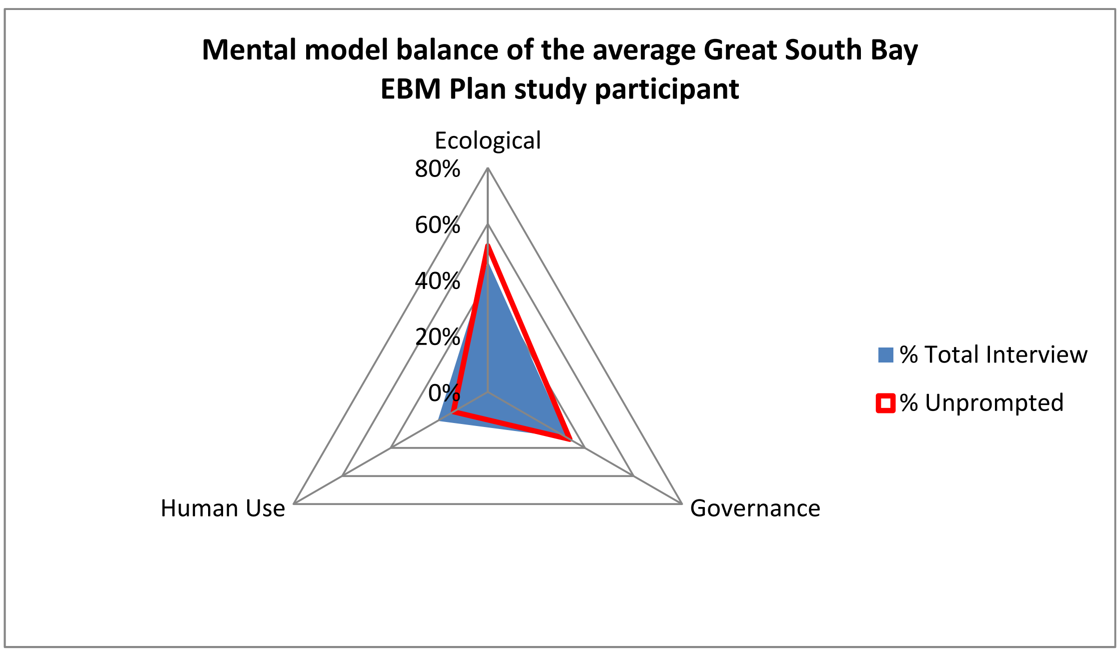

Figure 21. Mental model balance of average Great South Bay EBM Plan study participant

The balance scores of Great South Bay EBM Plan study participants were also examined by sub-group based on generalized affiliation and generalized expertise. Table 19 shows the average mental model balance scores of each sub-group based on generalized affiliation.

Table 19. Average mental model balance of Great South Bay EBM Plan study participants grouped by generalized affiliation

	Ecological		Governance		Human Use		Overall Balance	
Generalized Affiliation	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**(Total Interview)**	***St. Dev.***
Envtl. advocacy (n=5)	0.44	*0.05*	0.30	*0.08*	0.26	*0.05*	0.76	*0.05*
Local govt. (n=1)	0.52	*n/a*	0.30	*n/a*	0.17	*n/a*	0.62	*n/a*
State govt. (n=6)	0.44	*0.12*	0.37	*0.14*	0.18	*0.04*	0.62	*0.14*
University (n=1)	0.69	*n/a*	0.22	*n/a*	0.09	*n/a*	0.29	*n/a*
All participants (n=13)	**0.47**	***0.10***	**0.33**	***0.11***	**0.21**	***0.07***	**0.65**	***0.15***

Table 20 shows the average mental model balance scores of Great South Bay EBM Plan study participants based on generalized expertise. Generalized expertise is a useful consideration for the Great South Bay EBM Plan data in that it distinguishes resource managers from scientists. However, this distinction does not appear to be as important here as it was for mental model comprehensiveness. Marine resource managers had the most balanced mental model score, with an average of 67%, but this is not notably different than marine scientists. Standard deviations also show that there is considerable variation among some of these values.

Table 20. Average mental model balance of Great South Bay EBM Plan study participants grouped by generalized expertise

Generalized Expertise	Ecological		Governance		Human Use		Overall Balance	
	% Total Inter-view	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***	**% Total Inter-view**	***St. Dev.***
Envtl. mgmt (n=1)	0.52	*n/a*	0.30	*n/a*	0.17	*n/a*	0.62	*n/a*
Marine res. mgmt. (n=7)	0.44	*0.11*	0.35	*0.13*	0.21	*0.04*	0.67	*0.15*
Marine sciences (n=4)	0.51	*0.12*	0.26	*0.07*	0.22	*0.11*	0.63	*0.23*
Policy/legal (n=1)	0.40	*n/a*	0.48	*n/a*	0.12	*n/a*	0.58	*n/a*
All participants (n=13)	**0.47**	***0.10***	**0.33**	***0.11***	**0.21**	***0.07***	**0.65**	***0.15***

5.3.2.2. Hypothesis Testing Based on Mental Model Balance Scores

A. Practitioners who are <u>EBM plan project leaders</u> have *more balanced mental models* than other practitioners.

This hypothesis was found to be true. The two project leaders, GSB-03 and GSB-04, had an average mental model balance score of 76%. This is notably higher than the average for other study participants (n=11) of 63%. GSB-04, who is affiliated with the state coastal program, had the more balanced score of 79%, and GSB-03, who is affiliated with the environmental organization who was contracted to develop the plan, had a somewhat lower – but still, on average, very high – balance score of 73%. It is worth noting that GSB-04 and GSB-03's mental models were inclined toward different areas of focus: GSB-04 was much more focused on

Governance, whereas GSB-03 was much more focused on Ecological. It is also notable that GSB-03 was particularly responsive to prompts, and significantly expanded her discussion of the Human Uses area of focus when asked about it. See figures 22 and 23 below.

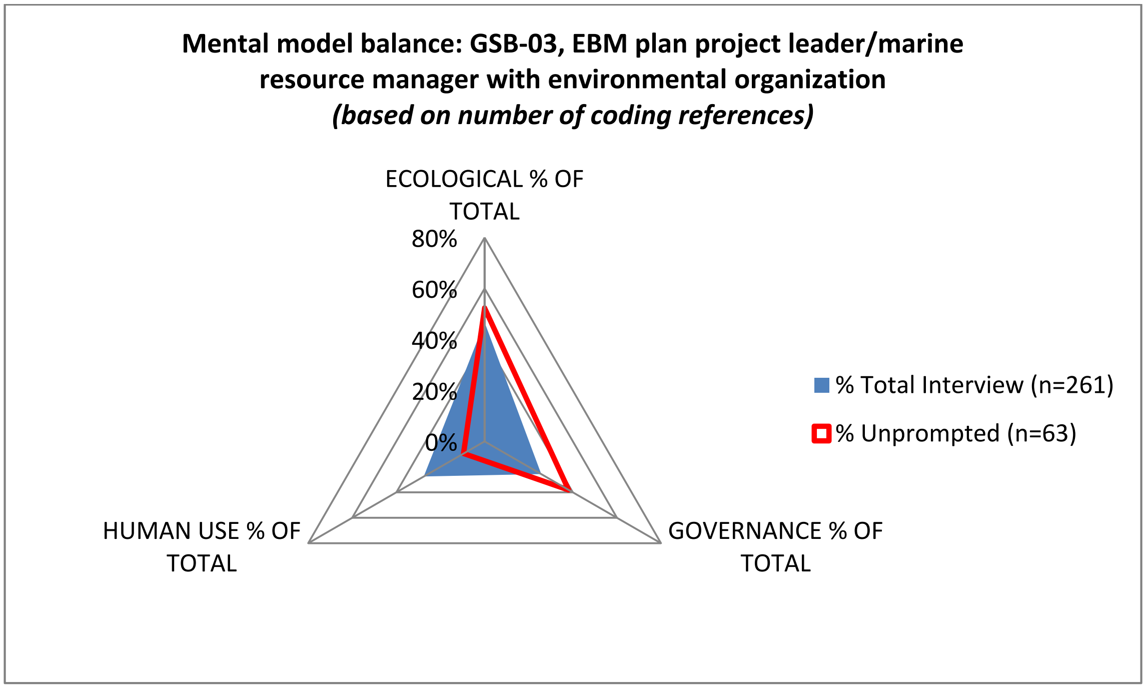

Figure 22. Mental model balance of GSB-03, marine resource manager/EBM plan project leader

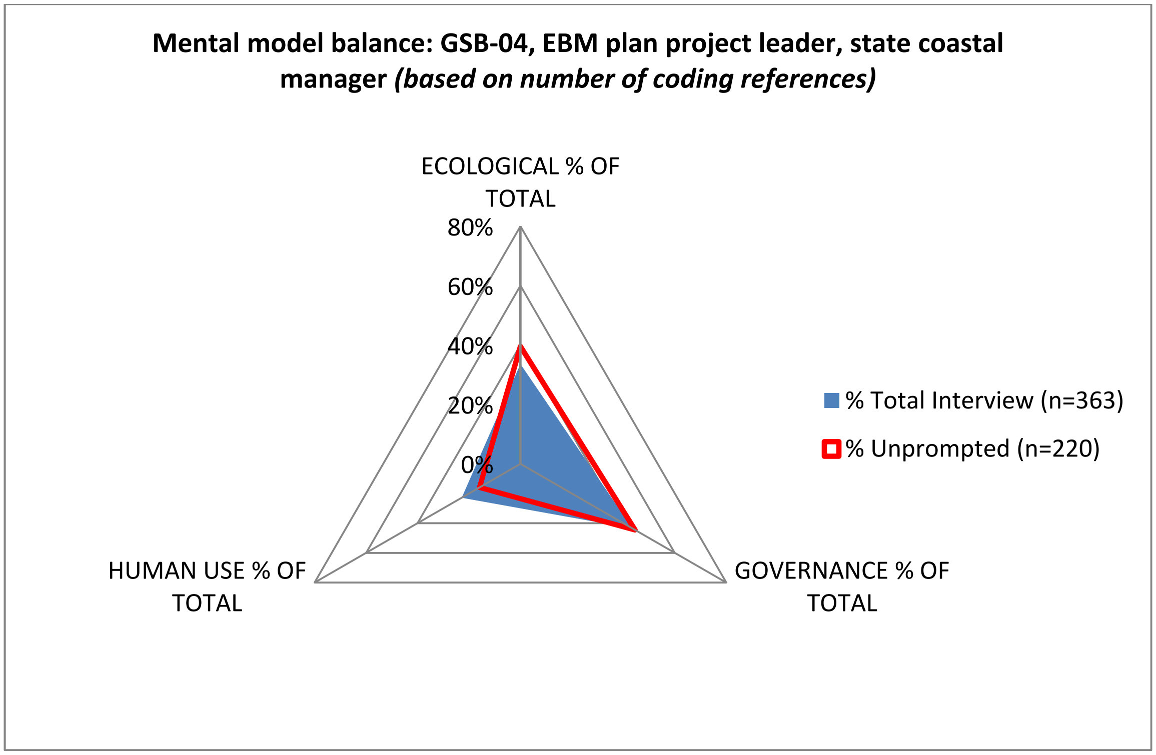

Figure 23. Mental model balance of GSB-04, state coastal manager/EBM plan project leader

B. Practitioners who are affiliated with state coastal management programs have *more balanced mental models* than other practitioners.

This was also found to be true. The three state coastal managers who participated in interviews had an average balance score of 70%, higher than the average for other study participants (n=10) of 63%. Coastal managers' average balance score reflects lower than average scores for Ecological (40%) and higher than average scores for Governance (42%), as well as rather low average scores for Human Uses (19%).

C. **Practitioners whose <u>generalized expertise is in marine resource management</u> have *more balanced mental models* than other practitioners.**

This was also found to be true. The seven marine resource managers who participated in interviews had an average balance score of 67%, which is higher than the average score for all other participants (n=6) of 62%. However, it should be noted that marine resource managers who participated in this planning had relatively imbalanced mental models, with a notably greater focus on ecological content and a minimal focus on human uses (data are summarized in Table 20 above). There is also notable variation within this sub-group, as illustrated by the standard deviation values included in this table. This group includes some outliers including one of the least balanced participants, GSB-08, with a balance score of 40%; see Figure 24.

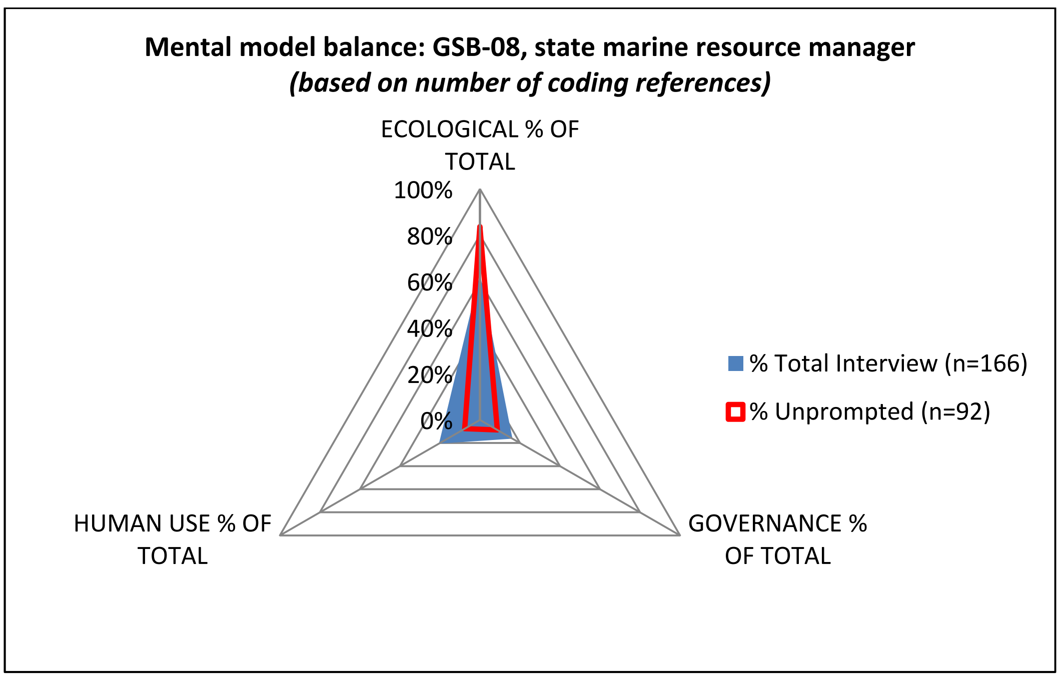

Figure 24. Mental model balance of GSB-08, state marine resource manager

D. **Practitioners whose <u>generalized expertise is in the marine sciences</u> have *less balanced mental models* than other practitioners.**

Last, this hypothesis was found to be true. The four marine scientists interviewed for this study had an average balance score of 63%, which is slightly lower than the average for other study participants (n=9) of 66%. However, this average score is misleading. Of the four marine scientists, three were affiliated with environmental advocacy groups and one was affiliated with a university. These two groups played very different roles in the development of this plan; those affiliated with environmental groups were much more actively involved in drafting the EBM plan than was the university researcher, who was primarily engaged in scientific research that was used to inform the plan. When considered separately, the marine scientists affiliated with environmental advocacy groups had an average balance score of 74% - well above that of other participants. In fact, these marine scientists include some of the most balanced scores of the entire universe of study participants. GSB-15 and GSB-16 also had two of the highest human use scores of all the study participants. By contrast, GSB-05, the university researcher, was an outlier with one of the least balanced models in the group.

5.3.2.3. Unexpected Findings about Mental Model Balance

Analysis of Great South Bay EBM Plan study participants' mental model balance revealed some unexpected findings. Table 19 above illustrates that those affiliated with environmental advocacy organizations had an average balance score of 76%, indicating that these individuals have the most balanced mental models of all Great South Bay study participants. This balance score is in part due to the fact that this group of practitioners had the highest score for the Human Use area of focus (26%) of all sub-groups. The standard deviations associated with this sub-group also indicate that their range of scores was relatively consistent compared to those of the other groups. See below for further discussion.

5.4 Discussion

5.4.1 Overview

This section includes a discussion of the mental models findings reported above. Findings from the two case studies are first compared; additional insights into mental models analysis are then reported. Table 21 presents a summary of average mental model comprehensiveness and balance measures for both cases, and Table 22 summarizes the results of mental models hypothesis testing for the two cases. Both tables illustrate that several relationships hold up across both cases despite the numerous differences in institutional arrangements, number and type of practitioners involved, and scope of the planning effort; alternatively, these results also highlight a number of contrasts and dissimilarities between the two cases. Discussion of these results, including both expected and unexpected findings, is woven into the following discussion which explores mental model comprehensiveness; mental model balance; the relationship between the two; and the importance of prompts in eliciting practitioners' mental models. With all results and discussion, it is important to note that each practitioner's mental model analysis is based on one interview, which took place on one day, regarding one specific ecosystem and collaborative EBM planning effort. While the below results contribute to understanding about the study participants themselves and may provide insight into broader issues and themes regarding coastal management practitioners' mental models, they should be interpreted with caution as they are based on this limited amount of data. See Chapter 8, Conclusions and Recommendations, for further discussion.

Table 21. Summary results of mental model measures for both cases

Mental Model Metric	Greenwich Bay SAMP (n=28)	Great South Bay EBM Plan (n=13)
Mental Model Comprehensiveness		
Overall	71%	71%
Difference between average overall score and average unprompted score	10%	17%
Range of overall comprehensiveness scores	36%	51%
Ecological	66%	72%
Governance	84%	79%
Human Uses	62%	60%
Mental Model Balance		
Overall	78%	65%
Range of overall balance scores	41%	53%
Ecological	35%	47%
Governance	40%	33%
Human Uses	26%	21%

Table 22. Summary results of mental models hypothesis testing for both case studies

Hypothesis	Metric Used	Findings: GB SAMP		Findings: GSB EBM Plan
A1. EBM plan project leaders have *more comprehensive mental models* than other practitioners.	Mental model comprehensiveness score	True		True
A2. EBM plan project leaders have *more balanced mental models* than other practitioners.	Mental model balance score	Not true		True
B1. Those affiliated with state coastal management programs have *more comprehensive mental models* than other practitioners.	Mental model comprehensiveness score	Not true (overall)	True *(professional staff)* Not true *(appointed officials)*	True
B2. Those affiliated with state coastal management programs have *more balanced mental models* than other practitioners.	Mental model balance score	True (overall)	Not true *(professional staff)* True *(appointed officials)*	True
C1. Those whose generalized expertise is in marine resource management have *more comprehensive mental models* than other practitioners.	Mental model comprehensiveness score	True		True
C2. Those whose generalized expertise is in marine resource management have *more balanced mental models* than other practitioners.	Mental model balance score	True		True
D1. Those whose generalized expertise is in the marine sciences have *less comprehensive mental models* than other practitioners.	Mental model comprehensiveness score	True		True
D2. Those whose generalized expertise is in the marine sciences have *less balanced mental models* than other practitioners.	Mental model balance score	True		True

5.4.2 Mental Model Comprehensiveness

The above tables illustrate that the two groups of study participants had the same average overall mental model comprehensiveness score of 71%. This score indicates that the average practitioner in both cases had a moderately well-developed understanding of the various facets of the coastal ecosystems for which they were planning. However, examination of several aspects of these scores reveals some important differences. First, the range of Greenwich Bay SAMP practitioners' scores, 36%, was notably lower than that of the Great South Bay EBM Plan practitioners' scores, 51% - in other words, there was a much greater difference between the highest and the lowest scores in the Great South Bay case. Given that there were over twice as many practitioners in the Greenwich Bay SAMP group, and that this group was considerably more diverse (including business owners/users, citizens, community planners, and others), this suggests that, despite the similarity in average comprehensiveness, this group might have had greater capacity in collaborative EBM planning. Greenwich Bay SAMP practitioners' scores also increased in response to prompts (10%), but not nearly as much as those of the Great South Bay EBM Plan counterparts (17%), indicating that they had fairly comprehensive mental models even when unprompted.

There are notable differences between the two cases' comprehensiveness scores for each area of focus. On the whole, Greenwich Bay SAMP study participants had notably higher scores in Governance (84%) than in the other two areas of focus (62% for Human uses and 66% for Ecological). As described in Chapter 4, the Governance area of focus includes government agencies and activities as well as stakeholders. Greenwich Bay SAMP participants' high score in this area may reflect the fact that the three-year Greenwich Bay SAMP process, as described in Chapter 3, involved an intensive stakeholder process through the Citizen's

Advisory Committee, as well as extensive interagency involvement through the Technical Advisory Committee. For these reasons it is not surprising that practitioners were more oriented toward the Governance aspects of this process.

While Great South Bay EBM Plan study participants had a high Governance score as well (79%), they had a higher Ecological score (72%) than their Greenwich Bay counterparts. This might be explained by the nature of the Great South Bay EBM Plan effort: the plan was drafted by an environmental advocacy organization, and the content of the plan, as described in Chapter 3, is focused primarily on key ecological resources and threats to these resources. It is also worth noting that this plan was drafted in response to a new state law mandating ecosystem-based management, and that most study participants volunteered some insights on the concept of ecosystem-based management during their interviews. Although New York State had adopted a definition of EBM that explicitly included human considerations (see Chapter 3), these findings suggest that Great South Bay EBM Plan practitioners may view EBM with a somewhat greater focus on the Ecological area of focus.

In this regard, it is also notable that in both cases, practitioners' mental models were least comprehensive with regard to human uses (62% for Greenwich Bay; 60% for the Great South Bay). Moreover, of all three of the areas of focus, prompts were especially important in encouraging most practitioners to expand their discussion of human uses. In the case of the Great South Bay participants, average human use comprehensiveness scores increased 26% in response to prompts. This lack of comprehensiveness in recognizing the role of human uses speaks to the broader debate within the EBM literature on the role of humans in the ecosystem (e.g. Endter-Wada, et al., 1998); see Chapter 2 for further discussion of literature and below for further discussion of these findings.

Only one of the hypotheses tested above resulted in unexpected findings regarding mental model comprehensiveness. As predicted, for both cases, EBM plan project leaders, those affiliated with state coastal management programs, marine resource managers, and marine scientists all had more comprehensive mental models than the average practitioner. The one important exception to this was discovered when testing the hypothesis about those affiliated with state coastal management programs: appointed officials affiliated with the coastal program had less comprehensive mental models than the average practitioner. This is not surprising given the unique role these appointed officials play. Unlike New York, Rhode Island's coastal management program is administered by a council, a quasi-judicial entity comprising appointed members who represent the public and state and local government, which makes final decisions on approving plans, policies, regulations, and other state agency matters. These officials arguably have more in common with other state or local elected or appointed politicians than with the agency's professional staff of subject matter experts. However, their low average mental model comprehensiveness is an important finding as it suggests that this Council may have relatively low capacity for developing coastal EBM plans. See Chapter 7 for further discussion.

Last, there were some unexpected and surprising findings regarding mental model comprehensiveness. Among the Greenwich Bay SAMP study participants, community planners, citizens, and business operators/users were some of the practitioners who had the most comprehensive mental models. This may be because all three of these groups are likely to have had strong local knowledge of the Greenwich Bay area, and in particular of the upland portions of the area. Community planners, who are affiliated with local governments and who typically focus more on upland matters such as land use, transportation, and development, would be expected to have comprehensive mental models of upland resources and uses, as well as the governance processes shaping their management. It may be that planners are also proficient at the interdisciplinary approach of EBM because they have been trained this way – planning education programs tend to have a strong interdisciplinary emphasis (e.g. Dalton, 2001). For this reason they may be so accustomed to understanding the ecological, governance, and human uses aspects of their towns that it is second-nature for them to apply this thinking to in-water resources and uses.

Marine-based business operators/users and citizens are also uniquely positioned to understand both the upland and in-water aspects of coastal ecosystems. A marina owner or shellfisherman, whose income relies on using coastal waters and resources, is likely to be intimately familiar with his own and other human uses of an area; the permits, regulations, and other governance aspects of such activities; and the nature of the resource itself. Similarly, a citizen who lives in a coastal community, is an active user of the nearby waters, and who actively participates in a coastal EBM planning process is uniquely positioned to understand both the upland and in-water aspects of coastal ecosystems. The comprehensiveness of users and citizens' individuals' mental models underscores the importance of stakeholder involvement in EBM initiatives (e.g. Leslie & McLeod, 2007). It also highlights an irony in this study: users and citizens were found to have the most balanced mental models, but human uses were the least well-developed parts of practitioners' mental models. Together, these findings about community planners, business owners/users, and citizens highlight the importance of involving individuals with local knowledge in coastal EBM planning efforts, as these individuals may be especially important in filling in the gaps in other practitioners' knowledge regarding upland activities and human uses. See below for further discussion of human uses in mental models, and see Chapter 6 for further discussion of the ways in which these and other practitioners collaborated to develop these plans.

5.4.3 Mental Model Balance

As a whole, there were many more unexpected and surprising findings with regard to mental model balance. This suggests that mental model balance may be a somewhat complex measure to elicit and interpret. Only one practitioner, GB-18, a university outreach/communications specialist, appears to have a nearly perfectly balanced mental model. On average, Greenwich Bay SAMP study participants had more balanced mental models, with an average balance score of 78%, when compared to Great South Bay EBM Plan study participants (65%). Balance scores for both groups of study participants were widely distributed, though Great South Bay EBM participants had a wider range (53%). This is consistent with the wide range of comprehensiveness scores for these practitioners discussed above, and is, again, notable given the distinctly smaller number of practitioners who participated in the Great South Bay EBM Plan.

Balance scores for each sub-area of focus show that Greenwich Bay SAMP study participants' mental models were weighted toward Governance (with a score of 40%), whereas Great South Bay EBM Plan participants were weighted toward Ecological (with a score of 47%). These findings are, again, more or less consistent with above findings regarding mental model comprehensiveness. Greenwich Bay SAMP participants had more comprehensive views of governance, and placed more emphasis on this during their interviews, likely because of the nature of the planning process. By contrast, Great South Bay EBM Plan participants had rather comprehensive views of ecological content, and placed significant emphasis on these resources and problems during their interviews. In both cases, participants placed least emphasis on human uses, though this was more pronounced for the Great South Bay EBM Plan (21%) than for the Greenwich Bay SAMP (26%).

Hypothesis testing revealed numerous unexpected findings regarding mental model balance. Not all EBM plan project leaders had well-balanced mental models; in fact, GB-11 had the least well-balanced model of his entire group of practitioners, which is a notable contrast to his high comprehensiveness score. This may be explained by the complex relationship between mental model comprehensiveness and mental model balance, which is further discussed below. There were numerous other surprising findings in the case of the Greenwich Bay SAMP. For example, state coastal program staff (76%) had less well-balanced mental models than other practitioners in that case. However, this finding is somewhat misleading, as the average Greenwich Bay SAMP study participant had a relatively high balance score of 78% (in comparison to the Great South Bay EBM average score of 65%). This finding highlights the strong capacity that the Greenwich Bay SAMP practitioners, as a whole, seemed to have with regard to conceptualizing coastal EBM and developing coastal EBM plans.

Hypothesis testing revealed some surprise findings for the Great South Bay EBM Plan as well. Marine scientists who were affiliated with environmental advocacy groups had relatively well-balanced mental models. This may be due to the fact that marine scientists who are affiliated with environmental advocacy groups are more likely to participate in numerous EBM planning efforts or other coastal management initiatives throughout their careers. As a result, they may become more conversant in the governance and human use aspects of an ecosystem. Moreover, these scientists are likely influenced by the advocacy orientation of their organizations, and may even have been drawn to work for those organizations because of that. This finding suggests that marine scientists affiliated with environmental advocacy groups may have very different ways of thinking than university scientists, and as such, may play very important roles in collaborative EBM planning processes. See Chapter 6 for further discussion of the role these individuals played within the Great South Bay network.

There were numerous other unexpected findings regarding mental model balance. Business operators/users were found to have some of the most balanced mental models of all sub-groups across both case studies. This finding may be related to the relatively high comprehensiveness of most business operators/users' mental models, discussed above. Users are very familiar with human activities in the Greenwich Bay area, but their professions also require them to consider their reliance on ecological resources, as well as how governance processes and decisions shape their work. For example, Figure 25 shows the mental model of a business operator/user who is a shellfisherman and representative of his trade. He, like the other two business operators/users, participated in the Greenwich Bay SAMP through the rigorous stakeholder process. That these users had such balanced models again underscores the importance of engaging stakeholders in EBM planning processes (e.g. Leslie & McLeod, 2007). See Chapter 6 for discussion of the ways these practitioners collaborated to develop coastal EBM plans.

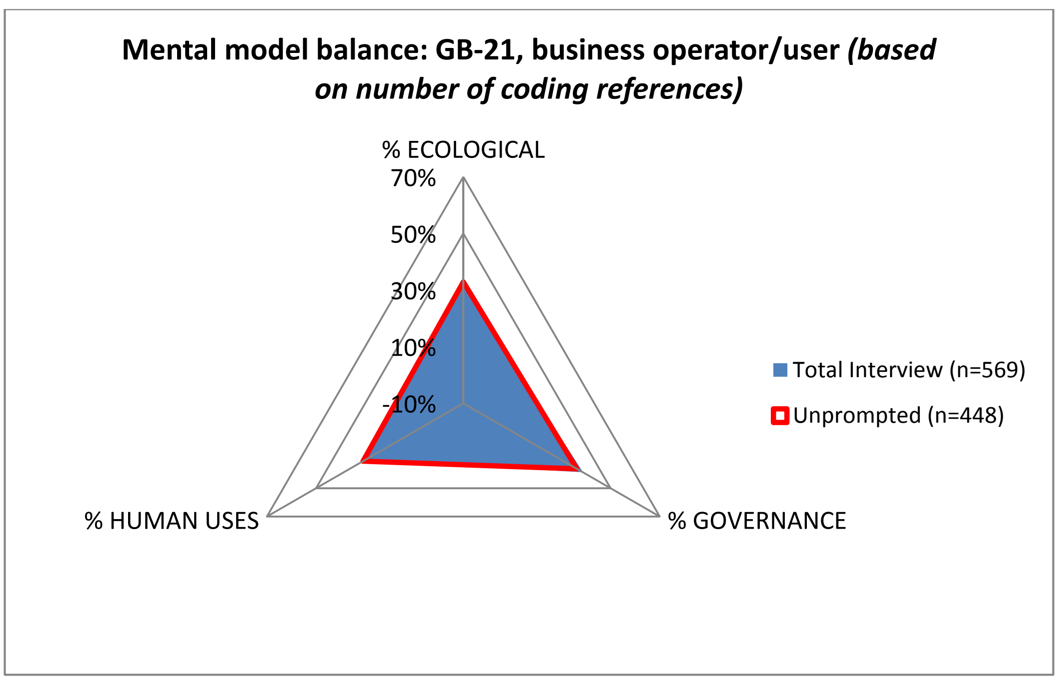

Figure 25. Mental model balance of GB-21, business operator/user

5.4.4 Mental Models and Human Uses

Comparison of mental model comprehensiveness and balance scores for all study participants revealed that the vast majority of study participants in both cases were lacking in the human uses area of focus – nearly all practitioners' mental models were less comprehensive in this area, and were weighted toward either the ecological or governance area of focus. Moreover, of all of the areas of focus, participants' discussion of human uses expanded most significantly in response to topic-specific prompts. This is notable and suggests that, for the most part, human uses were not as prominent a part of any of these participants' mental models.

Further examination of these findings revealed that practitioners were more commonly able to identify in-water human activities like fishing and recreational boating, but spoke very little about upland uses like residential development or transportation, even when speaking about associated environmental problems like stormwater runoff. This is notable, and suggests a fundamental disconnect between upland and in-water activities and impacts – practitioners were not even thinking about basic watershed linkages, much less broader ecosystem connections. This lack of attention to human uses is also notable within the broader context of EBM. On the one hand, some of the EBM literature is arguably rather biocentric in focus (e.g. Grumbine, 1994) and there has been extensive debate about the role of humans in the ecosystem (see e.g. Endter-Wada, et al., 1998; Hyun, 2009). On the other hand, in their review of marine EBM plans, Arkema et al. (2006) found many more detailed human activity objectives than ecological or management-related objectives. The reasons for this inconsistency are unclear and merit further consideration, in both the scholarly literature and the practice of EBM, about how to incorporate human activities into an EBM approach.

5.4.5 Integrating Comprehensiveness and Balance

Mental model comprehensiveness and balance scores present very different aspects of practitioner's mental models of coastal ecosystems. As noted above, balance in particular has proven to be a somewhat complex aspect of practitioners' mental models and may best be understood within the context of its relationship to mental model comprehensiveness. Comprehensiveness, measured by whether a practitioner identified each element of the reference coastal EBM model, provides an indication of what practitioners know about and consider valid with regard to coastal EBM planning. By contrast, balance, or lack thereof, which is measured by the number of times a practitioner identified elements of the reference model within each area of focus, may provide insight into what an individual feels is most important. However, depending on the individual, importance may reflect either the individual's understanding of policy problems that are important and worthy of her attention, or the individual's bias, which may be shaped by his disciplinary background, training, or other considerations. The individual's comprehensiveness may provide insight into what their balance score actually reflects. The relationship between comprehensiveness and balance may best be understood by considering the four different ways the two may be combined, and the role each type of practitioner may play as part of a collaborative coastal EBM planning effort.

Comprehensive but imbalanced: One type of practitioner's mental model is comprehensive but imbalanced. A practitioner may demonstrate awareness and understanding of all of the various factors that must be considered in coastal EBM planning, but may spend most of his time and energy focusing on a few particular issues within one of the EBM areas of focus. Consider, for example, GB-11: Figure 10 above shows that he has a very high level of comprehensiveness, and Figure 14 above shows that he has a very imbalanced model with a particular focus on ecological matters. This suggests that GB-11 knows all of the different aspects of the model, but focuses on a few key ecological matters which he may see as requiring most of his attention. In this case, balance may reflect the individual's problem orientation (e.g. Clark, 2002). GB-11 is both a project leader and a state agency manager; Kingdon (1995) notes that public managers tend to only focus on a limited "agenda," or discrete number of policy problems, at any one time. For this reason it is logical that GB-11 and many other practitioners would focus on some aspects of a coastal ecosystem to the exclusion of others. The mental models approach raises the question of how, or why, an individual focuses on a given set of problems: is it because those problems are part of a broader policy agenda (see Kingdon, 1995)? Or is it because of the individual's disciplinary bias or some other factor? It also suggests that an individual with a narrow problem orientation may not be best suited for leading a coastal EBM planning effort, and that public managers may, in reality, have limited capacity to adopt the comprehensive view required of EBM.

Balanced but not comprehensive: Another type of mental model is very balanced but not very comprehensive. One such individual may be focused on just a few key aspects of the ecosystem, but views them in a multidimensional way, considering all three of the areas of focus. GB-21, the shellfisherman discussed above, is one such example. Figure 25 above shows how GB-21 has a very well-balanced mental model. However, GB-21 has one of the least comprehensive mental models, with an overall comprehensiveness score of 63%. It is logical that this type of mental model would be expected for a business operator or user – the nature of their activity requires that the individual knows his activity well, and understand it from various perspectives. This type of practitioner would be a valuable participant in a coastal EBM planning process – they would contribute their in-depth knowledge of their activity, and perhaps be able to work and negotiate with individuals of different background and areas of expertise - but would not be appropriate for leading such an effort as they would not have a sufficiently comprehensive understanding of the coastal ecosystem. This illustrates the importance of including diverse stakeholders and users in a collaborative EBM planning process.

Neither balanced nor comprehensive: A third type of mental model is neither very comprehensive nor very balanced. GB-27, who is a state appointed official, is a good example of this. Figure 14 above shows how GB-27's mental model is heavily weighted toward the governance area of focus –and that this is especially pronounced for his default mental model, as elicited through the unprompted portion of the interview. In addition, GB-27's mental model comprehensiveness is 55% - the lowest of all Greenwich Bay study participants. In this case, balance may reflect a practitioner's bias or limited scope of knowledge and experience, rather than his choice to focus on certain key policy problems. It is not entirely surprising that a state appointed official would be focused on governance matters to the exclusion of ecological and human use consideration, and would not have a comprehensive mental model of coastal ecosystems. However, such a person may have limited capacity to contribute much to a coastal EBM planning effort, and it would be important for such individuals to constitute only part of an otherwise diverse group of practitioners.

Both balanced and comprehensive: A fourth type of mental model may be both very comprehensive and very balanced. GB-19, one of the EBM project leaders, is a good example of this; she had the most comprehensive mental model of all Greenwich Bay SAMP study participants, and also had one of the highest balance scores (85%). Again, these attributes are logical for this practitioner: she is affiliated with an outreach office of the university, and was in charge of facilitating the Greenwich Bay SAMP stakeholder group as well as the engagement of other agencies, organizations, and experts in the planning process. Arguably, this type of mental model is ideal for an EBM plan project leader. This person recognizes the complexity of a coastal ecosystem, and also seems to employ a balanced approach that enables her to understand different points of view, and perhaps even negotiate complex agreements or consensus between diverse user groups.

Consideration of these different types of mental models raises the question of what role individual practitioners played in their respective collaborative EBM planning processes; see Chapter 6 for further discussion of practitioners' social networks. This discussion also raises the question of what can be done to build the capacity of those who may need to improve their comprehensiveness or their balance. These matters are further discussed in Chapter 8, Conclusions and Recommendations.

5.4.6 The Importance of Prompts

Prompts played an important role in assessing the mental model comprehensiveness and balance of all study participants. In all cases, topic-specific prompts caused practitioners' mental models to expand in comprehensiveness, and in almost all cases to shift in balance, thus conveying a broader and more balanced view of coastal ecosystems. This indicates that prompts were a very important part of this study methodology and require further discussion. The mental models analytical method of interviewing participants and distinguishing between open-ended and prompted questions and prompts is based on the work of Morgan et al. (2002), yet these authors do not delve deeply into how to interpret the difference between the two types of input. In some ways, prompts resemble the types of questions or ideas that would be raised through a collaborative process, and an individual's responsiveness to prompts, or lack thereof, may provide insight into how receptive he or she would be to these questions or ideas, and in general to the experience of working with others of different affiliations and areas of expertise, during such a process.

It is also notable that prompts did not have much of an effect in certain circumstances. Certain individuals were more open to prompts than others; if, as discussed above, being prompted in an interview is similar to being asked a question through a collaborative planning process, then an individual who expands or shifts her mental model in response to a prompt may be receptive to others with different views during group processes. Conversely, one whose mental model balance does not shift in response to prompts may not be as open or receptive to others during group processes. This raises the question of what can be done to enhance the capacity of coastal management practitioners who may be less receptive to the views of others (see Chapter 8 for further discussion). This also raises the question of how practitioners actually did work together to develop the coastal EBM plans. The next chapter addresses this question by presenting findings and discussion from the social network analysis component of this study.

Chapter 6. Social Network Analysis

6.1 Overview

As described in Chapter 4, social network analysis methods were applied to the networks of practitioners within each of the two case studies to provide insight into research question 2:

How did practitioners collaborate with others to develop the coastal EBM plan?

This overarching question is investigated in this chapter through two sub-questions:

(2a) To what extent were practitioners collaborating with others?, and

(2b) To what extent were practitioners collaborating with others of different affiliations and different areas of expertise?

These questions are addressed in part through a series of hypotheses which are detailed below. This chapter addresses these questions through presentation of the findings and discussion for the social network analysis components of both case studies.

Social network analysis provides insight into collaboration by allowing for a systematic analysis of the "internal deliberations" of collaborative processes (Hartley, et al., 2008). Ties between actors provide insight into communication and the exchange of information, ideas, and resources (Wasserman & Faust, 1994). Exchange of information, ideas and resources toward the solution of a common problem is one fundamental attribute of collaboration, and scholars have found networks to be effective means through which knowledge, information, and ideas can be exchanged (e.g. Bodin & Crona, 2009; Isaac, et al., 2007). Actor centrality measures provide insight into the position and influence of individual actors within a network, thus indicating how influential each actor is in disseminating information and ideas, as well as in receiving information and ideas (Hanneman & Riddle, 2005). Degree centrality, which is a measure of an individual actor's connections in the network, may be considered a measure of an actor's capacity to develop communication within the network (Degenne & Forse, 1999). Betweenness centrality, which measures the extent to which an actor is "between" other actors in the network, provides insight into which actors may act as brokers or gatekeepers in a network, thus exerting control over the flow of information within a network (Scott, 1991). Egonet homophily measures provide further insight into this exchange of information and ideas by measuring the extent to which actors exchange information with people of similar or dissimilar attributes (Degenne & Forse, 1999). Diversity has been found to be critical for the development of resilient networks that are equipped to develop solutions to complex environmental problems (e.g. Newman & Dale, 2005).

Chapter 4 describes the methods by which study participants were identified and social network analysis data were collected for this study. The below findings and discussion are focused on participants' responses to the central network analysis survey question, "Tell us about the people you worked with during the development of the Greenwich Bay SAMP [Great South Bay EBM Plan]." It is important to note that in both cases, study participants frequently identified other actors who were neither surveyed nor interviewed for this study.[31] As network analysis requires discussion of the complete network of actors, results for the entire network will be presented. However, discussion – which focuses on the research questions and related

[31] The method by which study participants were selected is detailed in Chapter 4, Methodology. The modified snowball sampling method was designed to focus on the core participants in both case studies and to sift out those who were marginally involved or uninvolved. Network analysis results corroborate that this method captured the core of both networks; see discussion throughout this chapter.

hypotheses – focuses for the most part on the network roles and attributes of the study participants themselves.

As outlined in Chapter 1, the hypotheses which are tested here to address the above research questions focus on four sub-groups of the coastal management practitioners who participated in this study. These four sub-groups are: EBM plan project leaders; those affiliated with state coastal management programs; those whose generalized expertise is in marine resource management; and those whose generalized expertise is in the marine sciences. Project leaders are a logical focal point, as they would be expected to have extensive and diverse networks through which they collaborated to develop these coastal EBM plans. Those affiliated with state coastal management programs are of interest because of the central role of these state programs in leading and developing these plans. As discussed in Chapter 4, state coastal management programs were intended to be intergovernmental, collaborative programs; accordingly it would be expected that state coastal managers had extensive and diverse networks through which they collaborated to develop these plans. Those whose expertise (based on both training and job responsibilities) is in marine resource management, whether they are working for a state coastal program or other entity, would similarly be expected to have extensive and diverse networks because of the inherently integrated nature of managing marine resources within the complex governance environment described in Chapter 4. Finally, those whose expertise (based on both training and job responsibilities) is in the marine sciences, who may be affiliated with universities or other entities, would NOT be expected to have extensive and diverse networks within the context of a collaborative EBM planning process because of their focus on scientific research, rather than on management and planning processes. Hypotheses relating to these four sub-groups are tested in this chapter for the two different case studies.

It is important to interpret social network analysis data with caution. Aggregated study participant responses provide just one static picture of each network, based on who participants could remember when they completed the survey. It is likely that in both cases, both networks expanded and contracted over the multi-year planning processes: expanded, in the sense that more practitioners became actively engaged and developed strong working relationships with each other; and contracted, in the sense that those with an initial interest in the process may have dropped out over time due to participation fatigue. Indeed, during the mental models interviews, numerous study participants in both cases suggested that the latter occurred, especially in the case of the Greenwich Bay SAMP. The networks presented here provide just static characterizations of what were likely very dynamic networks.   Moreover, it is important to interpret the network measures reported below with caution. As will be described below, the Greenwich Bay SAMP and the Great South Bay EBM Plan networks were found to be dramatically different in size and diversity. In a smaller network, it is theoretically easier for actors to be well-connected and influential. Additionally, in a more diverse network, it is theoretically easier to be connected with many individuals of varying affiliations and expertise. See below for further discussion about caution in interpreting each of the different network measures.

6.2 The Greenwich Bay SAMP Social Network

6.2.1 Overview

As described in Chapter 4, 32 coastal management practitioners were surveyed for the Greenwich Bay SAMP case study. The complete Greenwich Bay SAMP network dataset revealed a network comprising 100 actors representing 35 different agencies, organizations, or programs.[32] See Figure 26 for an illustration of this network of actors which highlights those who were also study participants. This figure visually conveys that the sampling strategy was effective in identifying and gaining input from all of the core members of the Greenwich Bay SAMP network. Figures 27 and 28 shows the same network but with actors color coded by their generalized affiliation and generalized expertise, respectively; these figures visually convey the diversity of actors involved in this network (see below for further discussion of network composition).

[32] As noted in Chapter 4, a slightly higher number of study participants were surveyed than were interviewed. For the Greenwich Bay SAMP, 28 participants were interviewed and 32 were surveyed. For the Great South Bay EBM Plan, 13 were interviewed and 15 were surveyed. See Chapter 4 for further explanation.

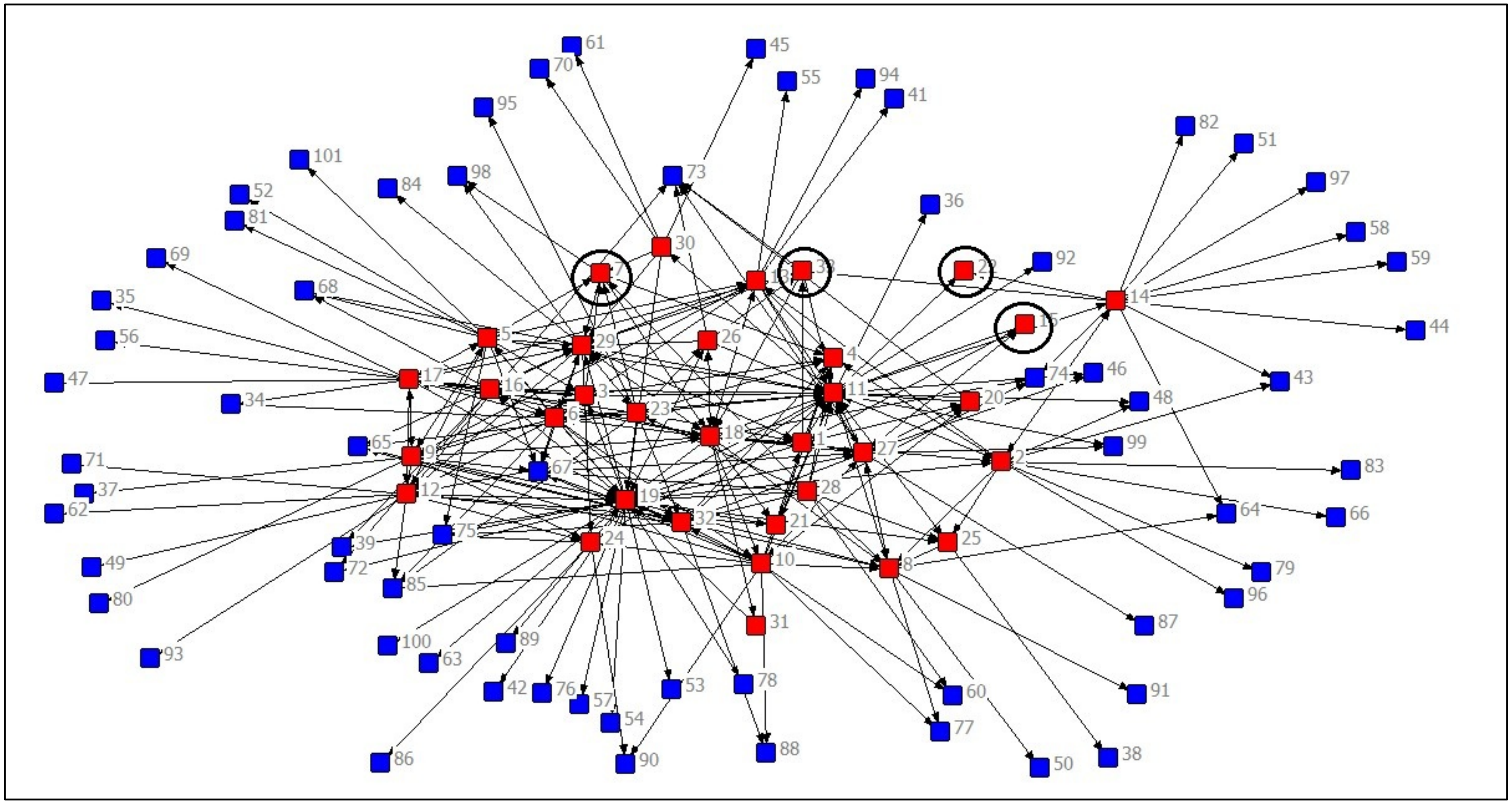

Figure 26. Greenwich Bay SAMP complete network with study participants highlighted

Red = participated in study; blue = did not participate in study; circled = completed a survey but did not participate in an interview. See study participant selection method outlined in Chapter 4 for further information.

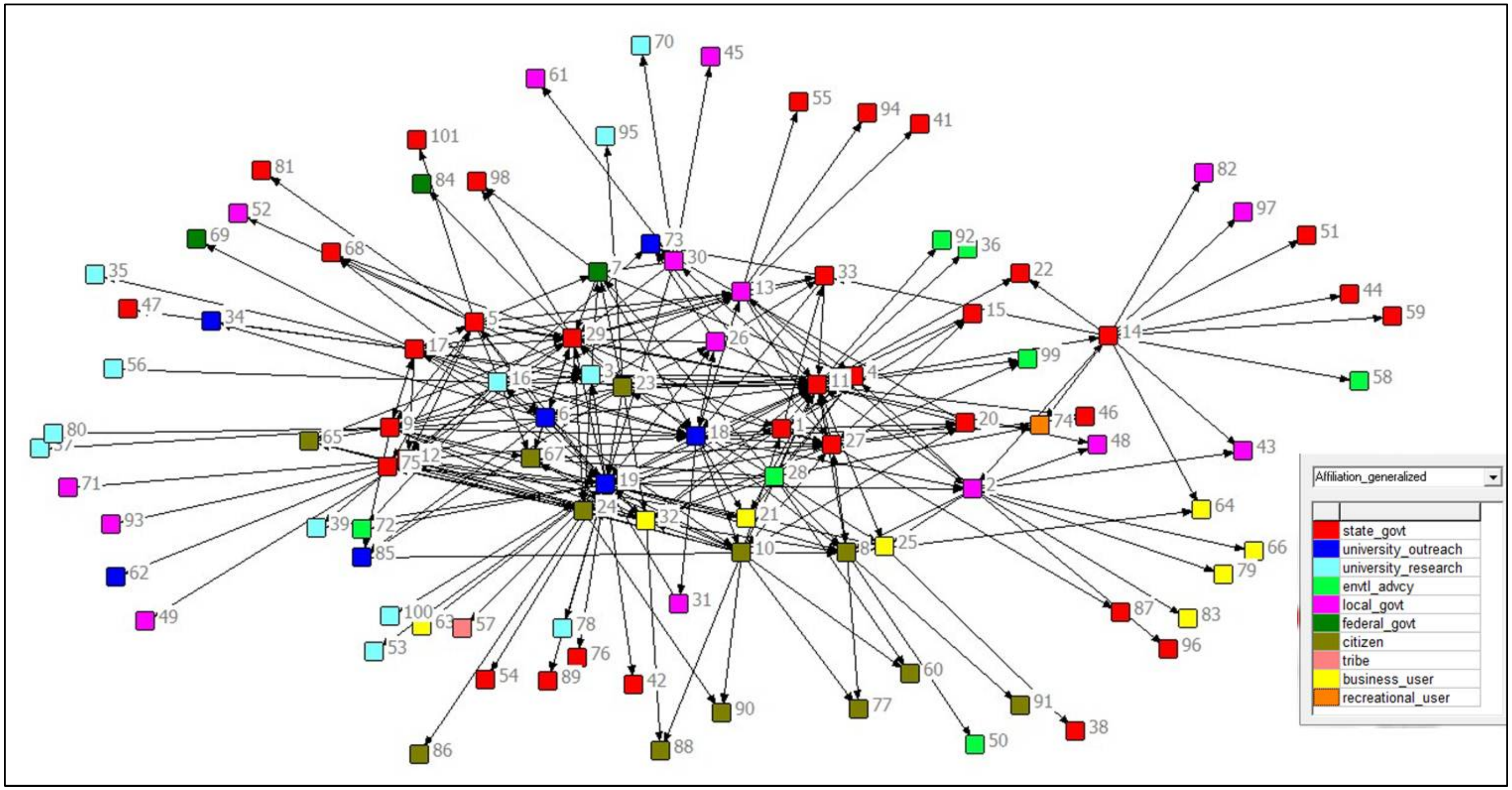

Figure 27. Greenwich Bay SAMP complete network shown by generalized affiliation

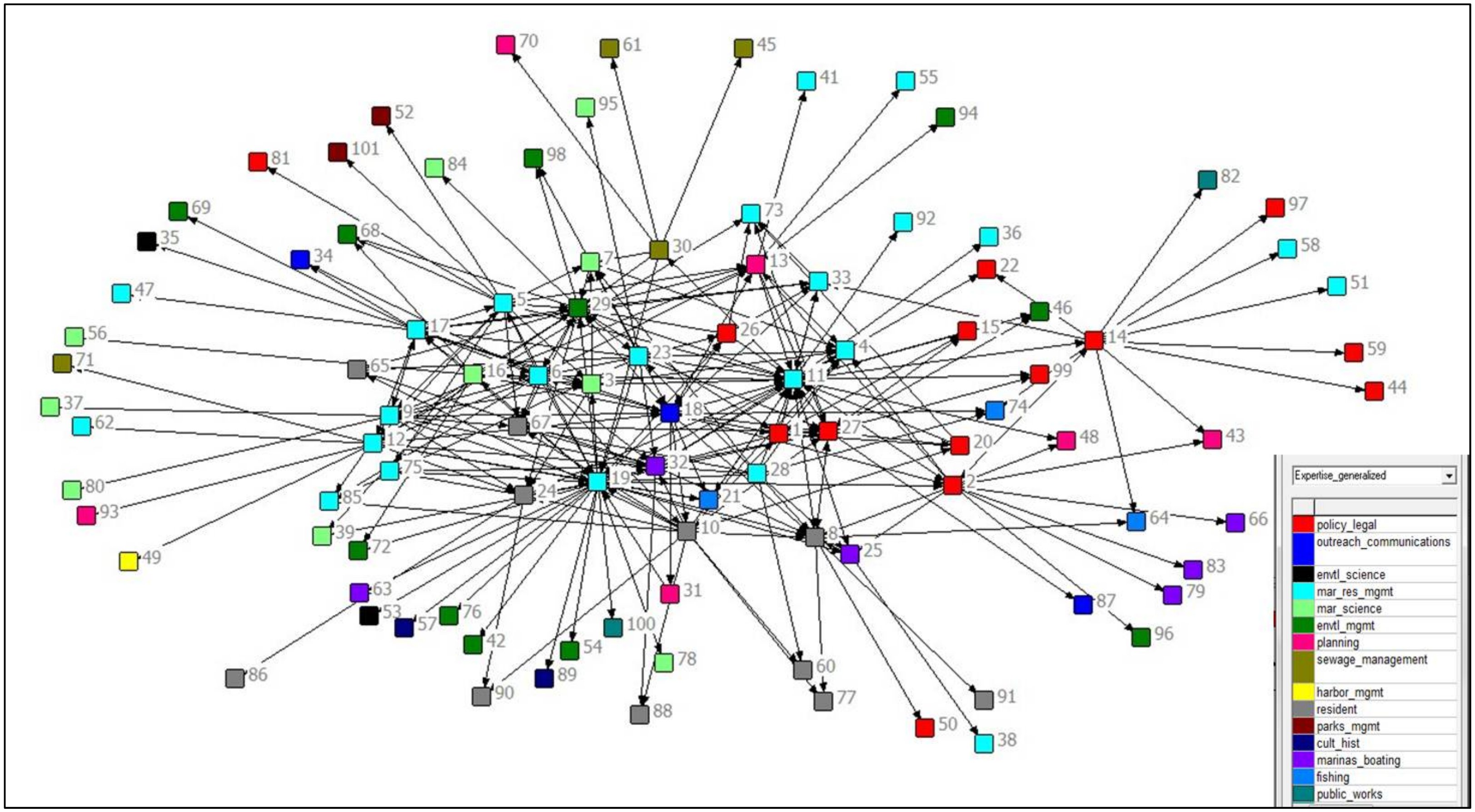

Figure 28. Greenwich Bay SAMP complete network shown by generalized expertise

6.2.2 Limitations of the Greenwich Bay SAMP Network Data

There are some limitations to the Greenwich Bay SAMP network analysis data that are important considerations in interpreting the results discussed below. As noted in Chapter 3, study participants were asked to recall from memory those with whom they had worked on the Greenwich Bay SAMP. While study participants were emailed the survey and therefore had time to review it and think about it before completing it, participants' responses are still likely limited to those who they were able to remember on the day they completed the survey. Recall could be affected by a number of factors, including how long they had known those with whom they'd worked, whether they had worked with those individuals on other projects since the conclusion of the Greenwich Bay SAMP in 2005 (six years prior to the collection of these data), and how closely they had worked with those individuals. Arguably, study participants were more likely to recall people with whom they'd worked very closely, or who they recalled as being particularly important to the process.

There were a few cases in which inconsistencies or inaccuracies in the Greenwich Bay SAMP survey data were evident. In no case was study participants' survey data altered to address these inconsistencies; rather, these inconsistencies are acknowledged here. One problem that recurred was that some study participants indicated they had worked with one or more other actors who had not actually participated in the development of the Greenwich Bay SAMP itself (as reported by those individuals, or by others who had worked on the project). This may have been due to inaccurate memory or the fact that the participant had worked with the actor on another project at the same time or at some point before or after the development of the Greenwich Bay SAMP. Another case of inaccuracy was when study participants were clearly able to recall the name of the organization, but were unable to pinpoint the individual from that organization with whom they had worked. This suggests that in some cases, the organization itself has such significant name recognition such that the individual who works on behalf of that organization is not as easily memorable, or the individuals representing the organization have relatively interchangeable roles and expertise.

6.2.3 Research Question 2a: To What Extent Were Practitioners Collaborating With Others?

To assess the extent of collaboration among coastal management practitioners, actor centrality measures as well as some overall network measures were evaluated. The results of the overall network measures are presented first, followed by actor centrality results, which include the results of testing a series of hypotheses which support this research question.

6.2.3.1 Practitioners Collaborating: Overall Network Structure

Figure 26 illustrates how the overall Greenwich Bay SAMP network is rather large, with 100 actors, and has a core-periphery structure, meaning that the network cannot be easily divided into distinct sub-groups; it has a central core of actors who are connected to each other, and a periphery of actors who are connected to the core actors, but not necessarily to each other (Borgatti & Everett, 1999). This structure may reflect the effectiveness of the study participant sampling process described in Chapter 3, which sought to identify and survey the core actors in the Greenwich Bay SAMP network. The periphery of this network is made up of numerous pendants, or actors which only have one connection in the network. 47% of the actors in the Greenwich Bay SAMP network are pendants. As most pendants were not study participants, again this may reflect the sampling methodology's effectiveness in identifying the main members of the network. However, it should be noted that a small number of study participants only identified one connection in the network. See below under degree centrality for further discussion.

Table 23 presents a series of network measures for the complete Greenwich Bay SAMP network. Network density is one measure of assessing overall collaboration in a network. Network density is the proportion of the number of ties that exist in a network to the number of ties that are possible. The density of the Greenwich Bay SAMP is 0.0296, meaning that 2.96% of all possible ties between actors are present. Network centralization is a measure of the extent to which the network is centered around one or more key actors; the network centralization (based on degree) for this network is 15.89%. See discussion section below for further discussion of density and network centralization.

Table 23. Network measures for the complete Greenwich Bay SAMP network.

Network measure	Value
Number of actors	100
Number of pendants (one connection in the network)	47
Density	0.0296
Network centralization (degree)	15.89%

6.2.3.2 Practitioners Collaborating: Actor Centrality Measures

As discussed in Chapter 4, actor centrality measures were calculated as a means of understanding the relative importance of individual actors within the network. Here, centrality measures are used to understand the extent to which actors were collaborating within the network, and the extent to which they were influential in the network by linking other actors.

Degree centrality, as described in Chapter 4, is a simple measure of the number of ties each actor has. More connections may provide an actor with many more opportunities to influence or be influenced (Hanneman & Riddle, 2005). Degree centrality may also be considered a measure of an actor's capacity to develop communication within the network (Degenne & Forse, 1999). Degree centrality provides one way of analyzing and comparing the extent to which each actor is collaborating with others. In Ucinet, Freeman degree centrality (Freeman, 1979) is a basic computation of the number of ties each actor has and may be calculated by either considering or ignoring the direction of a tie. Symmetrical and directional (out-degree and in-degree) centrality measures have been computed for the Greenwich Bay SAMP network. In addition, normalized degree centrality measures, which are based on the highest possible degree in the network and are represented as a percentage, are presented to facilitate comparison with the Great South Bay EBM Plan network (discussed below). It is important to note that raw degree centrality scores are reflective of the size of their networks – the bigger the network, the bigger the degree centrality score. Table 24 shows Freeman degree centrality measures for Greenwich Bay SAMP study participants; participants are ranked in order of their degree centrality measure, highest to lowest. Figure 29 shows the entire Greenwich Bay SAMP network with actor nodes sized to reflect their measure of Freeman degree centrality (symmetrical).

Table 24. Freeman degree centrality for Greenwich Bay SAMP study participants

Study Participant	Freeman Degree Centrality	Normalized Degree Centrality (%)	Out Degree	In Degree
GB-19	36	18.182	24	18
GB-11	31	15.657	14	22
GB-18	21	10.606	15	12
GB-29	21	10.606	13	13
GB-10	17	8.586	15	3
GB-05	16	8.081	15	5
GB-06	16	8.081	15	6
GB-27	16	8.081	14	8
GB-17	15	7.576	13	5
GB-32	15	7.576	8	7
GB-02	14	7.071	12	4

GB-12	14	7.071	10	7
GB-23	14	7.071	13	2
GB-08	13	6.566	7	9
GB-09	13	6.566	11	5
GB-14	13	6.566	13	2
GB-13	12	6.061	11	6
GB-16	11	5.556	11	2
GB-28	11	5.556	11	0
GB-01	10	5.051	7	5
GB-24	10	5.051	5	5
GB-03	9	4.545	5	5
GB-07	9	4.545	4	5
GB-26	8	4.04	7	3
GB-33	8	4.04	4	4
GB-30	7	3.535	6	1
GB-25	6	3.03	3	4
GB-20	5	2.525	2	3
GB-21	5	2.525	1	4
GB-15	3	1.515	3	2
GB-22	2	1.01	0	2
GB-31	2	1.01	1	1
Mean degree centrality (study participants n=32)	12.594	6.360		
Mean degree centrality (entire network n=100)	5.160	2.606		
St. dev. (entire network)	6.664	3.366		

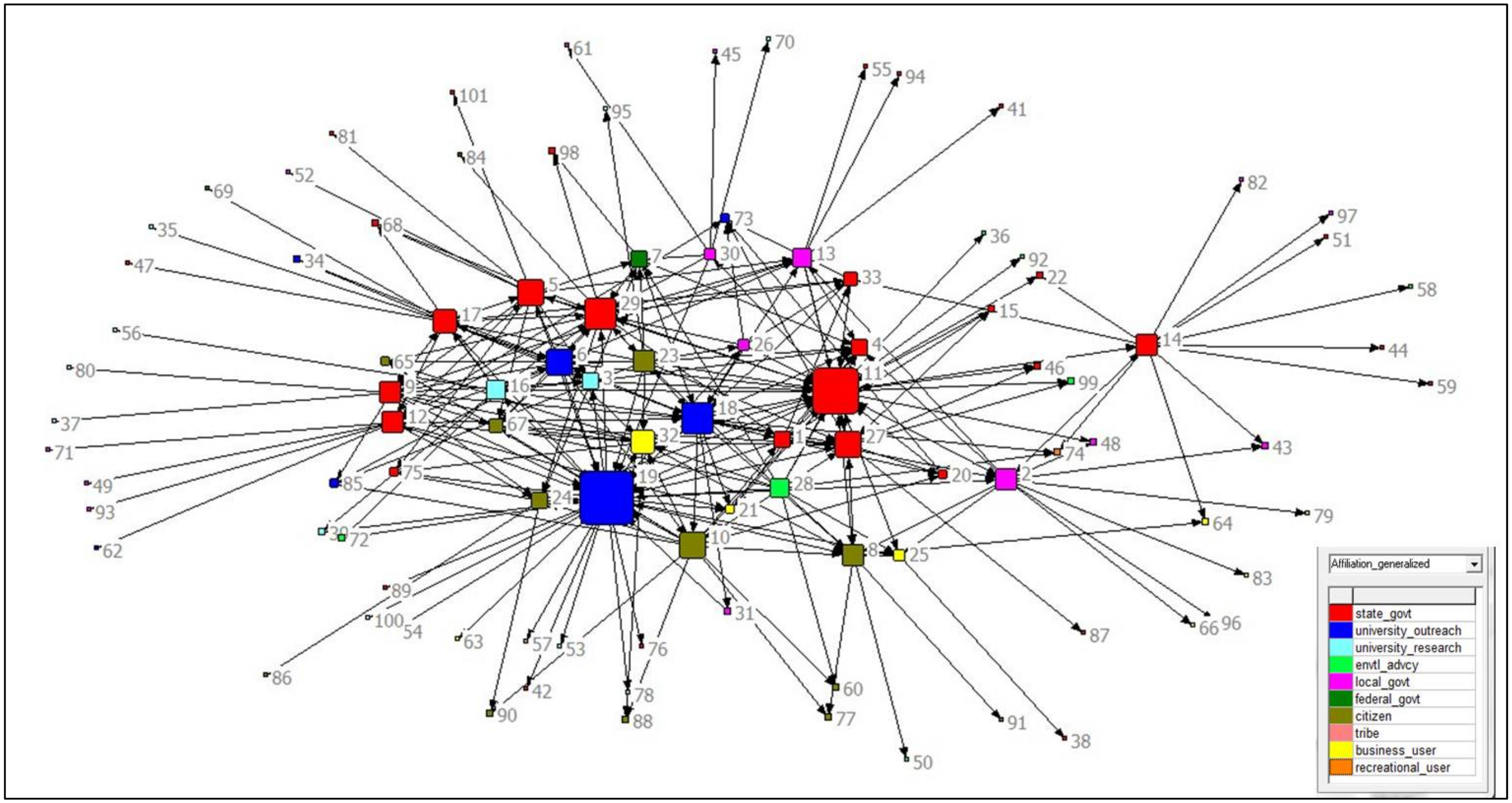

Figure 29. Greenwich Bay SAMP complete network shown by degree centrality

As described in Chapter 4, betweenness centrality is a measure, for each actor, of the number of people who depend on him or her to reach other actors in the network. Betweenness centrality, which measures the extent to which an actor is “between” other actors in the network, provides insight into which actors may act as brokers or gatekeepers in a network, thus exerting control over the flow of information within a network (Scott, 1991). Betweenness centrality is used here to understand the importance and influence of each actor in the collaborative process in which they participated. It may also provide insight into the extent to which actors influenced, or were influenced by, other actors’ mental models (see Chapter 7 for further discussion).

Betweenness centrality was calculated for all actors in the Greenwich Bay SAMP network and is shown below in Table 25. Participants are ranked in order of their betweenness centrality measure, highest to lowest. This table includes betweenness centrality as well as normalized betweenness centrality, which shows betweenness as a percentage of the maximum possible betweenness measure an actor can have. It should be noted that some study participants have betweenness centrality measures of zero, because as actors in the network, they do not lie on any path between any other two actors who are not otherwise connected. Figure 30 shows a network graph of the SAMP network with actor nodes sized for their betweenness centrality measures. Again, raw betweenness centrality scores reflect the size of the network – the bigger the network, the bigger the potential score.

Table 25. Betweenness centrality measures for Greenwich Bay SAMP study participants

Study Participant	Betweenness Centrality	Normalized Betweenness Centrality
GB-11	825.125	8.505
GB-19	804.238	8.289
GB-29	413.952	4.267
GB-18	311.099	3.207
GB-02	207.361	2.137
GB-14	201.976	2.082
GB-12	177.714	1.832
GB-27	175.646	1.81
GB-13	159.063	1.639
GB-05	159.041	1.639
GB-08	156.104	1.609
GB-17	117.962	1.216
GB-06	115.666	1.192
GB-09	104.248	1.075
GB-30	96.226	0.992
GB-10	75.949	0.783
GB-16	74.071	0.763
GB-23	67.181	0.692
GB-24	64.66	0.666
GB-32	49.777	0.513
GB-03	47.862	0.493
GB-01	36.141	0.373
GB-33	31.056	0.32
GB-25	29	0.299
GB-07	22.871	0.236
GB-26	10.89	0.112
GB-21	4.286	0.044
GB-20	0.833	0.009
GB-15	0	0
GB-22	0	0
GB-28	0	0
GB-31	0	0
Mean betweenness (study participants n=15)	141.875	1.462
Mean betweenness (entire network n=57)	45.40	0.468
St. dev. (entire network)	129.875	1.339

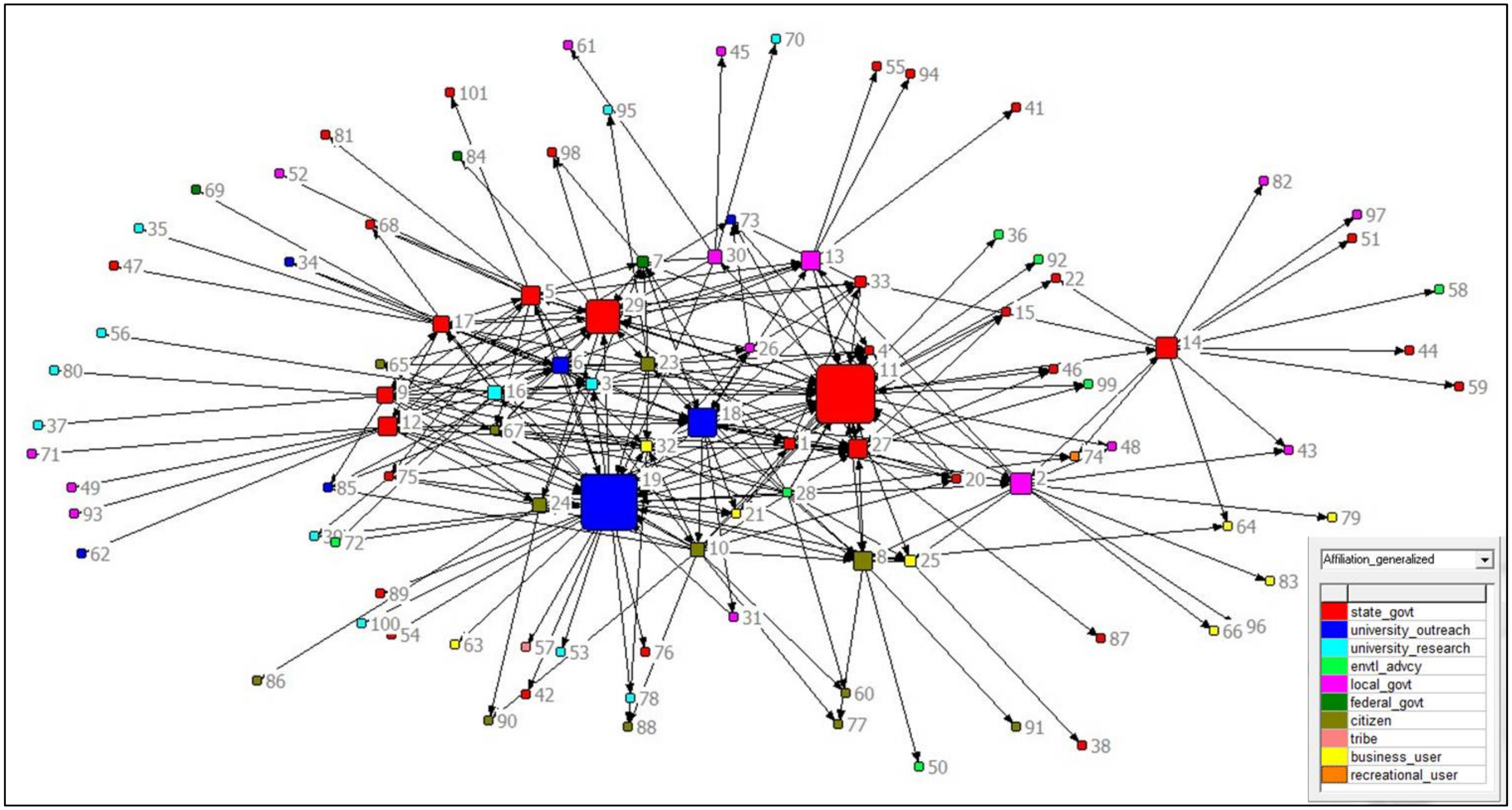

Figure 30. Greenwich Bay SAMP complete network shown by betweenness centrality

6.2.3.3 Hypothesis Testing Based on Actor Centrality Measures

A series of hypotheses were drafted to provide insight research question 2A, *To what extent were practitioners collaborating with others?* Freeman degree centrality measures were used to address hypotheses about collaboration with others; betweenness centrality measures were used to address hypotheses about influence in the network.

A. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people* than other practitioners.**
B. **Practitioners who are <u>EBM plan project leaders</u> *are more influential in the network* than other practitioners.**

As discussed in Chapter 5, the Greenwich Bay SAMP project leaders were GB-11, affiliated with the state coastal management agency, and GB-19, affiliated with an outreach office of the university (denoted with an asterisk in the above tables). Hypothesis A was found to be true; both GB-11 and GB-19 had the two highest Freeman degree centrality scores (average = 33.5), notably higher than the rest of the study participants (n=30; average = 11.2). Project manager GB-11's measures of directional degree centrality (out-degree and in-degree) further underscored his importance in the network. GB-11's in-degree centrality score, 22, was much higher than his out-degree score, meaning that more people reported connections with him than he reported connections with others. Hypothesis B was also found to be true; GB-11 and GB-19 also had the two highest betweenness centrality scores (average = 814.68) which was notably higher than the rest of the study participants (n=30; average = 97.02). The distribution of betweenness centrality scores further underscores the importance of these two actors – betweenness shows that these two individuals are disproportionately influential in this network. The third highest betweenness score among Greenwich Bay SAMP study participants was 413.95, nearly half that of the project leaders' scores.

C. Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people* than other practitioners.

D. Practitioners who are <u>affiliated with state coastal management programs</u> *were more influential in the network* than other practitioners.

Hypotheses C and D address those affiliated with state coastal management programs. Due to the inherently intergovernmental, collaborative nature, in theory, of state coastal management programs as discussed in Chapter 3, it would be expected that state coastal managers involved with these planning efforts would collaborate with more people, and be more influential, than others. In the Greenwich Bay SAMP network, there were a total of eight practitioners affiliated with the state coastal program. It should be noted that there is an important distinction in this group: four were professional staff with training and expertise in coastal management, and four were appointed officials.

When considered together as one group, both Hypotheses C and D are found to be true. Together, all eight state coastal managers were found to have higher average degree and betweenness centrality scores than the other study participants. The average degree centrality measure for state coastal managers (n=8) was 12.63, whereas the average for other participants (n=24) was 12.58; and the average betweenness centrality measure was 161.38, whereas the average for other participants was 135.37.

When considered as two separate groups, however, distinct differences are evident. Hypotheses C and D were both true for professional staff affiliated with the state coastal program. The average degree centrality measure for professional staff (n=4) was 16.75, and the average betweenness centrality measure was 269.60; clearly, the professional staff (which includes GB-11, the project manager) were well-connected and influential in the network. However, neither hypothesis was true for the appointed officials. The average degree centrality measure for appointed officials (n=4) was 8.5, and the average betweenness centrality measure was 53.16. These scores are well below the average scores for professional staff and for other non-coastal program-affiliated participants and indicate that these officials were notably less well-connected and influential in the network than their staff colleagues. See further discussion below.

E. Practitioners whose <u>generalized expertise is in marine resource management</u> *collaborated with more people* than other practitioners.

F. Practitioners whose <u>generalized expertise is in marine resource management</u> *were more influential in the network* than other practitioners.

Hypotheses E and F address those whose generalized expertise is in marine resource management. There were ten practitioners with this expertise, representing six different agencies, organizations or programs, included in this case. Based on their input, both hypotheses were found to be true. Marine resource managers (n=10) had an average degree centrality of 17.4, which is notably higher than the average of 10.41 for other study participants (n=22). Marine resource managers also had an average betweenness centrality of 240.22; by contrast, the average for other participants (n=22) was 97.17. These results indicate that marine resource managers were collaborating with many more people, and had greater influence in the network, than those actors of different areas of expertise. See below for further discussion.

G. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people* than the average practitioner.**

H. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *are less influential in the network* than the average practitioner.**

Hypotheses G and H address natural and physical scientists – in other words, those whose generalized expertise is in the marine sciences. There were three marine scientists who were surveyed for this study, two affiliated with a university, one affiliated with a federal program. Both hypotheses were found to be true. The average degree centrality for marine scientists (n=3) was 9.67, and the average betweenness centrality was 48.27. By contrast, the average degree centrality for other study participants (n=29) was 12.9, and the average betweenness centrality was 151.56. While these numbers show that these scientists had less influential roles in the network than others, it is important to note that these scientists were, in fact, still collaborating as part of this network; see further discussion below.

6.2.3.4 Unexpected Findings

Analysis of Greenwich Bay SAMP actor centrality measures revealed numerous unexpected findings. Several other actors of different affiliations and areas of expertise were found to have important positions in the Greenwich Bay SAMP network. For example, citizens who were involved in this process had relatively high degree centrality measures, meaning they were collaborating with many others within the network. The four citizens involved in this process had an average degree centrality of 13.5, which is higher than the average for other study participants (n=28; average degree centrality = 12.46). Two in particular, GB-10 and GB-32, were among the top ten highest degree centrality measures of this group. A third citizen, GB-08, who had founded a neighborhood-based non-profit organization to protect Greenwich

Bay, also had a notably high betweenness centrality measure (156.10). In addition, there were numerous elected and appointed officials involved in this planning process, and some of them were particularly influential in the network. Two such elected officials, GB-02 and GB-14, had the fifth and sixth highest betweenness centrality scores.

Other unexpected findings are disguised within the broader discussion above about those whose expertise is in marine resource management. Two of the individuals, GB-29 and GB-05, who were among the top ten highest degree centrality scores, were affiliated with other state agencies: the RI Department of Environmental Management and the RI Department of Health. GB-29 also had the third highest betweenness centrality score of the entire group. Last, those affiliated with the university office which developed the SAMP had notably important roles in the network. In addition to GB-19, one of the project leaders discussed above, GB-18 and GB-06 were also very well-connected and influential in the network; together their average scores (n=3) were a degree centrality score of 24.3 and a betweenness centrality score of 410.33. GB-18, an outreach specialist, was also especially influential in the network, with a betweenness centrality score of 311.10. These findings are further discussed below.

6.2.4 Research Question 2b: To What Extent Were Practitioners Collaborating with Others of Different Affiliations and Different Areas of Expertise?

The extent to which coastal management practitioners were collaborating with others of different affiliations and areas of expertise was assessed by gathering basic attribute data on all actors in the network, and then performing egonet homophily calculations for each of the study participants. The basic composition of the Greenwich Bay SAMP network, based on actors' affiliation and expertise, is presented first, to provide some insight into the diversity of actors. This is then followed by discussion of the egonet homophily calculations based on these attributes, and results of testing a series of hypotheses that support this research question.

6.2.4.1 Summary Data: Affiliation and Expertise of Actors in the Greenwich Bay SAMP Network

Both the Greenwich Bay SAMP study participants (n=32) and the broader Greenwich Bay SAMP network (n=100) were characterized by a diverse population representing a wide range of affiliations and areas of expertise representing government, non-governmental organizations, university scientists, users and private citizens. This section presents data on the generalized affiliation and expertise of both the Greenwich Bay SAMP study participants (a subset of the network), and the entire network.

Figure 31 below shows a breakdown of the Greenwich Bay SAMP study participants (n=32) by generalized affiliation. Approximately 60% of study participants were government employees or officials; of that number, most (41%) were affiliated with state government. In addition, a significant proportion of state government and local government participants were either elected or appointed public officials (see Figure 32). It should be noted that in these figures, university-outreach and university-research are not represented as part of state government, though all university-affiliated study participants were affiliated with the University of Rhode Island, a state university which was paid by a state agency to help develop the Greenwich Bay SAMP. If these individuals were to be considered state government-affiliated, 75% of all study participants would represent government, and 56% would be state government- affiliated.

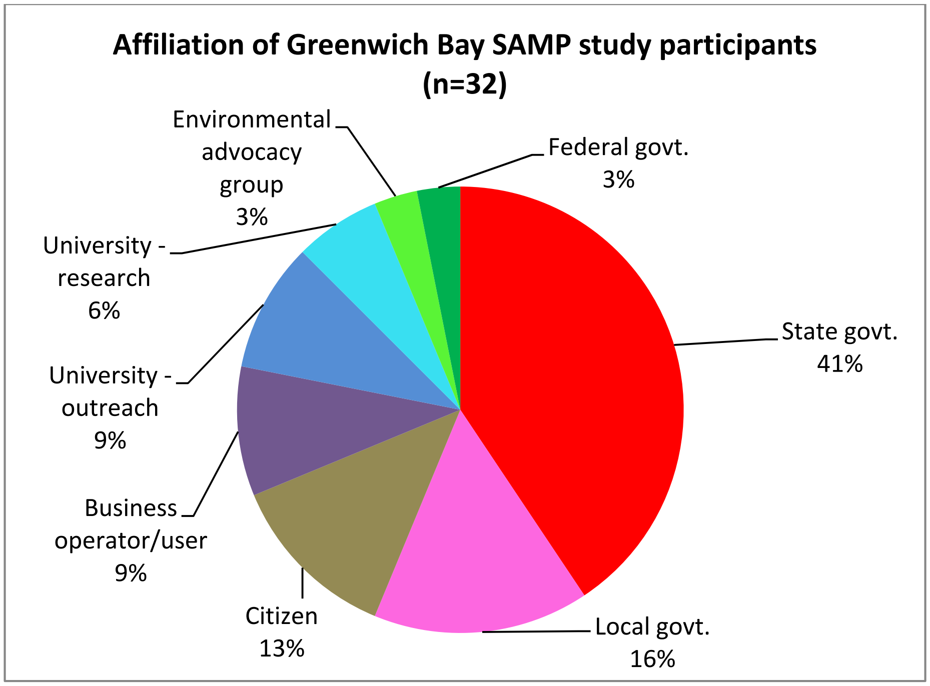

Figure 31. Breakdown of Greenwich Bay SAMP study participants by generalized affiliation

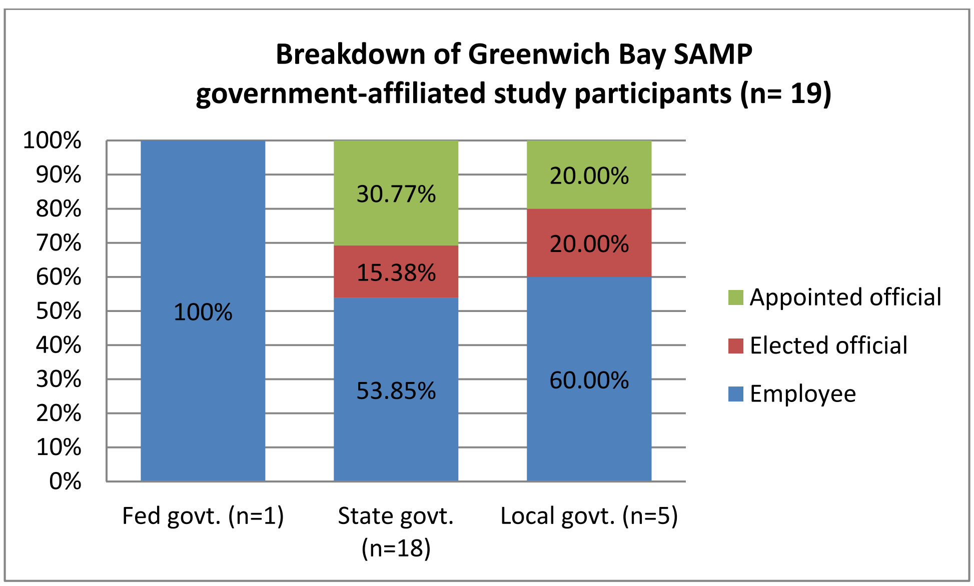

Figure 32. Breakdown of Greenwich Bay SAMP government-affiliated study participants

It is notable that 25% of those who were actively engaged in developing the Greenwich Bay SAMP were neither government nor university-affiliated, and in fact represented a range of constituencies: environmental advocates; business owners/Bay users; and private citizens. The latter two affiliations are especially notable. This study did not set out to investigate stakeholder participation *per se*, but through the process of identifying study participants, it became evident that numerous business owners/Bay users and private citizens had actively collaborated in the development of the Greenwich Bay SAMP. These included two Greenwich Bay marina operators who are also actively involved in the state's marine trades organization, and a commercial shellfisherman who is active on behalf of his trade association. These also included four private citizens, three of whom were Greenwich Bay area residents who became actively involved in the Greenwich Bay SAMP Citizen's Advisory Committee (CAC) discussed above, and one of whom is a professor of environmental management who was involved as a private citizen. One of these residents co-founded a new neighborhood-based advocacy group, Defenders of Greenwich Bay, which organized many of the citizens who participated in the SAMP. These findings are further discussed below within the context of mental models, social networks and collaboration.

Figure 33 shows a breakdown of all actors in the entire Greenwich Bay SAMP network (n=100) by generalized affiliation, and Figure 27 (above) shows a graph of the entire network by affiliation. The inclusion of all actors in the network added new affiliations, including Indian tribe and recreational users, to those of the study participants described above.

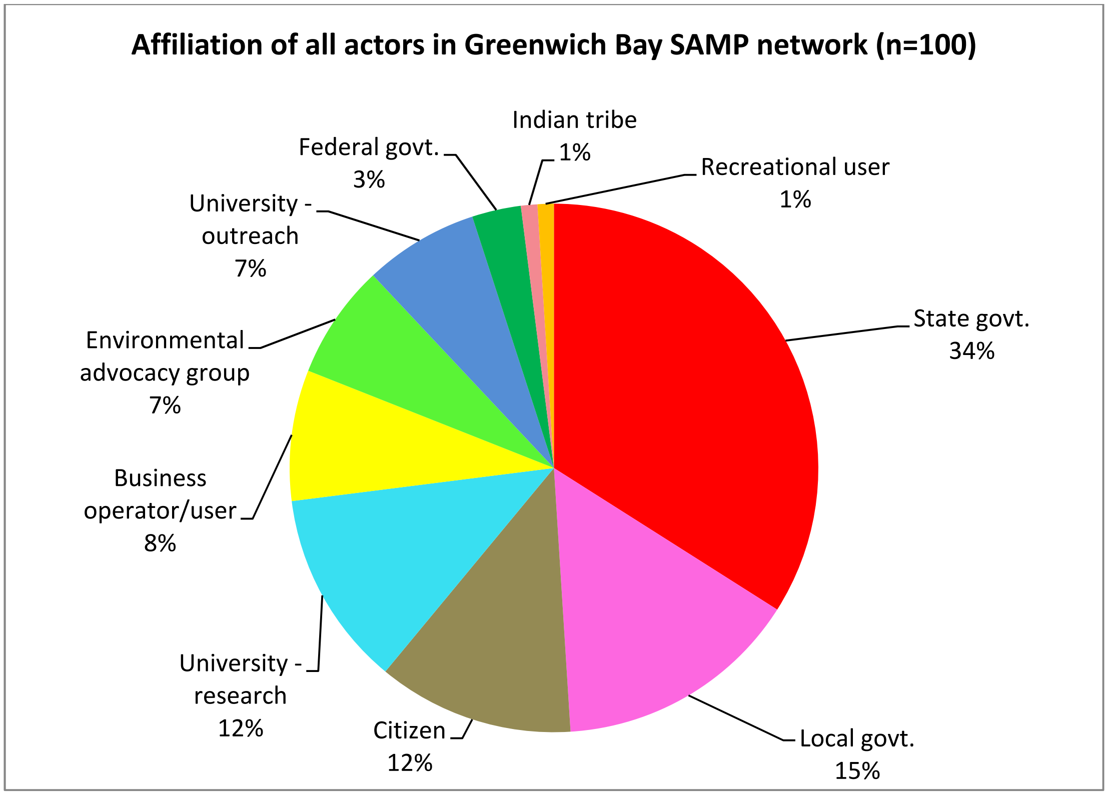

Figure 33. Breakdown of all actors in Greenwich Bay SAMP network by generalized affiliation

Both the Greenwich Bay SAMP study participants (n=32) and the broader Greenwich Bay SAMP network (n=100) also represented a notable range of professional expertise. Figure 34 shows the generalized expertise of the Greenwich Bay SAMP study participants (n=32). Whereas many practitioners' expertise would have been anticipated in the development of such a plan – marine resource management and the marine sciences, for example – others brought in very different disciplinary perspectives. These included managers focused more broadly on environmental management issues; community planners focused on land use issues; those involved with managing municipal sewers and sewage treatment plants; professionals in the field of outreach and communications; and those focused primarily on policy or legal matters. These also included business operators and users, with expertise in fishing and boating, as well as residents, whose primary expertise relevant to this planning effort is their first-hand, intimate knowledge of the Bay and environs.

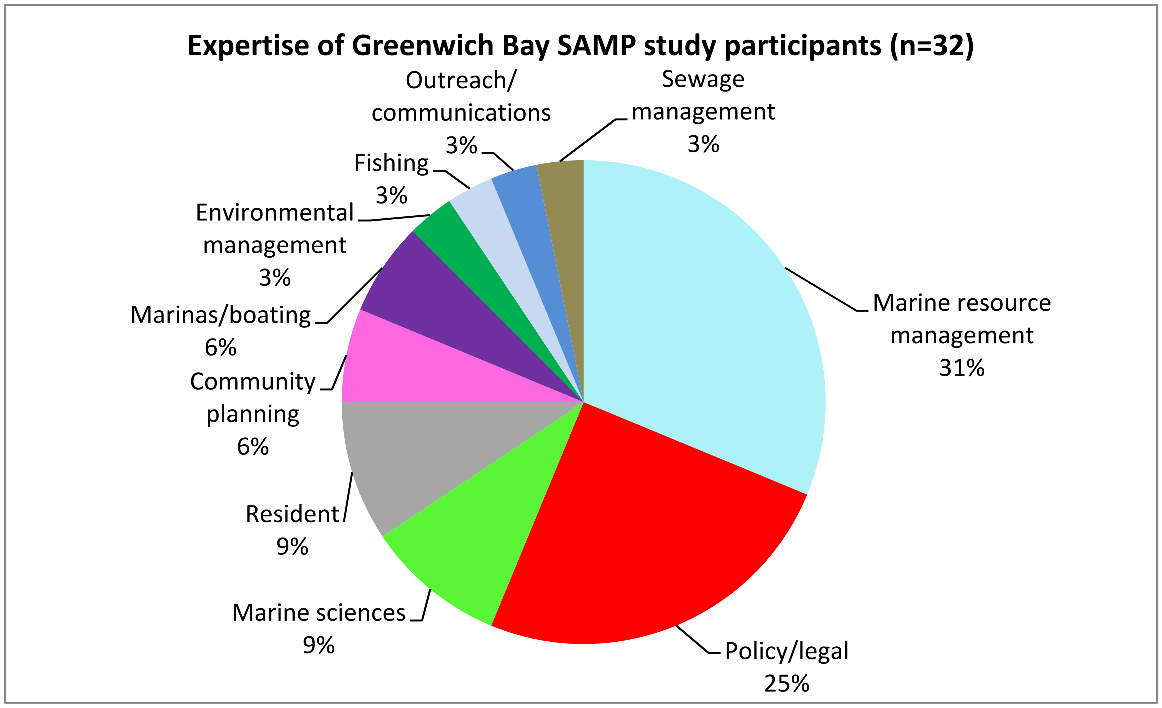

Figure 34. Breakdown of Greenwich Bay SAMP study participants by generalized expertise

Figure 35 shows a breakdown of all actors in the Greenwich Bay SAMP network by generalized expertise, and Figure 28 (above) shows a network graph of the entire network by expertise. The inclusion of all actors in the network added new areas of expertise – cultural/historic resources; engineering; environmental science; harbor management; parks management; and public works - to those of the study participants discussed above.

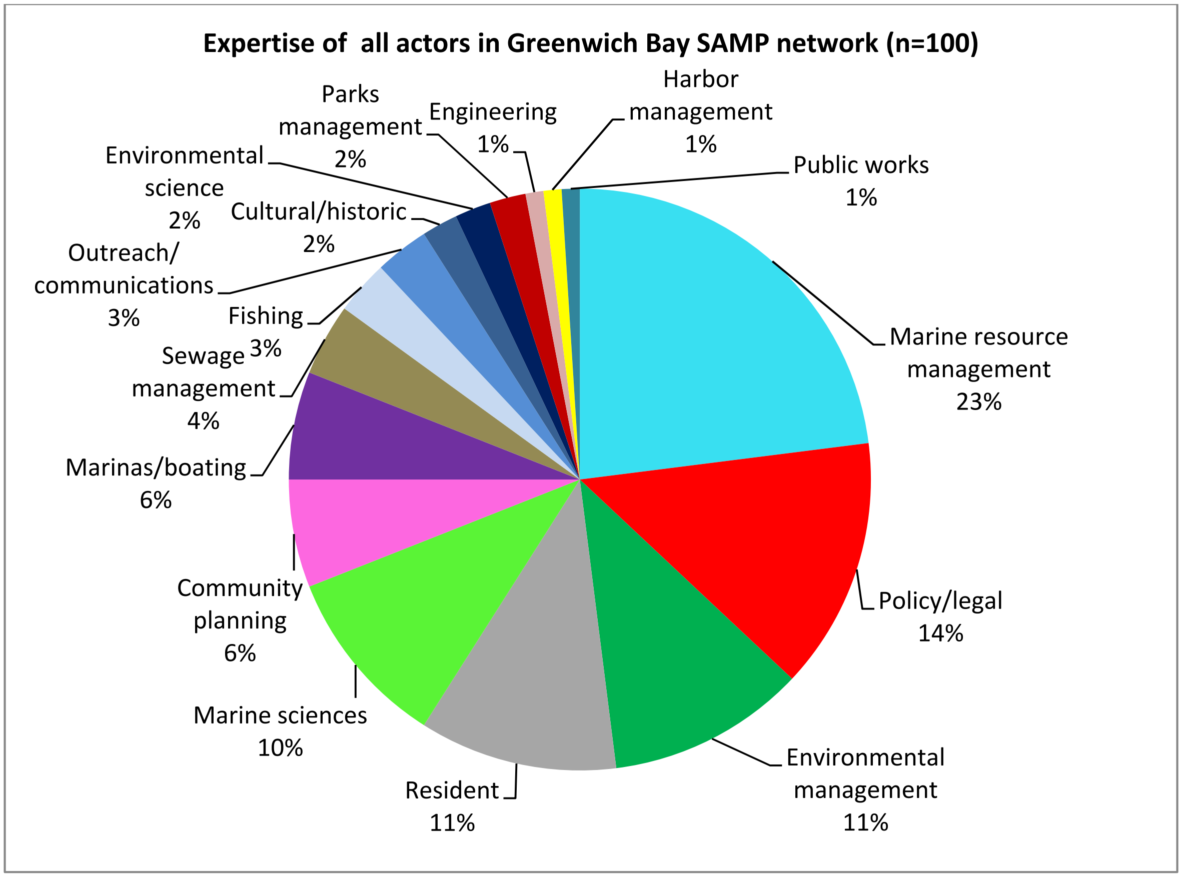

Figure 35. Breakdown of all actors in Greenwich Bay SAMP network by generalized expertise

6.2.4.2 Findings: Homophily Measures of Greenwich Bay SAMP Study Participants

As described in Chapter 4, egonet homophily measures were calculated to provide insight into the extent to which practitioners collaborated with those of different affiliations and areas of expertise. Krackhardt and Stern's E-I index scores, which range from -1 to +1, measure the extent to which an actor associates with others of similar or dissimilar characteristics: a score of -1 indicates perfect homophily, and a score of +1 indicates no connections with actors of the same attribute. Percent homophily scores are simple percentages indicating the extent to which an actor associates with others of similar characteristics; a score of 100% would indicate perfect homophily. Table 26 shows summary egonet homophily measures for Greenwich Bay SAMP study participants. Krackhardt and Stern's E-I index and percent homophily were calculated based on two different attributes: generalized affiliation and generalized expertise. As generalized affiliation and generalized expertise present insight into two different aspects of the network, E-I Index and homophily values for affiliation and expertise are in some cases quite different. These measures present insight into the extent to which actors collaborated with those with dissimilar attributes.

Table 26. Egonet homophily measures for Greenwich Bay SAMP study participants (outgoing ties only)

Study Participant	Generalized Affiliation		Generalized Expertise	
	Krackhardt and Stern's E-I Index	Percent Homophily	Krackhardt and Stern's E-I Index	Percent Homophily
GB-01	-0.714	0.857	0.143	0.429
GB-02	0.5	0.25	0.833	0.083
GB-03	1	0	0.6	0.2
GB-05	-0.2	0.6	0.2	0.4
GB-06	0.467	0.267	0.067	0.467
GB-07	1	0	1	0
GB-08	0.429	0.286	0.429	0.286
GB-09	0.818	0.091	0.455	0.273

GB-10	-0.067	0.533	-0.067	0.533
GB-11	0.429	0.286	0.571	0.214
GB-12	0.8	0.1	0.2	0.4
GB-13	1	0	1	0
GB-14	0.077	0.462	0.231	0.385
GB-15	-1	1	-0.333	0.667
GB-16	0.455	0.273	0.455	0.273
GB-17	0.077	0.462	-0.077	0.538
GB-18	0.733	0.133	1	0
GB-19	1	0	0.75	0.125
GB-20	0	0.5	1	0
GB-21	1	0	1	0
GB-22*	n/a	n/a	n/a	n/a
GB-23	0.846	0.077	0.077	0.462
GB-24	0.2	0.4	0.2	0.4
GB-25	1	0	1	0
GB-26	1	0	1	0
GB-27	0.143	0.429	0.429	0.286
GB-28	1	0	0.273	0.364
GB-29	0.231	0.385	0.692	0.154
GB-30	0.333	0.333	0.333	0.333
GB-31	1	0	1	0
GB-32	1	0	1	0
GB-33	0	0.5	0	0.5
AVERAGE	**0.470**	**0.265**	**0.499**	**0.270**

**Participant reported no out-going ties to individuals, only organizations*

It is important to interpret E-I Index and percent homophily values with caution. While these values provide useful insight into diversity within a network, they have several limitations. First it should be noted that the E-I Index is a measure of the extent to which an actor X had ties to actors with a dissimilar attribute – it is NOT a measure of the overall diversity of actor X's ego network, as it does not account for whether those surrounding actor X were different from each other. Second, E-I Index values are not normalized by the total number of sub-groups (i.e. affiliation or expertise), and so it is effectively easier to get a higher score in a more diverse network. Last, the fewer the number of actors within the network who share a given affiliation or expertise, the easier it is for an actor to get a high score. For example, if an individual is the only local government-affiliated actor within his group, he will automatically have an E-I Index score of +1 because there are no others of the same affiliation with whom he could be connected. Conversely, if an individual is one of 10 marine scientist actors in a network of 10 marine scientists and 1 fisherman, he will end up having a low E-I Index score because he has very few opportunities to collaborate with those of different areas of expertise. For these reasons, the values reported below provide insight into diversity, but are somewhat imperfect measures of this element of the network.

6.2.4.3 Hypothesis Testing Based on Homophily Measures

A series of hypotheses were drafted to provide insight into research question 2B, *To what extent were practitioners collaborating with others of different affiliations and different areas of expertise?* Krackhardt and Stern's E-I Index, which is a more direct measure of ties to actors with dissimilar attributes, is used to test the below hypotheses.

A. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people of different affiliations* than other practitioners.**
B. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people of different areas of expertise* than other practitioners.**

Based on the average scores for the two project leaders, Hypothesis A was found to be true. The two project leaders' average E-I Index score based on affiliation is +0.715, in comparison to the average for other participants (n=30; average = +0.453). However, there is a notable difference between the two project leaders. GB-19, who is affiliated with the university office which developed the SAMP, scored a +1 on the E-I Index, indicating that she collaborated entirely with people of different affiliations than her own. GB-11, who is affiliated with the state coastal management program, scored considerably lower on the E-I Index: +0.429, which is slightly lower than the average for other participants. Hypothesis B was also found to be true. GB-11 and GB-19 had an average E-I Index score, based on expertise, of +0.661, whereas the average for all other study participants (n=30) was +0.488. In this case, the difference between GB-11 and GB-19 was not as pointed; while GB-11 had a lower score (+0.571) than GB-19 (+0.75), indicating that he collaborated with fewer people of different areas of expertise than did GB-19, both scores are still higher than the average for all others. See below for further discussion.

C. Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people of different affiliations* than other practitioners.

D. Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people of different areas of expertise* than other practitioners.

Hypothesis C was found to be not true: those affiliated with the state coastal management program did not collaborate with more people of different affiliations than other practitioners. This entire group of practitioners (n=8) scored an E-I Index of -0.031, which is notably lower than the average score for all other study participants (n=24) of +0.644. As described above, the E-I Index ranges from +1 to -1, with -1 indicating perfect homophily; state coastal managers' score of -0.031 indicates they were more likely to collaborate with others from state government. Consideration of these eight practitioners as two sub-groups –professional staff and elected/appointed officials – does not change this result but nonetheless reveals a substantial difference between these groups. The professional staff (n=4) scored an average of +0.331, which is still less than the average for other participants but substantially higher than the group score. By contrast, the elected/appointed officials (n=4) scored an average of -0.393, which is markedly lower and indicates a much greater tendency for these state officials to collaborate only with others in state government. While this difference does not change the overall results for the hypothesis, it provides important insight into the distinction between these two groups.

Hypothesis D was also found to be not true; those affiliated with state coastal management programs did not collaborate with more people of different areas of expertise than others. The average E-I Index score, based on expertise, for all eight coastal management-affiliated actors was +0.274, which is notably lower than the average for other participants of +0.577. When considered as two separate sub-groups (professionals and appointed officials), relatively little difference is evident. The professional staff (n=4) scored an average E-I Index score, based on expertise, of +0.237, and the appointed officials (n=4) scored an average E-I Index score, based on expertise, of +0.310. See further discussion below.

Because of the limitations to the E-I Index values as described above, these results should be interpreted with caution as state coastal managers made up 25% of the Greenwich Bay SAMP network and therefore had somewhat limited opportunities to collaborate with those of different affiliations.

E. **Practitioners <u>whose generalized expertise is in marine resource management</u> *collaborated with more people of different affiliations* than other practitioners.**
F. **Practitioners <u>whose generalized expertise is in marine resource management</u> *collaborated with more people of different areas of expertise* than other practitioners.**

Hypothesis E was found to be true: marine resource managers collaborated with more people of different affiliations than others. The 10 practitioners whose expertise is in marine resource management scored an average E-I Index, based on expertise, of +0.524, which is higher than the average for other participants (n=22) of +0.444. This group also includes two practitioners with a score of +1, an environmental advocacy organization representative and one of the project leaders indicated that they collaborated with only with those of different affiliations. However, Hypothesis F was found to be not true; marine resource managers did not collaborate with more people of different areas of expertise than other practitioners. Marine resource managers (n=10) scored an average E-I Index, based on expertise, of +0.252, which is lower than the average for other participants (n=22) of +0.616. This is a notable difference; see below for further discussion. Again, these results should be interpreted with caution, as marine resource managers comprised a large subset of this network and therefore had some limitations on their opportunities to collaborate with those of different expertise.

G. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people of different affiliations* than other practitioners.**
H. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people of different areas of expertise* than other practitioners.**

Hypothesis G, testing for collaboration with those of different affiliations, was found to be not true. The three marine scientists who were included in this study had an average E-I Index based on affiliation of +0.818, quite close to the maximum of +1 and notably higher than the average for other study participants (n=29) of +0.432. Two of these scientists scored a perfect +1, indicating they collaborated with no one of the same affiliation. Hypothesis H, testing for collaboration with those of different areas of expertise, was also found to be not true; the three marine scientists had an average E-I Index based on expertise of +0.685, notably higher than that of other study participants (n=29) of +0.479. Again, these results should be interpreted with caution as marine scientists made up a very small subset of the Greenwich Bay SAMP group and therefore had many more opportunities to collaborate with a diverse group.

6.2.4.4 Unexpected Findings

Analysis of E-I Index scores for Greenwich Bay SAMP study participants yielded some unexpected results. Notably, there were ten study participants who scored a perfect +1 based on affiliation, meaning that they collaborated with no one of the same generalized affiliation. In addition to those discussed above these included three business operators/bay users, two local community planners, and a municipal appointed official. It is notable that none of these actors were state government-affiliated. It is also notable that those with some of the lowest E-I Index scores based on generalized affiliation were elected or appointed officials. Five of the ten lowest scores were elected or appointed officials; four of these were state appointed officials whose primary connections in the network were other state appointed officials and state agency staff. State appointed official GB-15 had perfect homophily, scoring -1 on the E-I Index, meaning that he only collaborated with those of the same generalized affiliation. E-I Index scores based on generalized expertise yielded some surprises as well. Nine individuals scored a perfect +1 based on generalized expertise; these individuals included business operators/users, those affiliated with local government, and university-affiliated practitioners.

6.3 The Great South Bay EBM Plan Social Network

6.3.1 Overview and Summary Data

15 coastal management practitioners were surveyed for the Great South Bay EBM Plan case study. While this may seem like a notably smaller sample size than for the Greenwich Bay SAMP, the same participant selection criteria was used in both cases, and this represented a higher response rate than for Greenwich Bay. The complete Great South Bay EBM Plan dataset revealed a network of 57 actors representing 21 different agencies, organizations, or programs. Figure 36 is an illustration of the Great South Bay network of actors, and highlights those who were also study participants. This figure visually conveys that, as with the Greenwich Bay SAMP, the sampling strategy was effective in identifying and gaining input from all of the core members of the Great South Bay network. Figure 37 and 38 illustrate the network color coded by generalized affiliation and generalized expertise, respectively; these figures visually highlight the relative lack of diversity within this network (see below for further discussion of network composition).

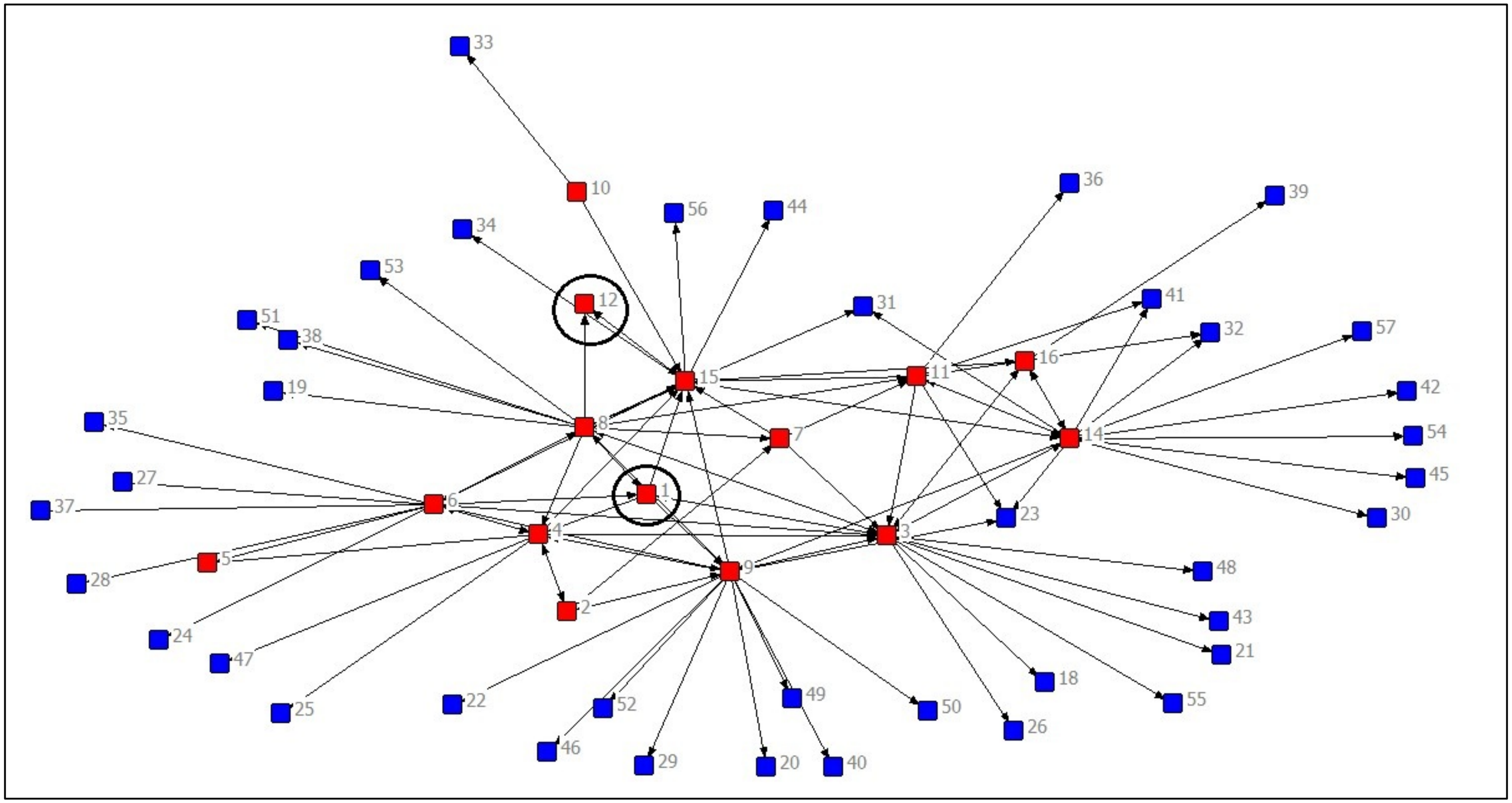

Figure 36. Great South Bay EBM Plan complete network with study participants highlighted

Red = participated in study; blue = did not participate in study; circled = completed a survey but did not participate in an interview. See study participation selection method outlined in Chapter 4 for further information.

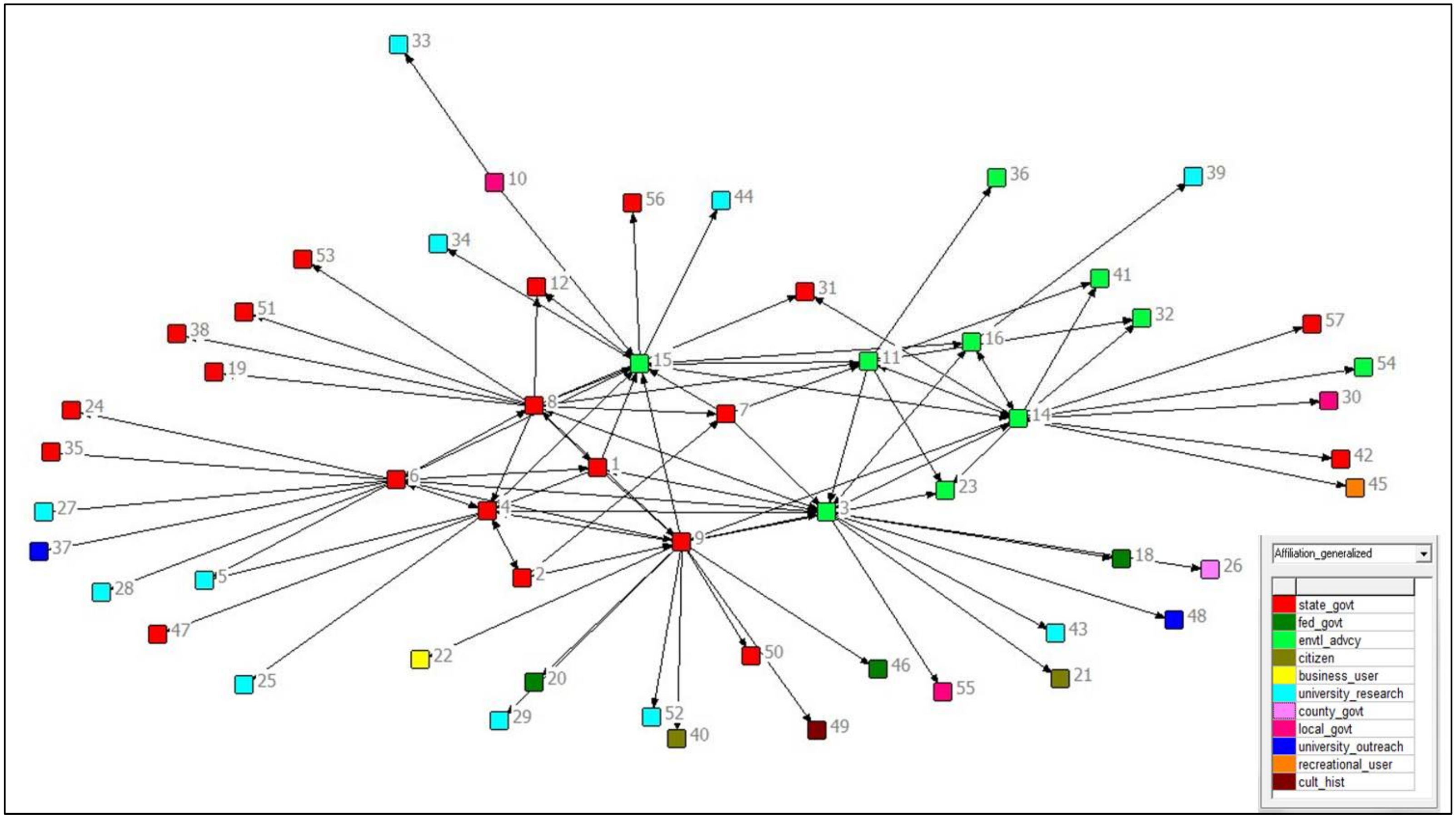

Figure 37. Great South Bay EBM Plan complete network shown by generalized affiliation

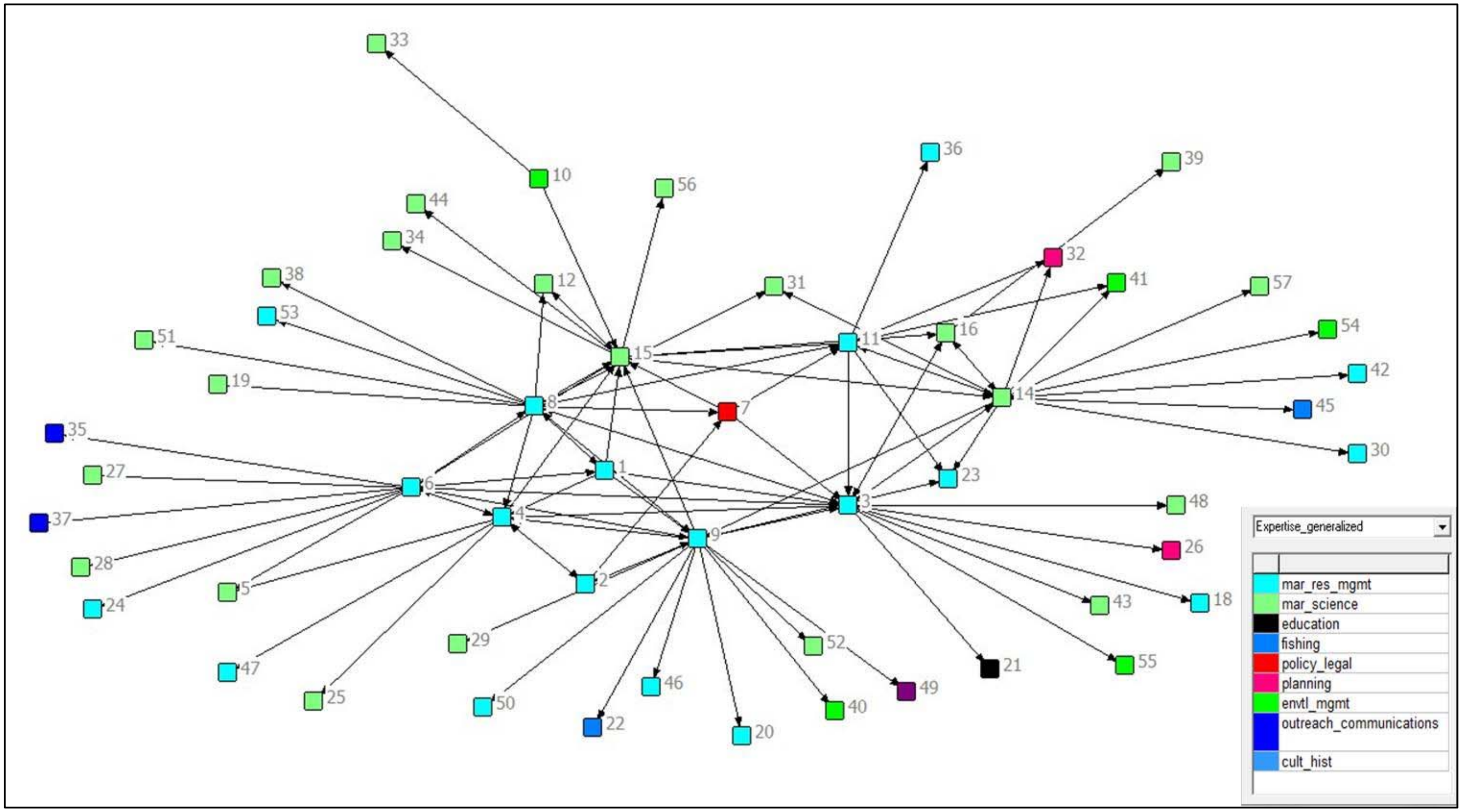

Figure 38. Great South Bay EBM complete network shown by generalized expertise

6.3.2 Interpreting the Great South Bay EBM Plan Network Data

There were generally many fewer cases with Great South Bay EBM Plan survey data in which inconsistencies or inaccuracies were evident. This may be due to the fact that this project was relatively more recent than the Greenwich Bay SAMP (it effectively concluded in 2008, rather than 2005). The only inconsistencies that were evident were through the snowball sampling process, through which two individuals were identified and agreed to participate in the study, yet indicated on their survey and in their interviews that they had not participated directly in the Great South Bay EBM planning effort. See Chapter 4 for further discussion.

6.3.3 Research Question 2a: To What Extent Were Practitioners Collaborating With Others?

To assess the extent of collaboration among coastal management practitioners engaged in the Great South Bay EBM Plan, actor centrality measures as well as some overall network measures were evaluated. The results of the overall network measures are presented first, followed by actor centrality results, which include the results of testing a series of hypotheses which support this research question.

6.3.3.1 Practitioners Collaborating: Overall Network Structure

Figure 36 illustrates how the overall Great South Bay EBM Plan network is generally much smaller than the Greenwich Bay SAMP network, with 57 actors, and has a distinct core-periphery structure that is much more pronounced than that of the Greenwich Bay SAMP; 63% (36) of this network are pendants. While, as with the Greenwich Bay SAMP, this structure may in part be an artifact of the study participant sampling process, it also suggests that the sampling methodology was accurate in identifying all key actors within this network.

Moreover, discussions with practitioners involved in this planning effort confirm that this was, in fact, a relatively small planning process, with a small group of core practitioners who brought in other practitioners or experts as needed.

Table 27 presents several basic network measures for the complete Greenwich Bay SAMP network. The network density of the Great South Bay EBM Plan network is 0.036, meaning that 3.6% of all possible ties between actors are present. While this is relatively low, it is higher than that of the Greenwich Bay SAMP. The network centralization measure for this network is 26.59%. See below for further discussion about these measures.

Table 27. Overall network measures for the Great South Bay EBM Plan network.

Network measure	**Value**
Number of actors	57
Number of pendants (one connection in the network)	36
Density	0.0360
Network centralization (degree)	26.59%

6.3.3.2 Practitioners Collaborating: Actor Centrality Measures

As with the Greenwich Bay SAMP, Freeman degree centrality and betweenness centrality measures were calculated for all actors in the Great South Bay EBM Plan network; measures for study participants are presented and discussed below. Table 28 shows Freeman degree centrality measures for Great South Bay EBM Plan study participants; participants are ranked by their degree centrality measures, highest to lowest. Figure 39 shows the entire network with nodes sized to indicate degree centrality measures. Freeman degree centrality is a simple measure of the number of ties an actor has in the network and these raw values are reflective of the overall size of the network; see above for further discussion.

Table 28. Freeman degree centrality for Great South Bay EBM Plan study participants

Study Participant	Freeman degree centrality	Normalized degree centrality	Out-degree	In-degree
GSB-09	17	31.481	15	6
GSB-03	15	27.778	13	9
GSB-08	14	25.926	14	3
GSB-14	14	25.926	14	4
GSB-15	14	25.926	7	11
GSB-06	12	22.222	12	6
GSB-04	10	18.519	7	6
GSB-11	9	16.667	7	3
GSB-01	6	11.111	5	3
GSB-07	5	9.259	3	2
GSB-16	4	7.407	4	3
GSB-02	3	5.556	3	2
GSB-23	3	5.556	0	3
GSB-05	2	3.704	0	2
GSB-10	2	3.704	2	0
GSB-31	2	3.704	0	2
GSB-12	2	3.704	1	2
Mean degree centrality (study participants n=15)	8.6	15.926		
Mean degree centrality (entire network n=57)	3.164	5.859		
St. dev. (entire network)	4.331	8.02		

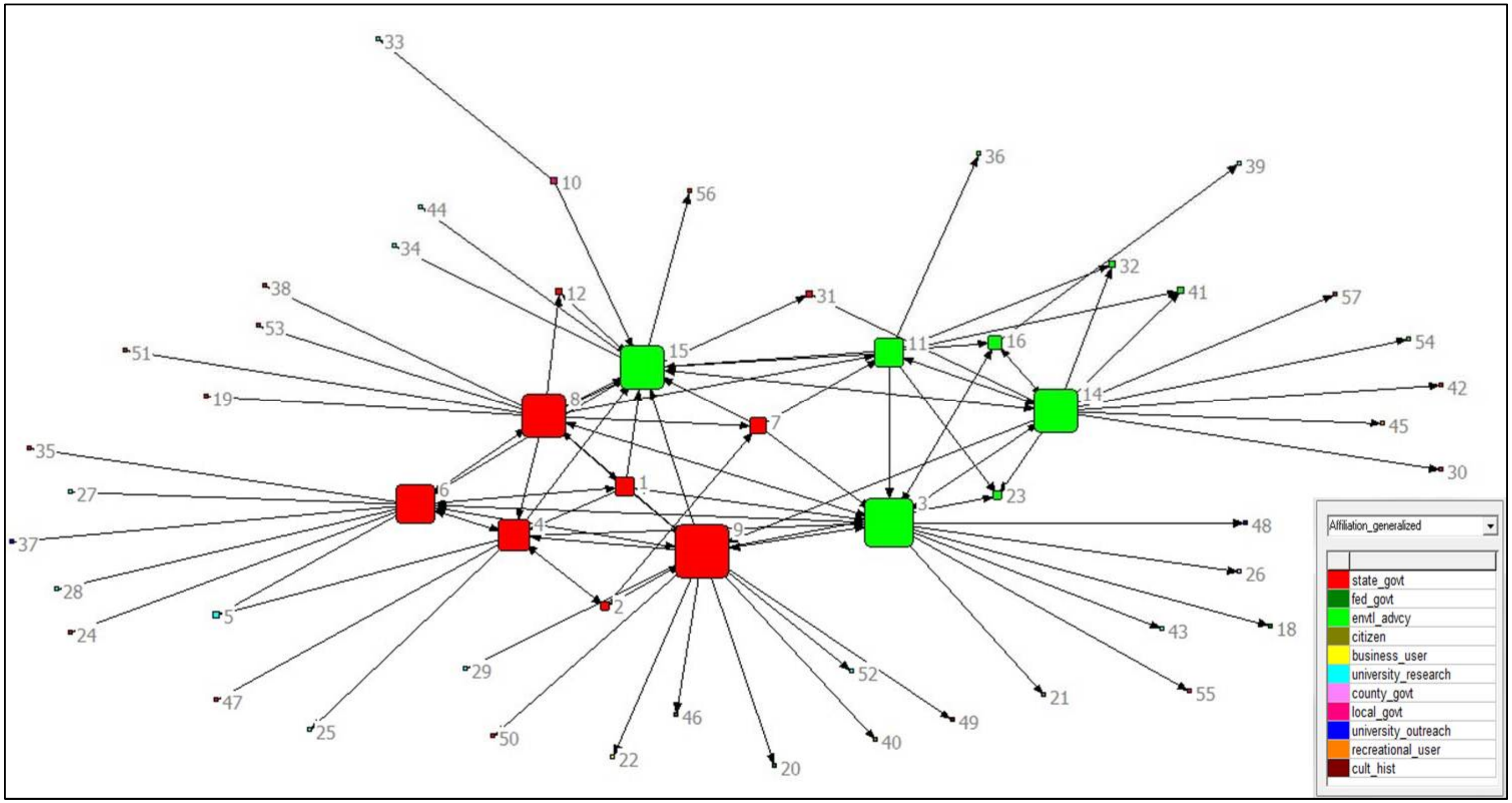

Figure 39. Great South Bay EBM Plan complete network shown by degree centrality.

Table 29 shows betweenness centrality measures for Great South Bay EBM Plan study participants; participants are ranked by betweenness centrality value, from highest to lowest. Figure 40 shows the entire network with nodes sized by their betweenness centrality measures. Betweenness centrality measures provide insight into who is the most influential in the network, as determined by the extent to which an actor lies between other sets of actors who are not otherwise connected. As with degree centrality, raw betweenness scores are reflective of the overall size of the network; see above for further discussion.

Table 28. Betweenness centrality for Great South Bay EBM Plan study participants

Study Participant	Betweenness centrality	Normalized Betweenness
GSB-03	187.738	6.56
GSB-15	187.221	6.542
GSB-09	141.786	4.954
GSB-14	136.721	4.777
GSB-06	135.655	4.74
GSB-08	77.271	2.7
GSB-04	44.969	1.571
GSB-11	26.94	0.941
GSB-16	20.571	0.719
GSB-07	11.721	0.41
GSB-02	5.833	0.204
GSB-01	0.571	0.02
GSB-05	0	0
GSB-10	0	0
GSB-12	0	0
Mean betweenness centrality (study participants n=15)	65.133	2.276
Mean betweenness centrality (entire network n=57)	17.764	0.621
St. dev. (entire network)	46.604	1.628

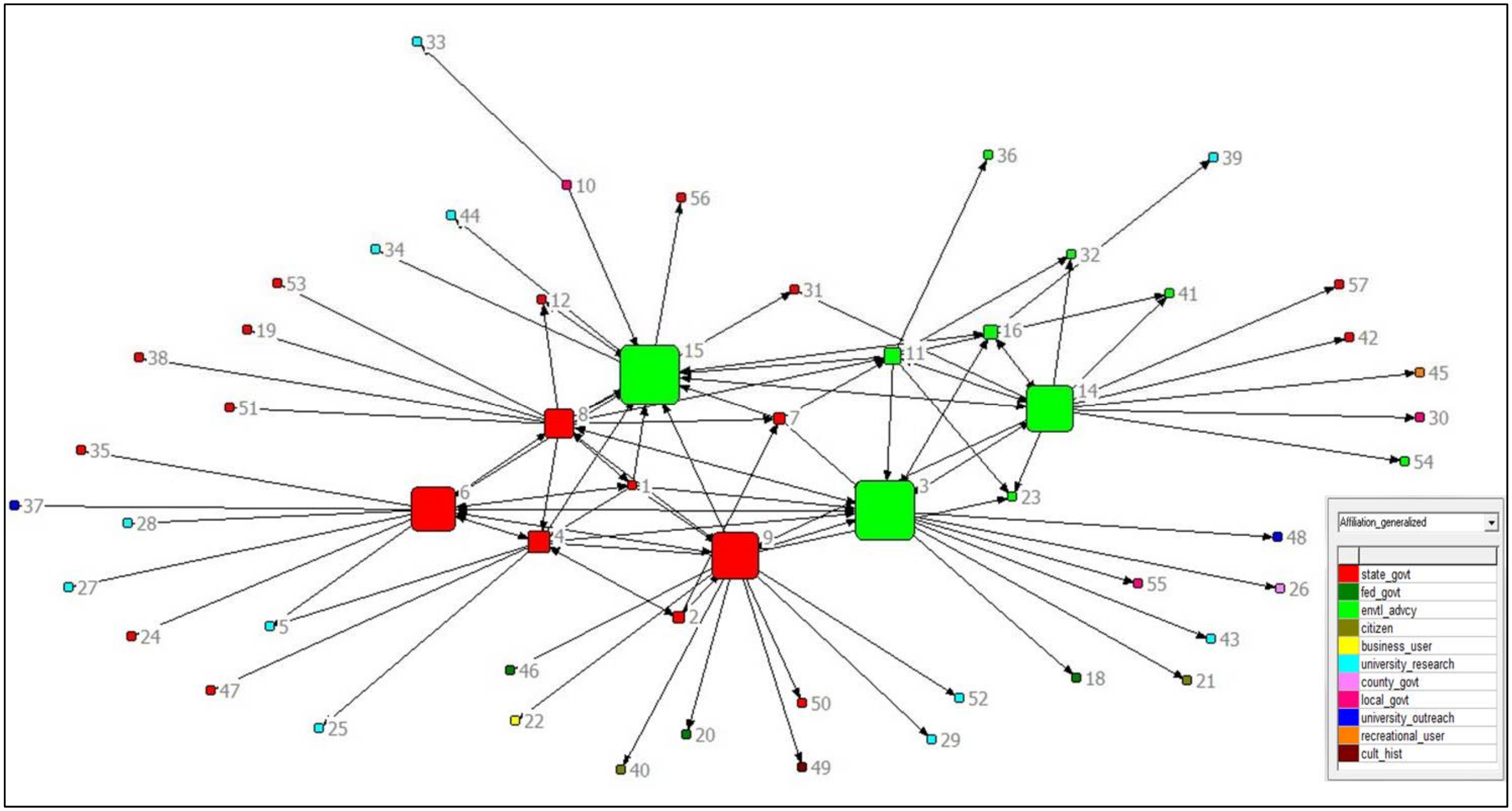

Figure 40. Great South Bay EBM Plan complete network shown by betweenness centrality.

6.3.3.3 Hypothesis Testing Based on Actor Centrality Measures

The same hypotheses presented above with regard to the Greenwich Bay SAMP were also tested for the Great South Bay EBM Plan to provide insight into research question 2A, *To what extent were practitioners collaborating with others?* Again*,* Freeman degree centrality measures were used to address hypotheses about collaboration with others; betweenness centrality measures were used to address hypotheses about influence in the network.

A. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people* than other practitioners.**
B. **Practitioners who are <u>EBM plan project leaders</u> *are more influential in the network* than other practitioners.**

For the Great South Bay EBM planning process, there were two project leaders: GSB-03, who is affiliated with an environmental advocacy organization which worked under contract to develop this plan, and GSB-04, who is affiliated with the state coastal program. Hypothesis A was proven to be true for these leaders. The average degree centrality measure for the project leaders was 12.5, which was higher than the average for other practitioners (n=13) of 8. GSB-03's degree centrality measure of 15 was the second highest of all participants in this group. Hypothesis B was also proven to be true. The average betweenness centrality score for the two project leaders was 116.35, which is notably higher than the average for other participants (n=13) of 57.25. However, when viewed separately, these two project leaders had widely divergent scores: GSB-03 scored 187.74 – the highest betweenness centrality measure of the entire group - whereas GSB-04 scored 44.97, which is notably lower than average. These results indicate that these two project leaders played distinctly different roles in this collaborative planning process; see further discussion below.

C. Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people* than other practitioners.

D. Practitioners who are <u>affiliated with state coastal management programs</u> *are more influential in the network* than other practitioners.

Hypotheses C and D both address those affiliated with state coastal management programs. Four study participants, including one of the project leaders, were affiliated with NY's coastal program; analysis of these participants' network scores revealed that neither of these hypotheses were true. In fact, coastal managers' scores were considerably lower than other practitioners in this case: their average degree centrality score was 6, whereas the average for other participants (n=11) was 9.55; and their average betweenness score was 15.77, whereas the average for other participants (n=11) was 83.08. When the project leader is removed from this group, the averages are even lower: the average degree centrality for the remaining three coastal managers was 4.67, and their average betweenness score was 6.04. The low degree and betweenness scores for state coastal management-affiliated participants is notable; see below for further discussion.

E. **Practitioners <u>whose generalized expertise is in marine resource management</u> *collaborated with more people* than other practitioners.**

F. **Practitioners <u>whose generalized expertise is in marine resource management</u> *are more influential in the network* than other practitioners.**

Hypotheses E and F both address those whose generalized expertise is in marine resource management. Eight of the 15 Great South Bay study participants had this generalized expertise. Both hypotheses were found to be not true for these study participants. The marine resource managers had an average degree centrality score of 10.75, whereas the average for other participants (n=7) was 12.55; and marine resource managers had an average betweenness centrality score of 77.59, whereas the average for other participants (n=7) was 91.85. This indicates that marine resource managers did not play as central a role in collaboration as did others of different areas of expertise; see further discussion below.

G. Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people* than other practitioners.

H. Practitioners <u>whose generalized expertise is in the marine sciences</u> *are less influential in the network* than other practitioners.

Hypotheses G and H both address those whose generalized expertise is in the marine sciences. Five of the 15 Great South Bay study participants had this generalized expertise, though unlike the Greenwich Bay SAMP, these participants included university scientists, scientists affiliated with environmental advocacy organizations, and a state employee. Hypothesis G was found to be true; marine scientists' average degree centrality score of 7.2 is lower than the average for all others (n=10) of 9.3. This indicates that marine scientists, as a group, collaborated with fewer people than other practitioners. Hypothesis H, however, was found to be not true. The average marine scientists' betweenness centrality measure was 68.90, which is higher than the average for all others (n=10) of 63.25. This indicates that these marine scientists were relatively influential in this group of practitioners; see further discussion below.

It should be noted that these averages mask the high level of collaboration and influence of two marine scientists: GSB-14 and GSB-15. GSB-15, who was affiliated with the environmental advocacy organization contracted to develop the plan, had a degree centrality score of 14 and a betweenness centrality score of 187.22. He had the second highest betweenness centrality score and the third highest degree centrality score of this group. GSB-14, who was affiliated with another environmental advocacy organization, had a betweenness centrality score of 136.72 and a degree centrality score of 14 – also among the highest scores of Great South Bay study participants. See below for further discussion.

6.3.3.4 Unexpected Findings

Analysis of Great South Bay EBM Plan study participants' actor centrality scores revealed some unexpected findings. The most notable is that, with one exception, the practitioners with the top six degree centrality and betweenness centrality measures were physically based in and working on Long Island. This includes practitioners from state government and environmental advocacy organizations. GSB-09, who was affiliated with the South Shore Estuary Reserve program, was particularly important in this network – he had the highest degree centrality score and one of the highest betweenness centrality scores. Given the relatively low scores of those affiliated with the state coastal management program as described above – who are all based in Albany, a 3-hour drive from the Great South Bay – this is notable. See below for further discussion.

6.3.4 Research Question 2b: To What Extent Were Practitioners Collaborating with Others of Different Affiliations and Different Areas of Expertise?

As with the Greenwich Bay SAMP, the extent to which coastal management practitioners were collaborating with others of different affiliations and areas of expertise was assessed by gathering basic attribute data on all actors in the network, and then performing egonet homophily calculations for each of the study participants. The basic composition of the Great South Bay EBM Plan network, based on actors' affiliation and expertise, is presented first, to provide some insight into the diversity of actors. This is then followed by discussion of the egonet homophily calculations based on these attributes, and results of testing a series of hypotheses that support this research question.

6.3.4.1 Summary Data: Affiliations and Expertise of Actors in the Great South Bay EBM Plan Network

Both the Great South Bay EBM Plan study participants (n=15) and the broader network (n=57) were characterized by a less diverse population than that of the Greenwich Bay SAMP, in terms of both their generalized affiliation and generalized areas of expertise. This section presents data on the generalized affiliation and expertise of both the Great South Bay EBM Plan study participants (a subset of the network) and for the entire network.

Figure 41 shows the breakdown of Great South Bay EBM Plan study participants (n=15) by generalized affiliation. Review of the affiliations and expertise of this group of study participants represents a rather small and considerably less diverse group than that of the Greenwich Bay SAMP. Only four generalized affiliations were represented, and two groups dominated: state government agencies and environmental advocacy groups. In the case of both local and state government, this group included only government employees – no elected or appointed officials were part of this network. It is also notable that no users or user group representatives were included in this network, and that only one local government employee was included. See below for further discussion.

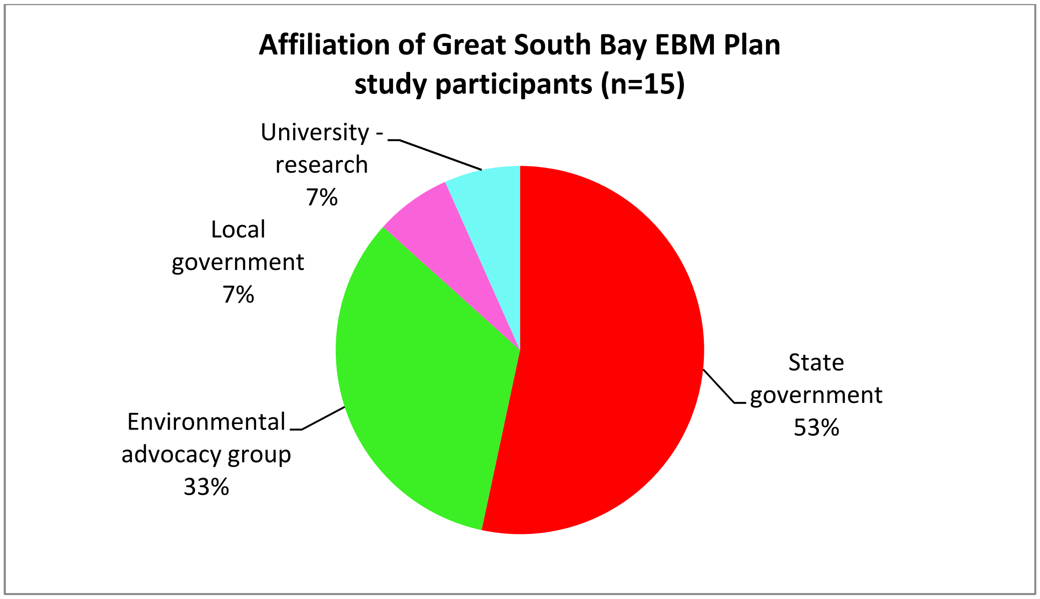

Figure 41. Breakdown of Great South Bay EBM Plan study participants by generalized affiliation

Figure 42 below shows a breakdown of all actors in the complete Great South Bay EBM Plan network (n=57) by generalized affiliation, and Figure 37 above shows a graph of the entire network by affiliation. The inclusion of all actors in the network added new affiliations to those of the study participants described above, including university-affiliated actors, those affiliated with federal and county government, citizens, and business operators/users. It is notable that the Great South Bay EBM Plan network as a whole is considerably more diverse than that of the study participants; see further discussion below.

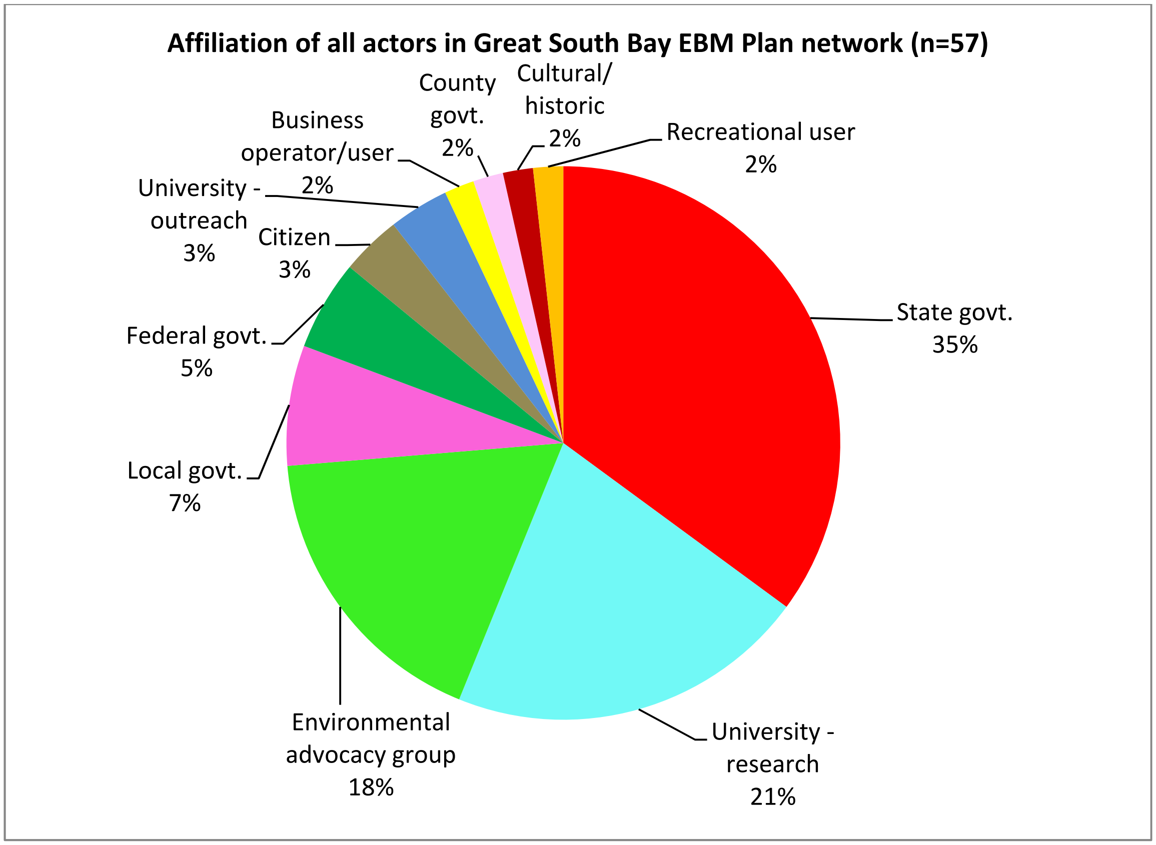

Figure 42. Breakdown of all actors in Great South Bay EBM Plan network by generalized affiliation

Great South Bay EBM Plan study participants (n=15) were also characterized by a smaller range of areas of expertise, as well (see Figure 43 as well as Figure 38 above). Only four different types of expertise were included, and those with expertise in marine resource management and the marine sciences dominated the group. When compared with the Greenwich Bay SAMP, the relative homogeneity of this group is notable. It should be noted that generalized expertise does not correspond directly to generalized affiliation; for example, numerous marine scientists included in this study worked for and were affiliated with environmental advocacy groups.

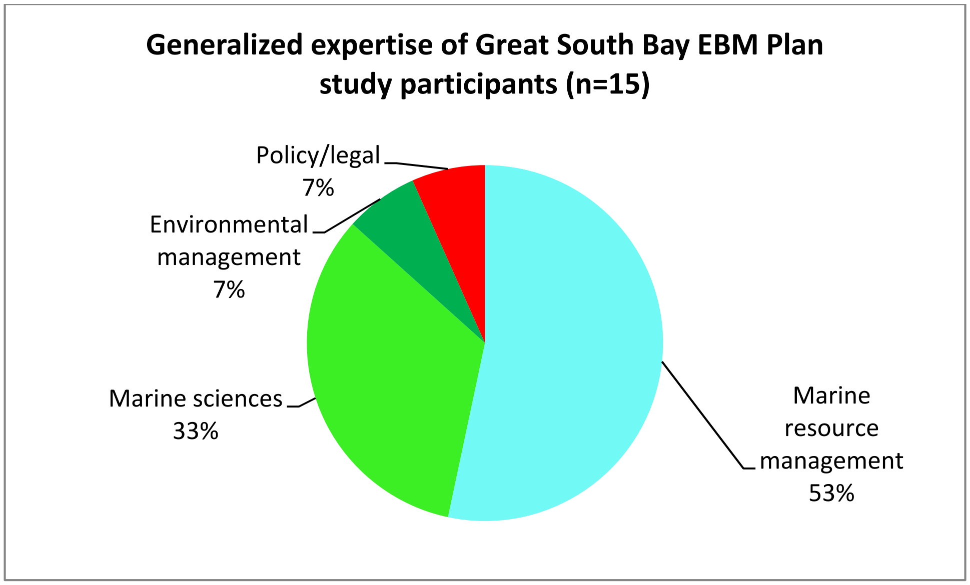

Figure 43. Breakdown of Great South Bay EBM Plan study participants by generalized expertise

Figure 44 shows a breakdown of the entire Great South Bay EBM Plan network (n=57) by generalized expertise, and Figure 38 above shows a network graph of the Great South Bay EBM Plan network by generalized expertise. As with generalized affiliation, there is considerably more diversity of expertise in the broader Great South Bay EBM Plan network. Areas of expertise that were added include community planning, outreach and communications, and fishing. However, once again, the actors who contributed to the diversity of this network were clearly peripheral; this is illustrated visually in Figure 38.

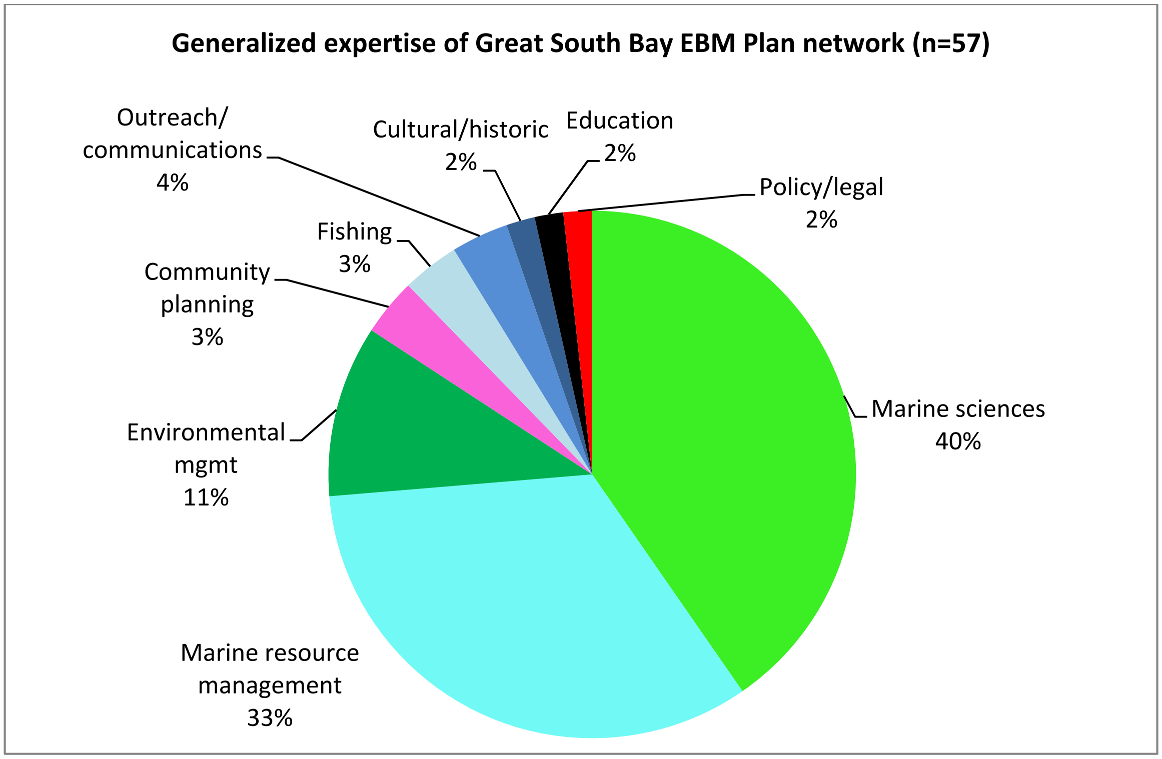

Figure 44. Breakdown of all actors in Great South Bay EBM Plan network by generalized expertise

6.3.4.2 Findings: Homophily Measures for Great South Bay EBM Plan Study Participants

Table 30 shows Krackhardt and Stern's E-I Index measures and percent homophily, calculated for both generalized affilation and generalized expertise, for Great South Bay EBM Plan study participants who completed surveys. These measures provide insight into the extent to which practitioners were collaborating with those with dissimilar attributes. As generalized affiliation and generalized expertise present different views of the network, participant scores based on each metric may vary considerably, or may not vary at all. Again, as discussed above, homophily measures should be interpreted with caution. Due to the relative lack of diversity of the Great South Bay EBM Plan network, and especially those who participated in this study, it was effectively harder for study participants in this case to get high homophily scores. See further discussion throughout this section and in discussion section.

Table 30. Egonet homophily measures for Great South Bay EBM Plan study participants (outgoing ties only)

Study Participant	Generalized Affiliation		Generalized Expertise	
	Krackhardt and Stern's E-I Index	Percent Homophily	Krackhardt and Stern's E-I Index	Percent Homophily
GSB-01	-0.2	0.6	-0.6	0.8
GSB-02	-1	1	-0.333	0.667
GSB-03	0.692	0.154	0.077	0.462
GSB-04	0.143	0.429	-0.143	0.571
GSB-05*	n/a	n/a	n/a	n/a
GSB-06	0	0.5	0	0.5
GSB-07	1	0	1	0
GSB-08	-0.571	0.786	0	0.5
GSB-09	0.333	0.333	-0.2	0.6
GSB-10	1	0	1	0
GSB-11	-1	1	0.143	0.429
GSB-12	1	0	-1	1
GSB-14	-0.143	0.571	0.429	0.286
GSB-15	0.429	0.286	-0.714	0.857
GSB-16	-0.5	0.75	-0.5	0.75
AVERAGE	**0.0845**	**0.458**	**-0.060**	**0.530**

**Study respondent did not report any outgoing ties.*

6.3.4.3 Hypothesis Testing Based on Homophily Measures

The same hypotheses applied to the Greenwich Bay SAMP were tested for the Great South Bay EBM Plan study participants to provide insight into research question 2B, *To what extent were practitioners collaborating with others of different affiliations and other areas of expertise?* Again, homophily measures were used to provide some insight into this question; Krackhardt and Stern's E-I Index, which is a more direct measure of ties to actors with dissimilar attributes, is used to test the below hypotheses.

A. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people of different affiliations* than other practitioners.**

B. **Practitioners who are <u>EBM plan project leaders</u> *collaborated with more people of different areas of expertise* than other practitioners.**

Hypothesis A, which tests for collaboration with those of different affiliations, was found to be true: together, project leaders GSB-03 and GSB-04 had a higher average E-I Index score based on affiliation (+0.418) than other participants (n=13), who had an average score of +0.029. This indicates that project leaders had an overall strong tendency to collaborate with others of different affiliations. However, there is a substantial difference between these two project leaders. GSB-03 had a score of +0.69, which was the fourth highest score among these participants, whereas GSB-04 had a score of +0.14. This indicates that GSB-03 collaborated with many more people of different affiliations than her state agency counterpart.

Hypothesis B, which tests for collaboration with those of different areas of expertise, was also found to be true. The two project leaders had an average E-I Index score based on expertise of -0.033, which is higher than the average for other participants (n=13) of -0.060. Again, a difference is evident between the two project leaders; GSB-03 has a higher score than GSB-04, indicating that she collaborated with many more people of different areas of expertise than her state agency counterpart. However, it is worth noting that E-I Index scores based on expertise were, overall, much lower than those based on affiliation, indicating that project leaders collaborated with fewer people of different areas of expertise. See below for further discussion.

C. **Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people of different affiliations* than other practitioners.**

D. Practitioners who are <u>affiliated with state coastal management programs</u> *collaborated with more people of different areas of expertise* than other practitioners.

Analysis of the four coastal managers' E-I Index scores based on affiliation revealed that Hypothesis C is not true: coastal managers did not collaborate with more people of different affiliations than other practitioners. The four coastal managers' average E-I Index score based on affiliation was -0.014, which is lower than the average score for other study participants (n=11; average score = +0.124). This indicates that these coastal managers had relatively homogeneous ego networks based on affiliation. However, hypothesis D, which tests for collaboration with those of different areas of expertise, was found to be true: coastal managers' average E-I Index score based on expertise was -0.019, which, while low, was higher than the average for other participants (n=11) of -0.070. However it is worth noting that there is a very narrow margin between the coastal managers' score and the average for other participants, indicating that there is little substantive difference. Given that the average for all participants in this case is -0.056, it seems that there was an overall tendency to collaborate relatively little with those of different areas of expertise. Given the relative homogeneity of the Great South Bay network, and the limitations inherent in E-I Index values as noted above, these results should be interpreted with caution, and may be explained by the relative lack of opportunities for diverse collaboration in this network. See below for further discussion.

E. Practitioners <u>whose generalized expertise is in marine resource management</u> *collaborated with more people of different affiliations* than other practitioners.

F. **Practitioners <u>whose generalized expertise is in marine resource management</u> *collaborated with more people of different areas of expertise* than other practitioners.**

As noted above, there were eight marine resource managers involved in developing the Great South Bay EBM Plan. Analysis of these eight practitioners' E-I Index scores based on affiliation indicated that Hypothesis E is true; marine resource managers collaborated with more people of different affiliations than did others. Marine resource managers' average E-I Index score based on affiliation was -0.020, whereas the average for other practitioners (n=7) was lower at -0.288. However, Hypothesis F, which tests for collaboration with those of different areas of expertise, was found to be not true. Marine resource managers' average E-I Index score based on expertise was -0.132, which is lower than the average for other practitioners (n=7) of -0.038. Again, given the relative homogeneity of the Great South Bay network, and the limitations inherent in E-I Index values as noted above, these results should be interpreted with caution, and may be explained by the relative lack of opportunities for diverse collaboration in this network. See below for further discussion.

G. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people of different affiliations* than other practitioners.**

H. **Practitioners <u>whose generalized expertise is in the marine sciences</u> *collaborated with fewer people of different areas of expertise* than other practitioners.**

Based on analysis of the five marine scientists involved in this case, Hypothesis G was found to be not true: in fact, marine scientists collaborated with more people of different affiliations than other practitioners. The five marine scientists had an average E-I Index score based on affiliation of +0.197, whereas the average for other practitioners (n=10) was +0.040.

Hypothesis H was found to be true; as expected, marine scientists collaborated with fewer people of different areas of expertise than other practitioners. Marine scientists had an average E-I Index score based on affiliation of -0.446, whereas other practitioners (n=10) had an average score of +0.094. These results indicate that marine scientists were more likely to collaborate with others of different affiliations but less likely to collaborate with others of different expertise; again, these results may be explained by the limitations of the E-I Index scores and the relative lack of diversity within this group. See discussion below.

6.3.4.4 Unexpected Findings

Analysis of Krackhardt and Stern E-I Index scores for affiliation and expertise revealed some unexpected findings. Five of the top six individuals with the highest E-I Index scores for affiliation, and four of the top six scores for expertise, were all Long Island-based practitioners; these include practitioners affiliated with local government, state government, and environmental advocacy groups. This is similar to unexpected findings regarding actor centrality described above; see below for further discussion.

While the homophily measures used in this study had some limitations and therefore should be interpreted with caution, these limitations also point to an unexpected finding. As discussed throughout this section, given that the Great South Bay EBM Plan network of study participants was both small and relatively homogeneous, there were limited opportunities for these study participants to collaborate with others of dissimilar attributes. This means that these scores are overall lower than those of the Greenwich Bay SAMP study participants. However, this also points to the fact that the Great South Bay EBM Plan practitioners did not assemble a large and diverse network at the outset: practitioners' limited opportunities for collaboration with a diverse group were shaped by their own decisions about who to involve in the process. See below for further discussion.

6.4 Discussion

6.4.1 Overview

This section includes a discussion of the social network analysis findings reported above. Overall network findings from the two case studies are first compared; additional insights into social network analysis results are then reported and discussed. Table 30 presents summary overall network measures that provide insight into the two case studies. Tables 31 and 32 below summarize the results of hypothesis testing, detailed above, to allow for comparison across the two cases. Discussion of these results, including expected and unexpected findings, is woven into a discussion that makes basic comparisons between the two cases; examines collaboration as illustrated by actor centrality measures; examines collaboration across affiliations and areas of expertise as illustrated by network composition and homophily measures; and explores the relationship between actor centrality and homophily measures.

6.4.2 Basic Comparison: Network Characteristics and the Extent of Collaboration

Table 31 presents summary overall network measures that provide insight into the two case studies and highlight the very different collaborative processes that characterized the two coastal EBM planning efforts.

Table 30. Summary network measures: Comparing the case studies

Network Measure	Greenwich Bay SAMP	Great South Bay EBM Plan
Number of study participants surveyed	32	15
Number of actors in network	100	57
Number of isolates	47	36
Network density measure (%)	0.0296	0.0360
Network centralization (degree)	15.89%	26.59%
Mean Krackhardt and Stern E-I Index based on generalized affiliation	+0.470	+0.0845
Mean Krackhardt and Stern E-I Index based on generalized expertise	+0.499	-0.060

As illustrated in Table 31, the Greenwich Bay SAMP network, which had 100 actors, had a density of 2.96% whereas the Great South Bay EBM Plan network, with 57 actors, had a density of 3.6%.[33] Density can be considered a measure of the cohesiveness of a community, or in this case, a group of practitioners; generally speaking, a higher density would indicate a more cohesive group characterized by more collaboration between actors (Bodin & Crona, 2008; Scott, 1991). The Great South Bay EBM Plan network is slightly more dense than that the Greenwich Bay SAMP network; this is not surprising given that this network is notably smaller than that of the Greenwich Bay SAMP, comprising fewer actors, and networks with more nodes are often, by necessity, less dense than networks with fewer nodes (Scott, 1991). This is because of the practical constraints of time and resources that limit actors' opportunities to collaborate with all others in large networks (Mayhew and Levinger (1976), cited in Scott, 1991).

[33] While these densities may seem low, they are not dissimilar from those calculated in other studies for networks of similar sizes (e.g. Stevens, 2010).

It is not necessarily the case that very high density would be necessary in order to facilitate effective collaboration, especially given the particular needs of coastal ecosystem-based management planning. In fact, a lower-density network may be arguably more effective for ecosystem-based management planning. Whereas network density is one indication of cohesiveness and the ability for collective action (Granovetter, 1973), a highly dense network may become too homogeneous and limit the exchange of new and different types of information (Oh, et al., 2004). Through a mental models and network analysis computer simulation, Bodin and Norberg (2005, p. 181) found that managers working within lower-density networks were better able to respond to resource management problems because they were able to “utilize each other’s diverse experiences,” whereas those in higher-density networks were functioning in a synchronous manner and were unable to respond effectively to changing or unexpected conditions. Bodin and Crona (2009) have argued that the management of complex systems such as ecosystems requires information exchange among a variety of specialists, and that a balance between overall cohesion and diversity is necessary to achieve this.

Given this, arguably the Greenwich Bay SAMP network fulfills the expectations of an exemplary EBM case, whereas the Great South Bay EBM Plan case does not. The Greenwich Bay SAMP network is distinctly more diverse and somewhat less dense, and arguably therefore more effective for accomplishing EBM, whereas the Great South Bay EBM Plan network is rather small, dense, and homogeneous. Practitioners in the Great South Bay EBM Plan network did not have the opportunity to draw upon a variety of specialists with a diversity of knowledge, and in a sense may be an example of the results of Bodin and Norberg (2005)’s simulation described above. This may also explain some observations, made by numerous

Great South Bay study participants, that this coastal EBM planning effort did not meet their expectations.

The two cases' network centralization scores further underscore this difference between the two cases. Network centralization, not to be confused with individual actor centrality measures, is a measure of the extent to which the network is centered around one or a few highly central nodes (Scott, 1991). As with density, high network centralization is not necessarily desirable; some have argued that decentralized networks are more effective at accomplishing complex tasks, because more decentralized networks are more likely to have greater diversity of information and problem-solving capacity (Bodin & Crona, 2009; Crona & Bodin, 2006). With a network centralization score of 26.59%, the Great South Bay EBM Plan network is notably more centralized than the Greenwich Bay SAMP network, with a network centralization score of 15.89%. This underscores the reliance of the Great South Bay EBM Plan network on a few key actors, and therefore their limited ability to facilitate a truly collaborative coastal EBM planning process involving a diverse group of practitioners.

6.4.3 Actor Centrality and the Extent of Collaboration

Hypothesis testing based on actor centrality measures for the two cases addressed research question 2a: To what extent were practitioners collaborating with others? Table 32 below summarizes the results of hypothesis testing based on degree and betweenness centrality measures for key sub-groups of both networks.

Table 32. Results of hypothesis testing for both case studies for Question 2a: To what extent were practitioners collaborating with others?

<table>
<tr><th>Hypotheses</th><th>Measures Used</th><th colspan="2">Greenwich Bay SAMP Finding</th><th>Great South Bay EBM Plan Finding</th></tr>
<tr><td>A. Practitioners who are <u>EBM plan project leaders</u> collaborated with more people than other practitioners.</td><td>Degree centrality</td><td colspan="2">True</td><td>True</td></tr>
<tr><td>B. Practitioners who are <u>EBM plan project leaders</u> were more influential in the network than other practitioners.</td><td>Betweenness centrality</td><td colspan="2">True</td><td>True</td></tr>
<tr><td rowspan="2">C. Practitioners who are <u>affiliated with state coastal management programs</u> collaborated with more people than other practitioners.</td><td rowspan="2">Degree centrality</td><td rowspan="2">True (entire group)</td><td>True (staff)</td><td rowspan="2">Not true (staff)</td></tr>
<tr><td>Not true (officials)</td></tr>
<tr><td rowspan="2">D. Practitioners who are <u>affiliated with state coastal management programs</u> were more influential in the network than other practitioners.</td><td rowspan="2">Betweenness centrality</td><td rowspan="2">True (entire group)</td><td>True (staff)</td><td rowspan="2">Not true (staff)</td></tr>
<tr><td>Not true (officials)</td></tr>
<tr><td>E. Practitioners <u>whose generalized expertise is in marine resource management</u> collaborated with more people than other practitioners.</td><td>Degree centrality</td><td colspan="2">True</td><td>Not true</td></tr>
<tr><td>F. Practitioners <u>whose generalized expertise is in marine resource management</u> were more influential in the network than other practitioners.</td><td>Betweenness centrality</td><td colspan="2">True</td><td>Not true</td></tr>
<tr><td>G. Practitioners <u>whose generalized expertise is in the marine sciences</u> collaborated with fewer people than other practitioners.</td><td>Degree centrality</td><td colspan="2">True</td><td>True</td></tr>
<tr><td>H. Practitioners <u>whose generalized expertise is in the marine sciences</u> were less influential in the network than other practitioners.</td><td>Betweenness centrality</td><td colspan="2">True</td><td>Not true</td></tr>
</table>

Degree centrality scores for both cases provided insight into those who were the most active collaborators within each network. Degree centrality is a measure of the number of ties an actor has, and may positively affect an actor's influence in a network (Degenne & Forse, 1999). As was expected, EBM plan project leaders had very high degree centrality scores in both cases. In the case of the Greenwich Bay SAMP, there were interesting differences in the degree centrality of both leaders: GB-19 had much higher degree centrality overall, and GB-11, who is also a state agency manager, had a notably higher in-degree centrality than out-degree centrality, meaning that more people identified connections to him than he did with others. These differences may speak to important differences between these project leaders: GB-11 is a state agency director who is well known (thus people identifying him as part of their network), but not always available. By contrast, GB-19 was affiliated with a university outreach office and was responsible for developing the SAMP document, running a rigorous stakeholder process, and facilitating the involvement of multiple other agencies, organizations, and experts. This distinction speaks to the differences in actors' activities and therefore the importance of context in understanding individuals' roles within a network.

In both cases, marine scientists had relatively low degree centrality scores. Other sub-groups revealed surprising differences between the two cases. In the Greenwich Bay SAMP, agency staff with the state coastal management program had high degree centrality scores, as did marine resource managers from other state agencies. By contrast, neither sub-group within the Great South Bay EBM Plan case had such influence. It was hypothesized that state coastal managers would engage in a high level of collaboration because of the inherently intergovernmental nature of such programs; yet these results revealed that New York's coastal managers played a rather limited role in this particular planning effort. Similarly, it was hypothesized that marine resource managers would engage in a high level of collaboration because such jobs are often interdisciplinary in nature, requiring practitioners to consider natural resources, the regulatory environment, and human uses and interests. However, degree centrality measures indicate that such practitioners in New York did not play such an important role. These results suggest that the Great South Bay EBM collaborative planning process was influenced by unexpected players, and that social capital was concentrated outside of the agency leading the planning effort.

Degree centrality measures revealed numerous other unexpected findings. In the case of the Greenwich Bay SAMP, some of the highest-scoring participants with regard to degree centrality were affiliated with other state agencies or the university, or were private citizens. Examples included GB-10, a private citizen who participated on the Citizens Advisory Committee; GB-18 and GB-06, both affiliated with the office of the university which developed the SAMP; and GB-29 and GB-05, both of whom were affiliated with other state agencies. These results illustrate the overall decentralization of the Greenwich Bay SAMP network, mentioned above –power was distributed within the Greenwich Bay SAMP network such that decision-making was not concentrated in the hands of a few (Bodin, et al., 2006). This also indicates that the Greenwich Bay planning process was not overly reliant on a few key players to keep collaboration going.

In the case of the Great South Bay EBM Plan, some of the highest degree centrality scores were attributed to practitioners who are based on Long Island, in relatively close proximity to the Great South Bay. This is not entirely surprising as geographical boundaries can distinguish sets of actors (e.g. Ramirez-Sanchez & Pinkerton, 2009), though it does not appear that Long Island-based practitioners in this case formed their own clique (a sub-group in which every actor is tied to every other actor) (Granovetter, 1973). It should also be noted that this same distinction cannot be made among Greenwich Bay SAMP study participants as there is no place within the state of Rhode Island that is less than an hours' drive from Greenwich Bay.

Nonetheless, this is an important finding as it indicates that the more active collaborators in this planning process were more closely connected to the planning area.

Betweenness centrality scores for both cases also revealed numerous important and unexpected findings. Betweennness centrality is a measure, for a given actor, of the number of other actors who would need to go through him or her to reach other actors in the network (Hanneman & Riddle, 2005). In other words, an actor with a high betweenness centrality score acts as a bridge or a connector between others who are not otherwise connected (Bodin & Crona, 2009). Such an actor may be thought of as a gatekeeper or broker (Scott, 1991), as they wield considerable influence by either limiting or facilitating the exchange of information between others in the network; he or she is also the recipient of diverse ideas, information, and resources (Bodin & Crona, 2009; Granovetter, 1973).

All betweenness centrality-related hypotheses tested on the Greenwich Bay SAMP study participants were found to be true. EBM plan project leaders, state coastal managers, and marine resource managers were all found to have high betweenness centrality scores compared to others, indicating a higher level of influence and power in the network, than others. Conversely, as was expected, marine scientists were found to have lower betweenness centrality scores. However, only one of these hypotheses was proven true for the Great South Bay EBM Plan case, and even that one hypothesis had an important caveat. These unexpected findings, discussed below, provide a great deal of insight into the Great South Bay EBM Plan case.

While Great South Bay EBM Plan project leaders were proven to be, on the whole, more influential than other practitioners, analysis of the betweenness centrality results for the two individual project leaders revealed a significant difference. GSB-03, affiliated with a Long

Island-based environmental organization, had the highest betweenness centrality score of the entire group whereas GSB-04, affiliated with the state coastal program in Albany, had one of the lower betweenness centrality scores of the group. This is a sharp distinction between the two project leaders. GSB-03's extraordinarily high betweenness centrality score identifies her as the single most influential broker in that case. Brokers are actors who link groups who would otherwise not work together (Burt, 2003). Conversely, betweenness centrality scores suggest that GSB-04 did not play a particularly influential role in bringing together collaborators in this case. This may be because GSB-04, who is a state agency employee, as a public manager played more of an oversight role, whereas GSB-03 played a much more hands-on role in collaborating with others to develop the plan.

State coastal managers and marine resource managers were not found to be particularly influential in the Great South Bay EBM Plan case. This is somewhat surprising. In the case of state coastal managers, it indicates a somewhat more peripheral role played by the state coastal agency and staff than was played by Rhode Island's coastal program in the development of the SAMP. This may be due in part to the different institutional arrangements of the two agencies, as described in Chapter 3, as well as the geographic distance between New York's coastal program and the planning area. What is most important about these results, however, is that marine scientists turned out to be very influential in this network, as indicated by their high betweenness centrality scores. In particular, marine scientists affiliated with environmental advocacy organizations turned out to be particularly influential and to act as brokers between different groups. This is notable and underscores the very important role environmental advocacy organizations and other NGOs can play in developing coastal EBM plans.

6.4.4 Egonet Homophily and the Diversity of Collaboration

Hypothesis testing based on actor centrality measures for the two cases addressed research question 2b: To what extent were practitioners collaborating with others of different affiliations and areas of expertise? Table 33 below summarizes the results of hypothesis testing based on Krackhardt and Stern E-I Index scores for key sub-groups of both networks. Again, as noted above, comparison of the findings for these two cases must be made with caution as the E-I Index scores have some limitations which are especially evident in the Great South Bay EBM Plan case.

Table 33. Results of hypothesis testing for both case studies for Question 2b: To what extent were practitioners collaborating with others of different affiliations and areas of expertise?

Hypotheses	**Measures Used**	**Greenwich Bay SAMP Finding**	**Great South Bay EBM Plan Finding**
A. Practitioners who are EBM plan project leaders *collaborated with more people of different affiliations* than other practitioners.	E-I Index (affiliation)	True	True
B. Practitioners who are EBM plan project leaders *collaborated with more people of different areas of expertise* than other practitioners.	E-I Index (expertise)	True	True
C. Practitioners who are affiliated with state coastal management programs *collaborated with more people of different affiliations* than other practitioners.	E-I Index (affiliation)	Not true (all) Not true (staff) Not true (officials)	Not true
D. Practitioners who are affiliated with state coastal management programs *collaborated with more people of different areas of expertise* than other practitioners.	E-I Index (expertise)	Not true (all) Not true (staff) Not true (officials)	True
E. Practitioners whose generalized expertise is in marine resource management *collaborated with more people of different affiliations* than other practitioners.	E-I Index (affiliation)	True	True
F. Practitioners whose generalized expertise is in marine resource management *collaborated with more people of different areas of expertise* than other practitioners.	E-I Index (expertise)	Not true	Not true
G. Practitioners whose generalized expertise is in the marine sciences *collaborated with fewer people of different affiliations* than other practitioners.	E-I Index (affiliation)	Not true	Not true
H. Practitioners whose generalized expertise is in the marine sciences *collaborated with fewer people of different areas of expertise* than other practitioners.	E-I Index (expertise)	Not true	True

As described above, Krackhardt and Stern's E-I Index provides one way of evaluating the homophily of each practitioners' ego network based on a given attribute; scores range from +1 to -1, with -1 indicating perfect homophily (contact only with those of the same attribute) (Krackhardt & Stern, 1988). Diversity within these two networks of practitioners is considered desirable for developing coastal ecosystem-based management plans because this approach inherently requires inter-organizational and interdisciplinary collaboration, as described in Chapter 2. This is also considered desirable because a diversity of connections can facilitate information transfer (Isaac, et al., 2007) and enhance problem-solving capacity (Bodin & Norberg, 2005). E-I Index scores were calculated for study participants within each of the two networks and average scores for the two cases are presented above. In general, practitioners in both cases demonstrated a tendency to collaborate with those of different affiliations: the average E-I Index for Greenwich Bay SAMP participants was +0.470, and the average score for Great South Bay EBM Plan participants was +0.0845. These scores illustrate that Greenwich Bay SAMP study participants had a much greater tendency to collaborate with those of different affiliations. This seems to be consistent with the overall greater diversity of agencies and organizations who were part of this case's planning process, as illustrated above. By contrast, Great South Bay EBM Plan study participants demonstrated only a slight tendency toward collaboration with others of different affiliations. While this finding must be interpreted with caution given the limited opportunities of practitioners in this case to collaborate with those of different attributes, it also points to the homogeneity of this network, which was in itself a result of decisions made by practitioners throughout the process. This homogeneity is illustrated visually in Figure 37 above, which highlights how state government and environmental advocacy group-affiliated actors dominated this planning process. This homogeneity in itself is an important finding and indicates that the Great South Bay case fell short of expectations as an exemplary EBM planning effort.

Krackhardt and Stern E-I Index scores for expertise show an even greater difference between the two cases. Greenwich Bay SAMP study participants demonstrated an even greater tendency to collaborate with others of different areas of expertise, as evidenced by their score of +0.499. By contrast, Great South Bay EBM Plan study participants demonstrated a tendency toward homophily, scoring an average E-I Index score of -0.060. Again, these differences between the two groups are consistent with the overall composition of the two groups as illustrated above; there were far fewer areas of expertise included in the Great South Bay EBM Plan group, and thus many fewer opportunities to collaborate with those of different expertise. These particularly low scores for collaboration across disciplines suggest that there may have been a rather homogeneous, shared view of coastal ecosystems among many of the practitioners involved in this case.

Hypothesis testing based on E-I Index scores revealed numerous unexpected results and many hypotheses were disproven. This may be in part due to the limitations of E-I Index scores as a measure of diversity. EBM plan project leaders in both cases were found to have diverse networks with respect to both affiliation and expertise. However, state coastal managers in both cases did not collaborate widely across both jurisdictions and disciplines. This may be due in part to the fact that state employees were working most closely with practitioners from other state agencies. The only exception to this, and the one hypothesis that was proven true, was for the Great South Bay EBM Plan: New York coastal managers collaborated actively with those of other areas of expertise. This may be explained by the fact that the Great South Bay EBM Plan effort involved a number of marine scientists, some of whom were study participants and others who were identified as part of the network. Marine resource managers across both cases were found to collaborate actively with those of other affiliations, but not with those of different areas of expertise; this may be because they collaborated with others who fell under the general category of marine resource management. Finally, marine scientists in both cases did not always collaborate with those of different affiliations, but were found to collaborate actively with those of other areas of expertise; this suggests that marine scientists who were involved were acting as advisors to resource managers and others.

While results are varied, Greenwich Bay SAMP study participants appeared to have an overall stronger tendency to collaborate across affiliations and areas of expertise. The Greenwich Bay SAMP network had overall high average E-I Index scores and included ten practitioners who scored a +1 on the E-I Index score for affiliation and eight with a +1 for expertise. The network itself comprised an extraordinarily diverse grouping of individuals and organizations; this composition alone indicates a broad conception of collaboration and an openness to multiple perspectives. By contrast, the Great South Bay EBM Plan study participants had much lower average E-I Index scores and included only two practitioners who scored a +1 (for both affiliation and expertise). A simple review of those who participated in the Great South Bay EBM Plan corroborates these observations. There were far fewer affiliations and areas of expertise included in the network, and some omissions were notable. Study participants included only one local government participant, no elected or appointed officials, no business owners or users, and no citizens; the complete network included just one or two additional such individuals, and both the study participant sampling strategy and the position of these individuals in the network, as shown in Figure 17 above, corroborate the observation that these other participants were not key players in this planning process.

6.4.5 Comparing Extent and Diversity of Collaboration

Last, in some cases there appears to be a relationship between practitioners' betweenness centrality measures and E-I Index scores. This is logical; those individuals who are collaborating actively and who are very influential in the network may be more likely to have more diverse networks, whereas those who are not collaborating actively may be less likely to have such diverse networks. For example, GSB-03 had a relatively diverse ego network as evidenced by her E-I Index scores, especially in comparison to the other project leader in the Great South Bay case; this may be related to her status as the most influential person in the network (as evidenced by her high betweenness centrality score). Similarly, the unexpected findings about Great South Bay marine scientists collaborating across both jurisdictions and disciplines may be explained in part by the very high betweenness centrality scores for some of these individuals. Conversely, the relative homogeneity of coastal managers' ego networks - especially pronounced in the case of New York – may be explained by these coastal managers' low betweenness centrality scores.

Much can be understood about practitioners' roles in the network by considering their mental models alongside their network analysis scores. Chapter 7, Cross-Cutting Themes, brings these two methods together to analyze the relationship between mental models and social networks and to make overall observations about the two cases.

Chapter 7. Cross-Cutting Themes: Integrating Mental Models and Social Network Analysis

7.1 Chapter Overview

To investigate the capacity of coastal management practitioners to develop coastal ecosystem-based management plans, this study applied two different methods to two different case studies. Chapter 5 presented the results for research question 1: What are the characteristics of coastal management practitioners' mental models? These results provided insight into the comprehensiveness and the balance of practitioners' mental models of coastal ecosystems in both the Greenwich Bay SAMP and the Great South Bay EBM Plan cases. Chapter 6 presented the results for research question 2: What are the characteristics of coastal management practitioners' social networks? These results provided insight into the nature of collaboration among practitioners in both the Greenwich Bay SAMP and the Great South Bay EBM Plan cases. The extent of practitioners' networks, and the extent to which practitioners collaborated with those of different affiliations and different areas of expertise, were assessed to provide insight into collaboration in these two cases. This chapter presents the results of research question 3, the culminating question addressed by this study:

> *What is the relationship between coastal management practitioners' mental models and practitioners' social networks?*

This question is subdivided into four questions to facilitate further investigation:

> *3a.) Is practitioners' mental model comprehensiveness related to the extent of collaboration?*

> *3b.) Is practitioners' mental model balance related to the extent of collaboration?*

3c.) Is practitioners' mental model comprehensiveness related to collaboration with others of different affiliations and expertise?

3d.) Is practitioners' mental model balance related to collaboration with others of different affiliations and expertise?

This study theorizes that practitioners who have comprehensive, balanced mental models of coastal ecosystems are active collaborators, collaborating with many other practitioners of varying affiliations and areas of expertise. This chapter uses a series of hypotheses, focused around the four above-mentioned research questions, to test this assumption. Unlike hypotheses tested in chapters 5 and 6, these hypotheses do not focus on sub-groups of practitioners, but rather look at the entire universe of study participants to determine whether there are meaningful relationships between mental models and social network analysis findings. Results of statistical correlation tests are presented and discussed; additionally, other observations about relationships between mental models and social network analysis findings are discussed. This chapter concludes with overall discussion about findings with regard to the two case studies.

7.2 Research Question 3: What is the relationship between practitioners' mental models and practitioners' social networks?

7.2.1 Hypothesis Testing Using Standard Correlation Tests

Spearman's rank correlation tests were first run on the Greenwich Bay SAMP data (n=28) and the Great South Bay EBM Plan data (n=13), as two separate populations, to test the statistical significance of correlations between a series of the mental models and social network analysis values. Correlations tested a series of hypotheses that address the above-mentioned four research questions for each of the two case studies, similar to the structure used in Chapter 5 and Chapter 6. Then, both datasets were combined (n=41) and both Spearman's rank correlation tests and Pearson's correlation tests were run to test the statistical significance of correlations for the entire universe of study participants, regardless of case study. In order to accurately compare all study participants to each other, regardless of which network they belonged to, normalized degree and betweenness centrality measures were substituted for raw centrality measures. While analyzing all study participant data together does not facilitate comparison between case studies, it does allow for further investigation of the relationship between mental models and social networks. Moreover the larger sample size satisfies the requirements for applying Pearson's correlation, which is a more efficient test. Hypotheses and results for all correlation tests are summarized in Table 34 and discussed below.

Table 34. Summary results of Spearman's Rank and Pearson's correlation tests on mental models and network analysis data

Hypothesis	Data used	Results: Greenwich Bay SAMP (n=28)	Results: Great South Bay EBM Plan (n=13)	Results: all study participants (n=41)	
		Spearman's correlation coefficient (α=0.05, 2-tailed)	**Spearman's correlation coefficient (α=0.05, 2-tailed)**	**Spearman's correlation coefficient (α=0.05, 2-tailed)**	**Pearson's correlation coefficient (α=0.05, 2-tailed)**
A1. There is a linear correlation between practitioners' mental model comprehensiveness and the extent to which they collaborated with others.	Mental model comprehensiveness score; degree centrality measure	0.265; p=0.173	0.124; p=0.685	0.227; p=0.154	0.238; p=0.134
A2. There is a linear correlation between practitioners' mental model balance and the extent to which they collaborated with others.	Mental model balance score; degree centrality measure	-0.022; p=0.912	0.122; p=0.692	-0.135, p=0.401	-0.187; p=.242
B1. There is a linear correlation between practitioners' mental model comprehensiveness and their influence in the network.	Mental model comprehensiveness score; betweenness centrality measure	0.171; p=0.384	0.168; p=0.584	0.185; p=0.246	0.346; p=0.027 (STATISTICALLY SIGNIFICANT)
B2. There is a linear correlation between practitioners' mental model balance and their influence in the network.	Mental model balance score; betweenness centrality measure	0.022; p=0.910	0.297; p=0.324	0.023; p=0.887	-0.052; p=0.744

C1. There is a linear correlation between practitioners’ mental model comprehensiveness and the extent to which they collaborated with others of different affiliations.	Mental model comprehensive ness score; E-I Index (for affiliation)	0.193; p=0.324	0.254; p=0.403	0.181; p=0.258	0.181; p=0.257
C2. There is a linear correlation between practitioners’ mental model balance and the extent to which they collaborated with others of different affiliations.	Mental model balance score; E-I Index (for affiliation)	0.100; p=0.612	-0.226; p=0.457	0.129; p=0.421	0.155; p=0.332
D1. There is a linear correlation between practitioners’ mental model comprehensiveness and the extent to which they collaborated with others of different expertise.	Mental model comprehensive ness score; E-I Index (for expertise)	0.076; p=0.702	0.161; p=0.598	0.048; p=0.766	0.117; p=0.468
D2. There is a linear correlation between practitioners’ mental model balance and the extent to which they collaborated with others of different expertise.	Mental model comprehensive ness score; E-I Index (for expertise)	0.203; p=0.301	-0.268; p=0.377	0.186; p=0.246	0.180; p=0.260

As illustrated in Table 34, Spearman's rank tests run on the two cases as two separate datasets found no statistically significant correlations between mental models and network analysis measures. In neither case was there a statistically significant correlation between practitioners' mental models (either comprehensiveness or balance) and actor centrality measures (either degree or betweenness). In addition, in neither case was there a statistically significant correlation between mental models and E-I Index scores (either affiliation or expertise). However, combination of the two case datasets into one population yielded different results. As shown in Table 34, Pearson's correlation tests revealed a statistically significant correlation that addresses research question 3a: What is the relationship between practitioners' mental model comprehensiveness and the extent of collaboration? A statistically significant relationship was found between mental model comprehensiveness and betweenness centrality (r=0.346, p=0.027). In other words, practitioners with highly comprehensive mental models of were found to be very influential within their respective networks. See below for further discussion of these results.

7.2.2 Hypothesis Testing Using Resampling Methods

Because a statistically significant correlation between the mental model comprehensiveness and betweenness centrality of all study participants (n=41) was found, additional statistical tests were used to further investigate whether there was a difference between the two different groups of study participants. Tests were run on mental model comprehensiveness and betweenness centrality, as well as mental model comprehensiveness and degree centrality. Resampling statistical methods (described in Chapter 4) were used as these have been established as effective for small sample sizes. Pearson's correlation tests were run on each dataset using an Exact Test with Monte Carlo resampling in SYSTAT 13

(Cranes Software International, 2010); results are presented in Table 35 and reveal that there is a statistically significant correlation between mental model comprehensiveness and degree centrality¸ as well as between mental model comprehensiveness and betweenness centrality, for the Greenwich Bay SAMP study participants but not for the Great South Bay EBM Plan participants. See discussion below.

Table 35. Results of Pearson's Correlation with Exact Test with Monte Carlo resampling for both case studies

Hypothesis	**Greenwich Bay SAMP finding (n=28)** *(2-tailed; 95% confidence interval)*	**Great South Bay EBM Plan finding (n=13)** *(2-tailed; 95% confidence interval)*
A1. There is a linear correlation between practitioners' mental model comprehensiveness and the extent to which they collaborated with others.	r=0.443 (p=0.018) (STATISTICALLY SIGNIFICANT)	r=0.253 (p=0.412)
B1. There is a linear correlation between practitioners' mental model comprehensiveness and their influence in the network.	r=0.452 (p=0.014) (STATISTICALLY SIGNIFICANT)	r=0.217 (p=0.492)

7.2.3 Discussion: Mental Model Comprehensiveness and Influence in the Network

As described above, Pearson's correlation test results showed that there is a statistically significant correlation between mental model comprehensiveness and betweenness centrality for the entire universe of study participants (n=41). This is a significant finding and speaks to one of the fundamental premises of this study, that coastal management practitioners with comprehensive, well-developed mental models of coastal ecosystems are key collaborators within their planning networks. It is especially meaningful that comprehensiveness was found to be correlated with betweenness centrality rather than other network measures. As discussed in Chapter 6, betweenness centrality is in some ways a more meaningful measure of an actor's role within a network. Betweenness centrality is a measure of an actor's influence in a network, as determined by the number of others who would need to go through that actor to access others in the network. An actor with high betweenness centrality may be thought of as a gatekeeper or broker (Scott, 1991). As described in Chapter 2, brokers, who are often described as bridging ties, are critical for collaborative natural resource governance efforts, especially those involving complex systems like ecosystems. Bridging ties wield considerable influence by either limiting or facilitating the exchange of information between others in the network (e.g. Bodin & Crona, 2009). A bridging tie can provide access to information and is also the recipient of diverse ideas, information, and resources; these individuals are key to the diffusion of information and innovation (e.g. Granovetter, 1973).

Actors with high betweenness centrality in coastal EBM planning efforts can play very important roles in developing and implementing such plans. Burt (2003, p. 157) notes that brokers, i.e. those with high betweenness scores, have high social capital because they have great capacity for "adaptive implementation" – in other words, they know their networks well, can adapt to changing circumstances, and can therefore solve problems by drawing upon their knowledge of individuals, organizations, information and resources. Bodin et al. (2006, p. r2) write that a broker "gains access to many pieces of group-specific information captured inside the different groups, which allows the broker to synthesize a large knowledge pool." Burt (2003) reviewed a series of studies which illustrate that brokers' networks are inherently more diverse and that this diversity enables brokers to be creative and innovative problem solvers. Newman and Dale (2005) underscore that bridging ties' links to diverse information can enhance a network's overall adaptability and resilience, thus enabling them to develop collaborative responses to complex environmental challenges.

Given this, within the context of a coastal EBM planning effort, it is not surprising that those with high betweenness centrality scores would have very comprehensive mental models of coastal ecosystems. Arguably, such individuals are essential to the success of coastal EBM planning efforts. Within the context of coastal EBM planning efforts, brokers would have access to a broad array of information representing the various aspects of a coastal ecosystem and would likely have contact with individuals and organizations representing all aspects of the reference coastal EBM model – natural resource scientists and managers; user groups, citizens, and advocates; and governance institutions. Brokers are well-positioned to receive diverse information from this wide variety of individuals, and to in turn distribute information among these players. This makes brokers not just important collaborators, but also the lynchpins of coastal EBM planning efforts, facilitating the interdisciplinary, integrated, adaptive thinking that is required for applying the EBM approach (Arkema, et al., 2006; Leslie & McLeod, 2007). However, it is not enough for a broker to occupy a position of influence – he or she needs to use their position to facilitate, rather than hinder, the exchange of information in the network. As some social network scholars have pointed out, position in the network is not enough to improve governance processes; central, influential actors must use their roles in ways to benefit the overall network (Bodin & Crona, 2009). (e.g. Bodin & Crona, 2009). An individual with a very comprehensive mental model is arguably much more likely to do that.

This is important as it cannot be assumed that those with high betweenness centrality scores alone are playing that role because of a desire to work toward a comprehensive ecosystem-based approach. Indeed, while this study reported an overall statistically significant relationship between mental model comprehensiveness and betweenness centrality, several individual study participants had high betweenness centrality scores but relatively low comprehensiveness scores. A practitioner with a high betweenness centrality score and a very comprehensive mental model would seemingly be more likely to use his or her position to support a broad, inclusive planning process and the development of a comprehensive, integrated EBM plan.

It is important to note that the above-mentioned results do not prove causality - it is not clear whether practitioners have comprehensive mental models because they are influential collaborators, or whether practitioners' comprehensive mental models cause them to actively collaborate with others. It may be a little of both, and it likely varies by actor depending on the individual's background, expertise, and prior experiences. Regardless, however, it is desirable for effective coastal EBM planning that practitioners have very comprehensive mental models and are active, influential collaborators. Moreover, it is desirable that influential brokers have very comprehensive mental models as, as noted above, they are much more likely to use their position in the network effectively to involve actors and sub-groups and exchange information about all aspects of a coastal ecosystem.

7.2.4 Discussion: Comparing Mental Model Comprehensiveness and Actor Centrality Correlations Across the Two Cases

As described above, resampling-based statistical tests further illustrated that there is a notable difference between the two cases: there is a statistically significant correlation between mental model comprehensiveness and betweenness centrality as well as actor centrality for the Greenwich Bay SAMP study participants (n=28), but not for the Great South Bay EBM Plan study participants (n=13). In other words, Greenwich Bay SAMP study participants who had very comprehensive mental models were also active and influential collaborators, whereas in the Great South Bay case, no such relationship existed. This is also a very important finding which highlights the key differences between the two cases. As described in Chapter 5, both the Greenwich Bay SAMP and the Great South Bay study participants had fairly comprehensive mental models of coastal ecosystems – the average comprehensiveness scores for the two groups were equal. Whereas there were many differences between the mental models of the two groups, it would seem that on the whole, both groups of practitioners had sufficiently comprehensive mental models to develop a comprehensive coastal EBM plan. However, there were notable differences between the two networks. As described in Chapter 6, the Greenwich Bay SAMP network was large and diverse, and was not overly dense and centralized – there were numerous well-connected and influential actors who shaped collaboration in this network. By contrast, the Great South Bay network was small, relatively homogeneous, and fairly dense and centralized – reliant on just a few key well-connected and influential actors who constituted the core of the network. The fact that Great South Bay practitioners had comprehensive mental models but relatively few network connections and relatively less-influential roles in their network suggests that their choices of who to collaborate with, and how, were influenced by other factors. See further discussion below.

7.2.5 Discussion: Limitations to the Relationship Between Mental Models and Collaboration

While this study has revealed a strong relationship between mental model comprehensiveness and betweenness centrality overall, and strong relationships between mental model comprehensiveness and both degree and betweenness centrality for Greenwich Bay SAMP participants, there are clearly limitations to the relationship between mental model attributes and actor centrality measures. This is illustrated in part by the results of the Great South Bay case, which revealed that actors with very comprehensive mental models were not necessarily well-connected or influential in their network. It seems evident that the relationship between mental models and collaboration is complex, and that many other factors may influence practitioners' mental models as well as their choices of who to collaborate with and how. Possible explanations for this are explored below.

7.2.5.1 Constraints on Collaboration

This study has revealed that there is a statistically significant relationship between mental model comprehensiveness and degree centrality for Greenwich Bay SAMP study participants, but not for Great South Bay EBM Plan study participants and not for the universe of study participants as a whole. This is likely due to the numerous unexpected findings in the data, described in Chapter 5 and Chapter 6: there were numerous cases of practitioners with comprehensive mental models who had relatively few connections in the network, and those with many connections in the network who had less comprehensive mental models.

There are multiple possible reasons for this. Practitioners' choices of who they work with, how many people they work with, and the nature of their contact with those people may be limited by the practical constraints of time and resources. Whereas an individual practitioner or an agency may have a comprehensive understanding of coastal ecosystems and see the importance of working with many different partners, staffing, budget, and workload constraints may limit their ability to do so. March and Simon (1958) identified such constraints to comprehensive, rational decision-making in their discussion of "bounded rationality," and Lipsky (1983) identified the problem of resources – time, information, training, and budget – as constraints that shape the day-to-day work of line agency professionals or "street-level bureaucrats." In the case of these coastal EBM planning efforts, geographic distance and travel budget limitations may have also constrained practitioners' ability to work with others, particularly with business operators, citizens, and other stakeholders; this, in particular, may explain some limitations in the Great South Bay EBM Plan case as the lead agency for this planning effort is located hours away from the planning area.

Practitioners' choices of who they work with, and how they work with them, may also be influenced by interagency and inter-organizational relationships. Bardach (1998) describes turf as a barrier to collaboration, especially between agencies which perceive themselves to be competing over problem domain or clients. Bardach (1996) further notes how interagency collaboration may be impeded by a variety of technical, legal, bureaucratic, and political barriers and that incentive to move past these barriers may be impeded by agency staff members' desire to protect their turf. These barriers to collaboration may not be limited to government agencies; political concerns or even ideological or philosophical differences may influence or limit working relationships between government agencies and non-governmental organizations.

Such issues may have influenced the nature of collaboration in both cases. Indeed, after completing the social network analysis survey, one Great South Bay EBM Plan study participant explained that the network of individuals with whom she worked was strongly influenced by her organization's contractual relationship with a state agency to develop this plan (Bortman, 2011). In some cases, this may have influenced whether certain agencies, organizations, or user groups participated at all: for example, it is notable that participation from local government was minimal in the Great South Bay EBM Plan case, despite the fact that Long Island towns own and manage underwater lands that were part of the planning area (see Chapter 3 for further discussion). In other cases, this may have influenced the nature of some actors' participation. For example, in the case of the Great South Bay EBM Plan, numerous study participants made reference to differing views among agencies and non-governmental organizations about this planning process; this apparent lack of common purpose may explain the lack of further involvement by other parties. And in the case of the Greenwich Bay SAMP, two different study participants from different government entities noted that their participation in this case was to protect their entities' interests. For example, one local government affiliated participant noted, "from my perspective I saw myself in a protective mode for the town, not to get caught up in someone overregulating the bay and having those regulations fall over the town." This view shaped this participant's view of the coastal ecosystem: he further elaborated that Greenwich Bay was not part of his town, even though his town's waterfront abutted one of the bay's five coves. Such a viewpoint may explain why a practitioner may have collaborated actively (as indicated by a high degree centrality measure) but have a relatively narrow mental model.

Last, practitioners' decisions about who to work with may be influenced by their prior work with other individuals and organizations. For example, in the case of the Greenwich Bay SAMP, the state coastal agency and an office of the university have nearly 30 years of experience in collaborating to develop all but one of Rhode Island's special area management plans (Lee, 2011). This meant that the Greenwich Bay SAMP network was influenced by a pre-existing network of individuals and organizations who have worked together for decades to conduct this kind of planning effort. Indeed, the high betweenness centrality of numerous practitioners within the Greenwich Bay network may be explained in part due to this longstanding history. While this pre-existing network likely enhanced collaboration in the Greenwich Bay case, it is not a necessary prerequisite for collaboration; an intensive outreach and education process could help build such collaborative relationships and provide the informal education and training that are gained over so many years of work together. Similarly, interdisciplinary training, such as that provided by graduate degree programs in resource management, could address this need. See further discussion in Chapter 8.

7.2.5.2 The Other Factors That Influence Practitioners' Mental Models

Study results revealed that there were numerous study participants who were well-connected in the network, as indicated by their degree centrality measures, but who had somewhat less comprehensive mental models. This illustrates how practitioners' mental models are shaped by much more than who they collaborate with on a given coastal EBM planning effort. Mental models have been characterized as dynamic, working models that are shaped by formal or informal learning processes (Jones, et al., 2011). Coastal management practitioners' mental models of coastal ecosystems may be shaped by a variety of factors, including their prior or concurrent personal or professional experiences; their prior academic training; and their personal knowledge of the planning area.

All of these themes emerged during the mental models interviews for both case studies. For example, numerous practitioners referred to other professional experiences they had that were not part of the coastal EBM planning effort in question. One New York resource manager described complaints her agency had received about commercial shellfishermen, using this to explain conflicting views about how coastal waters should be used. In the case of the Greenwich Bay SAMP, numerous practitioners offered descriptions of their participation in other special area management planning efforts for other areas of the Rhode Island coast, or their work on other projects with some of the key Greenwich Bay SAMP actors. In a couple of cases, such as that of a Long Island-based practitioner and that of two Rhode Island-based citizens, study participants spent significant proportions of the interviews offering preambles – that is, offering lengthy background stories about their own prior work, which they described as being important background to discussing the coastal ecosystem and planning effort in question. This study did not systematically record information about practitioners' overall professional experience, beyond their years in their current job. However, this anecdotal information suggests that practitioners' mental models are shaped by their professional experiences far beyond their participation in the single planning effort in question, and may point to the importance of including seasoned professionals, with a wide range of experiences, in coastal EBM planning efforts. See Chapter 8 for further discussion.

Numerous practitioners also referred extensively to their own previous or current personal experiences living, working, or recreating in or near the coastal ecosystem in question. Two New York resource managers made reference to their prior careers as commercial shellfishermen, during which time they worked on Long Island's south shore bays. One New York marine scientist made reference to growing up in a town abutting the Great South Bay, and referenced his family's history of working in shipping and fishing as he described the changing landscape of human uses of marine waters. Numerous Rhode Island-based practitioners – both citizens and professionals - described their connections to Greenwich Bay in highly personalized and sometimes even emotive terms, referencing time spent with children, parents, and grandparents on the Bay. One recently-retired marine resource manager described his youth growing up in East Greenwich and described Greenwich Bay as "the heart – it's the heart of marinas, it's the heart of the shellfishery, and it's this neighborhood thing back in there.....so Greenwich Bay is the heart, it's just a key place" (Ganz, 2011). It is also interesting to note that many participants who referenced their personal experiences showed themselves to have relatively comprehensive and well-developed models. Again, this study did not ask participants about their personal experiences with or knowledge of the ecosystem in question. Nonetheless, these anecdotes suggest the importance of including practitioners with extensive personal knowledge of coastal ecosystems into such planning efforts.

7.2.5.3 Interpreting and Explaining Mental Model Balance

Study results also revealed that mental model balance was somewhat more difficult to predict – fewer hypotheses about mental model balance were proven true, and as described in Chapter 5, analysis of mental model balance revealed numerous unexpected findings. In addition, mental model balance measures were not found to be correlated with any other measures, as reported above. This suggests that balance is a somewhat more complex assessment of coastal EBM mental models than is comprehensiveness and may require further investigation. For the purposes of this study, this is not a problem - arguably, comprehensiveness is the more important metric in terms of assessing practitioners' capacity to develop coastal EBM plans. However, balance provides a more in-depth analysis of the complexity of a practitioner's mental model, especially when compared with an assessment of the individual's comprehensiveness as well as the individual's role in the network. The following discussion builds on Chapter 5's discussion about what might be learned from mental model balance and how it relates to or is influenced by practitioners' roles in a collaborative network.

One way of considering mental model balance, which is especially relevant to coastal management professionals engaged in the policy process, is as an indication of a practitioner's problem orientation. A practitioner's problem orientation may be influenced by a range of factors including a broader political agenda, budgetary considerations, an individual's bias, or other factors. Coastal management professionals may likely have a particular problem orientation that frames how they see the coastal ecosystem for which they are planning (see eg. Clark, 2002). Whereas comprehensiveness provides insight into a practitioner's awareness of the different components of the reference EBM model, balance, which was calculated by quantifying the number of times an individual brought up a given topic, may indicate what the practitioner sees as most important and as requiring the most attention. For example, Figure 45 shows how GB-11, an EBM plan project leader, had a very comprehensive mental model but also a very imbalanced one – he focused his discussion disproportionately on ecological matters. GB-11's high degree and betweenness centrality scores indicate that he was very well connected and very influential in the Greenwich Bay SAMP network. This further illustrates that GB-11 likely has a very broad understanding of a wide range of issues, and that his mental model is likely influenced by his contact with a wide range of individuals, agencies, organizations, and experts. This suggests that his evident imbalance is less likely a result of ignorance than of orientation toward what he perceived to be the most pressing problems at hand.

Another way of understanding mental model balance is the capacity of an individual to think about an individual issue or subset of issues from a balanced ecosystem perspective. Figure 46 shows that GB-21, a commercial shellfisherman, had a very well-balanced mental model but did not have a very comprehensive view of the Greenwich Bay SAMP ecosystem. This would seem to suggest that GB-21 is focused on a narrow subset of coastal resources and activities, but has the capacity to view these resources and activities with a balanced approach that considers the ecological, governance, and human use elements of the ecosystem. GB-21's low degree and betweenness centrality underscore this participant's peripheral role in the network and indicate that he was not widely influenced by a range of different individuals and organizations with different opinions and areas of expertise. This suggests that balance, in his case, refers to his ability to see his own activities from an ecosystem perspective. Given these multiple ways of viewing mental model balance, mental model balance requires further examination and consideration. It is a valuable metric but should be interpreted within the context of other mental model findings.

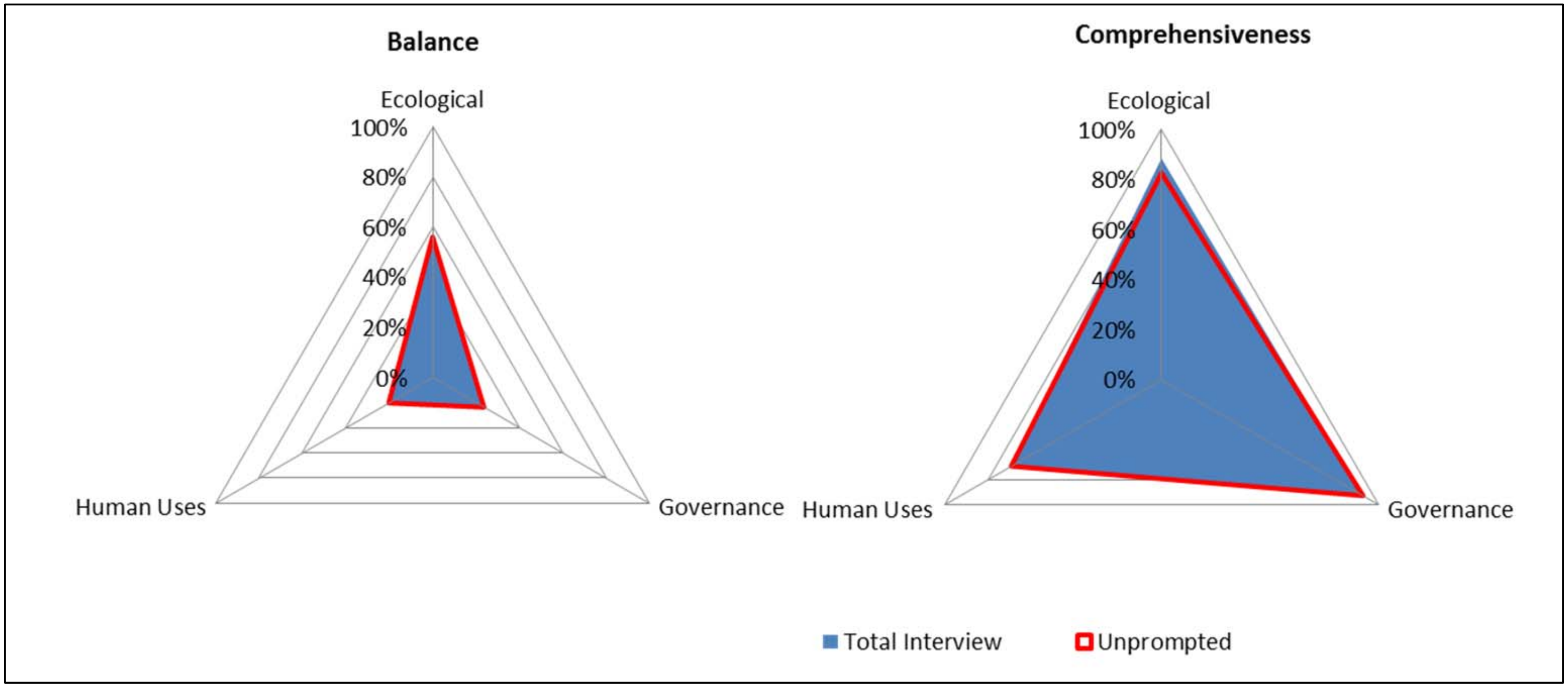

Figure 45. Mental model balance and comprehensiveness of GB-11, state coastal manager/EBM plan project leader (Degree centrality = 31; Betweenness centrality = 825.125)

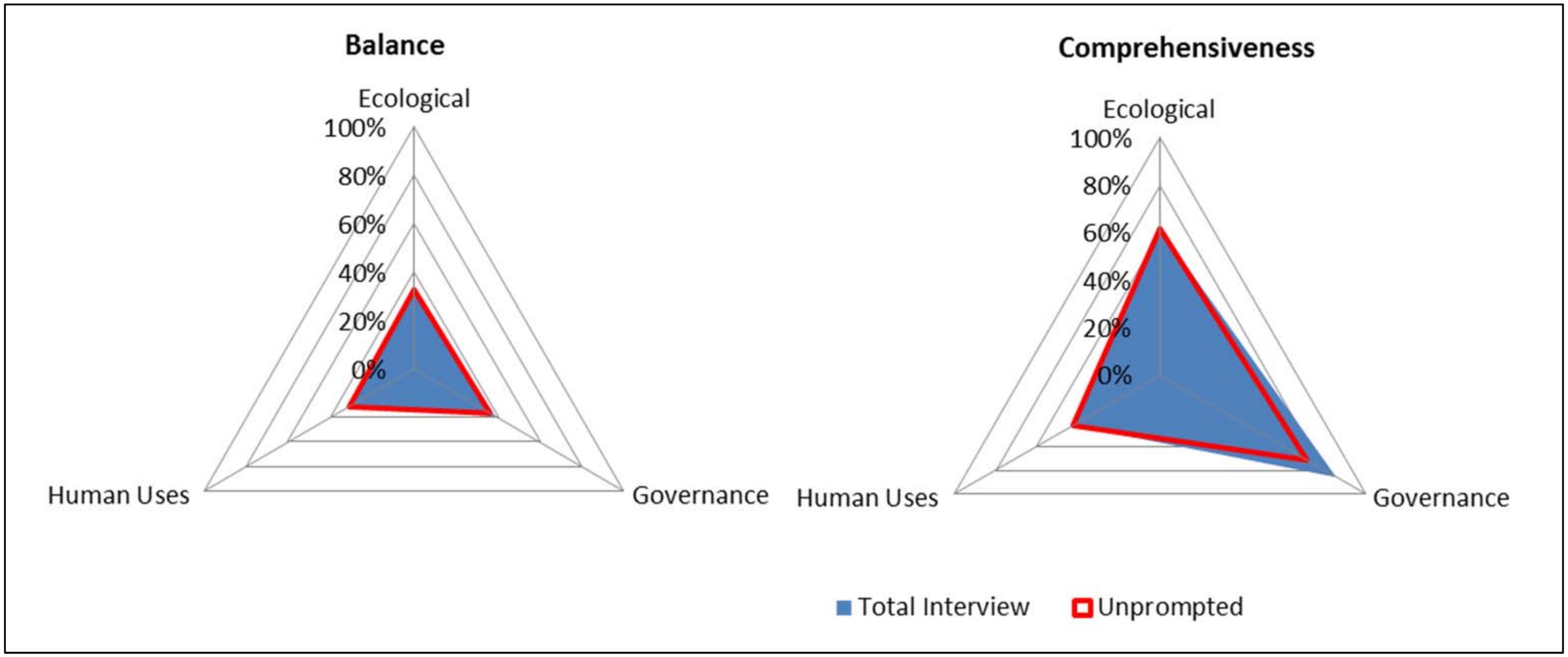

Figure 46. Mental model balance and comprehensiveness of GB-21, commercial shellfisherman (Degree centrality = 5; betweenness centrality = 4.286)

7.2.5.4 Interpreting and Explaining the Role of Prompts in Mental Model Analysis

Last, the role of prompts must be considered with regard to interpreting mental models results alongside social network analysis results. This study is somewhat unique in the way in which it has paired practitioners' mental models and social network attributes to understand practitioners' capacity to develop coastal EBM plans.[34] In a sense, each method addresses the questions unanswered by the other: network analysis provides insight into who practitioners collaborate with, and therefore who may be influencing, or influenced by, their mental models; and mental models analysis provides insight into how individual actors think and therefore how they might work with others in the network and what kinds of information and resources might be exchanged between actors. The prompted component of the mental models analysis provides an additional level of insight into practitioners' mental models and how they may be influenced by collaboration in the network, and merits further discussion.

The mental models analytical method of interviewing participants and distinguishing between open-ended and prompted questions and prompts is based on the work of Morgan et al. (2002), yet these authors do not delve deeply into how to interpret the difference between the two types of input. Prompts may be a particularly important part of this mental models methodology given that this study is focused on collaborative planning processes and social networks. In some ways, prompts resemble the types of questions or ideas that would be raised through a collaborative process, and an individual's responsiveness to prompts, or lack thereof, may provide insight into how receptive he or she would be to these questions or

[34] The only study located for this research that incorporates both of these concepts is that of Bodin and Norberg (2005), who incorporated both mental models and network analysis components into a simulation of information topology in adaptive natural resource management. They simulated decision-makers' mental models and network densities using specialized simulation software and found that decision-makers in low to moderately dense networks were able to use each others' diverse knowledge and experience to solve problems, whereas decision-makers in high density networks had synchronous mental models that inhibited their ability to solve problems.

ideas during such a process. In assessing comprehensiveness, prompts help distinguish between a practitioners' default mental model – the information they are most comfortable with and can readily access – as opposed to other content that the practitioner recognizes as valid but with which he or she may be less familiar, interested, or invested. In assessing balance, prompts accomplish a similar goal and in nearly all cases caused practitioners to present a more balanced mental model. This provides insight into how receptive practitioners may be to new or unfamiliar ideas while participating in a collaborative EBM planning process.

Consideration of prompts revealed two important points with regard to mental models and the overall structure and composition of the two cases' networks. First, prompts caused most practitioners across both case studies to expand their discussion of human uses, thus revealing more comprehensive and more balanced mental models. Great South Bay EBM Plan participants had relatively low mental models scores (both comprehensiveness and balance) in the human use area of focus, but analysis of prompts revealed that their mental model balance shifted considerably in the direction of human uses (7%) in comparison to their Greenwich Bay counterparts (3.3%). This suggests that Great South Bay participants might have been receptive to such considerations as part of the planning effort. However, no participants representing those uses and interests – such as business owners/operators, user groups, and citizens – were included in this planning process, and other information available about the draft plan indicates that such considerations were not actively incorporated into the planning process (see Chapter 3). As human uses and stakeholder involvement are considered essential components of coastal EBM processes (e.g. Arkema, et al., 2006), this indicates a shortcoming of the Great South Bay EBM planning process and also highlights a simple way in which it might have been addressed – through the inclusion of a more diverse group of participants into the planning network.

Second, the distinction between prompts and unprompted components of practitioners' mental models reveals that most practitioners were predisposed to a certain area of focus. In the case of the Great South Bay EBM Plan, the entire group of practitioners exhibited a much stronger predisposition to the ecological area of focus than their Greenwich Bay counterparts; this was particularly notable when considering the unprompted portions of interviews (Great South Bay EBM Plan unprompted ecological balance score: 52%; Greenwich Bay SAMP unprompted ecological balance score: 37%). It is not necessarily expected that all practitioners would have well-balanced mental models, but in the absence of well-balanced mental models, an effective coastal EBM planning process would be expected to include practitioners of many different types of mental models – thus achieving overall balance in the network and capacity to address the full range of problems affecting the coastal ecosystem. As discussed above, the network analysis literature emphasizes this, suggesting that diversity within a network is essential for solving complex ecosystem problems (e.g. Bodin & Norberg, 2005; Ernstson, et al., 2008). Again, this suggests a shortcoming in the Great South Bay EBM planning process that might have been addressed through the establishment of a more diverse collaborative planning network.

7.3 Summary Observations: The Two Cases

This study has sought to evaluate the capacity of coastal management practitioners to develop coastal EBM plans through the analysis of two ostensibly best-case planning scenarios. It has sought to do this by investigating the characteristics of practitioners' mental models of coastal ecosystems; the extent and nature of practitioners' collaboration within these planning efforts; and the relationship between practitioners' mental models and collaboration networks.

Overall, the Greenwich Bay SAMP has stood up to many of the expectations of being a best-case scenario, as it met many of the criteria of coastal EBM planning efforts that were expected based on review of the literature (see Chapter 2). Greenwich Bay SAMP practitioners appear to have a greater capacity to develop EBM plans as evidenced by their mental models characteristics and the characteristics of their social networks. Greenwich Bay SAMP practitioners had, on the whole, more comprehensive and fairly well-balanced mental models in comparison to their Great South Bay EBM Plan counterparts. While many practitioners of key affiliations and areas of expertise fulfilled the expected mental models characteristics, there were some surprises within this group that have drawn attention to the importance of community planners, business operators/users, and citizens in coastal EBM planning efforts. The Greenwich Bay SAMP network has also exhibited many characteristics of effective collaboration, which is considered to be the single most important factor for the application of an EBM approach (Yaffee, et al., 1996). The network included a large and extraordinarily diverse group of practitioners. The overall network structure was not overly dense and centralized, which is desirable as these qualities might indicate homogeneity (e.g. Bodin & Crona, 2009). The network comprised numerous well-connected and influential individuals – not just one or two – indicating that this collaborative effort benefited from many leaders and influential individuals of different affiliations and areas of expertise who drew together diverse groups and information sources to develop this plan (e.g. Bodin, et al., 2006). Finally, a statistically significant correlation was found between Greenwich Bay SAMP participants' actor centrality measures and mental model comprehensiveness scores, indicating that those who were active and influential collaborators had very well-developed mental models of coastal ecosystems. While the purpose of this study was not to evaluate plan quality or implementation, it is also worth noting that this plan was completed over a 3-year time period, was approved into law, and has since been implemented. This suggests the Greenwich Bay SAMP achieved some level of success in achieving its goals.

While the Greenwich Bay SAMP met many expectations, some findings point to areas in which improved capacity is needed. In particular, appointed officials associated with the state coastal program had notably less comprehensive mental models compared to other study participants. Some of these individuals had fairly prominent positions in the network, and clearly wield influence beyond this particular planning effort as they make many of the state coastal programs' final planning, policy and permitting decisions. This suggests that some investment should be made in improving the capacity of these individuals to understand and apply an EBM approach. See Chapter 8 for further discussion.

By contrast, the Great South Bay EBM Plan falls short of some of the expectations for coastal EBM planning efforts as described in Chapter 2. Great South Bay EBM Plan participants had lower mental model balance scores than their Greenwich Bay counterparts, and exhibited an overall predisposition to the ecological sub-area of focus that may reflect the overall tendency of this group toward homophily. The Great South Bay EBM Plan network was notably smaller and less diverse, and relied heavily on the connection and influence of a few key individuals. The Great South Bay EBM Plan itself could not be reviewed for this study as it was not completed and released by the time of this writing. While the purpose of this study is not to evaluate plan quality, it is worth noting that the bulk of work on this project was completed in 2007-2008, and a final plan had not been released as of September 2011. This suggests that this planning effort may have fallen short of its original goals.

While the Great South Bay EBM Plan effort falls short of some of the expectations for collaborative coastal EBM planning, mental models and social network analysis revealed several strengths that could be built upon in future planning efforts. This case did include numerous practitioners with very comprehensive mental models of coastal ecosystems; and the network did include several influential and well-connected actors who had high betweenness scores, demonstrating their connections to diverse experts, user groups, and other stakeholders. Mental models and network analysis results also indicated that practitioners affiliated with environmental advocacy organizations played critical, prominent roles in this planning process. In particular, marine scientists affiliated with these organizations were found to have comprehensive and balanced mental models as well as influential positions in the network. These results indicate that these organizations, in particular, may be important building blocks for future New York EBM planning efforts.

There are many possible reasons for the differences between the two efforts, many of which derive from factors which are difficult for practitioners to control. Rhode Island is a small state with a strong cultural connection to its ocean and coastal region and a strong, centralized coastal management direct permitting agency that has regular contact with coastal communities and citizens, and has been developing special area management plans since the 1970s. By contrast, New York is a large state with a complex coastal region and many pressing political and economic concerns. Its state coastal program is highly decentralized, with a small office based in Albany that has limited direct contact with coastal communities on Long Island and elsewhere; this agency, and the state as a whole, is arguably new to ecosystem-based management planning (see Chapter 3). Moreover, the Great South Bay EBM plan effort was largely on hold between 2008 and 2011, during which time an economic recession caused deep cuts in many state environmental budgets (e.g. Kaufman, 2011); indeed, numerous New York practitioners made reference to this problem. Nonetheless, this study has illustrated how EBM planning efforts are shaped by numerous other factors as well, such as those who work on these efforts and how they collaborate in order to develop EBM plans. See Chapter 8 for concluding discussion about ways these study results can be applied to help improve future coastal EBM planning processes.

Chapter 8. Conclusions and Recommendations

8.1 Overview

As stated in the introduction to this study, ecosystem-based management is widely recommended as the preferred approach to management, yet there are few examples of coastal EBM in practice. This presents a conundrum: why so much acclaim, yet so little application? One explanation is that applying an EBM approach is difficult. Practitioners must have comprehensive understandings of the coastal ecosystems they are managing, including the ecological, governance, and human use aspects of the ecosystem, and must collaborate across multiple jurisdictions and disciplines in order to apply this approach. For this reason, this study investigated coastal management practitioners themselves and how they collaborated with others to develop coastal EBM plans. In examining practitioners working on the front lines of EBM planning, this study delved deeply into the inner workings of collaborative coastal EBM planning processes in order to provide insight into how the application of the EBM approach can be advanced through the improvement of existing and the development of new collaborative coastal EBM planning efforts.

Two cases of collaborative coastal EBM planning, the Greenwich Bay Special Area Management Plan in Rhode Island and the Great South Bay Ecosystem-Based Management Plan in New York, were selected for this study. These cases were selected because they were believed to be best-case scenarios for the development of coastal EBM plans because they had clear ecosystem-based management goals and objectives as well as notable institutional and political support. Mental models and social network analysis methods were employed to analyze coastal management practitioners themselves, as practitioners play a critical front-line role in applying the EBM approach through their work developing and implementing coastal

EBM plans. These methods are appropriately paired and uniquely suited to the investigation of practitioners involved in collaborative coastal ecosystem-based management planning efforts. Just as ecosystem-based management is a relatively recent approach that seeks to address and embrace the complexity of coastal ecosystems, the mental models analysis and social network analysis techniques used in this dissertation are recently-developed methods, designed to analyze and understand complex systems within the context of natural resource management. Findings from these methods were used to investigate the characteristics of practitioners' mental models; the extent and nature of their collaboration with other practitioners; and whether there is a relationship between mental models and collaboration as evidenced by social networks.This chapter summarizes key findings for each of the three research questions; presents recommendations for future research and coastal management practice; and concludes with summary discussion about the significance and application of this study.

8.2 Summary of Findings

1. **What are the characteristics of practitioners' mental models of the coastal ecosystems for which they are planning?**

As presented in Chapter 5, practitioners' mental model comprehensiveness and mental model balance of coastal EBM were evaluated for all study participants in both cases. Given the inherently integrated nature of the EBM approach, comprehensiveness and balance were both useful and important ways of understanding and comparing practitioners' mental models, though it was not assumed that all practitioners would have perfectly comprehensive, balanced mental models. As discussed in section 5.4, practitioners in both planning processes were found to have equally comprehensive mental models of coastal ecosystems, whereas those involved in the Greenwich Bay SAMP planning process were found to have more balanced mental models than their counterparts in the Great South Bay EBM planning process. For the most part, hypotheses for mental model comprehensiveness were proven true; in both cases, EBM plan project leaders, staff affiliated with state coastal programs, and practitioners whose expertise is in marine resource management had more comprehensive mental models than others, while marine scientists had less comprehensive mental models than others. These results are meaningful as they indicate that key practitioners in both cases had a comprehensive understanding of the coastal ecosystems they were managing.

Hypotheses for mental model balance revealed mixed results. In the case of the Great South Bay EBM Plan, project leaders and state coastal managers had more balanced mental models than others, and in both cases, as hypothesized, marine resource managers had more balanced mental models whereas marine scientists were found to have less balanced mental models than others. In the case of the Greenwich Bay SAMP, some hypotheses were proven false: EBM plan project leaders and state coastal management staff did not have more balanced mental models than others. These results illustrate how mental model balance proved to be a somewhat complex measure that required further consideration; see discussion below.

In addition, study results revealed numerous unexpected and important findings. In the Greenwich Bay SAMP case, local planners, business operators/users, and citizens were found to have some of the most comprehensive mental models, and business operators/users were also found to have some of the most balanced mental models. In addition, appointed officials associated with RI's state coastal management program had less comprehensive but more balanced mental models than their professional staff counterparts. In the Great South Bay EBM Plan case, marine scientists affiliated with environmental advocacy organizations had some of the most balanced mental models of all Great South Bay participants. In both cases, practitioners were found to be the least comprehensive with regard to the human use area of focus; this is problematic given the importance of incorporating human concerns into EBM planning efforts. In the case of the Greenwich Bay SAMP, practitioners' mental models were more comprehensive in the governance area of focus, and balance scores were weighted towards governance. By contrast, in the Great South Bay EBM Plan case, practitioners' mental models were more comprehensive in the ecological area of focus, and balance scores were also weighted in that direction. On the whole, mental model comprehensiveness and balance results for the two cases suggest that Greenwich Bay SAMP participants had greater capacity for coastal EBM planning than Great South Bay EBM Plan participants.

These results highlight how mental model comprehensiveness was found to be a more straightforward, predictable and meaningful measure of mental models of coastal ecosystems, whereas mental model balance was found to be a more complex measure that is best interpreted alongside consideration of mental model comprehensiveness and other participant information including social network measures. While comprehensiveness provides an indication of what practitioners know about and consider valid with regard to coastal EBM planning, balance, or lack thereof, provides insight into what the practitioner considers important. However, importance can mean multiple things: it may reflect the individual's informed understanding of policy problems that require her attention; or it may reflect the individual's disciplinary or professional bias, or lack of knowledge of certain subject areas. Given this, mental model balance is best understood within the context of the practitioner's mental model comprehensiveness score as well as other information about the practitioner's background, training, and role in a collaborative planning network.

Study results also highlight the importance of prompts in eliciting practitioners' mental models. In all cases, topic-specific prompts caused practitioners' mental models to expand in comprehensiveness, and in almost all cases to shift in balance, thus conveying a broader and more balanced view of coastal ecosystems. This was most evident with regard to human uses; nearly all practitioners expanded and shifted their mental model when prompted to speak about this aspect of coastal ecosystems. This indicates that prompts were a very important part of this study methodology. In some ways, prompts resemble the types of questions or ideas that would be raised through a collaborative process. An individual's responsiveness to prompts, or lack thereof, may provide insight into how receptive he or she would be to these questions or ideas, and in general to the experience of working with others of different affiliations and areas of expertise during such a process. This illustrates the importance of considering who these same practitioners worked with, and the nature of that collaboration, in these two planning processes; this is discussed below.

2. How did practitioners collaborate with others to develop the coastal EBM plan?

As presented in Chapter 6, social network analysis was used to investigate the extent and nature of collaboration between coastal management practitioners in each case study. Degree and betweenness centrality were used to measure coastal management practitioners' level of collaboration and influence within the network, and Krackhardt and Stern's E-I Index was used to provide insight into the extent of collaboration with practitioners of different affiliations and areas of expertise. In addition, the overall size and composition of each network was examined. As discussed in section 6.4, the Greenwich Bay SAMP network was found to be notably larger and more diverse than that of the Great South Bay EBM Plan. The Greenwich Bay SAMP network was also found to be somewhat less dense and somewhat less centralized, which may be desirable for accomplishing collaborative EBM planning because this reduces homogeneity and over-reliance on a few key players to drive the process. In the case of the Greenwich Bay SAMP network, nearly all hypotheses regarding extent of collaboration and influence in the network were proven true: project leaders, state coastal managers, and marine resource management specialists were all active and influential collaborators, whereas marine scientists were not. The one exception to this was state coastal program appointed officials, who were less active and influential in the network than expected. In the case of the Great South Bay EBM Plan, results were mixed: project leaders were active and influential collaborators, but state coastal managers and marine resource management specialists were not. While Great South Bay marine scientists were not well connected, as expected, they were found to be far more influential in the network than others. This latter finding speaks to the influence of environmental organizations in this planning effort.

There were also several unexpected findings for these two cases. In the Greenwich Bay SAMP case, some citizens as well as some practitioners from the university and other state agencies were among the most active collaborators. In the Great South Bay EBM Plan case, Long Island-based practitioners were notably more active collaborators than their counterparts based in Albany or other locations. When considered alongside some of the results reported above, these findings point to the fact that social capital in both cases was not limited to those affiliated with the lead agencies, and that environmental organizations, universities, citizens, and those in close proximity to the planning area can play significant roles in collaborative coastal EBM planning processes.

Results for collaboration with those of different affiliations and areas of expertise were very mixed and revealed that the E-I Index scores must be interpreted with caution as they provide only limited insight into the diversity of an actor's ego network. On the whole, E-I Index scores indicate that Greenwich Bay SAMP study participants had a greater tendency toward collaborating with those of different affiliations and expertise, whereas Great South Bay EBM Plan study participants had only a slight tendency toward collaborating with those of different affiliations, and a slight tendency toward homophily in expertise. Whereas project leaders were found to collaborate more actively with those of different affiliations and areas of expertise, results for state coastal managers, marine resource management specialists, and marine scientists were mixed and may reflect the limitations of this method of measuring diversity of collaboration. On the whole, these results suggest more active and diverse collaboration within the Greenwich Bay SAMP planning effort and suggest that this case study was successful at this aspect of EBM, whereas the Great South Bay EBM planning effort did not appear to constitute active and diverse collaboration.

3. **What is the relationship between practitioners' mental models and practitioners' social networks?**

As described in Chapter 4, mental models and social network analytical methods were paired for this study in part because they are complementary. Mental models analysis provides insight into how practitioners in this study think about and understand coastal ecosystems, while social network analysis provides insight into how practitioners worked together within collaborative planning networks. Arguably, the two influence each other: individuals' mental models shape the collaborative networks within which they work, and collaborative planning processes shape individuals' mental models. To further investigate this relationship, a series of statistical tests were applied to mental models measures, reported in Chapter 5, and social network analysis measures, reported in Chapter 6, to determine whether there was a statistically significant correlation between any of the mental models and network analysis measures.

As reported in Chapter 7, correlation tests run on the entire universe of study participants (n=41) revealed a statistically significant correlation between mental model comprehensiveness and influence in the network (as evidenced by betweenness centrality). This is an important finding and speaks to the fundamental theory put forth in this study, that there is a relationship between practitioners' mental models and the extent and nature of their participation in collaborative EBM planning processes. As discussed in section 7.2.3, social network analysts have emphasized the importance of brokers, or bridging ties, in networks, as they are uniquely positioned to facilitate the exchange of diverse information and resources and to bring together otherwise unconnected subgroups. Given this, it is not surprising that there would be a strong correlation between mental model comprehensiveness and betweenness centrality – brokers have much greater exposure to diverse sources of information and ideas, which could be related to the comprehensiveness of their mental models. Moreover, brokers with more comprehensive mental models may be more likely to use their position in the network effectively – their comprehensive views indicate they may be better able to appreciate different viewpoints and facilitate, rather than limit, the exchange of diverse information and ideas. It is promising that the most influential actors in these networks have highly comprehensive mental models; this suggests that both cases have the capacity to develop collaborative coastal EBM plans. The critical role of brokers in collaborative coastal EBM planning efforts cannot be overstated. Given the unique complexities of the EBM approach, and the many different types of individuals, organizations, knowledge, and resources that must be brought together to apply this approach, brokers are the lynchpins – they are the ones who can make collaborative coastal EBM plans happen.

As discussed in section 7.2.4, resampling-based statistical tests run on the two individual cases revealed a second finding: there is a statistically significant correlation between actor centrality measures (both degree and betweenness centrality) and mental model comprehensiveness for Greenwich Bay SAMP study participants, but not for Great South Bay EBM Plan study participants. This is also a significant finding that highlights the central difference between the two cases. As a whole, the Greenwich Bay SAMP network met most of the expectations of a collaborative coastal EBM planning effort as described in Chapter 2, whereas the Great South Bay EBM Plan did not. The Greenwich Bay SAMP network was characterized by a much larger, diverse network of practitioners with both comprehensive and balanced mental models of coastal ecosystems. This network was not overly dense or overly centralized, and relied on several central, influential actors to facilitate collaboration. Moreover, study results showed that those practitioners who were active, influential collaborators in the network also had comprehensive mental models of coastal ecosystems.

By contrast the Great South Bay EBM Plan network was notably smaller and less diverse. Practitioners were found to have relatively imbalanced mental models with a disproportionate focus on ecological matters to the exclusion of human uses; and the network was rather dense and centralized, relying on just a few key central influential actors. Whereas the Great South Bay EBM Plan included numerous practitioners who had comprehensive mental models, no statistically significant correlation was found between comprehensiveness and actor centrality measures, which suggests a potential disconnect between practitioners' understanding of coastal ecosystems and their choices of who to collaborate with to develop the coastal EBM plan. This disconnect was confirmed by one of the study participants and may also explain the reason that work on this plan largely concluded in 2008, but no final plan has been released as of September 2011.

This disconnect within the Great South Bay case illustrates that there are limitations to the relationship between mental models and collaboration. As discussed in section 7.2.5, other political and institutional factors, ranging from resource limitations to interagency relationships, shape practitioners' choices of who to collaborate with as part of an EBM planning effort. Just as practitioners' mental models may have limited influence on collaborative planning processes, practitioners' mental models are influenced by much more than who they collaborate with on a given planning effort. Practitioners' mental models may also be shaped by their prior or concurrent personal or professional experiences, academic training, and personal knowledge of the planning area.

The Greenwich Bay SAMP effort may have been more exemplary because of Rhode Island's geography, cultural connection to its ocean and coastal resources, institutional arrangements, and extensive experience in special area management planning. By contrast, the Great South Bay EBM Plan effort may have been shaped by factors beyond the practitioners' control – geography, a lack of cultural support for ocean and coastal resources, institutional arrangements, and lack of experience in ecosystem-based management planning. However, both cases included influential practitioners with very comprehensive mental models who could be critical building blocks for future collaborative coastal EBM planning efforts.

8.3 Recommendations

Results of this study may be applied and expanded upon in both the academic realm and the practice of coastal management. The following section details a variety of recommendations for future scholarly research as well as application of these results toward the improved practice of coastal management in general and EBM planning in particular.

8.3.1 Recommendations for Expansion of this Study

This study provides numerous opportunities for further analysis of these case studies, and for application and expansion of these methods in other settings. Study results reported here provide just an initial assessment of practitioners' mental models. There are many more coastal EBM mental models questions that merit investigation: What do practitioners think about the way their mental models have been depicted based on interview data analysis? How do practitioners understand the links, or the causal relationships, between the different components of the coastal ecosystem? How do practitioners think about the more conceptual aspects of the EBM approach that are the focus of so much of the literature? Would practitioners' mental models be substantially different if a different coastal estuarine area were the focus of an interview? Is there a difference between the mental models of those who are seasoned professionals with decades of experience and those who are more recent entrants into the profession? Many of these questions could be addressed by a follow-up survey instrument that could test assumptions about mental model comprehensiveness and balance and pose a series of directed questions to participants. There is precedent for this approach; Morgan et al. (2002) have used such a follow-up questionnaire in their mental models research.

A similar follow-up survey instrument could also address unanswered social network analysis questions and test several of this study's findings. While the social network data collected for this study provide useful insight into these networks, several questions remain: how do those with high betweenness centrality scores behave? Do they use their positions to promulgate a comprehensive ecosystem approach? What kinds of information and resources are exchanged between different actors in the network? In practice, what is the nature of the interaction between actors with ties? – For example, how frequently did these actors have contact, and what was the nature of that contact? A follow-up survey could also ask participants to provide their own interpretation of the network and their position in it, and see whether participants can further explain their own role as well as the roles of other actors.

Finally, a third phase of data collection and analysis could be added to this study. Once the Great South Bay EBM Plan is completed and released, this plan and the Greenwich Bay SAMP could be evaluated systematically, perhaps using plan evaluation criteria developed by scholars such as Brody (2003b, 2008) as mentioned in Chapter 2. In addition, plan implementation could be evaluated to provide insight into whether these rigorous collaborative planning processes have resulted in discernible environmental improvements (Koontz & Thomas, 2006).

8.3.2 Recommendations for Further Research

This study has also raised additional questions that require further investigation through the use of these and other research methods. This particular combination of methods could be applied to other cases to build a larger dataset and allow for more effective comparison of a range of different coastal EBM planning efforts. As noted above, this combination of methods is rather unique in its application to coastal management practitioners engaged in coastal EBM planning efforts; whereas Bodin and Norberg (2005) examine the relationships between mental models and network attributes, they do so entirely by computer simulation.

Applying these methods elsewhere would allow for testing and refining of the reference coastal EBM model, which could ultimately be turned into a useful model for practitioners who are in the early stages of forming a coastal EBM planning effort. In addition, a larger dataset of practitioners' mental models and the attributes of planning networks would be very useful for better understanding the relationships between mental models and collaboration as illustrated by network attributes.

These research methods should also be applied to efforts other than coastal EBM planning. Applying these methods to a range of circumstances would also allow for comparison between practitioners who have participated in a coastal EBM effort and those who have not. This could help further investigate the question of whether participating in collaborative EBM planning process causes practitioners to develop more comprehensive, more balanced mental models. Further, these research methods should be applied but with the inclusion of a longitudinal element, where possible, so that data about practitioners' mental models and social networks can be collected before, during, and after the conclusion of an EBM planning process. This could also allow for a more refined social network analysis which quantifies the frequency of communication, the strengths of relationships, or other metrics that would provide insight into the quality of different ties.

8.3.3 Recommendations for the Practice of Coastal Planning and Management

Last, these study results may be applied in the practice of coastal management in multiple ways. Numerous elements of this study may be applied in practical settings to enable coastal management practitioners to assess and reflect upon their work. For example, the reference coastal EBM model, or a variation thereof, may prove a useful tool for coastal managers to shape the scope of their EBM planning efforts. Similarly, the basic building block of the mental models analysis – based around the idea that practitioners must give equal consideration to the ecological, governance, and human use components of the ecosystem – may be a useful tool to help individual practitioners reflect upon their own and others' expertise and to help focus future capacity-building efforts. Network analysis – which requires relatively little investment of time and resources - may be used in a similar way as a tool to help practitioners assess their own collaborative planning networks, identify strengths and weaknesses, and focus future capacity-building efforts accordingly.

This study provides some insight into the capacity of state coastal programs and other agencies to develop coastal EBM plans. In both cases, coastal programs partnered with outside entities to develop these plans. This suggests that these state programs have recognized their limited capacity to accomplish EBM on their own. In the case of the Great South Bay EBM Plan, the planning effort was shaped by a contractual relationship between the state coastal program and an environmental organization. Given the lack of collaboration in this network and the lack of plan completion, it seems that a different type of partnership – perhaps drawing more on Long Island-based experts and users who are familiar with and committed to the Great South Bay – might have been a more effective approach at accomplishing EBM. In the case of the Greenwich Bay SAMP, the planning effort benefited from a longstanding relationship between the state coastal program and an outreach office of the University of Rhode Island; this relationship may provide a useful model for other regions to consider. The Greenwich Bay SAMP findings also brought attention to the coastal program's Council, which shapes many of the agency's final decisions. Mental models and social network analysis findings indicate that these decision-makers have rather limited mental models of coastal ecosystems and may benefit from improved capacity to apply an EBM approach. One model might be to require that the Council be made up of members representing different areas of expertise, similar in concept to the composition of the New York City Landmarks Preservation Commission (New York City Landmarks Preservation Commission, 2011).[35]

This study also draws attention to the ways in which coastal management professionals are trained. The coastal management professionals who participated in this study reflect an extraordinarily wide range of education, training, and experiences. Arguably, coastal management practitioners with narrow or imbalanced mental models of coastal ecosystems are ill-equipped to apply the EBM approach, and those who enter the field with traditional discipline-specific training may be particularly challenged in the interdisciplinary practice of coastal management. The need for coastal managers who are equipped to apply a comprehensive, integrated, balanced approach to coastal ecosystems can be addressed through two different approaches. One strategy is to promote, invest in, and expand the development of interdisciplinary undergraduate and graduate degree programs in environmental management, natural resource management, and marine affairs, such as the University of Rhode Island's or the University of Washington's programs in Marine Affairs (e.g. Ducrotoy, Shastri, & Williams, 2000). An alternative strategy is to provide natural and physical scientists in traditional graduate programs with some tools for working across disciplines, as is the intent of the National Science Foundation's Integrative Graduate Education Research and Traineeship (IGERT) program and assessment methods such as the "T Assessment Tool," developed by the University of Rhode Island Coastal Institute (August et al., 2010).

Most importantly, however, this study underscores some fundamental practices which should be applied by coastal management practitioners who seek to develop and implement coastal EBM plans. Developing a coastal EBM plan is not just about the plan itself – it is about

[35] The New York City Landmarks Law (1965) requires that the New York City Landmark Preservation Commission comprise at least three architects, one historian, one city planner or landscape architect, and one realtor.

the people who collaborate to shape the plan, and how they work together throughout the process of its development. The collaboration of a diverse group of coastal management practitioners, incorporating agencies, organizations, and areas of expertise that address all of the components of the reference coastal EBM model, is paramount. This group should also include stakeholders such as business owners, users, and citizens. Ideally, many of these practitioners will have comprehensive and balanced mental models of coastal ecosystems; but if they don't, it is possible that their mental models will expand through the process of collaborating with a diverse group. Moreover, it is essential that this network include not one or two but several influential individuals who can make connections between otherwise unconnected groups and facilitate the exchange of diverse information, ideas, and resources. Collaborative coastal EBM planning efforts will have a better chance of success if these conditions are met.

8.4 Concluding Remarks

This study has drawn attention to the inner workings of collaborative coastal EBM planning processes. It has shown how practitioners who are on the front lines of developing such plans have varying mental models of coastal ecosystems. It has also shown that those mental models can be understood and compared by considering comprehensiveness and balance, and that topic-specific prompts, which resemble the questions and comments that would arise during a collaborative planning process, enable practitioners to exhibit more comprehensive and more balanced mental models. Further, this study has provided insight into how practitioners work together in collaborative planning processes involving diverse individuals representing different affiliations and areas of expertise.

Study results have illustrated that there is an important relationship between practitioners' mental models and their role in social networks. In particular, this study has shown that practitioners with highly comprehensive mental models are also very influential within their respective planning networks, thus acting as critical lynchpins to collaborative coastal EBM planning processes. These results highlight the importance of including a diverse range of practitioners in collaborative planning processes; they also suggest that participation in collaborative planning processes may, indeed, influence practitioners' mental models.

Ecosystem-based management is undoubtedly complex and challenging to put into practice. It requires practitioners to embrace complexity and apply systems thinking, and to develop collaborative working relationships with others of different jurisdictions and disciplines within the context of fragmented coastal ecosystem governance. Yet EBM is not the only complex problem that coastal and environmental managers must take on; problems such as offshore energy development and global climate change mitigation and adaptation are arguably at least as challenging, and also require a comprehensive approach involving the collaboration of a diverse range of practitioners and stakeholders. The methods and results of this study may be applicable to these and other problems as well, and can help both theorists and practitioners to both improve existing and develop new collaborative planning processes. Improved understanding of how practitioners think and how they collaborate with others to develop coastal EBM plans may not only improve the application of the EBM approach, but lays the groundwork for solving the next generation of coastal management problems.

APPENDIX A: INFORMED CONSENT LETTER

INFORMED CONSENT LETTER

Dear Participant:

You have been asked to take part in a study entitled "How Do Practitioners Do Ecosystem-Based Management? An Analysis of Practitioners Engaged in the Development of Two Coastal Ecosystem Management Plans." This study is supported in part by the University of Rhode Island Coastal Institute and by NSF IGERT grant #0504103 to the University of Rhode Island. The purpose of this doctoral dissertation research study is to understand how policymakers, planners, scientists and others think about coastal ecosystems and how they work with others from different agencies, organizations, and backgrounds to develop coastal ecosystem management plans.

As a participant in this study, we are asking you to complete a survey and participate in an interview. The survey will be administered online through SurveyMonkey and will take you no more than 15 minutes, and the interview will be conducted in person or on the phone and should last 40 minutes to 1 hour. To ensure we faithfully capture your views, we would like your permission to record the interview so that we can transcribe it afterwards.

We are required to inform you that there are no risks associated with this study and that your participation is entirely voluntary. However, study findings may benefit you by contributing to the development of better coastal management practices. Both the interview and the survey results will be strictly confidential. Your name will removed from your survey responses. Survey data, interview recordings, and interview transcripts will all be kept confidential and locked in a secure location for three years, after which time they will be destroyed per university policy. We will not identify you by name, quote you, or report anything that you said that might identify you unless we get prior written approval from you. The written permission would be to name you as a source of information, to use that specific quote, or to report that specific information.

If you have any questions, please feel free to contact the individuals responsible for this study, Tiffany Smythe (tcsmythe@my.uri.edu or 401-874-6015) or Dr. Robert Thompson (rob@uri.edu or 401-874-4485), at the University of Rhode Island Dept. of Marine Affairs. You may also contact the URI Vice President for Research at 401-874-4328. You have read the Consent Form. Your questions have been answered. Your signature on this form means that you understand the information and you agree to participate in this study.

___________________________	___________________________
Signature of Participant	Signature of Researcher
___________________________	___________________________
Typed/printed Name	Typed/printed name
___________________________	___________________________
Date	Date

APPENDIX B: SAMPLE INVITATION EMAIL TO PROSPECTIVE PARTICIPANTS

Dear ___________,

I am writing you regarding your past work on the Greenwich Bay SAMP. I am a Ph.D. candidate in Marine Affairs as well as a coastal manager at the URI Coastal Resources Center, and I am currently studying the Greenwich Bay SAMP as part of my doctoral dissertation. I am contacting you because I understand you were very much involved in the development of the Greenwich Bay SAMP, and I would like to survey and interview you as part of my study.

My dissertation is analyzing how coastal management practitioners – such as coastal managers, regulators, state and local officials, environmental advocates, scientists, and others - develop and implement coastal ecosystem-based management plans. It is comparing two cases: the Greenwich Bay Special Area Management Plan in Rhode Island, and the Great South Bay Ecosystem-Based Management Plan and related amendments to the LI South Shore Estuary Reserve plan in Long Island, NY. The focus is not on the respective plans but on the practitioners themselves. I am interested in learning from real, front-line coastal managers and other professionals about how they think about the coastal ecosystems they manage, and how they work with others to manage these areas.

I would very much like to speak with you about your work on the Greenwich Bay SAMP. As a study participant, you would complete a brief survey (which I'll email you) and then participate in an interview. The survey is a web-based survey I'm managing through Survey Monkey, and should take you about 15 minutes. The interview may take up to an hour, but will hopefully allow for some interesting discussion in which I can learn from you about your experience working on the GB SAMP. As this is university research, all information you provide is entirely confidential.

Would you be interested in being a study participant? If you are interesting in participating, please let me know a good time and place to call you so I can tell you a bit more about the study. We'll then set up a time for an interview so I can interview you at length.

Thank you for considering my request. I look forward to speaking with you!

My best,

Tiffany Smythe

Appendix C. Sample "Probe" to Prospective Second-Round Study Participants

Dear ___________,

I am contacting you regarding the Greenwich Bay SAMP. I am a Ph.D. candidate in Marine Affairs at URI as well as a coastal manager at the URI Coastal Resources Center, and am currently studying the Greenwich Bay SAMP as part of my doctoral dissertation. I am contacting you because your name has come up a couple of times as someone who was involved in the development of the GB SAMP (2002-2005).

Would you be able to help me in my research by telling me a little bit about your involvement in the SAMP? Specifically, did you consider yourself to be actively and directly involved in the development of the SAMP? - for example did you attend numerous meetings (and if so, approx. how many)? and did you review and comment on, or contribute to, SAMP documents? This information would be very helpful for me as I'm studying the network of people who participated in the GB SAMP process.

A quick reply to this email would be most helpful. You are also welcome to contact me at the below number. Thanks in advance for your help!

Thank you,

Tiffany Smythe

Appendix D. Survey Questions

[Survey content are presented below but not in original format as survey was web-based]

[For Both Cases:]

Survey Overview: The purpose of this study is to learn about the policy-makers, managers, and other professionals who were involved in developing the Greenwich Bay Special Area Management Plan *[Great South Bay Ecosystem-Based Management Plan]*. As a participant in this study, you will take this survey and then participate in an interview. Your survey responses are entirely confidential and for research purposes only. Neither you nor your colleagues will be identified by name in this study. If you have any questions or concerns, please contact Tiffany Smythe, tcsmythe@my.uri.edu or 401-874-6015, or Dr. Robert Thompson, rob@uri.edu or 401-874-4485, at the Department of Marine Affairs at the University of Rhode Island. Thank you in advance for participating in this study.

Instructions: Unless otherwise specified, all of the questions in this study are about the development of the Greenwich Bay Special Area Management Plan, which took place from 2002 to 2005 *[Great South Bay EBM Plan, which took place from 2007 to present]*. Please answer each question, to the best of your ability, with these dates in mind. This survey should take approximately 15 minutes of your time. You can go back and change answers while you are in the process of filling out this survey. However, please finalize and submit this survey before participating in your interview.

Part I. Your background and work

1. What is your name?
2. What agency or organization do you work for/are affiliated with?
3. What is your current job title?
4. Name three of your main responsibilities at your current job.
5. When did you start working in your current position?
6. What is your level of education/training in your field?
7. Please check the option that best describes you.

    - ☐ My current job is the same one I had when I was involved in developing the Greenwich Bay SAMP *[Great South Bay EBM Plan]*. (If you checked this option, please skip ahead to “Part II: Your Network”.)
    - ☐ I held different positions with my current organization during the development of the Greenwich Bay SAMP *[Great South Bay EBM Plan]*. (If you checked this option, see item “A” below.)
    - ☐ I held different positions at other organizations during the development of the Greenwich Bay SAMP *[Great South Bay EBM Plan]*. (If you checked this option, see item “B” below.)

A. If you held different jobs/positions in your CURRENT agency/organization while working on the Greenwich Bay SAMP *[Great South Bay EBM Plan]*, please list them here. If not, please skip this section.

B. If you held different positions in OTHER AGENCIES/ORGANIZATIONS while developing the Greenwich Bay SAMP *[Great South Bay EBM Plan]*, please list them here. If not, please skip this section.

Part II: Your network

Instructions: On this page, please tell us about the key people you worked with during the development of the Greenwich Bay SAMP(2002-2005) *[Great South Bay EBM Plan 2007 - present].* People may include coastal managers, policymakers, planners, scientists, environmental advocates, citizens, or other key individuals. Please fill in as many names as you can. You are not required to fill in all of the lines. Please remember that this information is CONFIDENTIAL and FOR RESEARCH PURPOSES ONLY. Neither you, nor any of the people you list, will be identified by name in this study.

In the first column, list the KEY INDIVIDUALS you worked with on the Greenwich Bay SAMP. In the second column, name the AGENCY OR ORGANIZATION, if any, the person was affiliated with. In the third column, describe the person's ACADEMIC or PROFESSIONAL EXPERTISE or INTEREST.

Part III: More About Your Network

Instructions: On the following pages, please tell us more about who you worked with during the development of the Greenwich Bay SAMP (2002-2005) *[Great South Bay EBM Plan 2007 – present]*. Please provide as many names as you can. You are not required to fill in all of the lines, and you may name people who you did not name in the preceding section. For each question, please identify the most important people and then rate each person's importance with regard to the question on a scale of 1 to 7. "Importance" means that you relied on the person for necessary, useful, or reliable information or advice. 7 indicates the most important and 1 indicates the least important.

1. Who are the people you relied on the most to help you with matters related to NATURAL RESOURCES or ECOLOGY (e.g. water quality, birds, other)?
2. On a scale of 1 to 7, with 7 being the most important, how important was each person with regard to this question?
3. Who are the people you relied upon the most to help you with matters related to LAWS and PLANNING PROCESSES (e.g. state regulations, other)?
4. On a scale of 1 to 7, with 7 being the most important, how important was each person with regard to this question?
5. Who are the people you relied on the most to help you with matters related to HUMAN USES of the bay (e.g. fishing, recreation, other)?

6. On a scale of 1 to 7, with 7 being the most important, how important was each person with regard to this question?
7. In general, who did you rely on the most to accomplish your work on the Greenwich Bay SAMP *[Great South Bay EBM Plan]*?
8. On a scale of 1 to 7, with 7 being the most important, how important was each person with regard to this question?

[For Greenwich Bay SAMP Survey Only]

Part IV: New people in your network, 2005 to present

9. Since the approval of the Greenwich BAY SAMP in 2005, there have been ongoing activities to implement and improve upon the SAMP, including the approval of amendments (e.g. the buffer program). Have you been involved in any of this work?
10. Please list or briefly describe the main Greenwich Bay SAMP-related activities you have been involved in since 2005.

Instructions: Please list any NEW KEY PEOPLE you have worked with, FROM 2005 TO THE PRESENT, on Greenwich Bay SAMP related activities. Please only list NEW key individuals you have worked with. Please fill in as many names as you can. You are not required to fill in all of the lines. IF YOU HAVE NOT WORKED WITH ANY NEW PEOPLE, PLEASE SKIP THIS SECTION.

In the first column, list the NEW KEY INDIVIDUALS you worked with on the Greenwich Bay SAMP. In the second column, name the AGENCY OR ORGANIZATION, if any, the person was affiliated with. In the third column, describe the person's ACADEMIC or PROFESSIONAL EXPERTISE or INTEREST.

Part V: Your Comments

11. Please include here any additional information you think we should consider

Thank you for your time and input! We appreciate your participation in and support of this research. If you have any questions or concerns, please contact Tiffany Smythe at tcsmythe@my.uri.edu or 401-874-6015, or Rob Thompson at rob@uri.edu or 401-874-4485

[For Great South Bay EBM Plan Survey Only]

Part IV: South Shore Estuary Reserve CMP Amendment Network

9. Are you working on or involved with plans to develop an amendment to the South Shore Estuary Reserve CMP, which will include provisions to address Great South Bay ecosystem-based management planning goals? (Yes/No)

Instructions: On this page, please tell us key people you are working with on an AMENDMENT TO THE SOUTH SHORE ESTUARY RESERVE CMP that will include provisions to address Great South Bay ecosystem-based management planning goals. If you are repeating names mentioned earlier, you may simply include last names and do not need to repeat affiliation and expertise information.

In the first column, list the KEY INDIVIDUALS you are working with on the South Shore Estuary Reserve CMP Amendment. In the second column, name the AGENCY OR ORGANIZATION, if any, the person was affiliated with. In the third column, describe the person's ACADEMIC or PROFESSIONAL EXPERTISE or INTEREST.

Part V: Other Great South Bay EBM Demo Area Projects

10. Have you been involved in any other Great South Bay Ecosystem-Based Management Demo Area-related projects? (Yes/No) (If no, please skip ahead to Part VI)
11. Please list or briefly describe the main Great South Bay EBM Demo Area-related projects in which you have been involved.

Part VI: Your Comments

12. Please include here any additional information you think we should consider.

Thank you for your time and input! We appreciate your participation in and support of this research. If you have any questions or concerns, please contact Tiffany Smythe at tcsmythe@my.uri.edu or 401-874-6015, or Rob Thompson at rob@uri.edu or 401-874-4485.

Appendix E. Interview Guide

Introductory script [example from Greenwich Bay SAMP]:
I'm here to talk to you about Greenwich Bay and your work on the Greenwich Bay SAMP. The plan was developed between 2002 and 2005; I understand there have been some amendments since 2005; we'll talk about entire time. I am not studying the plan itself. Rather I'm studying the coastal managers and practitioners, like you, who developed the plan – how they think about it, and how they worked to develop it. I may ask questions that you don't know the answers to, or are not entirely certain about. Or, I may ask questions about things that seem obvious. I have read the SAMP and related documents – so I'm asking you about what *you* think about Greenwich Bay. This is not a test – just share what you know.

Part 1. Breaking the Ice.

- May I have your permission to record this interview?
- Before we begin– I sent you a survey that I asked you to complete. Have you done this?

1. In the survey, we asked you some basic information about your job. Could you explain, more generally, what your role was, and is, with regard to the Greenwich Bay SAMP?

PHASE I: INTERVIEWEE-LED.

Part 2. Open Ended.

2. To get us started, what were the main reasons for doing a Greenwich Bay SAMP? In other words, what were the issues you were trying to address?

Open-ended prompts:

Anything else?
Could you tell me more about that?
What causes that?
Why is that important?
How does that work?
Can you give me an example of that?
How does that affect people?
Why was that a problem?
Were there particular people who helped you with that?

Phase II: INTERVIEWER-LED.

Part 3. Ecological (What can you tell me about GB's Natural Resources?)

3. What can you tell about Greenwich Bay's PLANT AND ANIMAL RESOURCES?

3a. __What are some of the problems facing these resources?

3b. __What are some of the causes of these problems (OR Take one of these problems as an example: what causes _____?)
3c.__Was there anyone who helped you understand (work on) that?

4. What can you tell me about Greenwich Bay's HABITATS?

4a. __What are some of the problems facing these habitats?
4b. __What are some of the causes of these problems (OR Take one of these problems as an example: what causes _____?)
4c.__Was there anyone who helped you understand (work on) that?

5. __What can you tell me about Greenwich Bay's WATERS?

5a. __What are some of the problems facing GB's waters?
5b. __What are some of the causes of some of these problems? (OR Take one of these problems as an example: what causes _____?)
5c.__Was there anyone who helped you understand (work on) that?

6. Any other natural resources, or natural resource management issues, we should talk about?

Part 4. Human Uses (What can you tell me about human uses of GB?)

7. __What can you tell me about FISHING or related activities in/around the Bay?

7a. __How do these uses affect GB's resources?
7b. __What are some of the problems facing some of these uses? (OR Take one of these problems as an example: what causes _____?)
7c. __What are some of the causes of some of these problems? (OR Take one of these problems as an example: what causes _____?)
7d.__Was there anyone who helped you understand (work on) that?

8. __What can you tell me about RECREATIONAL activities in/around the Bay?

8a. __How do these uses affect GB's resources?
8b. __What are some of the problems facing some of these uses? (OR Take one of these problems as an example: what causes _____?)
8c. __What are some of the causes of some of these problems? (OR Take one of these problems as an example: what causes _____?)
8d.__Was there anyone who helped you understand (work on) that?

9. __What can you tell me about COMMERCIAL or ECONOMIC uses the Bay?

9a. __How do these uses affect GB's resources?
9b. __What are some of the problems facing some of these uses? (OR Take one of these problems as an example: what causes _____?)
9c. __What are some of the causes of some of these problems? (OR Take one of these problems as an example: what causes _____?)
9d.__Was there anyone who helped you understand (work on) that?

10. __What can you tell me about WAYS THAT PEOPLE USE THE LAND surrounding the Bay?

10a. __How do these uses affect GB's resources?
10b. __Conversely, how GB's resources affect people's use of the surrounding area?
10c. __What are some of the problems facing some of these uses?
10d. __What are some of the causes of some of these problems? (OR Take one of these problems as an example: what causes _____?)
10e.__Was there anyone who helped you understand (work on) that?

11. __Any other human uses of GB and area around it?

Part 5. Closing.

12. Did participating in this SAMP change your understanding of Greenwich Bay? How?
Could you give an example?
Could you expand on that?

13. Were any of the people you worked with instrumental in changing your understanding of Greenwich Bay? Who, and how?
Could you give an example?
Could you expand on that?

14. What does the term "ecosystem-based management" mean to you?

15. Do you think the GB SAMP was an effort to accomplish ecosystem-based management? How?
Could you expand on that?
Could you give an example?

Appendix F. Interview Matrix

Ecological										
Living Resources	Algae	Birds	Crusta-ceans	Fish	Food web	Life history	Marsh/ buffer veg.	Plankton	Seagrass	Shellfish
Habitat/ phys	Beaches	Intertidal	Marsh/ wetlands	Benthic	Open water	Upland				
Water Quality	Chem-istry	Circ./ flushing	Atm. Depo-sition	Ground-water	Rivers/ tribu-taries	Storm-water runoff	Pollutants	Nitrogen/ nutrients	Patho-gens	Raw sewage
Human Uses										
Land Use	Parks	Comm/ indust. devt.	Cultural/ historic	Farming/ag riculture	Open space	Aesthetics/ viewshed	Res. devt.	Shoreline hardening	Upland transport -ation	
Comm-erce	Aqua-culture	Commer cial fishing	In-water transport ation	Marinas/ water dependent businesses	Tour-ism	Upland businesses				
Rec-reation	Boating	Hunting	Public access	Swimming/ beaches	Recrea tional fishing	Wildlife viewing				
Governance										
Govern-ment	Local	County	State	Federal						
Stake-holders	Busines s/trade	Interorg. council	NGOs	Residents/ citizen	Univer sity/ rsch	User groups	Recrea-tional users	Fishermen		

Appendix G. List of Nodes in Reference Coastal EBM Model/Coding Matrix for Interviews

Area of Focus	Sub-Area of Focus	First Tier	Second Tier	Third Tier
Ecological				
	Habitat/ Phys. Envt.			
		Beaches/Shoreline		
		Benthic		
		Intertidal		
		Marsh/wetlands		
		Open/water		
		Seagrasses		
		Upland		
	Living/Resources			
		Algaes		
		Birds		
		Crustaceans		
		Finfish		
		Food web		
		Life history		
		Marsh/buffer vegetation		
		Plankton		
		Shellfish		
	Water Quality			
		Chemistry		
		Circulation/ Flushing		
		Inputs		
			Atm. Deposition	
			Groundwater	
			Rivers/ tributaries	
			Stormwater	
		Pollutants		
			Nitrogen/ nutrients	
			Bacteria	
			Wastewater	
				Onsite septic systems
				Raw sewage/waste

				Sewers/treat-ment plants
Governance				
	Government			
		County govt (NY only)		
		Fed govt		
		Local govt		
		State govt		
			State university/ research (RI)	
	Stakeholders			
		Business/trade		
		Interorganizational councils (NY)		
		NGOs		
		Residents/citizens		
		TNC-NY (NY)		
		Tribes (RI)		
		University/research (NY)		
		User groups		
			Commercial fishermen	
			Recreational users	
Human Uses				
	Coastal Land Use			
		Aesthetics/ viewshed		
		Commercial/ industrial		
		Cultural/historic		
		Farming/ agriculture		
		Open space		
		Parks		
		Residential		
			Lawns	
			Residential docks	
		Shoreline hardening		

		Upland transportation		
	Commerce			
		Aquaculture		
		Commercial Fishing/Shellfishing		
		In-water transportation		
		Marinas/water-dependent businesses		
		Tourism		
		Upland businesses		
	Recreation			
		Boating		
		Public access		
		Recreational fishing		
		Swimming/ beaches		
		Wildlife (viewing/hunting)		
Overlays	Climate change/ sea level rise			
	Temporal aspects (past/future)			
	Scientific data/research			

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