MAPPING SOCIAL VALUES OF ECOSYSTEM SERVICES IN SARASOTA BAY, FLORIDA: E-DELPHI APPLICATION, TYPOLOGY DEVELOPMENT, AND GEOSPATIAL MODELING

By

ZACHARY DOUGLAS COLE

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LIST OF ABBREVIATIONS

CBD	Council on Biological Diversity
CESU	Cooperative ecosystem services unit
CMSP	Coastal and marine spatial planning
CSR	Completely spatially random
CZMA	Coastal Zone Management Act
GIS	Geographic information systems
GOMA	Gulf of Mexico Alliance
IP	Internet protocol
ITU	International Telecommunications Union
MA	Millennium Ecosystem Assessment
NOAA	National Oceanographic and Atmospheric Administration
NREM	Natural resources and environmental management
PPGIS	public participation geographic information systems
SAMP	Special Area Management Plans
SBEP	Sarasota Bay Estuary Program
SBF	Sarasota Bay, Florida
SES	Social ecological systems
SolVES	Social values of ecosystem services (tool)
SPSS	Statistical Package for the Social Sciences
SVT	Social values typology
USGS	United States Geological Survey

Abstract of Dissertation Presented to the Graduate School
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By

Zachary Douglas Cole

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This study represents a three phase project that sought to delineate social values of ecosystem services specific to the coastal zone, apply the resultant social value typology to a spatial data collection effort within Sarasota Bay, Florida, and analyze the data generated through a geographic information system tool called the Social Values of Ecosystem Services (SolVES). Phase one employed an e-Delphi methodology to engage a panel of coastal management experts in determining what social values exist in coastal and marine environments as related to ecosystem services. A detailed description of the e-Delphi process undertaken appears in chapter two and substantive findings resulting from the exercise are summarized in chapter three. Phase two, through the development and application of an online, interactive mapping survey that used the typology generated in phase one, gathered spatially explicit social value data from a variety of Sarasota Bay, Florida stakeholders. Initial analysis of that data within SolVES (phase three) are presented in chapter four. Chapter five describes the connection between social values of ecosystem services and spatial modeling, explores avenues for future research, and summarizes the project as a whole.

CHAPTER 1
OVERVIEW

Effective spatial planning and management of coastal zones is essential for resolving conflicts and adapting to changes in environmental conditions as human uses of coastal regions increases. Research and planning applications developed for terrestrial systems are likely useful and adaptable to coastal and marine environments as a means of evaluating critical factors in coastal systems. Assessment of comprehensive coastal and marine ecosystem services stands to benefit from research integrating social values information into natural and ecosystem interactions occurring across landscapes.

Natural resource decision-making can be broadly characterized as a complex web of biophysical elements and context specific social interests and trade-offs. The concept of coupled social-ecological systems (SES) links human and biophysical systems to examine and explain variations in landscape values perceived by people in their region (Alessa, Kliskey, and Brown, 2008). Ecological structures and the natural processes underlying ecosystem services have been studied extensively while stakeholder-level social and cultural values have recently garnered attention within environmental research and policy. An understanding of relevant social-ecological dynamics and the coupling of social and natural systems understanding is critical to long-term conservation success (Eadens, Jacobson, Stein, Confer, Gape, and Sweeting 2009) and valuable across environmental decision-making contexts; the proposed research addresses this need by integrating social and ecological values through the use of geographic information technologies.

Global climate change and an enhanced understanding of humans' impact on the environment have led to increasing investment in comprehensive coastal and marine spatial planning at the landscape scale. Agencies at all levels of government, from local to international, see inclusive evaluation of ecosystem services as crucial to robust decision-making regarding relevant resources. Recognition of widespread marine resource decline has additionally triggered a need to change the way coastal resources are managed. The benefits derived from coastal and marine resources, or ecosystem services, can range from tangible products (food and minerals) to cultural amenities (recreation and esthetics).

As the utilization of these benefits continues to increase, particularly in the coastal zone, additional pressures are placed on the natural ecosystems providing them. Aggregating increased resource use with issues of community resiliency to environmental change and response to hazards makes it all the more important, when assessing possible tradeoffs among ecosystem services, to consider human attitudes and preferences which express underlying social values associated with benefits. Even though some of these values can be measured using economic indicators, other social values can be much more difficult to quantify; attaching dollar amounts may not be very useful in all cases. Regardless of the processes or units chosen to quantify such values, the ability to map indicators across the landscape and therefore relate them to the ecosystem services to which they are attributed is necessary for effective, comprehensive assessments.

In addition, development of strategies for identifying and including diverse stakeholders in planning and decision-making processes is critical to responsible resource policy. Reactive and sectorial management has begun to give way to proactive and integrated approaches reliant on partnerships and citizen participation, science-based approaches to social data collection and integration, and the institution of comprehensive, long–term goal setting. The primary aim of this research project is to assess and improve the usefulness of ecosystem services valuation for coastal and marine spatial planning (CMSP) by evaluating and integrating place-based social values across a marine landscape through the involvement of a broad range of stakeholders. This project seeks to extend ecosystem services valuation, primarily conducted in terrestrial environments, to a coastal and marine setting by expanding the functionality of a geographic information system (GIS) application, *S*ocial *V*alues for *E*cosystem *S*ervices (SolVES; http://solves.cr.usgs.gov), to a region of the Gulf of Mexico with important environmental and social attributes.

To address the needs associated with social values inclusion in ecosystem service assessments, SolVES was created as a GIS application designed to use public attitude and preference data to assess, map, and quantify social values across landscapes. SolVES calculates and maps a Value Index representing the relative perceived social values of ecosystem services, such as recreation and biodiversity, for various groups of ecosystem stakeholders; the potential exists to produce predicted Value Index maps for areas where social value data are not available. Currently, the SolVES tool has been developed and tested in terrestrial, specifically forest, environments; this project seeks to continue development of a more robust SolVES version by pursuing an opportunity in a coastal and marine environment, namely Sarasota Bay. Initial use of the SolVES tool (Sherrouse, Clement, and Semmens, 2011) has proven valid and reliable in a forest ecosystem; application in a coastal and marine environment is a logical next step in the development of its extension and overall usefulness.

Ecosystem services are understood as the conditions, processes, and components of the natural environment that provide both tangible and intangible benefits for sustaining and fulfilling human life (Daily, 1997). A framework for understanding the connections between ecosystem services and human well-being was established by the Millennium Ecosystem Assessment (MA), an integrated ecosystem assessment established with the involvement of government, the private sector, nongovernmental organizations, and scientists (2003). The MA framework is organized around four categories of ecosystem services that correspond to 21 distinct benefits, considered 'ecosystem services'. As a framework that seeks to incorporate social and ecological variables, it requires for analysis a broad range of natural and social science information. Suggested elements of ecosystem service analysis include the measurement of their flows and underlying processes, the dependence of human well-being on these flows, valuation, and provisioning (Brown, Bergstrom, and Loomis, 2007). Complementary to Sherrouse et al.'s (2011) work on the creation of SolVES, this study will build on previous efforts by applying SolVES in a coastal/marine environment. The diversity of stakeholder attitudes, preferences, and behaviors associated with such values and uses are a source of ongoing conflict for resource managers as they are addressed through various approaches within the decision making process (Zendehdel, Rademaker, De Baets, and Van Huylenbroeck, 2009). SolVES provide a tangible model for incorporating and representing social values equitably amongst the layers of data available regarding ecological processes and environmental conditions.

Sarasota Bay, the research site, is a coastal lagoon of many small embayments and one large bay segment, each with a diverse natural and human dynamic. The bay system is home to diverse wildlife and provides sustenance and abundant beauty to local populations as it has for millennia. The health and vitality of Sarasota Bay is essential to local quality of life while contributing significantly to the region's economy and international reputation as a desirable destination. In building from the original SolVES model, the proposed research project will focus first on modification of terrestrial social value typologies to fit a coastal-marine environment, second on mapping of social values attributed to ecosystem services by stakeholders of Sarasota Bay determined to be of importance among user subgroups (differentiated according to attitudes about human uses of coastal regions in the Gulf of Mexico), and lastly on exploration of the usefulness of ecosystem valuation frameworks for modeling social values across marine landscapes using SolVES.

The adaptation and application of the SolVES tool to Sarasota Bay reflects a process whereby social values represent measureable ecological end-products or endpoints of ecosystem services at the interface of human well-being (Boyd and Banzhaf, 2007), with potential for broad use in similar coastal environments. The application has proven potential to provide “functionality to assess the relationship of these social value endpoints to both their physical and social contexts in a manner that is informative to decision makers and scientists” (Sherrouse et al., 2011; p. 749). The goal of the proposed research is to assess and improve the usefulness of ecosystem service valuation tools for CMSP by integrating social science information into a spatial modeling framework (e.g., SolVES).

The research questions guiding this study correspond to objectives and project structure as outlined in the following two sections, respectively. Each research question builds upon the data collected from a previous study phase, beginning with a place specific value typology and priority resource use listing created in phase one. The research questions are:

RQ1 - What social values and resource uses exist in and around Sarasota Bay?

RQ2 - How are the social values and resource uses spatially situated across the land and seascape and differentiated according to user subgroup?

RQ3 - How can the spatial assessment of social values be utilized (modeled) to the benefit of citizens, decision-makers, and policy?

Problem Statement

Coastal areas provide a wealth of natural and economic resources and represent some of the most developed areas in the United States and elsewhere. For instance, the coastal fringe that makes up 17% of the nation's contiguous land area is home to over half its population (NOAA, 2005). As pressure on coastal and marine resources increase in concert with increases in population and development, managers and policy makers increasingly require practical tools that allow for comprehensive valuation of ecosystem services. Coupled with the challenges of sea-level rise and climate change, the issue becomes finding a way to represent all values, across a given spatial extent, in a way that makes comparison possible. The CMSP process currently lacks standardized methods to collect and interpret beliefs about the social values held by the general public toward various coastal and marine ecosystem services in a way that can equalize the individual and organized group interests ever present in the planning process. Spatially explicit social values alongside stakeholder subgroups use preferences analyzed through programs such as SolVES have the potential to enhance the CMSP process by both increasing public engagement and providing place-based information to aid in making planning decisions.

Effective, sustainable CMSP requires managers to seek methods for integrated analyses of social and environmental data in a variety of contexts. This research seeks to further develop the SolVES tool for generating maps that illustrate the distribution of a quantitative, non-monetary value metric, or Value Index, across Sarasota Bay along with graphical and tabular reports containing metrics characterizing the physical environment at locations across the value range. Additionally, both the map and table outputs can be analyzed for different social value types as calculated for various stakeholder subgroups.

These factors will be addressed in three research stages. First, a social value typology and evaluation of which resource uses are most important and/or controversial will be established within the study context. Second, spatial data collection will occur through stakeholder mapping of social values and evaluation of use perceptions across the Sarasota Bay region. Third, spatially referenced values assigned to ecosystem services differentiated by user subgroups will be modeled using the SolVES mapping tool, ultimately providing a comprehensive evaluation and possible predictability of ecosystem service valuation across the landscape.

Research Objectives

The objectives for the dissertation are dually derived from relevant policy and management directives and theoretical development of applicable concepts. Pertinent issues identified through United States Geological Survey (USGS) research themes and strategic themes for the Gulf Coast Cooperative Ecosystem Studies Unit (CESU) along with needs identified by regional and local management bodies, such as the Sarasota Bay Estuary Program (SBEP) and Gulf of Mexico Alliance (GOMA), represent the policy and management edicts that underscore the dissertation objectives. Recent USGS science strategy has laid out six broad science themes: climate and land use change; core science systems; ecosystems; energy and minerals, and environmental health; natural hazards; and water. The 2008-2010 Strategic Plan includes three themes for the Gulf Coast CESU specifically:

1. research related to landscape ecology and habitat diversity, natural and cultural resources heritage, and data and information exchange;
2. critical issues for the management of coastal landscapes, including the overexploitation of natural resources, and biodiversity and habitat loss; and
3. understanding ecosystem change related to a wide variety of coastal uses including the impact of waterways, tourism, and offshore energy development.

Additionally, GOMA priority issues mirror these and include: water quality; habitat conservation and restoration; ecosystem integration and assessment; nutrient and nutrient impacts; coastal community resilience; and environmental education. Lastly, the current SBEP Comprehensive Conservation Management Plan provides direction on actions to be implemented by the community along with recommendations for improved management. Four critical problems facing the estuary are identified: declines in sediment and water quality; loss of freshwater and saltwater wetlands; declines in living resources and fisheries; and increase in recreational use. Numerous studies have been conducted that focus on the keystone ecological issues, mainly nutrient loading and sediment loss; applying the SolVES tool will complement these efforts by providing the missing social link and with it a more holistic understanding of the bay system (St. Martin and Hall-Arber, 2008).

From a theoretical perspective there are a number of concepts which form the basis of this research. Relevant theories include ecosystem services valuation, sense of place dynamics, coastal and marine spatial planning (CMSP), participatory natural resource management, carrying capacity in the coastal zone, and public perception of resource use appropriateness. Ecosystem services have been recently forwarded as a concept which links the biophysical attributes of the environment to their benefit with regard to human well-being (MA, 2003). Current methods of ecosystem service valuation, in order to become more efficient and effective, require incorporation of values as perceived by those who benefit from the services. Most contemporary processes fail to produce a comprehensive assessment of social value by focusing almost exclusively on the economic utility (and monetization) derived from ecosystem services as a base measurement. The values perceived by ecosystem stakeholders are inadequately captured by these conventional utilitarian valuation methods due to neglect of the psychological well-being derived from an individual's relationship with nature (Kumar and Kumar, 2008) that cannot easily be assigned a monetary worth. Centering valuation on utilitarian benefits avoids much of what ecosystem services provide: public goods and their benefits which are outside the money economy (Constanza, et al., 1997). As a result, the value of incorporating place-based meanings into natural resource management and policy has received increasing attention within academe (Williams and Stewart, 1998), policy, and management. By recognizing the variable nature and effect of sense of place dynamics across landscapes to the planning process which underpins management and policy initiatives, efforts are made more robust by aiding resource managers in identifying and deciding on desired future conditions in both ecological and human terms. Further, incorporation of place-based conceptions lends itself to public participation in decision processes, a desired goal within natural resource management in the coastal zone and elsewhere.

As the pressure on coastal and marine environments has increased, there has been wide-spread acknowledgement of the need for more comprehensive planning efforts. Similar to terrestrial ecosystems which has been the focus of most traditional efforts, marine environments can be viewed as places with heterogeneous biophysical and social attributes that must be considered in planning. Ecosystem-based management has been posited by managers and researchers alike as a way to address this heterogeneity with CMSP described as an essential step in achieving the relevant goals within coastal and marine environments (Douvere, 2008).

The guiding principle in research design, therefore, is to respond to management needs within the constraints of available staff time and resources by developing a set of simple but informative tools for collecting and evaluating the social values of ecosystem services in the coastal zone, specifically Sarasota Bay. It is a premise of this study to explicitly link data collection, analysis, and outcomes to management needs and actions for immediate use and adaptive implementation (Plummer, 2006). Study objectives are organized around a three phase research process that corresponds to the research questions outlined above.

Objective 1: Typology of social values of ecosystem services

Modify the terrestrial-based ecosystem service typology to fit a coastal and marine environment with the Sarasota Bay, Florida region as a demonstration

area. Two variables act as priority inputs to SolVES: 1) social values and 2) resources uses. First, in order for SolVES to quantify and map relative social values across the seascape an initial understanding of which social values exist in Sarasota Bay is needed. The social value typology originally used by SolVES (Sherrouse et al. 2011) was based on a forest ecosystem and represented a framework originally created by Rolston and Coufal (1991). This typology was later applied by Clement (2006) in collecting the survey data used in application development. The first study objective was to modify existing frameworks to fit the social values of ecosystem services represented in Sarasota Bay following Raymond et al.'s (2009) approach to ecosystem service typology modification that uses the Millennium Ecosystem Assessment (MA, 2003) and other alternative ecosystem service typologies (see also Wallace, 2007) as a baseline. Collection of representative attributes of the Sarasota Bay ecosystem that are valued by stakeholders will be used as valid and reliable variables of social value for use within SolVES.

In a similar fashion, the second part of phase one assembled a priority listing of important (and possibly conflicting) resource uses and users of coastal ecosystems. The functionality of SolVES relies on representation of social values across the landscape as differentiated by user subgroups determined by perceptions of use, reaching its potential when it can not only compare social values and ecological conditions across the landscape but when it can additionally do so amongst and across user subgroups. For instance, it may be useful to represent the distribution of social values amongst fishermen but the application becomes more valuable and robust in understanding the similarities and difference of commercial versus recreational fishermen. By establishing the relevant uses of the ecosystem services provided by Sarasota Bay, differentiating user subgroups becomes increasingly valid and the resultant data much more practical to managers.

Objective 2: Apply SolVES to a coastal ecosystem

Apply, extend, and expand SolVES by collecting spatially explicit social values, resource uses, and perceptions of resource use from stakeholders via online interactive mapping and survey assessment. Using the value typology and resource uses established in phase one, the second phase will ask stakeholders to specify social value locations across Sarasota Bay through a participatory mapping process. To supplement this information, perceptions of acceptability regarding various uses of the relevant resources, along with demographic data and use patterns, were collected. In this way, the spatial locating of values by study participants were linked to their individual and aggregate attitudes about various uses and actual use patterns of Sarasota Bay resources; as noted above, an essential component for taking full advantage of SolVES functionality.

As managers seek to more robustly manage opposing resource uses while satisfying constituency demands and stakeholder participation policy requirements, it is imperative to gather, understand, and integrate both place-based values and perceptions regarding the range of resource uses. This process of comparing spatially-explicit values to perceptions of appropriate use and use patterns helps develop the capacity to identify areas of conflict, cooperation, and potential threat between user subgroups.

There are a number of examples where public value and attitude data have been used to map values perceived by stakeholders, or social values. A forest value typology validated by Brown and Reed (2000) has been used extensively in social value mapping studies, alternatively referred to as ecosystem values (Reed and Brown, 2003), environmental values (Brown, Reed, and Harris, 2002; Brown, Smith, Alessa, and Kliskey, 2004), landscape values (Alessa et al. 2008), and wilderness values (Brown and Alessa, 2005). The development of ecosystem service valuation has been dominated by research conducted in terrestrial environments; the objective of phase two was to apply this existing body of knowledge to a marine environment, namely Sarasota Bay, using the social value typology and priority resources uses established in phase one.

Objective 3: SolVES analysis and modeling

Validate the applicability and usefulness of the SolVES tool in a coastal and marine environment by modeling spatial value data within Sarasota Bay. Following the initial two phases of research (value typology modification and resource use establishment; spatial value mapping and use perception analysis), the third step is spatial database and application development using the SolVES tool as developed by Sherrouse et al. (2011) and currently being expanded to include capacity of user introduced place-based value types, public uses, and environmental layers (personal communication, Sherrouse, 2011). Spatially explicit value data derived from phase two was loaded into a geodatabase as a point feature class; similarly the supplementary use perception survey data was loaded into separate database tables. Each spatial data point and any other data record includes a unique identifier so all information from each individual can be related. Ancillary datasets of appropriate spatial resolution were loaded into the database to generally characterize the physical environment of Sarasota Bay. Environmental data layers of importance included bathymetry, seagrass distribution, species habitat, and maps depicting the location of important use resources such as waterways and marinas.

The objective for the third phase was to utilize the SolVES functionality to generate maps that illustrate the distribution of a quantitative, non-monetary value metric, called the Value Index, across the landscape. These social value maps are complemented with graphical and tabular reports containing metrics characterizing the physical environment at locations across the range of the Value Index for different social value types as calculated for various subgroups of study participants.

To review, the research is organized around a three phase process whereby each step builds upon the previous. In completing these phases, the overarching goal was to combine quantitative and qualitative data through landscape-based results, providing multi-scale spatial tools for planning efforts. The component process provides a method for diverse stakeholders to look at “their” landscape together, and discuss that area, their desires and concerns for it, and possible solutions, shoulder to shoulder, rather than face to face. The process and outcomes reveal the many connections the community has with the land and seascapes, both similarities and differences, and the values underlying those connections; information and data likely invaluable to managers when making resource decisions.

A series of three manuscripts is presented to capture study methods, results, and conclusions: 1. a methods article covering the use of an e-Delphi in study phase one (objective 1), 2. a chapter outlining the results from the e-Delphi (objectives 1 and 2), and 3. a summary of initial findings from stakeholder data collection and SolVES analysis (objectives 2 and 3). A concluding chapter brings together the three study components by describing how they work together to synthesize and produce theoretical, methodological, and substantive contributions.

CHAPTER 2
INTERNET-BASED DELPHI RESEARCH: A CASE BASED TUTORIAL

Introduction

The availability and adoption of Internet technology has increased phenomenally since its introduction in the late 1980s and has transformed the management and decision making that surrounds natural resources and the environment. The United Nations International Telecommunication Union (ITU) reports that the number of Internet users surpassed 2 billion in 2010, with projections indicating that half of the world's population will have broadband access by 2015 (ITU News, 2011; United Nations, 2010). While the United States has historically maintained the most users on a per capita basis, growth is not limited to developed nations. In fact, the spatial reach or 'penetration rate' of the Internet continues to grow within developing countries as well. China, for example, surpassed the United States in 2006 with the most Internet users – 160 million, as a result of their rapidly improving infrastructure and growing economy (China Internet Network Information Centre, 2007; ITU News, 2011). In the realm of natural resource and environmental management (NREM), these technological advances have given rise to online collaborative communities – virtual spaces that contain a wide range of new tools and services that facilitate local, regional, and global interactions between and amongst relevant stakeholders around the world.

Suffice to say, the Internet has changed the way that environmental data and information is shared, which has clear implications for the evolution of NREM research methodology. The Internet promises the potential for increased sample size and diversity, reduced administration costs and time investments, innovative data management and analysis tools, and a number of other appealing benefits (Donohoe and Needham, 2008). In the NREM context, Dalcanale, Fontane, and Csapo (2011); and Mahler and Regan (2011) report that advances in environmental management have paralleled the evolution of information technology, most notably the prevalence and integration of geographic information technologies in research and decision making. More information publicly available through digital mediums has resulted in a shift from centralized decision making to increasing movement toward participatory processes (Dalcanale, et al., 2011). While “the evolution of information technology that came about as a result of the increased complexity of the available hardware and software, and the development of the World Wide Web, has resulted in a change from centralized mainframes, to the wide popularity of personal computers, collaborative sites, and online, social and professional networks” (Dalcanale, et al., 2011; p. 443), it has also come at a cost. Benfield and Szlemko (2006) warn that the growing use of Internet-based research methods, techniques and tools is misleading because e-research remains marginal in size and scope, especially when compared to the wealth of existing traditional research (e.g., paper and pencil survey research, face-to-face interviews, focus groups, etc.) published over similar time periods.

Internet-based NREM research has yet to undergo critical methodological review, thus refinement to procedural and analytical practice is lean. The majority of peer-reviewed articles identified in Benfield and Szlemko’s meta-analysis of Internet-based data collection methods report little evidence supporting the appropriateness of the Internet as a tool for scientific inquiry. Dalcanale, et al. (2011) agree, arguing that despite efforts to capitalize on the potential of information technology for NREM research and practice, inadequate attention has been paid to *how* newly emerging e-research methods are being utilized. In the absence of such conversation, Roztocki (2001, p. 1) argues that “it is likely that the resulting academic research will be flawed or compromised in some manner.” Because of this, there is need for discussion on the amelioration of unique methodological issues confronting researchers operating in an increasingly electronic and interconnected world. Understanding how e-research methods have been applied in NREM studies may offer scholars unique insights on how to incorporate these burgeoning techniques into future studies. Therefore, this study makes a contribution to the literature by critically examining the e-Delphi technique and offers a tutorial on its use for NREM researchers.

The Delphi Technique

One traditional research method now being operationalized via the Internet is the Delphi technique. The Delphi technique is used to systematically combine expert opinion in order to arrive at an informed group consensus on a complex problem (Linstone and Turoff, 1975). In principle, the Delphi is a group method that is administered by a researcher or research team, which assembles a panel of experts, poses questions, synthesizes feedback, and guides the group towards its goal – consensus. The Delphi is a technique for organizing conflicting values and judgments through facilitating the incorporation of multiple opinions into consensus (Powell, 2003). The payoff of a Delphi study is typically observed through expert concurrence in a given area where none existed previously (Sackman, 1974). This is achieved using iterative rounds of sequential surveys interspersed with controlled feedback reports and the interpretation of experts’ opinions. Iteration with the above types of feedback is continued until convergence of opinion reaches some point of diminishing returns, which suggests agreement. In light of this, Delphi toolkits and meta-analyses are available in a breadth of fields including health education and behavior (de Meyrick, 2003), nursing and health services (Cantrill, Sibbald, and Buetow, 1996; Powell, 2003; Keeney, McKenna, and Hasson, 2011), tourism management (Donohoe, 2011; Green, Hunter, and Moore, 1990), information and management systems (Okoli and Pawlowski, 2004), and business administration (Day and Bobeva, 2005; Duboff, 2007; Hayes, 2007). In the NREM domain, the technique has been used to investigate a variety of research topics and issues. Representative examples published in *Environmental Management* include but are not limited to: mediation of environmental disputes (Miller and Cuff, 1986); citizen participation in decision making (Judge and Podgor, 1983); environmental initiative prioritization (Gokhale, 2001); exploration of diversity in contemporary ecological thinking (Moore, et al., 2009); and adaptation options in the face of climate change (Lemieux and Scott, 2011).

The technique's advantages and benefits are summarized in Table 2-1 (adapted from Donohoe and Needham, 2009); like other research tools, the Delphi is not without limitations, however. The Delphi is highly sensitive to design and administrative decisions (e.g., panel design and survey architecture) which can affect the research outcome (Donohoe and Needham, 2009). Additionally, participants generally do not meet or discuss issues face-to-face, as they are often geographically remote from one another, both circumstances which can cause threats to the internal validity of a study. The risk of specious consensus and participants simply conforming to the median judgment for compliance sake is also a reality that must be addressed and stands as a common limitation within group techniques generally. There is also debate about how to determine "sufficient consensus" along with concomitant questions regarding the appropriate point in time to terminate the consensus-building exercise. Empirically, consensus has been determined by measuring the variance in Delphi panelists' responses over rounds, with reduction in variance indicating greater consensus. Results from Delphi studies seem to suggest that variance reduction is typical, although claims tend to be simply reported and not analyzed (e.g., Dalkey and Helmer, 1963). Indeed, the trend of reduced variance is so typical that the phenomenon of increased 'consensus' no longer appears to be an issue of experimental interest (Rowe and Wright, 1999).

Difficulty determining adequate consensus aside, the considerable time commitment required is identified as the most significant limitation for both the researcher and participant (Wagner, 1997). For the researcher, the amount of time required to develop an expert panel, deliver communications, administer multiple survey rounds, and prepare interim reports is quite noteworthy and often underestimated. Traditional Delphi studies are paper-based with communications, surveys, and reports distributed by regular postal mail (Green et al., 1990). MacEachren et al. (2006) report that a significant managerial burden is placed on the traditional Delphi administrator who must devote a substantial amount of time gathering, organizing, compiling, and synthesizing participant responses. For Delphi participants, the iterative, paper-based survey completion exercise is demanding by nature and can be a deterrent to participation acceptance and continuance. The time required to complete several rounds of surveys is further complicated by the traditionally long waits between survey rounds which can produce diminishing interest and frustration (Donohoe and Needham, 2009). For these reasons, high attrition has been widely reported in the literature (Sinha, Smyth, and Williamson, 2011).

Given these limitations and others, Donohoe and Needham (2009) recognized that using the Internet for Delphi research presents a new and exciting research frontier. They ascertained that the e-Delphi could provide a promising alternative that may reduce time, costs, communication difficulties, consensus monitoring challenges, and participant attrition. But, having said this, they point out that Internet-based technology is a relatively new research opportunity and that “challenges common to Internet-based communications are present” (Donohoe and Needham, 2009, p. 423). Researchers must be cautioned that the deficiencies in methodological discourse are certainly putting at risk the design, implementation, success, and evolution of e-Delphi research. Therefore, through a critical analysis of an e-Delphi case study, this paper contributes to the evolution of best-practice methods in e-Delphi research and provides sage guidance for NREM Delphi researchers.

An e-Delphi Example

An e-Delphi was initiated to facilitate the development of a social values typology of ecosystem services and a listing of important resource uses in coastal environments among international experts in coastal and marine management. The reason for this research focus is directly related to a critical gap in NREM research: the lack of consensus regarding theory and measurable variables of social values derived from ecosystem services, particularly in the coastal zone. A widely accepted social values typology that contributes to ecosystem services discourse and management guidelines is important when describing the foundational elements of the human-environment relationship. In addition, such a typology aids in identifying facilitators and obstacles to more readily establishing those connections globally. The development of a unique typology is judged to be the fundamental basis or starting point for a paradigm shift in NREM practice; one that is traditionally defined by ecosystem-specific parameters but plagued by non-inclusive knowledge and management systems. While much work has been done to establish such a typology in terrestrial environments (see Rolston and Coufal, 1991; Reed and Brown, 2003; Brown and Reed, 2000; Brown, Smith, Aleesa, and Kliskey, 2004), the effort outlined here has been made to extend or modify this existing typology fit coastal and marine ecosystems. To propose a unified vision for what represents the social values of ecosystem services in coastal environments, the Delphi technique was selected over more traditional methods (i.e., surveys, group interviews and focus groups) due to it being judged a "best-fit" on the basis of the Delphi's attributes/benefits (Table 2-1) and its congruency with the above-mentioned study objectives.

A three-stage e-Delphi exercise (Figure 2-1) was adapted after Day and Bobeva's (2005) Generic Delphi Toolkit. In the *preparation stage*, a panel of international experts was assembled. The panel was comprised of two relevant expert groups: professionals from government, private industry, and non-governmental organizations; and academics engaged in related research and education. The inclusion of both professional and academic experts is substantiated by Briedenhann and Butts (2006), and Sunstein (2006) as a means for achieving a balance between differing perspectives on 'knowledge' and for mitigating the existent divide between research and professional communities with regard to knowledge sharing, communications, priorities, and epistemology. A geographically diverse expert panel was also essential for capturing a diversity of perspectives on the issue at hand. In this vein, the e-Delphi endeavour achieves a more inclusive and relevant consensus. Through a review of peer-reviewed publications and investigation into several membership-based international companies and organizations, an initial set of 1,024 potential participants was identified (see Appendix B).

Given the global nature of the study and the conventional constraints imposed on Delphi methodology, the use of the Internet for communications and data collection (i.e., e-Delphi) was appealing due to the time and cost savings it provides (Hung and Law, 2011). To pilot test the utility of this e-technique, the Internet comprised the primary communication medium throughout the preparation stage. Before contacting potential participants, an Internet-based research portal was created to share information with research participants, supporters, and other stakeholders. A research problem statement was prepared and a research description – including human subjects protections (e.g., description of study purpose, informed consent, etc.), was posted to the research portal. A profile of the researchers – including contact information as well as research institution information was also posted. Once the research-portal was established, e-Delphi invitations were disseminated to potential participants by email. The invitation contained a description of the research including ethics compliance statements, a link to the research-portal for more information, and a link to an expert screening e-survey. The survey requested that potential participants identify which, if any, of the pre-determined selection criteria they satisfied. Inclusion criteria mandated that study participants possess a minimum of five years of experience in the public, governmental, or private sectors, and/or exhibit evidence of professional productivity in terms of peer-reviewed or professional publications and research, participation in academic or industry symposia, and/or a related teaching portfolio in a specific domain.

The survey was administered using Qualtrics™, an Internet-based survey provider that offers a user-friendly interface for survey design and administration as well as for survey completion. This service provider was selected over others on the grounds that little to no training was required of users and there was no cost or obligation associated with the subscription due to institutional access for the researchers. Once the screening survey was developed, a unique URL or web address was created and included within the e-Delphi invitation. When the potential participant clicked the link, they were directed to the initial survey; the internet-based survey software, Qualtrics™, tracks unique user internet protocol (IP) addresses to ensure that each respondent only fills out one survey (for security and experimental control purposes). The screening survey proved to be simple to design and administer with only one technological difficulty reported (the inability to complete the survey if the link was received in a forwarded email) that was corrected within a half hour of sending the initial invitation email. From the initial email invite to 1,024 unique addresses, 154 potential participants completed the survey (response rate = 15.04%), and a review of the responses revealed a broad geographical distribution (14 countries were represented) as well as a range of expertise across the desired expertise spectrum (both academics and professionals).

Those satisfying the selection criteria (127) were sent an email message requesting their participation for the duration of the e-Delphi exercise. A total of 27 individuals that did not satisfy the expert criterion were given an additional opportunity to clarify their answers to the scoping questionnaire. Two participants who had completed the initial survey and were excluded based on their responses answered that message with clarification of their qualifications and were subsequently chosen as panel participants (bringing the expert panel total to 129 individuals). At this point, an interactive Internet-based map was created for the purpose of sharing information about the ‘virtual laboratory’. The research participants’ locations (city and country) and professional background (academic, commercial/private, government agency, non-governmental agency, or a combination) were marked on a Google map (all personal identifiers being excluded), with a link to the map posted on the research-portal. Though portal visits were not tracked, several of the research participants reported via email that they returned to the website frequently during the preparation stage and found it to be an important source of information about the research project and its participants. In light of the relative administrative success, the Internet was judged to be a ‘best-fit’ for the study as it allowed the research team to: (a) access a geographically diverse expert panel; (b) communicate and share information conveniently and securely; and (c) collect data efficiently, in a timely manner, and at a low cost.

In the *convergence stage,* the 129 experts were invited to complete the Round one survey. Again, an email invitation with instructions and a link to the e-survey was included. The survey was designed as a scoping exercise to encourage participants to elaborate on the research problem and the task at hand (i.e., developing a typology of social values of ecosystem services and identifying priority issues of management in the coastal zone). An initial, working definition for social values of ecosystem services was provided to the panellists (based on a comprehensive review of the literature); it was purposefully broad and loosely structured so as to allow the group to inform the shape and content of the typology over the course of the e-Delphi exercise. Participants were provided with a two-week period in which to respond. A response rate of 45% was achieved (n = 58). As was expected, Round one resulted in the submission of hundreds of valuable comments, suggestions, and critiques.

In Round two, a Round one summary report that included pooled data and representative commentary was sent to participants by email and posted on the research portal for download. The expert contributions and Round one results were used as a baseline and a second survey was circulated to solicit feedback regarding the appropriateness of the initial typology and listing of resource uses, along with observations and interpretations about the working definition of “social values of ecosystem services”. Again, participants were provided with a two-week period in which to respond and several reminder emails were dispatched as the deadline approached. The same procedure was followed for Round three. In order to assess the level of convergence between rounds, simple mean scores and associated standard deviations were calculated across all three rounds. Table 2-2 describes the e-Delphi panel composition, response rates and convergence measures. Between Rounds two and three, the typology enhancements were minimal, no significant change in the mean scores was observed, but the increase in convergence (reduction in standard deviation value) was noteworthy. Scheibe, Skutsch, and Schofer (1975) state that measuring the stability of participant responses in successive iterations is a reliable method of assessing consensus. In addition, the dispersion measures in the present study satisfied the guidelines for establishing consensus in the Delphi literature (Day and Bobeva, 2005; Donohoe and Needham, 2009). Thus, it was decided that optimal consensus had been reached and that further rounds would not produce additional convergence of opinion.

It is important to note that the design of the data collection instrument evolved between rounds. This was informed by difficulties reported by participants when completing the e-surveys and by the challenges encountered by the administrator when compiling and analyzing the data. For example, in Round one, several participants reported a need to review answers made on previous pages to inform those later in the survey and could not go back to do so. The Delphi administrator worked with the participants (by email) to identify the source of the technical problems, and minor survey formatting alterations successfully eliminated existing technical problems (i.e., adding in a back button). Changes were also informed by the recommendations of Day and Bobeva (2005) who suggest that the key to formulating Delphi surveys, and to mitigating attrition, is to ensure that the survey is technically unchallenging, that questions are clear, concise and unambiguous, and that they are complimented with clear instructions for the panelists. The e-Delphi approach used in the study of social values of ecosystem services attempted to operationalize these recommendations by employing a combination of open and closed-ended questions. As well, the majority of consensus building activities and measures were based on a 5-point Likert-type scale where panelists judged the appropriateness of the typology variables from ‘5’ for very appropriate to ‘1’ not appropriate. The e-survey platform provided a simple interface for organizing questions, designing question sequences, and for pilot testing the surveys. It also allowed the administrator the ability to monitor response rates and progress towards consensus. The enhanced functionality of Qualtrics™ produced simple statistics in ‘real-time’ as participants submitted their judgments. The participants reported that the e-survey interface allowed them to jump easily between questions, modify their answers, quit and return to the survey at a later time (a function added between the expert qualifications survey and Round one), access technical support (through help functions), and respond to the survey when and where it was most convenient.

In the *consensus stage*, a draft final report was prepared and circulated by email to the expert panel. Before declaring ‘consensus’, final comments and suggestions on the report and its content were requested. Panellists submitted their recommendations and the administrator integrated them into a final consensus statement. This process ensured that the typology and resource use listing had undergone sufficient testing and that a consensus judgement had been rendered regarding its value and appropriateness. A final Delphi report was then prepared and disseminated by email to the panellists, supporting organizations, and other interested stakeholders, and also posted to the research portal. The total time to complete the e-Delphi exercise was just over two months.

Discussion

Using the e-Delphi presents a new and exciting NREM research frontier, but caution is warranted as methodological guidance has yet to emerge in the literature (Donohoe and Needham, 2009). Clearly, this is an important and evolving contribution area for Delphi research specifically, and e-research generally. While many of the issues can be considered characteristic of computers and the Internet, problems associated with traditional methods can be intensified by the conditions of the virtual landscape (Hung and Law, 2011). These include perceived anonymity, respondent identity (real or perceived), and data accuracy (response selection control and transmission errors) (Baym and Markham, 2009; Jones, 1999; Roztocki, 2001). Because of the problems associated with e-research and complimented by the issues revealed during the aforementioned research process, select issues – convenience, administration, control, and technology - are brought forward for discussion.

Convenience

The e-Delphi exercise revealed that the convenience of 'anytime' and 'anywhere' research was a pragmatic feature of the data collection process, given that the e-Delphi administrator and participants could access the research portal and surveys anytime and anywhere that Internet access was available. Participants could choose to respond when it was most convenient to do so, and the administrator could monitor response rates and respond to technical difficulties without being physically tied to the research center. Convenience was also revealed by the familiar interface offered by the personal computer via the e-survey provider. As e-surveys have become ubiquitously distributed to millions of people around the world, the standard format and user interface reduced the amount of training and/or instruction required for participants to complete the surveys. By extension, Internet technology made the collecting and sharing of group level information accessible and convenient across national boundaries and time zones, a result of the global web phenomenon that has been brought to light elsewhere (Hung and Law, 2011).

Administration

In this case study, full access to the Qualtrics™ data management service for the duration of the active research phase was provided to the researchers through institutional licensing. This level of access allowed participants the ability to view the statistical summary reports – thereby improving knowledge exchange and research transparency by providing direct, fast access. It is important to note that other e-survey management services are available at no cost or for minimal fees, making use of these technologies easily accessible and rarely cost prohibitive. As such, the use of an e-Delphi reduces the research costs of the traditional mail-out Delphi surveys. In this case, the Internet expedited communications and expert recruitment so that the total amount of time between recruitment and consensus was just over two months. The time commitment would have been much greater if traditional communication methods were used; the literature indicates that a traditional Delphi can take anywhere from 45 days to six months (Delbecq, Van de Ven, and Gustafson, 1975) or longer. The data management advantages of the e-Delphi technique were also confirmed. The e-survey provider made available a large database for gathering and storing data electronically. The format also made it possible to easily move the data into Microsoft Excel (or other formats such as SPSS) for analysis. Survey software also monitored response rates and attrition, and where numerical data was captured, simple statistical reports were provided. To facilitate transparency, participants and other interested parties could access the statistical reports throughout the course of the e-Delphi through the established research web portal or via email request to the researchers (for instance, individuals not selected as expert panelists and participants lost to attrition could opt to receive summary reports between rounds).

Control

The issue of experimental control did not present itself as a concern during the e-Delphi exercise. However, where control did appear to be an issue was in reducing participant distractions. While distractions can never be completely avoided, the researcher made efforts to identify and avoid known distractions (as recommended by Briedenhann and Butts, 2006). The surveys were dispatched so as to capture the maximum availability of the panellists and to achieve the best possible response rate. For the e-Delphi, care was afforded to the timing of the e-surveys so that they did not coincide with traditional periods of occupation leave (in this case initiation of the Delphi exercise was delayed to the first of the calendar year to avoid the typical holiday season of November and December). Although attrition did occur, the response rate improved and attrition rates decreased as the rounds progressed. This may be evidence of the panellists' level of commitment to the study, but it may also suggest that efforts to avoid distractions through calculated timing may be an effective strategy.

Representation, however, was identified as a potential issue given that "there is a high degree of uncertainty… in terms of 'knowing' the identity of the other" (Ward, 1999, p. 5). To mitigate threats to sampling an ecologically valid and representative sample, efforts to corroborate participant expertise areas (self-identified experts) were completed in the early stages of expert identification (e.g., peer reviewed portals, secondary verification, and the use of the screening survey). To control misrepresentation in survey responses, panellists were limited to one response per unique IP address. This provided some measure of control over identity but the researcher acknowledges that representation remains an unresolved issue in Internet-based inquiry. This limitation is confirmed by Hung and Law's (2011) analysis of e-survey research in tourism and hospitality, for example.

Technology

Technological complications presented a challenge to participant recruitment and data collection. Several participants reported other technological difficulties such as an inability to open survey links, download the e-survey, or submit their responses. In most cases, difficulty was the result of user error and administrator assistance resolved the issue. In other cases, computer hardware such as operating systems, Internet connections, security filters, and technical failures were the source of difficulty. As an example, the initial invitation to fill out the expert screening survey link was forwarded by potential participants to interested colleagues. However, those links were limited to the IP address they were sent to causing them to fail when forwarded. In a positive reflection of the use of Internet technologies, researchers were informed of the issue immediately via email and the problem was corrected within an hour of the initial message. Finally, some email addresses were inactive and this resulted in approximately 25 returned emails in the preparation stage.

Recommendations for Avoiding Potential Pitfalls

On the basis of the practical limitations and issues revealed by the e-Delphi case study, a set of recommendations are introduced for assisting the e-Delphi NREM researcher. *First*, it is strongly suggested that NREM researchers critically assess the advantages and limitations of Internet-based tools and their 'fit' for the research agenda before making research design decisions. The Delphi and Internet-based research literature should be consulted for guidance. *Second*, before initiating participant recruitment, it is recommended that a website be established for sharing information about the research project. This both legitimizes the research and it serves as a central communication portal between the researchers, the research participants, and other stakeholders throughout the study (and beyond). It is suggested that the researcher share information about the research design (purpose, timelines, method, ethics), 'how-to' or 'frequently-asked questions' for completing the e-surveys and participating in an e-

Delphi exercise, researcher and institutional information, relevant publications and reports, and contact information. *Third*, make use of Internet-based databases and online mailing lists (listservs) for recruiting potential participants and select participants with high interest to reduce potential attrition. *Fourth*, invest in strategies to mitigate misrepresentation. The use of a screening tool (e-survey) to capture and winnow out the most appropriate experts for the study is recommended as is validation of self-identified experts through membership organizations, academic or professional institutions, publications or secondary confirmation. It is also highly recommended that e-survey access be protected by using unique IP addresses to limit responses (other strategies could include password protection or use of unique survey hyperlinks), which in this case was provided as a function of the Qualtrics™ data management service used.

Fifth, select an e-survey software or service provider that is going to allow the greatest flexibility in survey design, reliable technological support (for both the researcher and respondent), data processing and analysis options, attrition monitoring and response tracking features, data sharing capabilities, security, and ease of use. In this regard, consult Wright's (2005) comprehensive review of the twenty most popular software packages and e-survey services that are commonly used for academic research. While the Qualtrics™ software is not included on that particular list it does provide a good starting point for investigating relevant programs to use. *Sixth*, researchers are strongly urged to pilot test all communications (including email and hyperlinks) and e-surveys to avoid interpretation and technological difficulties. In this respect, make sure to test communications in all the ways participants would be expected to use the software by, for instance, utilizing a communication test group of immediate colleagues for assistance. *Seventh*, maintain copies of all documents, data, and reports in case of hardware failure or software failure (worst case – survey provider problems and data loss).

Finally, identify known or possible distractions and time administration threats and plan accordingly. The literature indicates distractions such as vacations, holiday periods, and disciplinary conferences, as events that have led to low response rates during a Delphi exercise (e.g., Briedenhann and Butts, 2006; Donohoe, 2011). While external distractions cannot be controlled and the Internet itself can be considered a distraction, careful design and planning can help to alleviate the potential for attrition due to distraction.

Conclusion

The adoption of the Internet as a tool for conducting research is now common in a variety of disciplines including NREM. Given its increasing popularity, it is expected that a growing proportion of future studies will be conducted online. While it is unlikely that e-research will replace traditional research methods, it is certainly a viable alternative for the right research topic and target audience (Palmquist and Stueve, 1996). However, e-research is still in its infancy and NREM researchers must be critical and calculated when adopting Internet-based tools and techniques. Importantly, however, in light of the practical advantages that the e-Delphi offers, and because of the evolving set of recommendations and best practices coming forth about the technique, analysis of this case study suggests that the benefits far outweigh the costs. The e-Delphi is effective and efficient in terms of overcoming geographical barriers, saving time and money, and building group consensus. In this regard, the authors support Deshpande, Shiffman, and Nadkarni's (2005, p.55) claim that the e-Delphi is a "feasible, convenient and acceptable alternative to the traditional paper-based method." However, the authors would add that the e-Delphi offers more than just an alternative to the traditional method. The interactive capacity of the Internet offers a range of benefits that are inextricably linked with contemporary Internet-based innovation and its growing popularity in the research domain.

Despite its value, it must be emphasized that without careful consideration of the advantages and limitations associated with e-Delphi administration specifically, and Internet-based research generally, NREM researchers are likely to face challenges that could potentially compromise research findings and their publication in peer-reviewed journals. Since methodological quality is a major assessment criterion for publication, an understanding of emerging e-research methods can potentially enhance scholars' understanding of how the Internet can be utilized for NREM research. The critical analysis presented here may help researchers make informed decisions when planning and designing their studies while keeping the advantages and disadvantages of e-research in mind. Given the increasing awareness and emerging critical discourse regarding e-research, this tutorial is a timely methodological contribution to the NREM literature. Clearly, there are opportunities here worthy of further exploration, which necessitates appropriate investments in methodological applications, reporting, and evaluation of the e-Delphi method within and beyond the boundaries of NREM research.

Table 2-1. Delphi advantages and benefits for natural resource and environmental management researchers

Advantages	Benefits for Natural Resource and Environmental Management Researchers
It is well-suited for forecasting uncertain factors	It is well-suited for forecasting uncertain factors that may affect natural resource and environmental management.
It is anonymous	It provides opportunity for participants to express their opinions without being influenced by others and without fear of ‘losing face’ amongst their peers.
It is dependent on expert judgment	It is particularly compatible with natural resource and environmental management experts as they are often in a position to be affected by or to operationalize the research product. Thus, they may be more willing to participate.
It is not limited by narrow expert definitions	It facilitates capacity building for expert interaction in an industry characterized by fragmentation and limited opportunities for interaction and knowledge exchange (i.e., increases interdisciplinary interaction and understanding).
It is effective and efficient	It is a low-cost technique that is easily administered by natural resource and environmental management researchers and/or practitioners.
It is reliable and outcomes can be generalized	It is a legitimate technique for natural resource and environmental management research. The generalizability of research outcomes is well-suited for management forecasting.
It is non-linear by design	It offers an alternative research approach for addressing emergent and/or complex environmental management problems that do not benefit from the traditional linear approach.
It is insightful	It facilitates progress. Through iterative feedback, participants are part of the process, and the sum is much more than its parts. This is particularly complementary to natural resource and environmental management research where participants (managers, local stakeholders, etc.) are increasingly key/mandatory contributors to the research process and outcomes. Community-based natural resource research and collaborative stakeholder environmental management research are just a few examples.

Adapted from: Donohoe & Needham, 2009, P. 420

Table 2-2. e-Delphi panel composition, response rates and convergence measures

		Round 1	Round 2	Round 3
Surveys delivered		129	58	38
Survey completed		58	38	37
Government panelists		36	25	24
Academic panelists		39	14	14
Non-governmental panelists		25	10	10
Commercial/Private panelists		29	9	9
Response rate		45%	66%	97%
Convergence Measures	Mean Score*	n/a	4.3	4.4
	Standard Deviation	n/a	0.85	0.71

*Typology consensus measured on a five-point Likert-type scale: 5=strongly agree, 4=agree, 3=somewhat agree, 2=disagree, 1=strongly disagree.

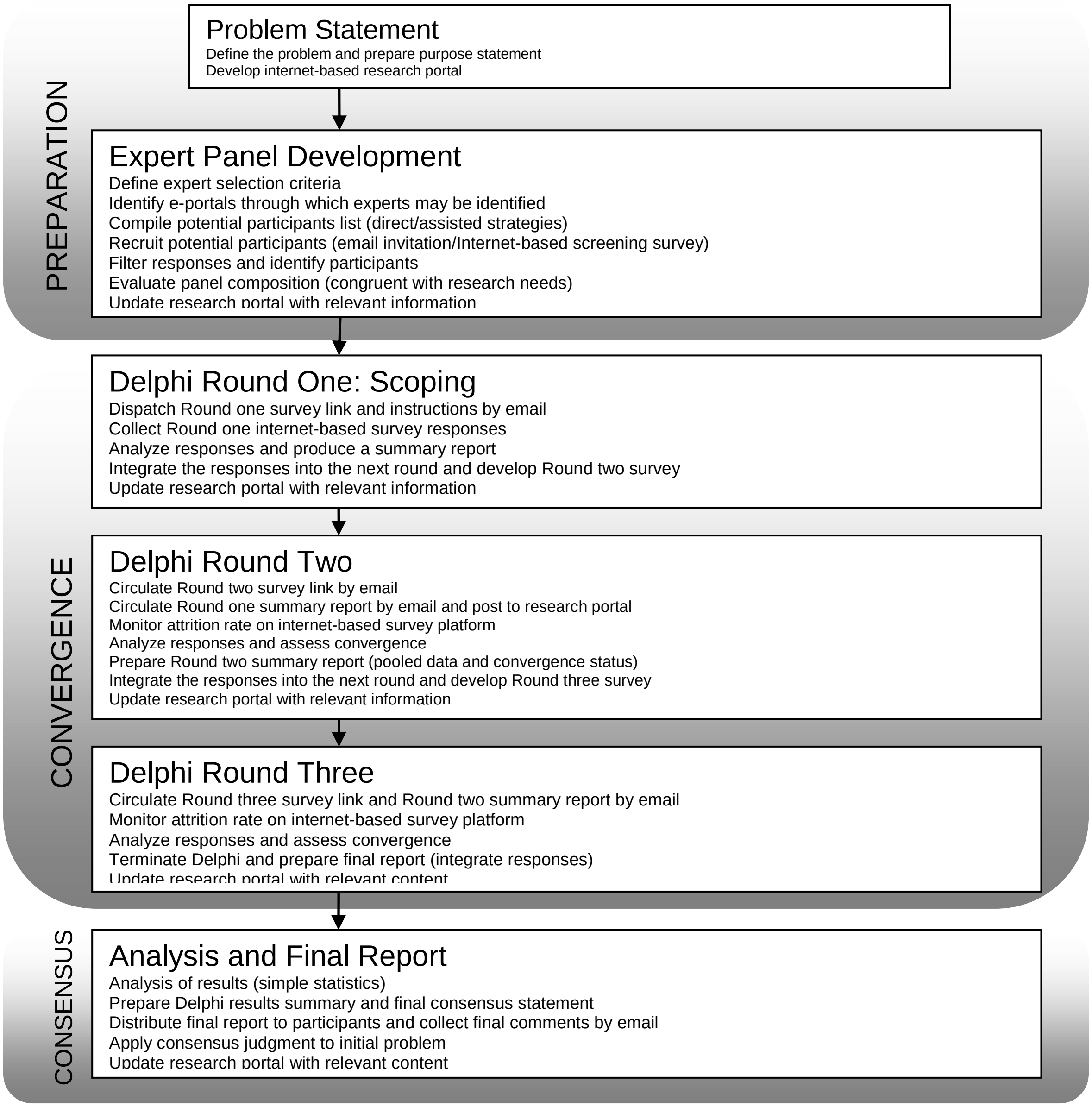


Figure 2-1. Delphi study methodology (adapted from Donohoe, 2011).

CHAPTER 3
A SOCIAL VALUES TYPOLOGY FOR COMPREHENSIVE ASSESSMENT OF ECOSYSTEM SERVICES IN THE COASTAL ZONE

Introduction

Coastal areas provide a wealth of resources and represent some of the most developed areas in the United States and elsewhere. The coastal fringe, representing just 17% of the nation's contiguous land area, is home to over half its population (NOAA, 2005). Globally, the same proportion reside on 12% of the available landmass referred to as the coastal interaction zone (Crossland et al., 2005). As pressures on coastal and marine resources increase in concert with growth in population and development, managers and policy makers increasingly require understanding that facilitates the comprehensive valuation of ecosystem services. While the ecology of natural processes underlying ecosystem services has been studied extensively, along with large advances in economic-based assessment and valuation, stakeholder-level social and cultural values have only recently garnered increased attention within environmental research and policy. An understanding of relevant social-ecological dynamics and the coupling of social and natural systems is critical for environmental decision-making. The emergence and proliferation of ecosystem management approaches have created a need to increase knowledge of social systems commensurate to baseline ecological understanding; i.e., managers can benefit from integrating stakeholder values and perceptions into decision-making processes.

Many contemporary ecosystem management processes, despite the emerging utilization of ecosystem service discourse, fail to produce comprehensive environmental assessments because they focus primarily on economic utilities and ecological structures while overlooking the social value perceptions of stakeholders. These stakeholder social values are in essence overshadowed by conventional utilitarian and ecological assessment methods, in large part due to neglected recognition of the psychological well-being aspects of an individual's relationship with nature (Kumar and Kumar, 2008) and the subsequent role, or lack thereof, of such consideration within dominant natural resource management paradigms. Focusing predominantly on economic and ecological aspects of natural resource management at the cost of equitable social considerations avoids much of what ecosystem services provide: public goods and their benefits which are outside the money economy (Constanza, et al., 1997) and traditional ecological assessment. By recognizing the variable nature and effect of place-based social dynamics (e.g., consideration of the stakeholder perceptions and social impacts derivative of resource decisions) to planning processes, decision-making efforts become more robust. Identification of desired future conditions with consideration of complementary ecological, economic, *and* human (e.g., social) variables defines a truly comprehensive assessment within ecosystem approaches to management. Indeed, one need not look far across natural resource and environmental policy in the US to find mention of the need to assess social variables relative to ecological and economic measurement across contexts (e.g., National Environmental Protection Act, National Trails System Act, Coastal Zone Management Act, and Sustainable Fisheries Act).

This article advances the human social aspects of ecosystem management by establishing a social values typology (SVT) of ecosystem services specific to a coastal resource context. Identifying these variables provides for potential future development of indicator-based measurement and assessment to capture the social side of ecosystem management alongside traditional metrics. Social values, in reference to landscapes, or in this case, coastal zones, are collective perceptions about places and locations that reflect resource use aspirations and potential conflict (Brown and Brabyn, in review). We hypothesize that while existing ecosystem value typologies have been validated (Brown and Reed, 2000) in terrestrial ecosystems (e.g., Brown and Reed, 2000; Brown, 2005; Raymond and Brown, 2006; Alessa, Kliskey, and Brown, 2008), there is a need to develop a typology specific to coastal ecosystems. With the exception of one known application in coastal area management (Alessa et al., 2008), social value typologies have been uniformly developed and implemented in terrestrial resource management contexts; e.g., forest management (Beverly, Uto, Wilkes, and Bothwell, 2008; Brown and Reed, 2000; Brown and Reed, 2009; Clement and Chang, 2009; Rolston and Coufal (1991), tourism development (Raymond and Brown, 2007; Brown, 2006), rural development (Nielsen-Pincus, 2007), and protected area management (Pfueller, Xuan, Whitelaw, and Winter, 2009; Brown and Weber, 2011). We posit that a large enough distinction exists between terrestrial and coastal ecosystems, with regard to ecological, economic, and social drivers; system dynamics; and subsequent resource issues, to warrant the development of a separate, but inevitably related, typology of social values of ecosystem services specific to coastal contexts. For our purposes we use the terminology "social values" of ecosystem services to encompass the range of alternative names including ecosystem values (Reed and Brown, 2003), environmental values (Brown et al., 2002, 2004), landscape values (Brown and Raymond, 2007; Alessa et al., 2008), and wilderness values (Brown and Alessa, 2005) (see Table 3-1).In this paper, we present the results of an e-Delphi exercise that sought expert consensus on a social value typology of ecosystem services specific to coastal (and marine) contexts (ecosystems). In presenting this typology, which delineates sixteen distinct ecosystem services, we outline the progression toward consensus, via the e-Delphi method (see Cole, Donohoe, and Stellefson, in review, for a complete discussion). It is important to note that although our operational focus is coastal contexts specifically, our work builds off the seminal work of Rolfston and Coufal (1991) and other researchers and policy-makers (e.g., Brown and Reed, 2000; Brown, 2005; Reed and Brown, 2003) to address gaps in the literature.

The purpose of this study is to develop a SVT of ecosystem services in coastal contexts. The Delphi technique is employed in order to capture and synthesize expert judgment on social values as it relates to coastal ecosystem services. In doing so, the results provide a management tool framework that enhances: (1) coastal resource management and its sensitivity to stakeholder values and perceptions; and by extension, (2) the sustainability of ecosystem management (i.e., social, economic, and environmental). The research increases our understanding of the links between culture, sustainable policy, social pressures and perceptions, and nature resource management by advancing consideration of social values within the framework of ecosystem management and engaging the environmental community in the social complexities of contemporary natural resource management paradigms.

Social values of ecosystem services

Natural resource decision-making can be broadly characterized as a complex web of biophysical elements and context specific social interests and trade-offs; a reality heightened in the coastal zone due to high (and increasing) populations and associated resource pressures. The ecosystem approach to natural resource management requires that decisions integrate human and non-human factors through equitable application of appropriate scientific methods, focused dually on biological organization and the recognition that humans, with their inherent social diversity, are integral to ecosystems (Council on Biological Diversity, 2008). Such an approach is not expected to be, nor can it be, the same in all contexts. On the contrary, every environmental policy, planning, and management situation requires a different strategy determined by local, provincial, national, regional, and global conditions (MA, 2003). In a departure from the traditional pillar structure of environmental and resource management based on collections of disciplinary expertise, ecosystem management at its core seeks to be adaptable to each context by taking into account social, ecological, political, and market realities in attempts to improve practice. Within these adaptive, ecosystem-based approaches, ecosystem services has become both the language and "currency" of the ecosystem approach to management, providing the unifying discourse for relating natural processes and human development and well-being.

The idea of ecosystem services has been developed by a number of scholars (see Constanza et al. 1997; Yoskowitz et al. 2010). For our purposes we use Daily's (1997) definition to help frame the study: "ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life" (p. 3). As noted by Brown, Bergstrom, and Loomis (2005):

> 'Ecosystem service' is the latest environmental buzzword. It appeals to ecologists, who have long recognized the many benefits derived from well-functioning ecosystems. It appeals to resource economists, who endeavor to measure the value to humans of natural resources. And it appeals to a host of other – public land managers and many private landholders included – who see opportunities for a more efficient and effective provision of basic environmental service flows. (p. 329-330)

While the ecosystem service construct is not new, with its first use occurring in the 1960s (see King, 1996; Helliwell, 1969), there has been a recent surge in its development and application in ecosystem valuation research (see Constanza et al., 1997; Daily, 1997; Daily et al. 2000; de Groot, Wilson, and Boumans, 2002). The advent of ecosystem management has required new ways of valuing relevant natural resources (Manzo, 2003) and processes that account for values people associate with places or landscapes (Brown, 2005; Williams and Patterson, 1996) within decision-making. Following the development of the ecosystems concept as a unit of understanding and analysis in the 1930s and 1940s (see Tansley, 1935; and Lindeman, 1942), scholars and practitioners began to investigate the valuation of the multiple benefits provided by ecosystems (Hein, et al., 2006). During the formative years of ecosystem service theory development, Helliwell (1969) and Odum and Odum (1972) point out that the benefits derived from ecosystems are often underestimated in decision-making. Concomitantly, attempts to more precisely assign value to ecosystem services have increased consistently. Most of these efforts have focused heavily on the economic (utilitarian) and ecological values of ecosystem services with the most recent development centering on monetary valuation for its potential for comparing trade-offs in a way that is universally understandable.

As Costanza et al. (1997) note in their study estimating the total economic value of global ecosystem goods and services, most of what ecosystem services provide exists as public goods with benefits that bypass the money economy. While the absence of market data has not precluded development of estimation techniques to indirectly derive monetary value (see travel cost method, Hein et al. 2006; and value transfer method, Troy and Wilson, 2006) the valuation methods have, by design, focused on economic utility. While these assessments produce tangible results that provide a method for weighing alternatives, they miss the inclusive nature of ecosystem service understandings that include values outside monetary, utilitarian valuation and traditional ecologically-based assessment. The goal of this study and others (see Sherrouse et al., 2011; Brown and Reed, 2000; Brown, Reed, and Harris, 2002; Brown, 2005; Brown and Alessa, 2005) is to turn the historically economic and ecological assessment lens toward social and human capital spheres as a way to expand value definitions regarding ecosystem services thereby creating a more comprehensive picture of the true value (benefit) of ecosystems.

Social values, as we conceive them, are the perceived attributes of a given ecosystem that are thought to result from a transactional concept of human-landscape relationships (Brown, 2005; Zube, 1987). As active participants within an ecosystem, the transactional model frames humans' experience – thinking, feeling, and acting – as leading to the attribution of meaning and the placement of value onto specific landscapes and places (Brown and Brabyn, in review). While social values of ecosystem services have been shown to exist, the application of rigorous methodologies to capture and ultimately integrate these values into resource decisions remains relatively elusive. Generally accepted value categories, as they pertain to ecosystem services, parallel the three-pronged structure of sustainability: environmental (ecological), economic, and social. The three value framework of total ecosystem service value by de Groot et al. (2002) helps to situate these categories within the larger framework (Figure 3-1).

All three value segments - ecological, social, and economic - must be equitably accounted for in order to attain a comprehensive aggregate value of a given ecosystem. The study presented here focuses on how to better measure the social values of ecosystem services, which we argue remain vague within natural resource decision-making structures, specific to a coastal ecosystem. Research aimed at developing models for mainstreaming ecosystem service assessment into policy and management has noted the need to include information resulting from both social and biophysical assessments (Cowling et al. 2008). Consideration of the former as a psychosocial concept (Nijkamp, Vindigni, and Nunes, 2008) underscores the development of various social value typologies and theories related to the environment in general and ecosystems in particular.

Study methods

This study selected the Delphi technique over traditional survey methods (surveys, group interviews, and focus groups) to elicit knowledge and opinions from a group of international coastal experts. Using iterative rounds of sequential questionnaires interspersed with feedback reports, the technique relies on the interpretation of expert opinion. It provides a mechanism for organizing conflicting perspectives and experiences, and facilitates the incorporation of multiple opinions into an informed group consensus (Donohoe and Needham, 2009; Briedenhann and Butts, 2006; Linstone and Turoff, 1975).

The method was selected due to its suitability for research topics in which little or no knowledge exists (i.e., no typology has yet been developed to frame social values of ecosystem services in coastal contexts), there are no correct answers or hard facts, and/or consensus of expert opinion is considered a valid alternative (Donohoe and

Needham, 2009). Table 3-2 (Donohoe, 2011) outlines a set of key attributes and advantages that are consistent with the study objectives. Since natural resource management, particularly in coastal contexts, has historically been advanced by non-inclusive, entrenched knowledge systems (predominantly biological and utilitarian in nature), a ‘counter-hegemonic’ methodology as represented by the Delphi method was chosen to support the achievement of consensus (Donohoe, 2011; Habermas, 1990). The result of the Delphi is agreement regarding study variables while at the same time reflecting multiple interests, values, and expertise.

A three stage Delphi exercise, with three survey iterations, comprises the methodological framework (Figure 2-1; Donohoe, 2011). Using Donohoe’s (2011) generic Delphi toolkit as a guide, an expert panel was developed as the foundational step in the research design. Guidelines suggest that panel size, characteristics, and composition should be based on the purpose of the investigation, the scope of the problem, and the resources available (Cantrill, Sibbald, and Buetow, 1996; Linstone, 2002). For this study, international coastal resource management experts were sought to create a panel with a diversity of knowledge, experience, skills, and social perspectives. Four relevant expert groups were identified: natural resource professionals from governmental organizations; academics engaged in coastal or marine research and/or education; professionals actively working in non-governmental organizations whose focus centers on coastal and/or marine resource issues; and commercial enterprise representatives whose interests revolve around coastal and marine ecosystems. The inclusion of this expertise spectrum provides a means for achieving a balance between differing approaches to, and perspectives on, ‘knowledge’, for mitigating the existent divide between research and professional communities, while ensuring a more inclusive and relevant Delphi consensus (Donohoe, 2011).

Through a review of peer-reviewed publications, membership listings of environmentally oriented non-governmental organizations and commercial groups, participant manifests at conferences of relevance, and extensive internet-based searching for coastal management experts, an initial set of 1,025 potential participants were identified. The target panel size was between 50 and 150 individuals from a range of socio-cultural perspectives, professional experiences, and geographic locations. Considerations of optimal panel size in the literature represents a wide range of opinions with little evidence of the effect of size on validity, efficacy, and reliability (Donohoe, 2009); therefore the number of experts was capped at 150 due to considerations of communication coordination between participants and researchers along with clarity of analysis concerns. An expert panel of 129 individuals – 36 government employees, 39 academics, 25 non-governmental workers, and 29 commercial representatives – were selected on the basis that they satisfied two predetermined ‘coastal expert’ selection criteria (determined through an initial potential participant survey).

Selection criteria included: current or previous experience in the public, governmental, or private sectors related to coastal resources (minimum 5 years), or evidence of professional productivity in terms of peer-reviewed or professional publications and research and/or participation in academic or industry symposia; and English language proficiency. Additionally, as noted by Donohoe (2011), the geographic dispersion of the expert panel provided a secondary measure of richness.

To represent this, a map (http://g.co/maps/n7ebd) showing the expert panelists' location was created, with different colored markers used to differentiate between expert type (governmental, nongovernmental, private, and academic). Global participation was achieved in terms of the geographical distribution of expert panelists, with North America (90.0% of participants), Europe (5.4%), Asia (1.5%), and Australia (2.3%) represented.

Once the expert panel was established, the Delphi surveys were administered sequentially over a two month period using an online interface. A full description of the e-Delphi methodology can be found in Cole, Donohoe, and Stellefson (in review), including an outline of the survey software used (Qualtrics™), the benefits of using an online project portal (http://www.flseagrant.org/boating/projects/solves/solves-phase-1-edelphi/) to disseminate summary reports between questionnaire rounds, and a thorough discussion of the advantages, disadvantages, and lessons learned in facilitating the Delphi exclusively via electronic communication.

The first Delphi round was a scoping exercise designed to define the study variables and stimulate participants' reflections about the relationship between social values, ecosystem services, and coastal resource management. Round one asked three questions: 1. List and describe the four most important issues or controversial resource uses facing contemporary coastal and marine management and policy; 2. How important is it for ecosystem service valuation to be inclusive of social values alongside traditional metrics of economic and ecological values?; and 3. List and describe up to four social values of ecosystem services specific to coastal and marine contexts.

Participants were provided with a two week period in which to respond. A response rate of 45% was achieved (Table 2-2).

As the iterative process progressed through rounds two and three, a consensus list of social values began to emerge. In both rounds, a chance for open ended comments was provided, resulting in hundreds of participant comments and suggestions used for enhancing the Delphi process and products. In order to measure the level of convergence between rounds, simple mean scores and standard deviation were calculated. This approach is validated throughout Delphi literature regarding data analysis in determining consensus (Green et al. 1990; Moeller and Shafer 1994) and follows Donohoe's (2011) toolkit procedures.

As the typology was enhanced and refined, a convergence of group opinion between rounds was observed. Between rounds two and three, the enhancements were agreeable across expert panelists and remained stable, evidenced by a reduction in standard deviation (signaling increased convergence) and no significant change in mean scores (signaling stability of opinion)(Table 2-2). It was therefore decided that consensus had been reached and further rounds would not produce additional convergence of opinion.

Study Findings

Typology: Social values of ecosystem services

Round one prompts to identify (list and describe) social values of ecosystem services specific to coastal and marine contexts produced an initial list of 19, based on content and frequency analysis, with their rank importance established by the frequency in which they appeared in open-ended survey responses. Frequency tabulation (number of references to each issue) was independently completed by two researchers with resulting inter-coder reliability, that is, the congruency between the two independent tabulations, at 93% (satisfying the most stringent measure of reliability). The initial social values list was 74% congruent with antecedent social values typologies (e.g., fourteen of nineteen; see Table 3-1), with five emergent values: identity, access, symbolic, novel experience, and transportation. While these nascent values are not exclusive to the coastal zone, it is interesting to note their application relative to terrestrial environments, as many would not translate very well to, say, forest ecosystems from which previous typologies have been developed.

In round two, the initial typology of 19 social values was presented and expert panelists were asked to reflect on their relevance within coastal resource management. A request was made for respondents to rank the values based on relevance (most relevant to least relevant) and to comment on the salience of each. A response average measure was generated for each value to measure consensus amongst the group. Using mean stability and decreasing standard deviation as measures of consensus, a final typology of 16 social values was presented in the final (round three) summary. The concluding SVT was also inclusive of respondent comments from each round regarding the definitions of each value; these definitions were presented in the final SVT summary (Table 3-3).

It is important to mention some specifics of how particular values developed through the iterative rounds. There were three predominant suggestions regarding ways to refine the typology by collapsing some of the social values listed. Those recommendations included: Natural/Wilderness-Biodiversity; Spiritual-Novel Experience; and Identity-Symbolic. While the latter two merged within the final typology, a majority of respondents (59.4%) vehemently resisted the suggestion of combining Natural/Wilderness with Biodiversity. These values were therefore separated in the final SVT, along with dropping “Wilderness” for two reasons: 1. its redundancy with respect to the definition of Natural; and 2. Natural being more relevant within a coastal context relative to Wilderness. In addition, it was stressed by multiple experts that Transportation (an identified value in round one) would be inherently captured within other values, such as Economic and Recreation, and therefore could be, and was, removed from the typology.

There were a number of other suggestions for modifying the social value descriptions. For example, a representative suggestion for the Future value was used to refine the description: “‘Future: Allowance for future generations to know and experience coastal ecosystems as they are now’ is a very different service value than ‘Allowance for future generations to know and experience healthy, productive and sustainable coastal ecosystems’. The social importance for restoration of natural ecosystem service values should not be lost when we discuss a ‘preferred future.” As a final typology validity check, including definitions of each value, experts were asked to to review and provide judgment on the appropriateness of the SVT. No additional critiques or comments were submitted signaling an adequate degree of consensus.

Relating coastal social values to past typologies

> Within the ecosystem services community, the need for better integration of social and ecological science has mostly been framed in terms of cooperation between ecologists and economists; however…the cooperation must be extended to broader domains of… social sciences. (Daniels, et al., in press)

Broad based recognition of the need to consider social-environment connections, within and external to the ecosystem service community, is a crucial next step to sustainable resource management. Drawing clear connections between ecological knowledge, economic data, and emerging social value understandings must be undertaken if ecosystem service discourse is to serve as the salve to viable, sustainable ecosystem-based management applications. As an approach that claims adaptability across contexts with underpinnings of integrative thinking between disciplinary expertise, the idea of ecosystem services and their value as treatise for comprehensive assessment must continually undergo scrutiny. As evidenced by the variety in social value typologies used in previous studies (see Table 3-1), there remains a need to further solidify comprehensive lists that work within certain contexts and eventually across them. The effort put forth in this study is an extension of that terrestrial ecosystems work and offers a corollary typology for use in marine and coastal ecosystems.

The wide range of references to the values derived from ecosystem services, i.e., ecosystem values (Reed and Brown, 2003), environmental values (Brown et al., 2002, 2004), landscape values (Brown and Raymond, 2007; Alessa et al., 2008), and wilderness values (Brown and Alessa, 2005), shows the range of understandings that currently exist and also reinforces the need for increased universal understanding of what is meant by the social values of ecosystem services. By falling back on the foundation of ecosystem service theory it is possible to situate social values alongside others ecosystem values. Indeed, the very definition of ecosystem services calls for the integration of human and non-human factors through dual application of scientific methods on biophysical aspects and human dynamics (Council on Biological Diversity, 2008). Through that understanding of ecosystem services, their value within resource management hinges on concurrent response to complex biological, cultural, and political scenarios (MA, 2003) and it becomes vital to drill deeper into the value connections through the use of typologies such as the one offered here. In doing so, it becomes possible to capture the full range of benefits and in essence, true ecosystem services, provided by the environment.

Ecosystem management requires valuation of natural resources (Manzo, 2003) traditionally based on utility, that must be extended to account for place in the form of social values (Williams and Patterson, 1996). It has been argued since the inception of ecosystem services discourse, that these human-assigned values have often gone underestimated (Odum and Odum, 1972) within decision making processes. If we are to aim for more comprehensive consideration of ecosystem service value within natural resource management broadly, and we perceive the social value attributes of a given ecosystem to result from transactional human-landscape relationships (Brown, 2005; Zube, 1987), then typologies of social values must be used to capture the range found within each ecosystem of relevance, in this instance coastal and marine contexts.

One model that utilizes this type of social value information and has been proven effective in terrestrial environments is the Social Values of Ecosystem Services (SolVES) geographic information system tool developed by the United States Geologic Survey (Sherrouse, et al., 2011). An application of the typology presented here, through SolVES modeling, is being conducted in Sarasota Bay, Florida. While previous applications of typologies outlined in Table 3-1 have found success in modeling social values of terrestrial landscapes, the application of the coastal specific typology of social values is the first of its kind. Data and conclusions from that study will not only highlight the similarities and differences between the typologies but will also aid in refining the typology to a more manageable number of values, an important step in making it viable to managers and other decision makers. This is the necessary next step after typology development.

Integrating social values of ecosystem services into coastal resource management: opportunities and barriers

Throughout the Delphi exercise, experts alluded to opportunities and barriers that could potentially affect the integration of social values as a natural resource imperative alongside traditional metrics of economy and ecology within ecosystem management approaches. We expand now on the opportunities and barriers that were noted throughout the Delphi exercise. These opportunities and barriers emerged openly and directly in participant comments throughout the three survey iterations. In order to better understand the complexity of using social values alongside economic and ecological measures, content of open-ended responses was analyzed and a discussion of findings follows.

The range of human understandings regarding the environment, both individual and collective, are observed through examination of perceptions, attitudes, and values directed at relevant resources and their management. Linked to human behavior and decision-making, these variables can vary and change across time and space while not being immediately available or considered important to managers. Barriers as it pertains to the integration of social values of ecosystem services into management include misunderstanding, insensitivity, lack of knowledge, and conflicting values (often defined by professional expertise) amongst managers (as represented by our expert panelists in this case). Key concerns raised were related to the difficulty in considering the emerging importance of social values alongside long understood economic and ecological variables, the latter of described as “well-defined”, the former as “soft”. As one respondent noted:

> “Ecosystem valuation is important, but a difficult concept for the general public to grasp. Having accurate assessments of ecosystem values helps decision makers with funding allocations and decisions regarding use patterns. Social values estimation must be done as well. But the quantitative methods used must provide for comparable estimates and must be done in a manner that does not encourage bias and overestimation.”

While there was general agreement that ecosystem services valuation should incorporate social values, many acknowledged the difficulty in doing so as evidenced by the lack of this type of measurement in most contemporary assessments:

> “Social values are an important consideration with ecosystem valuation, particularly during project planning, however social values are difficult to use in project ranking. Therefore social values become qualitative considerations rather than quantitative economic considerations or ecological values that often are reduced to quantitative values. If social values can be defined and then normalized in some manner to economic and ecological values project planning would benefit.”

As this participant expressed, the need to normalize these social values in a quantitative manner, rather than traditionally qualitative, is the crux of true integration into contemporary measurements. The move toward social value standardization within a coastal context represents one of the key opportunities identified by this study.

Accepting the equitable consideration of social values was also judged to be a barrier to its true assimilation into relevant planning and evaluation.. A number of respondents saw that integrating social value measure into the existing decision-making milieu of natural resources management is simply not effectual relative to traditional considerations or is adequately captured by existing assessments. To the former point, one respondent remarked that “social values…are much harder to quantify, and enter into the decision-making process with much less impact. That is, decision-makers, regardless of the strength or time spent discussing social issues, tend to make decisions based largely on perceived or real cost-benefit ratios." In terms of the latter assumption:

> "While social values can be important, ultimately I think the ecological values to a degree, but more importantly, the economic values will adequately capture this. If coastal resources are valued for aesthetic reason and represent a social value of entertainment or enjoyment, then society will place more value on more enjoyable resources and the economic indicators related to how people choose to use those resources will reflect that. Restated simply, I believe the social values are inputs to the ecological and economic values and need not be broken out."

Even in light of these debates and challenges, many of the experts saw that "lack of accounting for social values can destroy resources vital to community and resident functions", while consideration of these factors can provide "a broader based ownership of the [ecosystem] services provided."

Conclusion

Agencies at all levels of government, from local to international, see inclusive evaluation of ecosystem services as critical to robust decision-making regarding relevant resources. Specific to this study, recognition of the widespread coastal and marine resource decline has additionally triggered a need to change the way these resources are managed. The diversity of stakeholder attitudes, preferences, and behaviors associated with such values and uses are a source of ongoing conflict for resource managers as they are addressed through various approaches within the decision-making process (Zendehdel, Rademaker, De Baets, and Van Huylenbroeck, 2009). The purpose of this study was to build on the increasingly universal language of ecosystem services by presenting a social values typology that when applied in concert with traditional measures, provides a more comprehensive understanding of the human benefits derived from the coastal environment. As a conception from which managers can understand and assess the trade-offs inherent to landscapes/seascapes and their management, typologies such as the one advanced here, will facilitate more robust and equitable decision-making.

The Delphi method was used and proved to be a valuable and inclusive forum for the generation of ideas and debate. It produced a rich data set that contributed to an evolving understanding of social values of ecosystem services in the coastal zone. The research captured and interpreted expert opinion related to the importance of considering social values alongside traditional metrics (economic and ecological) within natural resource management, including barriers and opportunities for its integration into relevant decision-making. While little doubt remains that social values of ecosystem services is an issue of import, the study also reveals that investments are required to put the results presented here into action. Through the Delphi approach, this study accomplished its central objective of moving the group toward consensus on a comprehensive social values typology. Participants expressed much hope (apparent in comments) that the results of this work can serve as an important first step towards making management of coastal resources more comprehensive and responsive to societal interests. Additionally, researchers were encouraged by the positive feedback regarding the methodology of the study, particularly the ease of communication with which the e-Delphi created.

Although somewhat enigmatic in its complexity and necessity, this study identifies the consideration of social values within perceptions of ecosystem services as a contemporary coastal planning and management imperative. While use of ecosystem service discourse as the basis for resource decision-making continues its maturation within existing policy structures and our understanding of the social values of ecosystem services evolves, it is hoped that the study's findings will provide guidance for coastal resource stakeholders in both the academic, professional, and general public domains who are contributing to relevant management plans, policy initiatives, research agendas, or other ecosystem management-related advancements related to social values, their evaluation, and use in decision-making.

From a theoretical perspective, the typology emergent from this study contributes to a growing body of knowledge concerned with defining and measuring the human side of ecosystem services. The nature of ecosystem services, and the parent concept of ecosystem-based management, is based on flexibility and context specific understanding of the relationship between variables acting in a given environment. The findings reported here advance that understanding by providing a conceptual basis for digging into that connection, specifically in the coastal zone. Methodologically, this study advances movement toward information technology based techniques for social research, in this case the use of an e-Delphi, that appear to be gaining momentum within academic and professional realms.

The logical next step in future use of the findings presented here is application of the social values typology in resource assessment initiatives, within both research and practical based efforts. This will require the development of a set of frameworks, techniques, tools, methods, and policies for social values assessment that are supported by this study. While participants expressed concern about the process and resources required to integrate social values assessment into existing measures, there was agreement about its importance and contribution to more comprehensive natural resource decision-making.

Table 3-1. The social value typologies used in related studies.

Research Source	Social Values: life sustaining	economic	scientific/learning	recreation	aesthetic	wildlife	biodiversity	historic	spiritual	intrinsic	future	subsistence	therapeutic	cultural	wilderness
Rolston and Coufal (1991)	x	x	x	x	x	x	x	x	x	x					
Brown and Reed (2000); Reed and Brown (2003)	x	x	x	x	x		x	x	x	x	x	x	x	x	
Brown (2005); Alessa et al. (2008)	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Sherrouse et al. (2011)	x	x	x	x	x		x	x	x	x	x		x	x	

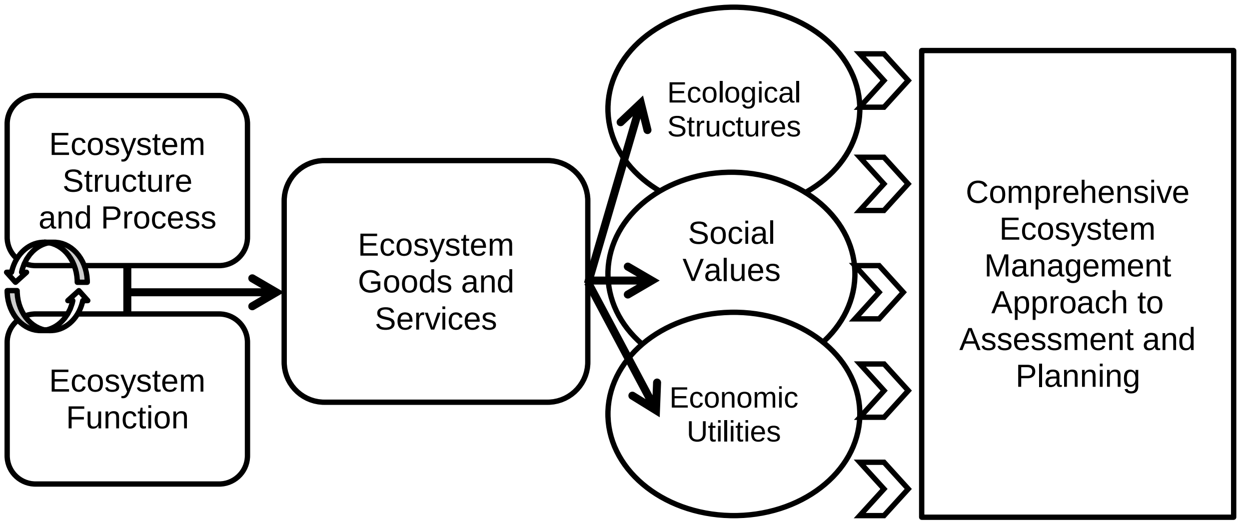
Table 3-2. Delphi attributes and advantages

Legitimacy: The Delphi is considered an established research technique.
Suitability: The Delphi is well suited to complex problems where exact knowledge is not available and the contributions of experts would contribute to advancing understanding and knowledge about the problem.
Proximity: Given the potential difficulties involved with bringing participants together for face-to-face meetings, the Delphi offers a 'virtual laboratory' where physical meetings are not required.
Reflexivity: By design (iterations), the Delphi allows for participants to really think through the concepts and questions – so that resulting data is very rich, and by extension, valid research findings result (and statistical presentation of results is possible).
Flexibility: The Delphi is flexible, allowing for a variety of design decisions to be made. Flexibility permits methodological adaptation in order to achieve a more comprehensive understanding of the research problem.
Repetition: The Delphi is designed to move a group towards convergence of opinion. The process requires multiple iterations where surveys are distributed and feedback (summary reports) is provided to participants. The product is an informed judgment about a complex problem.
Anonymity: By design, the Delphi reduces the risk(s) for group dynamics to influence outcomes. Experts are free to express their opinions without fear of losing face among their peers.

Table 3-3. Social values typology for coastal contexts (alphabetical order)

Value	Definition
Access	Places of common property free from access restrictions or exclusive ownership/control.
Aesthetic	Enjoyable scenery, sights, sounds, smells, etc.
Biodiversity	Provision of a variety and abundance of fish, wildlife, and plant life.
Cultural	Place for passing down wisdom, knowledge, and traditions.
Economic	Provision of fishery (commercial/recreational), minerals, and tourism industry that support livelihoods.
Future	Allowance for future generation to know and experience healthy, productive, and sustainable coastal ecosystems.
Historic	Place of natural and human history that matter to individuals, communities, societies, and nations.
Identity/ Symbolic	Places that engender a sense of place, community, and belonging; represent a distinctive “culture of the sea”.
Intrinsic	Right to exist regardless of presence; value based on existence (being rather than place).
Learning	Place of educational value through scientific exploration, observation, discovery, and experimentation.
Life Sustaining	Provision of macro-environmental processes (i.e., climate regulation, hydrologic cycle, etc.) that support life, human and non-human.
Recreation	Place for favorite/enjoyable outdoor recreation activities.
Spiritual/Novel Experience	Places of sacred, religious, unique, deep, and/or profound experience where reverence/respect for nature is felt.
Subsistence	Provision of basic human needs, emphasis on reliable, regular food/protein source from seafood.
Therapeutic	Place that enhances feelings of well-being (e.g., “an escape”, “stress relief”, “comfort and calm”).
Wilderness	Place of minimal human impact and/or intrusion into natural environment.

Figure 3-1. Three-pronged structure of comprehensive ecosystem management.



CHAPTER 4
SOCIAL VALUES OF ECOSYSTEM SERVICES IN THE COASTAL ZONE: AN ADAPTATION AND EXTENSION OF SOLVES GIS MODELING

Introduction

As the use of and pressures on natural resources continues to rise, particularly in the coastal zone, there is a critical need for research to quantify tradeoffs amongst relevant ecosystem services (Carpenter et al., 2009). Ecosystem services discourse provides a structure in which to view and weigh the inherent tradeoffs of environmental decision-making. The Millennium Ecosystem Assessment (MA, 2003), an integrated ecosystem assessment established with the involvement of the private sector, government, nongovernmental organizations, scientists, and other stakeholders, provides the formative framework for making connections between ecosystem services and human well-being within this study. As a social-ecological framework, further analysis requires information drawn from both natural and social sciences (Carpenter et al., 2009; Sherrouse et al., 2011). This study extends initial Social Values of Ecosystem Services (SolVES) model development, which focused on spatial quantification of social values across a terrestrial landscape, to a coastal and marine environment. The SolVES model (Sherrouse et al., 2011) combines social and ecological data by creating a Value Index of spatially explicit social values across a given landscape as a method for spatial quantification and relative value comparison while linking those values to underlying environmental characteristics of the corresponding ecosystem. The model addresses a source of continued difficulty for land and resource managers using ecosystem services concepts in decision-making: the challenge of comprehensively including a full range and diversity of stakeholder attitudes and preferences associated with such values when accounting for and trying to resolve the resulting value conflicts inherent to decision-making processes (Zendehdel et al., 2009).

Responding to calls for additional research into refinement of the social value typology used within the original SolVES modeling tool (Sherrouse et al, 2011), we began this research with a Delphi exercise to engage coastal resource experts in creating a comprehensive list (typology) of relevant values specific to our context, the coastal ecosystem of Sarasota Bay, Florida (see chapters two and three above for a full review). This typology (Table 3-3) was used in the data collection and modeling reported here. The second iteration of the modeling tool (SolVES 2.0) represents a framework in which user entered social values represent measureable ecological end-products or endpoints of ecosystem services at their interface with human well-being (Boyd and Banzhaf, 2007) that are specific to the context of interest. The value of ecological endpoints, within this framework, are accounted for distinctly from the elements and processes of the ecosystems that produce them while retaining acknowledgement of the dependency of these endpoints on the condition of the ecosystem (Boyd and Banzhaf, 2007). From a practical perspective, the functionality of the model allows quantification of the relationship between these social value endpoints and both their social and physical contexts in a way that is informative and useful to decision makers and scientists. Additionally, the model supports potential for incorporation into broader ecosystem services assessments and valuation studies while remaining specific to the needs and dynamics of the ecosystem of interest. The results presented here summarize the collection and modeling of social value data related to coastal ecosystem services in Sarasota Bay, Florida (SBF).

Ecosystem Management: Coastal and Marine Spatial Planning

The conceptual foundation of ecosystem services stems from the ecosystem approach to natural resource management and explicitly provides the impetus for coastal and marine spatial planning (CMSP) efforts which are the purview of this study. The ecosystem approach, including the idea of ecosystem services, has developed in response to inherent uncertainty in environmental management, planning, and policy. The Millennium Ecosystem Assessment (2003) defines an ecosystem approach to management as a bridge between the environment and human well-being; parallel and related concepts include the development of coupled socio-ecological systems (SES) (Alessa et al., 2008) and the advent of participatory, stakeholder-inclusive management efforts within natural resource management. The Council on Biological Diversity (CBD) provides the most widely used and arguably most comprehensive description of the ecosystem approach:

> A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Application of the ecosystem approach will help to reach a balance of the three objectives of the Convention [conservation; sustainable use, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources]. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems (CBD, 2008).

Such an approach is not expected to be, nor can it be, the same in all contexts. On the contrary, every situation involving environmental policy, planning, and management requires a different implementation strategy as determined by local, provincial, national, regional, and global conditions (MA, 2003) in terms of political climate, social conditions, and ecological foundations. Ecosystem management at its core seeks to be adaptable to each context by taking into account the existing social, ecological, political, and market realities in attempts to improve practice.

Expanding value definitions

A major focus of the ecosystem approach to natural resource management is to gain a more comprehensive, context specific, and equitable understanding of all the factors – environmental, economic, and social – from which decisions are purportedly based. As both the language and currency of such approaches, ecosystem services and their valuation have begun to dominate the relevant discourse when developing tradeoff models and deciding between management alternatives. Generally accepted value categories, as they pertain to ecosystem services valuation in resource decision-making contexts, can be seen to parallel the three-pronged structure of sustainability considerations: environmental (ecological), economic, and social. All three value segments must be accounted for in order to attain a true aggregate (total) value of a given ecosystem; however, most traditional management emphasis (including valuation efforts) have focused on the ecological and economic variables to the detriment of social consideration.

In response to this reality, a common theme emergent from a broad range of research perspectives is the need for valuation of ecosystem services to more effectively incorporate social values as perceived by those who benefit from the services (Sherrouse et al., 2011) and which tend to fall outside of traditional ecological and economic assessments. As Costanza et al. (1997) noted in their study estimating the total economic value of global ecosystem goods and services, most of what ecosystem services provide exist as public goods with benefits that bypass the money economy. While the absence of market data has not precluded development of estimation techniques to indirectly derive monetary value (see travel cost method, Hein et al. 2006; value transfer method, Troy and Wilson, 2006), the valuation methods have, by design, focused largely on economic utility derived from the provision of ecosystem goods (e.g., timber, fish, minerals, etc.) along with quantification of the resulting ecological impact. While these assessments produce tangible results that can provide a method for weighing alternatives, they miss the inclusive nature inherent to conceptions of ecosystem services that include values outside monetary, utilitarian valuation (i.e., social values). Robust ecosystem management and policy must include a full range of ecosystem values including the socio-cultural, the ecological, and the intrinsic in addition to utilitarian values (MA, 2003) while being informed by the analysis of integrated socioeconomic and biophysical data (de Lange, Wise, Forsyth, and Nahman, 2010).

As Carpenter et al. (2006) note, greater management emphasis should be placed on the linkages between ongoing social and ecosystem change dynamics including more indirect drivers such as demographic and cultural factors. Research aimed at developing models for mainstreaming ecosystem service assessment into policy and management have also noted the need to include information resulting from both social and biophysical assessments (Cowling et al. 2008). Consideration of the former as a psychosocial concept (Nijkamp, Vindigni, and Nunes, 2008) underscores the development of various social value typologies and theories related to the environment in general and ecosystems in particular, such as the one used here (Table 3-3).

Concurrent to calls for the inclusion of these social values, the assessment of ecosystem services has become an increasingly spatial affair within ecosystem management of coastal and marine resources (e.g., CMSP), with researchers and practitioners finding traction in models that allow for spatial quantification of all relevant variables simultaneously across space, as demonstrated by the SolVES model utilized here.

Social values of ecosystem services in coastal and marine spatial planning

Since the mid-1990s, there has been growing recognition that natural resource management benefits from spatial assessment of landscape characteristics that underpin policy decision-making within ecosystem management approaches. In the coastal zone, specific calls for spatial planning within resource management structures, CMSP, is found in contemporary national and international policy initiatives such as the Coastal Zone Management Act (United States), Marine Strategy and Maritime Policy (European Union), and Convention of the Law of the Sea (United Nations).

The idea of CMSP was initially stimulated by global interest in development of marine protected areas (Douvere, 2008), with those early efforts since extended to address the increased “pressures on the marine environment and the potential for multiple use conflicts, arising as a result of the current expansion of offshore wind energy, fishing and aquaculture, dredging, mineral extraction, shipping, and the need to meet international and national commitments to biodiversity conservation” (Douvere and Ehler, 2009; p. 77). As a method within broader efforts at ecosystem based management, CMSP scholars have identified various steps and key concepts to consider in its implementation (see Gilliland and Laffoley, 2008; Maes, 2008; Plasman, 2008) along with lessons learned in the decade since its first inception (see Douvere and Ehler, 2009; Ehler, 2008). The study presented here extends this discussion by exploring the use of a social values typologies of ecosystem services, specific to coastal contexts (chapter three), through spatial quantification and modeling in SBF using SolVES 2.0; establishing what St. Martin and Hall-Arber (2008) call the missing social data layer. Indeed, as a process and framework, CMSP is most beneficial as an integrating platform of relevant objectives; information about pressures and use; and environmental status of proximally significant ecosystems. The spatial planning process aims to assess the spatial interactions and cumulative impacts among these different ecosystem variables while analyzing a range of alternative measures for managing those interactions; “it is therefore axiomatic that [C]MSP encompasses all sectors of economic as well as environmental and social issues” (Gilliland and Laffoley, 2008; p. 788).

Stakeholder value mapping

The literature is replete with examples where public value and attitude survey results have been used to quantify and map social values perceived by stakeholders. Variations of a forest values typology created by Rolston and Coufal (1991) and validated by Brown and Reed (2000) has dominated social value mapping studies, where values of interest are alternatively referred to as ecosystem values (Reed and Brown, 2003), environmental values (Brown et al., 2002, 2004), landscape values (Brown and Raymond, 2007; Alessa et al., 2008), and wilderness values (Brown and Alessa, 2005) (see Table 3-1). This study utilizes a typology specific to coastal ecosystems, albeit closely related to others, developed through the Delphi exercise with coastal experts conducted and outlined in previous chapters (Table 3-3).

In general, there are two approaches for mapping social values, both of which fall under the umbrella of public participation geographic information systems (PPGIS) (Sieber, 2006). One approach relies on mapping results according to predefined planning and management units (Tyrväinen, Mäkinen, and Schipperihn, 2007), while the other, used in this study, is more flexible and scalable by relying on calculation of the weighted density of points marked on maps by stakeholders (Brown et al., 2004; Brown, 2005; Alessa et al. 2008; and Sherrouse et al., 2011). The latter method allows results to be expressed in a manner that is similar to monetary expressions of economic value (Brown, 2005) making the outcomes more practical to decision-makers.

SolVES 2.0 Application in the Coastal Zone

The use of a GIS for conducting analyses that integrate social and environmental data in a number of contexts is well established (e.g., Snyder et al., 2008; Saqalli et al., 2009; Silberman and Rees, 2010; Wyman and Stein, 2010; Sherrouse, et al., 2011). Using SolVES model analysis, this paper presents findings from a similar effort which examined the attitudes and preferences of stakeholders regarding their perceived social values of SBF alongside spatial data characterizing the physical environment of the ecosystem. Survey design and ensuing results analysis were based on the procedures and methods described by Brown et al. (2002) and later used by Sherrouse et al. (2011). SolVES provides a tool for generating maps that illustrate the distribution of a quantitative, non-monetary value metric (Value Index) across the landscape along with graphical and tabular reports containing metrics characterizing the physical environment at locations across the range of the Value Index for different social value types as calculated for subgroups of survey respondents (Sherrouse, et al., 2011). A case study is presented to demonstrate existing SolVES functionality, explore adaptation and application of the model in a coastal context, and discuss enhancements for future versions. As noted in initial development of the SolVES tool, its intent is to serve as a model for the continued development of more robust tools useful to decision makers, stakeholders, and researchers (Sherrouse et al., 2011). This study contributes by exploring the model's utility in a different ecosystem from that which it was initiated, further extending its applicability across a range of environments and associated decision-making contexts.

Methods

Study Context

Sarasota Bay is a coastal lagoon system formed by barrier islands to the west, mainland Florida to the east, and Anna Maria Sound and Venice Inlet to its north and south, respectively. The geographic scope of the study, which was coined "Greater Sarasota Bay", is an area that extends from the southern tip of Fort De Soto Park (Pinellas County) in the north to the northern shore of Siesta Key in the south, nine nautical miles offshore (state waters boundary), and landward to the watershed boundaries for Sarasota Bay and Palma Sola Bay (Figure 4-1). The analysis was limited to this area for two reasons: 1. to strike a balance between robust data analysis and adequate respondent understanding, and 2. to incorporate resource use factors and relevant policy/management boundaries. As such, we used boating data to determine that Sarasota Bay proper, including the associated barrier islands, represented a concentration of boating departure and destination points. While boating was not the specific focus of this study, the amount and degree of data available made it a viable contributor in determining the final study area. Additionally, setting the southern boundary at the northern shoreline of Siesta Key allowed incorporation of the popular Big Pass, a popular access point to Gulf waters from the southern portion of Sarasota Bay and adjacent to the highly developed area of downtown Sarasota. The decision to extend seaward nine nautical miles corresponded to the state waters line for the Gulf of Mexico. For the purpose of clarity to respondents of the mapping and survey tool, Greater Sarasota Bay was used to reference the study area, presented as: "The area includes the watershed, bay, barrier islands and nearshore Gulf waters (extending out to 9 nautical miles offshore) extending from Anna Maria Sound in the north to Siesta Key in the south." Lastly, all developed areas, or those not considered natural (i.e., buildings, transportation infrastructure), within the study boundary on the included barrier islands and landward terrestrial environments, were excluded as the model operates on natural spaces.

The ecological landscape of the bay provides an abundant store of natural capital upon which the quality of life and economic success of the region is built. The embayment endows a rich diversity of ecosystem services including environmental regulating processes, social and cultural heritage, high quality water supply, abundant habitat, educational opportunities, commercial assets, and recreational activities, making it the most important resource base and number one economic driver of the area (Sarasota Estuary Program, 2012). Serving as a nursery of over 1,400 plant and animal species, the bay system was designated an estuary of national significance in 1987, allowing for cooperative management and goal setting over the past 20 years.

Greater Sarasota Bay includes two small embayments (Palm Sola and Sarasota) along with two main tributaries (Whitaker Bayou and Hudson Bayou). Average bay depth is 6.5 feet with both embayments having unique size, depth, shoreline characteristics, habitat, and sediment profile. This variability creates unique ecosystem processes (water circulation, freshwater input, nutrient load, etc.) that require both individual and network understanding for their management. Around 15% of the total bay bottom, or roughly 4,800 acres, was altered in the 1950s and 1960s to create home sites and boat channels. It is hypothesized that coastline and marine ecosystem diversity is indicative of the potential variability of social values assigned to those environments by the 600,000 residents of the area.

Data Collection

A mail invitation to complete an online, interactive mapping survey was sent in mid-2012 to a random sample of 2,172 households located within the two counties (Sarasota and Manatee) adjacent to the study area. Initial response rate in the first two week period was 5.75%, with 125 surveys completed. In addition to the random mailing, representatives of identified local stakeholder groups were contacted and asked to send a similar invitation to their memberships, producing 77 more completed surveys in that same period. The 125 completed surveys from the random sample were used in the initial analysis reported here. Figure 4-2 provides a map of the study area depicting the spatial dispersion of mapped points used in analysis.

In addition to the dual sampling strategy, a workshop was held prior to survey distribution with local managers in order to pilot test and discuss critically the advantages and disadvantages of the online interface in collecting data so as to refine the tool and make subsequent results more attune to their needs. The goal of this refinement was to respond to management needs by developing a simple informative tool for collecting and evaluating the social values of ecosystem services while explicitly linking data collection, analysis, and outcomes to management needs and actions for immediate use.

The survey, which can be found at sarasotabaysurvey.org, was divided into two sections. Section 1 queried individuals regarding Sarasota Bay specifically, including their perceptions of policy and management within the area over the next 10-15 years, the role of the public in management decisions, the degree of public access to bay resources, observations of environmental condition indicators, and personal connections to the bay as a special place. This section included the first half of what is required for SolVES modeling, i.e., the value allocation and value mapping exercises. The first step, value allocation, requested that respondents “spend” $1000 among 16 different social value types associated with SBF. While dollar units were used for convenience to express value denominations (e.g., points could have been used instead of dollars), it was explained in the instructions that this was not a reference to any actual money, either the respondents’ or the researchers’ (Sherrouse, et al., 2011). Also, while the SolVES application requires allocation amounts be scaled between 0-100, the workshop participants recommended $1000 be used as it was a more appropriate amount for the area. As such, allocation amounts were rescaled as part of preparing the data for SolVES model input. Following the allocation exercise, respondents were instructed in the next step, value mapping, to mark points on a map of the study area corresponding to the social value types to which they had allocated dollars. For example, if the respondent had allocated dollars to Spiritual value they were to place a mark at up to four locations on the map indicating Spiritual value, and label each mark accordingly.

Section two requested that respondents take a broader look at similar ecosystems occurring outside the study area, including the entirety of the Gulf of Mexico, and indicate whether they favored or opposed each of 45 public uses, divided into three use categories – recreational activities; commercial, industrial, and residential uses; and ecological and environmental opportunities (Table 4-1) – which represents the second half of what is required for SolVES modeling. The last part of section two asked a variety of socio-demographic information; however, that information was not used in the initial analysis presented here.

Spatial Database Development

The online survey we created and used for data collection produces a digital database of survey responses with mapped locations recorded as latitude/longitude markers and other survey responses logged as tabular data. The aggregated result is a seamless database spreadsheet where each column represents a separate variable (geographic point or tabular notation) and each row a unique respondent, identified by an alpha-numeric code, so all data from a single survey can be related while remaining anonymous. Also loaded were 30-meter resolution rasters to characterize the physical environment of SBF: distance to shoreline, distance to roads and channels, and bathymetry. The geodatabase schema within SolVES 2.0 is generalized so that survey and landscape data from any study area can be input into the modeling tool with minimal effort, as such, additional data layers for future analysis could include terrain elevation (to be merged with bathymetry) and land cover. For exploration into modeling specific values, such as aesthetics and recreation, it will also be possible to examine the effectiveness of the model using alternative data layers like distance to reefs, distance to boat ramps and access points, and shoreline tenure (i.e., public vs. private).

SolVES is a series of models using ESRI® ModelBuilder, augmented with VB.NET. SolVES 2.0 uses geospatial and tabular data to parameterize three separate models: the Ecosystem Services Social Values Model, the Value Mapping Model, and the Value Transfer Mapping Model. Data can be entered into the model describing particular management actions, public uses, and other relevant variables alongside survey respondents' attitude, preference, or perception regarding those parameters. These provide the criteria for selecting the value allocation amounts and the related mapping points for a specified subgroup. Users of the tool can compare values either by survey subgroup (determined alternatively by management attitude, use preference, or perceived attachment) across social value types or by social value type across survey subgroups. To produce weighted density surfaces depicting relative value amongst and between survey subgroups, the amounts allocated to each social value type along with their associated points are used. Points with higher value allocations obtain a greater weighting and hence result in higher density values. As kernel density surfaces, they are generated following a methodology similar to Alessa et al. (2008) and later used by Sherrouse et al. (2011) in model development.

The kernel density function represents a smoothly curved surface fit over each point and extends out to a defined search radius (defined by the user). The assigned weight is defined by the volume below each point. As determined by the spatial extent of the study area, the kernel density search radius parameter was set at 1500 meters. The kernel density output cell-size parameter was correspondingly set to 150 meters, the closest standard size based on the scale of the maximum extent used in the survey maps, 1:288,880. Survey respondents could zoom in on the study area as much as desired, however, using the maximum extent in initial analysis assured an adequate and uniform parameter.

For a selected survey subgroup and each of the 16 social value types, SolVES generates a weighted density surface. Of those surfaces, the one containing the cell having the maximum overall weighted density value is identified, and this value is then used to normalize each of the 16 density surfaces. The result of this normalization is that the value of every cell on every weighted density surface is scaled relative to the most highly valued geographic location and to the most highly valued social value type as rated by the selected survey subgroup. A Value Index is then created by standardizing the normalized values, through production of an integer surface, into a consistent 10-point scale. Measurement and comparison regarding the magnitude of value differences within, between, and amongst survey subgroups can be made using this Value Index, along with production of social value maps and associated landscape metrics.

The higher the value attained on the Value Index by a particular social value type within a subgroup, the more highly it is valued by that subgroup. Within a single subgroup, a social value type that attains a 10 on the Value Index corresponds to one or more locations within the study area where that survey subgroup values that social value type more highly than at any other location and more highly than any of the other social value types regardless of location. For social value types that attain less than a 10 on the Value Index, the maximum index value that they do attain (9, 8, 7, etc.) corresponds to locations where that value type is valued more highly than at any other location within the study area. Among different survey subgroups, the maximum attained index value can be used to make some general comparisons regarding the relative value each subgroup places on a social value type.

The Value Index is further supported by the calculation of spatial statistics describing relative dispersion, clustering, or randomness of the mapped points, aiding the SolVES user in selecting social value types for further analysis. Point data is subjected to Complete Spatial Randomness (CSR) hypothesis testing through the calculation of average nearest neighbor statistics. Statistically significant clustering is identified through the ratio of the observed distance between points to the expected distance between points (R value), along with each R value's number of standard deviations from the mean (Z score). Hence, R values less than one with highly negative Z scores indicate clustering. By referring to these statistics, SolVES users can limit their focus to social value types occupying locations with specific levels of significance on the landscape. For a specific social value type SolVES then generates a corresponding Value Index surface, displays it on a map, and uses Maxent to calculate landscape metrics. The integration of Maxent maximum entropy modeling software into the model represents an additional enhancement with SolVES 2.0. As a species distribution model, Maxent's modeling structure provides a fitting analogy for its application to mapping social values. In this context, the logistic output Maxent produces represents the relative intensity that survey respondents attribute to a social value type (analogous to a species) at a location given the underlying environmental characteristics and the respondents' identification of such locations as representing a particular social value type. This output, together with the kernel density method already used by SolVES, provides more complete maps within study areas where survey attitude and preference data are available, such as in this case. In addition, Maxent also enhances functionality of SolVES 2.0 by producing statistical model output that describes the relationship between environmental variables and survey mapping points. This text does not attempt to provide an exhaustive account of the enhancements provided to SolVES 2.0

via Maxent methodologies, for additional technical information refer to the Maxent website at www.cs.princeton.edu/~schapire/maxent/; for additional information about its use within SolVES 2.0 refer to the associated user manual at http://pubs.usgs.gov/of/2012/1023/contents/OF12-1023.pdf.

Data Analysis

A SolVES output was produced for all survey responses collectively across three social values to demonstrate the utility of the tool and begin to explore its application in a coastal context. Three values, Recreation, Aesthetics, and Biodiversity, were chosen as they represent the most commonly mapped values within the sample; similar to findings from previous SolVES applications (Sherrouse et al., 2011; van Riper, in press). Table 4-2 summarizes the survey responses in terms of the frequency of mapped points and allocations alongside average and total allocation for each value. The social value types used in analysis represent a reduction from the 16 total values in the typology to three based on Clement's (2006) CSR hypothesis testing later used by Sherrouse et al. (2011), which identified them as more likely to be clustered than the remaining twelve. After determining which values would be used through CSR analysis, spatial value maps were created using an initial set of environmental data layers that included bathymetry, distance to roads and channels, and distance to shore. These value maps were then compared amongst each other to validate the use of those layers in future analysis. This comparison, as given in the example below, is supplemented by the researchers' general understandings of physical characteristics and use patterns in the area. The discussion that ensues provides an example that demonstrates how SolVES output is designed and can be used to communicate and analyze information describing the relationship of social values and the underlying landscape for managers and the general public.

Findings

Spatial Clustering

Statistically significant ($p < 0.01$) spatial clustering of point locations was found for all three social value types. Amongst the social values, Recreation tended to be the most clustered, with the remaining two relatively equal. The number of points for each value used in spatial clustering analysis is represented alongside R ratio and Z score statistics in Table 4-3; R ratios below one indicate clustering (along with large negative Z scores), equal to one indicate randomness, and greater than one indicate dispersion. It is important to note that this type of spatial clustering analysis can be influenced by number of points and not just distribution; however, in the case of these three values the statistical findings support a conclusion that all appear grouped, respectively, across the study area.

Value Maps and Landscape Metrics

SolVES generates a geographic representation of the index values calculated for each social value type (and survey subgroup, if queued) through value maps. By relating a specified social value type and the amount of value perceived by stakeholders, the dimensions of space and place can be evaluated. Metrics characterizing the physical environments are also calculated from the range and extent of the Value Index zones these maps indicate. The analysis and outcomes outlined below demonstrate SolVES output capability for communicating information about the relationship between social value points (intensity and location) and the underlying landscape by comparing the value maps generated for Recreation, Aesthetic, and Biodiversity across all survey responses.

The example presented in Figure 4-3 looks at the social value maps for the southern portion of the study area adjacent to and north of downtown Sarasota, from Longboat Pass in the north to Big Pass in the south (see Appendices G-I for larger value maps). This area is considered the busiest portion of the bay and home to a large number of public and private marinas, boat ramps, and moorages; waterfront restaurants; and a number of natural areas such as parks and greenways. First, the spatial extent and Value Index scores will be discussed for each map in the context of the local area dynamics followed by a brief comparison of the corresponding landscape metric graphs.

Looking first at the Recreation map, it is apparent that higher values (relative to the other value maps), as determined by the Value Index, are spread throughout this section with concentrations at the north and south near the passes (maximum value attained: 9; see Table 4-3). This generally corresponds to boating patterns, i.e., trips to the Gulf waters originating from these areas, and shore-based recreation related to the predominance of public beaches and other coastline access concentrated in these locations. In terms of the former, it is worthy of noting that recreation values, although lower on the Value Index, appear to extend into the Gulf from those passes, particularly on the furthest southern extent of the study area boundary, which also corresponds to boating behavior. With respect to the latter, the shoreline between these areas of high Recreation value along the inner barrier island and mainland coasts is generally developed, predominantly by private residences, which restricts access to the coast, and would therefore cause less recreation value along that reach from a large portion of the local population.

If we turn attention to the Aesthetic value map, the first thing to note is that those values scored lower across the area of focus on the Value Index, attaining a maximum value of 7, relative to Recreation. Compared to Recreation value, the higher Aesthetic values appears to be even more concentrated along the shoreline, which would logically follow the idea that most views deemed aesthetically valuable would originate from those places as one can immediately imagine standing on a beach and admiring the view of the open ocean or city skyline, for instance. This conclusion is also corollary to previous findings that concluded aesthetic value in mountainous terrain originates from high elevation viewpoints (Sherrouse et al., 2011), again where one could easily conceive taking in a dramatic view. There is a general alignment between Aesthetic and Recreation values in their concentrations in the northern and southern ends of this area of focus, which could be accounted for in the close relationship between those values, particularly in a coastal context.

Lastly, looking at the Biodiversity value map there appears a general concentration of higher values in the northern portion of the presented extent. As noted above, the southern portion of the map is adjacent to the city of Sarasota and represented the most highly developed area depicted here. This circumstance could indeed account for the disparity in higher Biodiversity value as one moves from the north, with less development and possibly more naturally undisturbed environments, to the south, which is highly developed and urbanized. Another interesting dynamic represented is the line of lowest value oriented vertically in the middle of the bay segment. This could be due to that portion of the waterway being maintained through dredging as the main boating channel used to traverse the bay, which would indeed cause that specific area to have lower biodiversity.

Moving away from the value maps and examining the associated landscape metric graphs, we see general trend line agreement respective to the underlying environmental characteristics that they represent. The first row of graphs, depicting the bathymetry (depth) of the waterway, generally shows that values increase as water depth decreases, reinforcing above mentioned findings that show all values concentrated along the shoreline (i.e., water depth of zero). Looking at the second row of graphs, depicting the distance to shore, again we see a general trend of values decreasing the further one moves from the shoreline. Lastly, the third row of graphs representing distance to roads and channels, while trending similarly across the values, shows the biggest amount of disparity respective of the other environmental characteristics represented. While Recreation and Biodiversity are nearly identical, it appears that Aesthetic value is more influenced by this variable. This could potentially indicate that distance to channel and roads has an effect on some individuals' perception of Aesthetic value and no effect on others.

These landscape metrics provide a baseline characterization of the underlying physical environment associated with each index value. With this particular case, it is apparent that relationship between the environmental data used in this model (bathymetry, distance to shore, and distance to roads and channels) to the represented values (Recreation, Aesthetic, and Biodiversity) is consistent with regard to the general physical and social dynamics of the area. It is worth noting that additional variables should be explored and used to improve the effectiveness of the model, potentially uncovering more influential factors in the dispersion and weight of these, and other, values.

Discussion

Case Study Lessons

As noted by Reed and Brown's (2003) values suitability analysis methodology, this study aimed to "place attention on the importance of human uses and values, attempt to systematically, interactively, and defensibly operationalize human dimensions of ecosystem management; and integrate social and biophysical data" (Sherrouse et al., 2011, p. 756). This pilot adaptation of the SolVES model to a coastal and marine ecosystem has provided an opportunity to explore the robustness of social-biophysical integration in disparate environments. In forwarding the idea of social-ecological space, SolVES analysis is founded on spatial quantification describing the social values relationship with underlying environmental variables. This research case, in using a newly created typology of social values of ecosystem services specific to the coastal zone, also advances the refinement of that typology for use in future, similar applications. By applying these social value variables, or an iteration of them, in subsequent coastal applications, it is possible to fetter out which values, of the 16 total that represent the typology, are most important in relation to underlying environmental characteristics and can be best predicted across the land- and seascapes.

Results from the adaptation of the SolVES model to SBF demonstrate its capabilities and potential for further extension and applicability in a variety of contexts. It is important to note that advances within SolVES version 2.0, particularly the allowance of user generated parameter entry, allow for extreme flexibility in its application. Integration of the Maxent technology provides an advanced systematic means for identifying statistically significant spatial patterns of social values that warrant further investigation.

Overall, the spatial distribution of the three values analyzed was consistent on its face with what is understood about how people perceive and behave in coastal environments (i.e., activity and value concentrated along the coastline). Similarly, the underlying zonal statistics used in this initial model run reiterated these findings and trended analogously amongst each other. It is vital to model improvement, in the context of SBF and in other coastal environments, to explore the use of additional environmental (and social) data layers for refining the model's efficacy in interpreting the relationship between social values and the environment.

As a standardized, quantitative indicator with which to express relative value across geographic extents and within or across survey subgroups, the calculation of the Value Index provides a metric for the perceived, non-monetized social value of ecosystem services without relying on dollar-value terms. This allows index values to be potentially analyzed in some form of tradeoff analysis, in a relative sense, within a geographic context where various conflicting or compatible value layers are overlain to allow for spatial and quantitative optimization among management alternatives.

A major advance within SolVES development resulting from this application is the development and implementation of an online, interactive data collection process. Previous SolVES data collection has relied on either traditional mail surveys (Clement and Chang, Sherrouse et al., 2011) or intercept, paper-based surveys (van Riper, in press). Methodologically related to those prior studies, this research developed and utilized a web accessible survey platform that integrated traditional research questions with Google map functionality to gather geographically specific value points from respondents. This combination creates a continuous user interface while producing a digitized, page separated database of survey responses, including latitude and longitude records (with necessary attributes). The generated digital database of spatial records and corresponding tabular data reduces drastically the time needed for input into the SolVES model, one of the biggest hurdles in conducting any PPGIS research.

Adapting Terrestrial SolVES to a Coastal Environment

One of the biggest challenges in this study was adapting the SolVES modeling tool, originally created and developed for use in terrestrial ecosystems, to fit and work in a coastal context. Producing viable model outcomes hinged on adapting three essential elements of data collection and subsequent analysis: creation and use of an *a priori* list of management issues in the coastal zone (dependent variable) for determining use preference to subgroup respondents (Table 4-1); establishment of a social values typology specific to a coastal ecosystem (dependent variable) to provide relevant parameters for value measurement (Table 3-3); and determination of the appropriate underlying environmental data layers that best characterize the study area ecology and geography (independent variable) in relation to spatially-explicit values.

The chosen zonal data layers (distance to shoreline, distance to roads and channels, and bathymetry) proved useful and effective in initial modeling as demonstrated above. The biggest functional improvement in SolVES 2.0 is the ability to include any data layers deemed appropriate for pragmatic purposes specific to given contexts. In our case, future analysis will include alternative layers, such as distance to reefs and/or shoreline tenure, in the model to explore their effectiveness in extending to a coastal ecosystem. The main challenge in the exploratory extension of SolVES into the coastal zone, particularly greater Sarasota Bay, was the inherent complexity of the landscape being dealt with. The area of interest is home to over 600,000 residents and highly developed. As a model based on natural areas (i.e., undeveloped), it was difficult to drill down when it came to data collection and guide respondents to focus on those spaces of interest. Encouragingly, a vast majority of the spatial data collected (over 98%) was indeed in areas of relevance to the model (i.e., placed in natural areas). While much remains in fine tuning the extension of the model, the application of SolVES 2.0 in greater Sarasota Bay, Florida, provided an opportunity to explore the adaptation of the tool, developed in a terrestrial ecosystem, to a coastal context and by all measures was successful.

Future Directions

Model Improvement

The most immediate step in further data development is using alternative subgrouping parameters (examples: place attachment or management attitudes) and data layers (such as access points, socioeconomic variables [e.g., population, income, education, occupation], and ancillary spatial measurements [e.g., boating routes, activities mapping]) for analysis. Exploring and pushing the limit of the model's capability will contribute to substantive improvements in its effectiveness of describing the relationship between social values and underlying environmental characteristics. While initial applications of SolVES (Sherrouse et al., 2011) focused solely on resource use preferences in comparing and contrasting respondent subgroups, constructs such as place attachment or management attitudes could potentially serve as alternative baselines in examining within group, across group, and across values comparisons in the spatial extent and density of social values for SBF and elsewhere.

In modeling the spatial relationships between landscape characteristics and social values, the original development of SolVES described the underlying ecosystem through data layers representing elevation, slope, distance to roads, and distance to water (Sherrouse et al., 2011). For our purposes in adapting that modeling structure to a coastal context, we utilized corollary data layers representing elevation, bathymetry, distance to shore, and distance to roads. While this gave us tangible results in the initial analysis presented here, the introduction of additional data layers could improve the robustness of the model outputs. This can be especially important to the values transfer functionality of SolVES, a process whereby primary data (survey respondent points and underlying environmental characteristics) are used to establish landscape metrics that can be used to produce predicted social value maps through multiple regression analysis in areas where survey data is unavailable. In further developing the viable application of the SolVES tool to other environments, notably those that span terrestrial and marine ecosystems, it will be important to penetrate to those data layers that give us the most statistically significant relationships between social values and environmental characteristics. In a coastal context specifically, workable data layers describing the environment (and larger context) could include recreation or commercial access points, socioeconomic variables (population, income, education, etc.), boating and other recreational dispersion patterns, land cover/benthic substrate, coastal form, distance to channels, viewsheds, and coastline tenure/ownership (public vs. private).

Manager Involvement

Much as Sherrouse et al. (2011) indicate, critical enhancement of the tool's effectiveness can be advanced by engaging important stakeholders (managers, politicians, local citizens) in its application and outcomes, specifically within the context of ongoing management and planning processes. The feedback they could provide would undoubtedly drive future development of additional, more refined functionalities and with them information products that better inform relevant decision making processes. Often managers are faced with decisions between a number of alternative scenarios and by modeling social values across a given landscape for each of those alternatives, a more informed decision about how to move forward can be made. Ongoing involvement from managers and local stakeholders that leads to a greater frequency of data collection along with the increasing feasibility of near real time collection of required data, as demonstrated by our online mapping survey (additionally enabled by future integration of GPS, wireless, cell phone applications, and other participatory technologies), could be valuable for change analysis and scenario development (Sherrouse, et al., 2011). The involvement of managers with specific expertise in various elements of the ecosystem of concern (e.g., marine biologists, hydrologists, etc.) could lead to the identification of additional data at appropriate scales and resolutions that would provide improved measures and descriptions of relevant environmental characteristics and related ecosystem services. Overall, future study and increased stakeholder involvement could aid in refining the design of public attitude and preference surveys needed for SolVES modeling and "facilitate the identification of statistically significant relationships with environmental data and assist with the crosswalk between social value and ecosystem service typologies" (Sherrouse, et al., 2011; p. 759).

Conclusion

While the guiding principles of CMSP are entrenched in ecological variables (see Foley, Halper, et al., 2010), the need for equitable focus on the human dimensions of land- and seascapes is gaining traction amongst ecosystem service scholars and practitioners (see St. Martin and Hall-Arber, 2008; Goodhead and Aygen, 2007; Rees, Rodwell, et al., 2010). The challenge in development of social data layers for use in CMSP is representation of human processes and practices in ways similar to mapped biophysical processes (and values) so that the complex, integrated, and multi-scalar dimensions are properly accounted for (St. Martin and Hall-Arber, 2008) and can be compared relative to each other. This shift toward spatial understandings, planning, and management has required a shift in technical methods, namely the increased reliance on geographic information systems (GIS) (Meaden and Chi, 1996; Meaden, 1999).

SolVES provides a method for uniting concepts from ecosystem services assessment and social values mapping through a GIS application. Within the use of GIS, there exists a need for multiple data layers to be used in CMSP for its rightful claim as an ecosystem-based, equitable, and sustainable approach to resource management. The advancement of remote sensing, tracking technologies, global positioning systems, and spatial modeling are rapidly creating a platform for merging and analyzing these variable data sources (e.g., living and mineral resources; marine habitats; environmental conditions; sea bottom morphology; hydrologic regimes; species range and interaction; and social values). As this case study suggests, SolVES has value as a tool for making decisions based on explicit quantification and illustration of the connections between social values, attitudes and preferences that produce such values, and the environmental characteristics, associated ecosystem services, and locations that invoke such values.

The coastal and marine environment, as a collection of habitats, natural processes, multi-stakeholder practices, and use rights that are tied to specific places, presents a context ripe for integration of these elements in decision-making surrounding planning, management, and the role of CMSP within each. Specifically, this application of the SolVES model answers St. Martin and Hall-Arber's assertion that "while the call to integrate a diversity of ecosystem processes over a variety of collection initiatives, the scope of the information being collected falls short relative to the 'human dimensions' of the marine environment" (2008, p. 779; citing St. Martin, McCay, Murray, Johnson, and Oles, 2007). Additionally, we argue that while neither the complexity of human communities nor their relationship to locations and resources in relevant ecosystems are represented in current data collection initiatives, this application serves that purpose and is the start of a bigger process of refinement and integration into environmental decision making. While it is agreed that there remains room to grow, this effort contributes a foundation for future efforts by quantifying social value spatially alongside ecological characteristics, making them relatable within relevant processes (i.e., management and policy). This case analysis represents continued development, refinement, and validation of a robust application for linking social and biophysical variables of concern. Future improvements will be informed by continued insight from both social and environmental perspectives alongside input from managers and have significant implications for ecosystem assessment, planning, and valuation

Table 4-1. Resource use perception items.

RECREATIONAL ACTIVITIES	COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL USES	ECOLOGICAL AND ENVIRONMENTAL OPPORTUNITIES
Sight-seeing	Agricultural land use (e.g., crops, orchards, nurseries,)	Conservation easements
Shore/Pier fishing	Aquaculture (fish farming)	Manatee protection zones
Recreational boat fishing	Commercial fishing (including shellfish)	Artificial reef development
Scallop/shellfish harvesting	Commercial forestry	Fish/wildlife habitat expansion
Scuba diving/snorkeling	Shore development that hardens natural shoreline	Commercial fisheries regulations
Motorized recreational boating	Shore development that retains natural shorelines	Recreational fisheries regulations
Non-motorized recreational boating	Beach nourishment	Development setbacks for natural shoreline
Personal watercrafts (i.e., jet skis)	Canal/navigational dredging	
Birdwatching	Commercial marine port	
Walking/Jogging along shorelines	Commercial shipping (e.g., cargo ships, tankers)	
Picnicking	Marinas and boat ramps	
Swimming	Mooring fields	
Golfing and golf courses	Charter Boat fishing	
Hiking	Private dock development	
On-shore beach activities	Tour Boats (sightseeing)	
	Waterborne passenger transportation (e.g., ferries)	
	Off shore oil/gas exploration/drilling	
	Offshore alternative energy (e.g., wind, solar)	
	Power generation plant and energy infrastructure	
	High-rise condominium construction	
	Transportation infrastructure	
	Desalinization plant/water treatment	
	Industrial manufacturing/processing (e.g., refinery)	

Table 4-2. Summary of value mapping and allocation.

Value	Map point frequency		Average allocation		Allocation frequency		Total allocation	
	Count	Rank	Amount	Rank	Count	Rank	Amount	Rank
Recreation	165	1	23.06	2	74	1	1707	1
Aesthetics	116	2	16.04	8	55	5	882	7
Biodiversity	86	3	21.29	5	65	3	1384	3
Future	66	4	22.62	3	53	6	1199	4
Wilderness	63	5	19.96	6	57	4	1138	5
Life Sustaining	61	6	23.15	1	66	2	1528	2
Learning	52	7	15.05	9	44	8	662	9
Access	48	8	21.75	4	45	7	979	6
Economic	41	9	17.54	7	43	10	754	8
Intrinsic	35	10	14.28	10	33	11	471	11
Therapeutic	31	11	13.60	11	44	9	599	10
Historic	24	12	13.35	12	23	12	307	12
Subsistence	15	13	10.48	15	20	13	209	13
Cultural	12	14	10.86	14	14	16	152	16
Spiritual	11	15	10.90	13	19	14	207	14
Symbolic	5	16	9.39	16	17	15	160	15

Table 4-3. Average nearest neighbor statistics and Value Indices.

	Spatial cluster statistics			
Social value	N	R value	Z score	Value index attained (maximum)
Recreation	155	0.301	-16.650	9
Aesthetic	113	0.235	-15.562	7
Biodiversity	79	0.287	-12.130	6

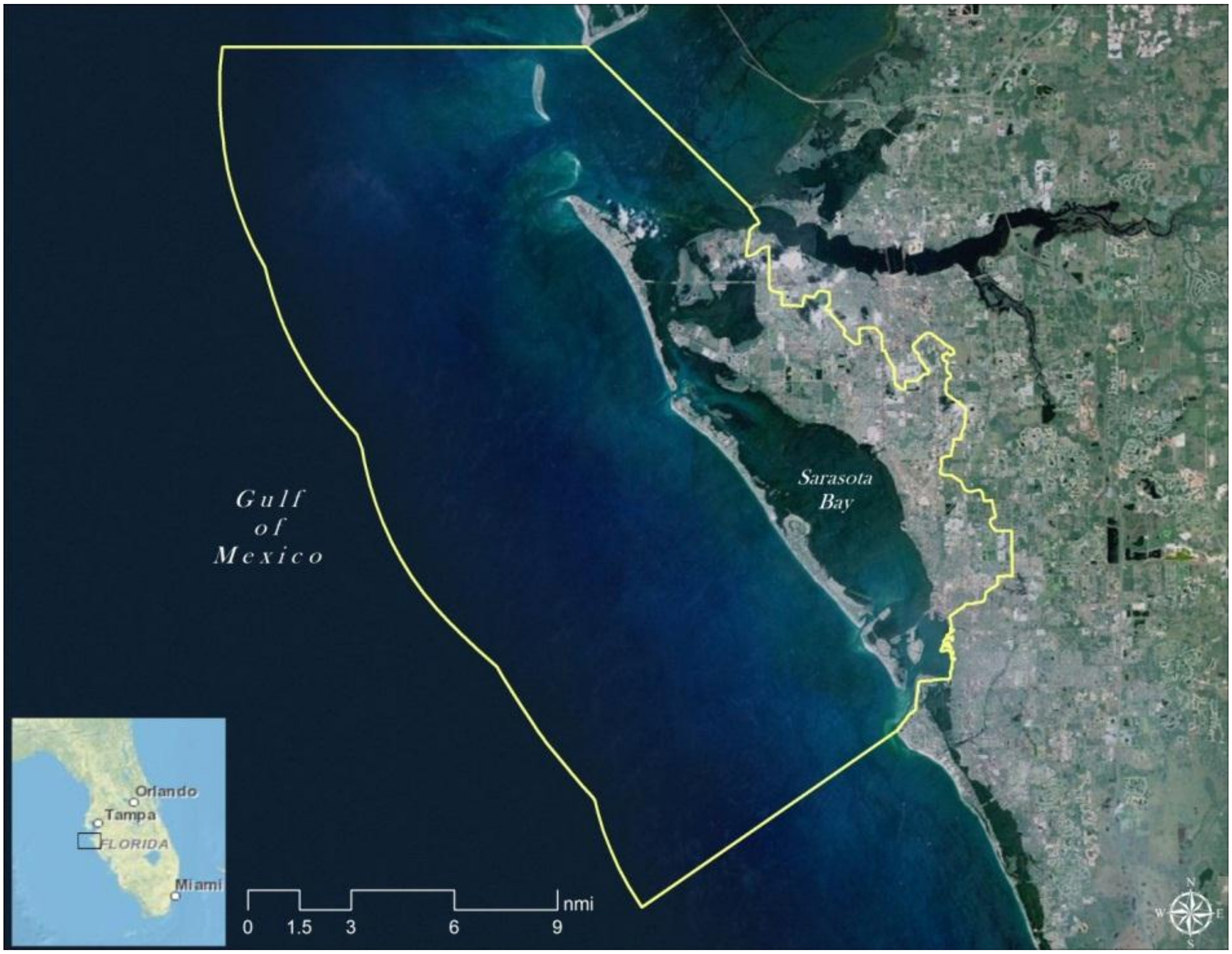


Figure 4-1. Study area – Greater Sarasota Bay.

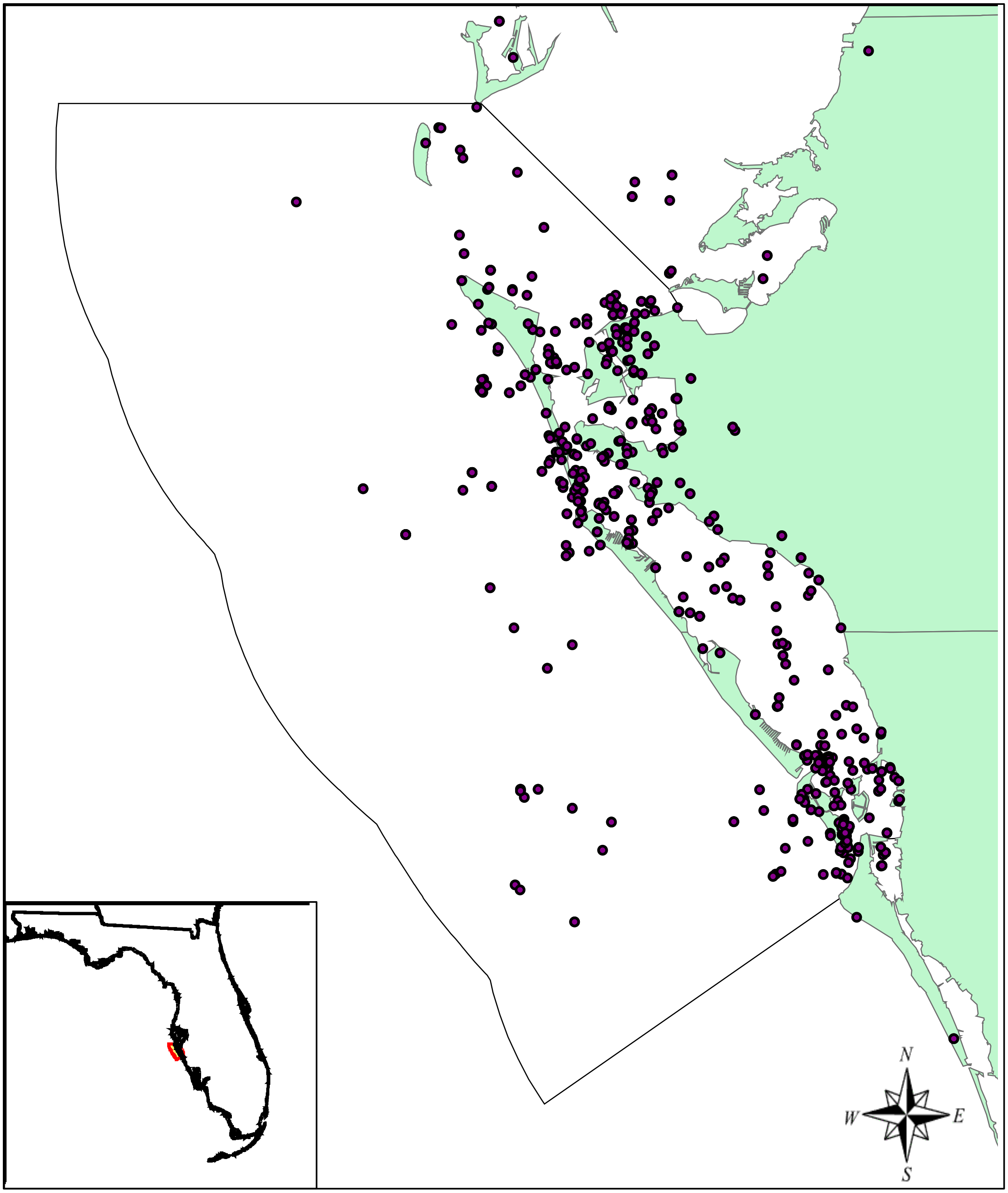


Figure 4-2. Greater Sarasota Bay study area with value mapping points.

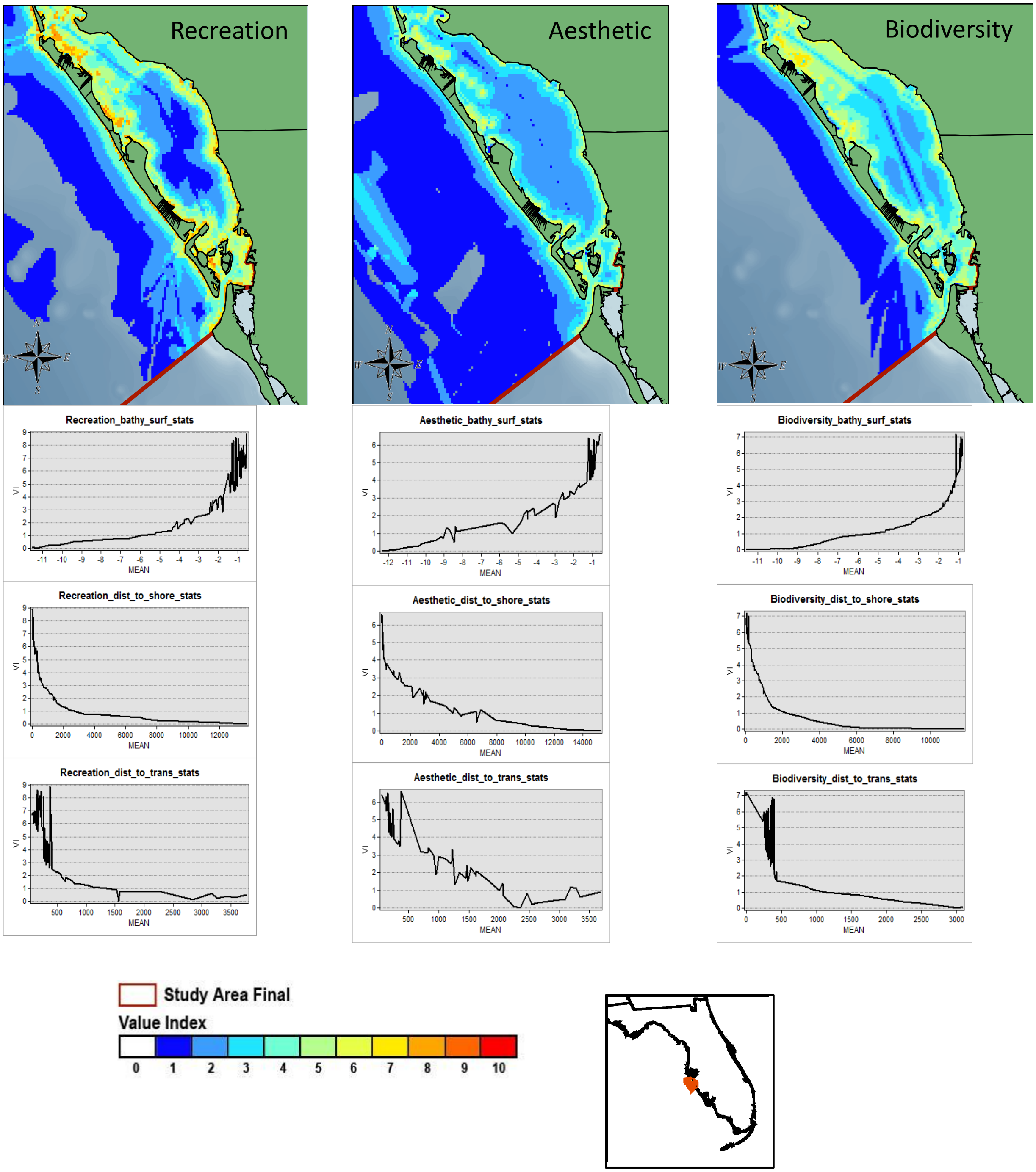


Figure 4-3. Recreation, Aesthetic, and Biodiversity value maps with corresponding landscape metrics (bathymetry, distance to shore, and distance to channels and roads).

CHAPTER 5
OUTCOMES

Findings across Social Values and Spatial Modeling

Contemporary stakeholder-management clashes have emerged in the coastal zone as a result of increasing pressure on resources, revealing a need for better understanding of how people value their landscape across space. Understanding the social, cultural, and political constructs of human-environment interactions is vital for comprehensive consideration and assessment regarding issues of resource use. As these dynamics are becoming increasingly multifarious due to the range of demands on natural resources, the idea of spatially based resource management and planning has been put forward as a method for addressing this complexity, in the coastal and marine context this approach is known as coastal and marine spatial planning (CMSP). Through CMSP efforts, in this case the spatially explicit modeling of social values of ecosystem services through SolVES, social dimensions of concern find an avenue for equitable consideration alongside more traditional metrics of economy and ecology.

In the context of coastal management and policy generally, social dimensions (values) hold relevance in a number of initiatives, most notably the goal of increased stakeholder representation in decision-making processes and more equitable illustration of such within traditional resource management structures. Federal and state agencies generally manage marine and coastal resources using the predominate paradigm of the Progressive Era, in which management decision-making is conducted primarily by well-meaning and well-trained disciplinary experts in the biophysical sciences. However, marine and coastal managers and planners develop and implement coastal management plans on behalf of society, who have a diversity of preferences and desires regarding ecosystem conditions and functions. Adherence to the antiquated approach, often dominated by economic and ecologic concerns to the detriment of social considerations, has created a situation wherein coastal management and research are not reflective of the diversity of social values expressed in enabling legislation, which has in turn set the stage for stakeholder-management conflict.

The importance to society of marine and coastal resources, as conveyed in legislation and policies that are developed to manage them, typically reflect the social benefits derived from conserving, using, consuming, or preserving those resources. In the United States, resource legislation and policies are products of a representative process, in which legislators and agencies strive to balance society's social, economic, and ecological preferences. Because of this, a broad array of values – from biocentric to anthropocentric – may be expressed in any given piece of resource management legislation. For example, every major U.S. marine and coastal resource act articulates not just the ecological values associated with enacting that law, but also values that pertain to commerce, industry, access, recreation, subsistence, culture, and aesthetics (e.g., Coastal Zone Management Act). Therefore, resource policy and legislation can be seen as providing social values guidance to managers who develop and implement marine and coastal resource management plans. With this relationship in mind, the research presented here sought to fill the social value consideration gap within coastal and marine spatial planning by modeling ecosystem services as perceived by stakeholders.

There are at least two practical implications of accepting social values as a driving force within coastal marine resource management, represented here through SolVES modeling. One is that managers are civil servants, engaged primarily in a task of stewarding resources on behalf of a public that, largely, pays for that stewardship and owns the resources being managed. They are therefore not free to impose their own management preferences on society, despite their good intentions or their expertise (Hobbs, 2004). A second, and related, implication is that resource managers must seek to balance what is good for the natural environment with what is good for society. In rare cases, those two goals are harmonious. However, as Lackey (2006) points out, selecting an environmental policy choice almost always results in winners and losers, accepting trade-offs, and dealing with a clash of values. It is within the context of deciding on appropriate trade-offs that tools such as SolVES can advance societal values as a determining factor in management actions.

The results of this study revealed conclusive validity for the consideration of coastal specific, spatially explicit social values of ecosystem services alongside traditional resource management metrics, including quantitative modeling describing the relationship between social values and underlying environmental characteristics. A discussion of research implications, divided into theoretical, methodological, and substantive (practical) contribution categories, follows. Noted theoretical contributions center on the advancement and refinement of ecosystem services conceptions, particularly related social values and a discussion of these concepts within coastal and marine spatial planning. Following that, highlighted methodological contributions explore the development of online, interactive tools for gathering necessary data from a wide array of stakeholders and the role of such in developing a more holistic understanding and integration of manager and citizen perceptions surrounding ecosystem services. While chapter two above provides a detailed description of the eDelphi process as a methodological advancement into consensus building utilizing relevant concepts (i.e., social values of ecosystem services), the development of an easily accessible platform for gathering relevant information on social values across a particular land- or seascapes, in this case, SBF, is discussed below. It also draws attention to the difficulties in participatory mapping methods and how these types of interfaces can ease the burden for both the stakeholders providing input and the managers or researchers tasked with analyzing requisite data and producing results that are practical, applicable, and valuable. The implications section is completed with a dialog of the substantive research contributions, notably how the data generated from this study and others like it can find practical application for coastal resource managers.

Implications

Theoretical Contributions

The concept of ecosystem services, as used in this examination of social values, is largely an extension of the ecosystem-based management approach in that it seeks to consider and understand the links between all facets of the environment, notably the biophysical and social. While a pragmatic ecosystem approach to environmental decisions and actions is relatively new, the concept of ecosystem itself has been around since the 1930s and 1940s (see Tansley, 1935; and Lindeman, 1942) and became solidified in the environmental studies discourse through the seminal text in its conceptual development, Odum's (1953) textbook titled “Fundamentals of Ecology”. Within the ecosystem approach, we utilized its deliberately adaptive nature by avoiding preclusion of existing management or conservation approaches, instead producing data to act as a force in integrating and supplementing grounded decision-making frameworks. In order for this to take place, a set of umbrella concepts along with a common “language” in which to convey findings and analyze relevant data was produced (i.e., coastal specific social values of ecosystem services typology).

The ecosystem services discourse, dually utilized in this research for the development of the social values typology and its application to SolVES modeling, provides a structure to view and weigh the inherent trade-offs of environmental decision making. In responding to the Millennium Ecosystem Assessment’s (2003) criteria of a viable framework for understanding ecosystem services, this research cuts across spatial dimensions; is inclusive of the accessibility and sustainability of natural resources, systems, and their products for the benefit of human societies as well as for the maintenance of these systems in their own right (i.e., the essence of the ecosystem service concept); and examines all resources simultaneously and in an integrated manner, taking into account past and potential trade-offs and their consequences.

With regard to the coastal specific social values typology, three values emerged as unique constructs, discrete from past research: access, spiritual/novel experience, and identity/symbolic. While the ecosystem service construct is not new, with its first use occurring in the 1960s (see King, 1996; Helliwell, 1969), there has been a recent surge in its development and application in ecosystem valuation research (see Constanza et al., 1997; Daily, 1997; Daily et al. 2000; de Groot, Wilson, and Boumans, 2002). As this vein of research continues and is extended into new, complex resource contexts, the ongoing refinement of the definition of social values of ecosystem services along with an appropriate typology for its measurement as represented within this research will be invaluable to moving forward.

While past valuations of ecosystem services have succeeded in assigning tangible values to ecosystem services occurring in the sphere of natural and manufactured capital (MA, 2003) (see Dixon and Hufschmidt, 1986; Pearce and Turner, 1990; Freeman, 1993; Hanley and Spash, 1993; Ruitenbeek, 1994; Kramer, Sharma, and Munisinghe, 1995; and Van Beukering, Cesara, and Janssen, 2003), this study turned the figurative assessment lens toward social and human capital spheres to expand value definitions and provide a more comprehensive picture (Figure 5-1).

While assigning tangible values to ecosystem services allows them to be accounted for in traditional land and resource decision making, it is not always possible or necessary to express the economic value of an ecosystem service in monetary terms (Sherrouse et al., 2011) and by doing so can miss a large part of its value that may fall outside the money economy (Constanza, et al., 1997). In response to this and related recommendations from a broad range of research perspectives, specifically regarding ecosystem services valuation effectiveness in incorporating values as perceived by those who benefit from the services (Sherrouse et al., 2011), this research extends the idea of their social value and specifically how those values relate to underlying environmental characteristics. In essence, this study and others like it, through explicit, spatial linkage between social and environmental variables, increases the robustness of ecosystem management and policy by including a full range of ecosystem values. Full-bodied ecosystem management must include socio-cultural, ecologic, and intrinsic values in addition to utilitarian values (MA, 2003) while being informed by the analysis of integrated socioeconomic and biophysical data (de Lange, Wise, Forsyth, and Nahman, 2010); the research represented here contributes directly to those efforts.

Corresponding to the standards of ecosystem management, as alluded to above through the need for a holistic conception and utilization of ecosystem services understandings, coastal and marine spatial planning (CMSP) also seeks comprehensive consideration of social, ecological, and economic factors at work in an ecosystem while adding the lens of spatial relationships between variables. As noted by Douvere (2008), the evolution of CMSP has become a crucial step in making ecosystem-based sea use management a reality. Originally borne of the marine protected area (MPA) movement and early applications of terrestrial zoning practices in marine ecosystems, its application has reached the level of international, national, and regional environmental policy support as evidenced by the large number of CMSP initiatives (alternatively referred to as marine spatial planning; ocean zoning, Douvere, 2008; and ecosystem-based zoning, Day, Paxinos, Emmett, Wright, and Goecker, 2008) being put forth all over the world. Prominent examples include the Marine and Coastal Access Act (United States); Marine Strategy and Maritime Policy (European Union); Bergren Declaration of the North Sea (Belguim, The Netherlands, and Germany); Environment Protection and Biodiversity Conservation Act (Australia); and Convention on the Law of the Sea (United Nations).

While the guiding principles of CMSP are entrenched in ecological variables (see Foley, Halper, et al., 2010), the need for equitable focus on the human dimensions of the land- and seascape, indeed the focus of this study, is gaining traction amongst ecosystem service scholars and practitioners (see St. Martin and Hall-Arber, 2008; Goodhead and Aygen, 2007; Rees, Rodwell, et al., 2010). Developing and applying the coastal specific social value typology through SolVES modeling in SBF is a response to the challenge of developing relevant social data layers for use in CMSP generally: representing human processes and practices in ways similar to mapped biophysical processes (and values) so that the complex, integrated, and multi-scalar dimensions are properly accounted for (St. Martin and Hall-Arber, 2008).

The shift toward spatial understandings, planning, and management has required a shift in technical methods, namely the increased reliance on geographic information systems (GIS) (Meaden and Chi, 1996; Meaden, 1999) as exemplified by the application of SolVES in this case. As the forum where coastal and marine spatial data is aggregated, planning options are visualized, impact analyses are performed, and regulatory zones are established and mapped according to established methods, social data must fit into the mold in order to be considered, a reality brought to life within this project. As Eastman, Jin, Kyem, and Toledano (1995) note, the layer approach to data used to query and combine variables, within GIS, structures analyses and decision-making; in order for social values to gain traction amongst other ecosystem service values, they must be presented as a layer, given a weight for comparison to other layers, and aggregated through algorithm that accounts for trade-off and risk relative to the objectives at hand; SolVES does just this by presenting a weighted layer of spatial data that accounts for stakeholder-derived social values tied to underlying land- and seascape metrics (e.g., bathymetry, ground cover, etc.).

In essence, the degree of comprehensive consideration of important factors within a GIS-based system for environmental decision-making is limited by the layers of data that are available; "while the biophysical environment is being mapped in ever greater detail and incorporated into systems of spatial analysis, the 'social landscape'…remains largely undocumented" (St. Martin and Hall-Arber, 2008), a concern addressed and advanced through this study. While information concerning the social values assigned by stakeholders across landscapes is, traditionally, only vaguely known relative to ecologic and economic spatial data, the modeling produced here represents a starting point and example for integrating those three variables equitably.

Methodological Contributions

The major methodological contributions from this study are two-fold: advancement of electronic Delphi (e-Delphi) methods and application of an online interface within a public participation geographic information system (PPGIS; Brown and Reed, 2009) data collection effort. Using phase one of this project as a case study, chapter two above gives a detailed account of applying the e-Delphi method to efforts aimed at creating an *a priori* list of coastal management issues along with a typology of social values of ecosystem services and corresponding working definitions. Similarly, an online interface was developed and utilized in phase two of the study, with initial results presented in chapter four, to collect spatially explicit social values throughout the study area along with corresponding tabular data (i.e., management perceptions, value allocations, place attachment, and socio-demographic information) used in SolVES modeling. This process is briefly described in the methods section of chapter four and discussed in more detail below. Both processes benefitted from the wide availability and adoption of Internet technology, mainly through the ease and speed of communication between researchers and participants that facilitates a decrease in the burden of data collection, input, and analysis typical of paper-based survey and mapping approaches.

Delphi methodologies

The Delphi method, over traditional survey, was judged to be a stronger methodology for rigorous query of experts and stakeholders of contexts representative of Sarasota Bay. This process facilitated organization of divergent values based on varied experience and sought the integration of multiple opinions into an informed group consensus, which in this study focused on social values of ecosystem services and relevant resource issues. In comparing traditional survey to Delphi methodology, the latter was chosen to reach data goals for the following reasons (Okoli and Pawlowski, 2004):

- This stage of the study seeks to capture social value and use factors potentially important to Sarasota Bay stakeholders. This complex issue requires knowledge from the people who understand the different economic, social, political, and environmental issues there, thus, a Delphi study answers the study question most appropriately.

- Delphi, as an appropriate group method, provides a panel study that most appropriately answers the research question, rather than any individual expert's response.

- The Delphi study consists of a flexible design that is amenable to follow-up inquiry. The first stage of the research requires modification of existing typologies, a task requiring an allowance of emergent data uniquely suited to this malleable structure.

- The Delphi procedure selected for conducting this study is taken from Schmidt (1997) because it serves the dual purpose of soliciting opinion from the experts along with ranking in terms of their relative importance.

- The Delphi method aids in the identification of important stakeholders eligible for engagement in phase two of the project. Identifying key stakeholders and their interests at that stage helps ensure the comprehensive representation of study participants and provides insight into other relevant stakeholders to be offered inclusion in the process.

Given that natural resource management is traditionally advanced by non-inclusive knowledge systems, the Delphi method advances the principle of universalizability and the achievement of inclusive consensus. Additionally, SolVES initial development (Sherousse et al. 2011) noted discrepancies between the social value variables used and current ecosystem service typologies (see MA, 2003) and recommended addressing that gap to strengthen model validity which was done through the e-Delphi conducted for this study. Without going into the detail covered in chapter two above, the major hurdle of traditional Delphi exercises addressed through the digital-based communication utilized within the e-Delphi conducted in this research includes the relatively long periods of time needed to construct questionnaires and collect panelists' opinions using traditional mail procedures and the high attrition rate prevalence as a result of the effort required from participants and researchers to mail and return questionnaires (Chou, 2002). The e-Delphi provided a decrease in the time period required for sequential rounds and an increase in the level of questionnaire return.

The use of digital technologies, such as the email correspondence and web posting of relevant information used in this study, aided in reducing the duration between rounds via more immediate communication and decreased analysis time requirements due to the relevant data being sent and received digitally (i.e., saving the effort needed to translate into a format that could be aggregated for analysis). The use of electronic communication also decreased the efforts required by both parties, researchers and experts, in conveying the questionnaires and responses (Hatcher and Colton, 2007). In other words, it seemed much easier to send and respond to relevant research topics using email and web applications than the more traditional use of physical mail processes. Chou (2002) provides a comprehensive list of basic requirements for an e-Delphi that were modified and adopted for this phase of the research process, they include:

- Provision of a user friendly interface that allowed the project leader (researcher) to develop and distribute sequential questionnaires to the expert panel while allowing for easy input of data by participants.
- Near immediate calculations on expert panel members' input entries as they were already digitized through online survey software (Qualtrics^{TM}) that provided that functionality.
- Aid to the project leader (researcher) in determining the stability of each questionnaire item.
- Allowance for the project leader (researcher) to monitor the execution of the study and to communicate with panel members easily; done via email and an online portal where results from each round were posted (http://www.flseagrant.org/boating/projects/solves/solves-phase-1-edelphi/)
- Aid to the project leader (researcher) in measuring progress (or lack thereof) toward group consensus in real time.

The use of an e-Delphi process relative to traditional procedures using mail systems reduced the duration, including the usual three iterative questionnaire rounds, follow-up letters, and data analysis (Chou, 2002), to a period that lasted around two months; traditional mail-based Delphi exercises can take anywhere from six months to a year. Turoff (1991) claims that by utilizing computer mediated communication, the Delphi process and results can be strengthened over traditional procedures using paper and pen. Further, the use of the e-Delphi maintained the validity claims of traditional forms of the methodology while decreasing the duration of the study and minimizing the effort by both researcher and participants.

The foundational and most important step in Delphi research design, and often the most neglected (Okoli and Pawlowski, 2004), is development of the expert panel. The guidelines provided by Dalbecq, Van de Ven, and Gustafson (1975) were modified to direct the solicitation of qualified experts and stakeholders for involvement in this study. These guidelines provided a rigorous procedure that ensured the identification of relevant experts while providing an opportunity for participation in the study. An additional benefit provided by the use of Internet technology with respect to panel establishment was the ease in which potential experts could be identified (i.e., via websites) and reached (i.e., via email). Through a combination of web-based searches and listserv access, outreach to individuals with some noted familiarity with study topic areas could be contacted and asked to fill out an expert screening survey that established their level of expertise and subsequent potential as a participant. This process led to the initial identification of over a thousand individual emails, an amount that would be difficult (and costly) to reach through traditional mail methods.

Participatory mapping

Beginning in the 1990s, PPGIS has seen wide application ranging from community planning to mapping indigenous knowledge systems (Seiber, 2006; Kalibo and Medley, 2007). The most seminal development of PPGIS comes from Brown and others (2000, 2004, 2005, 2006; see also Reed and Brown, 2003; and Farnum and Reed, 2008). Mapping values in relation to spatial attributes can be achieved using a number of different data collection methods. Mail surveys with map components are the most common method while online mapping applications are in development (see Beverly, Uto, Wilkes, and Bothwell, 2008); this research contributed to the latter by creating and utilizing a web-based interactive mapping workbook that combined a traditional survey question format with Google map functionality to collect spatially explicit value responses. Similar to the advantages and ease of communication noted above for the phase one e-Delphi, this online mapping workbook allows for easy access to participants and ease of response for those individuals.

A large methodological, and indeed structural, trend of natural resource management and CMSP specifically is the call for increased involvement within decision making processes of local stakeholders. For instance, Pomeroy and Douvere (2008) point out that within a variety of initiatives, it is increasingly apparent that documentation of and engagement with local communities and resource users are vital if CMSP is to be effective. Advocates of ecosystem-based approaches in a variety of environmental sectors have suggested the need for local participation through the gathering local ecological knowledge, participation in policy writing and management planning, and action administration (see Neis, Schneider, Felt, Haedrich, Fischer, and Hutchings, 1999; Hanna, 1998; Wilson, 2006; National Research Council, 2001).

Consideration at the stakeholder level is increasing in coastal and marine sector impact analyses to document the possible effects on and transformations of local economies and communities relative to development and management initiatives; indeed at a broader level efforts are being made to link ecosystem services to human well-being (MA, 2003). While these considerations are an important part of the environmental decision making process, they have traditionally been “a response to individual developments or management plans and do not represent a comprehensive integration of the social landscape of the marine environment into the planning process” (St. Martin and Hall-Arber, 2008; p. 781), often times due to the difficulty and cost of comprehensive outreach and collection of stakeholder perspectives on issues of relevance

Participatory research methods, of which the online mapping workbook represents, presume that “ordinary people are capable of critical reflection and analysis and that their knowledge is relevant and necessary” (Thomas-Slayter, 1995, p. 11; quoted in Kalibo and Medley, 2007). Employing participatory outreach such as this shifts involvement by local stakeholders from passive to interactive, promoting a sense of collaboration and stewardship regarding conservation of the natural resources that are important to them (Pimbert and Pretty, 1997; Tuxill and Nabhan, 2001). The working assumption of PPGIS, in this case achieved through completion of an online mapping workbook, as a tool for all-inclusive CMSP, is that coastal landscapes should be managed for compatibility with the values the public holds for relevant resources and uses (Brown and Reed, 2009).

Lacking within CMSP are standardized methods to collect and interpret social values of ecosystem services that the public holds toward relevant land- and seascapes in ways that can equalize the stakeholder interests with ever-present ecological data of traditional environmental planning. While data collection in phase two through the online mapping workbook does not necessarily establish a standard collection method, it does represent an effective community mapping effort with the potential to enhance coastal and marine spatial plans. Through increased public participation in a way that is relatively cheap and easy to implement, using web-based data collection methodologies like the one utilized here can reach a large number of people on a platform (digital, web-based) that is increasingly familiar to a growing segment of the population.

Substantive Contributions

With most academic research there exists a tension between concept or theory development and practical application of study outcomes; this project is no different.

While a number of theoretical and methodological contributions have been noted in previous chapters and sections above, there are additionally a few notable substantive contributions that can be derived from this study. The social variable assessment at the heart of this project, specifically the collection and modeling of spatially specific and weighted social values, reveals relevant human processes in concert with biophysical process models that ultimately allows more accurate trade-off analysis, a need identified across a wide range of management contexts and natural resource policy initiatives.

The layer approach to data used to query and combine variables within the SolVES model, and predominant within CMSP generally, structures analyses and contributes to decision-making in a way that allows for social values to gain traction amongst other ecosystem service values. When these social values are presented as a layer, given a weight for comparison to other layers, and aggregated through algorithm that accounts for tradeoff and risk relative to the objectives at hand (Eastman, Jin, Kyem, and Toledano, 1995), they have the potential to gain equal footing alongside other spatial data layers, for instance land cover or bathymetry, commonly used amongst managers and policy makers. In essence, the degree of comprehensive consideration of important factors within a GIS-based system for environmental decision-making is limited by the layers of data that are available. As St. Martin and Hall-Arber (2008) note, "while the biophysical environment is being mapped in ever greater detail and incorporated into systems of spatial analysis, the 'social landscape'…remains largely undocumented" (p. 780); it is this gap that is directly addressed in this study.

In adding a (missing) social data layer to the spatially-based milieu of information available to coastal resource managers, the SolVES model as applied here also answers the call within a number of coastal policies, both nationally and internationally for consideration of social impacts and benefits. One does not need to look far within relevant legislation to find instructions to decision makers for consideration of the social (and cultural) aspects of resource decisions, including guidance on using that information to aid in decision making and determine actions.

Throughout this dissertation it has been suggested that coastal resource management be substantially founded, alongside traditional considerations of economy and ecology, on current information about the attitudes, values, and preferences of relevant stakeholders and, in some cases, those held by society at large. However, this is not a universally recognized or shared take-home message whether based on policy requirements or continued adherence to antiquated management paradigms. For example, Sharp and Lach (2003) found divergent opinions among fishery managers in the Northwest U.S. regarding the need for and management utility of understanding social values, with one respondent stating, "Resource agencies are not trained nor charged with the sociological implications...this is the job of human resource agencies and politicians" (p. 14). This perspective indicates a startling lack of understanding about both the role of the social system in the management of public resources (as well as what human resource agencies do) and the policy mandate for its integral consideration.

It is probable that ignoring these “sociological implications” is partially responsible for creating or adding to conflicts between resource managers and the publics they serve and has undoubtedly contributed to the persistence of many marine and coastal resource management challenges (Weinstein et al., 2007). The primacy of the ecological and biophysical disciplines within management agencies (Degnbol, 2006) can be traced back to the Progressivism of the late 1800s (Fairfax, 2001). This means the management paradigm in place today is the child of a 100 year-old approach that generally has eschewed a broad, interdisciplinary structure. Progressivism is grounded in a (often superficial) belief that scientists are objective and neutral, meaning that understanding the biological and physical oceanography of marine and coastal environments is sufficient to address the policy issues inherent in the management of public trust resources (Pisani 2006; Fairfax, 2001; Bengston 1995). Thus, the main difference between the Kennedy and Thomas (1995) model of resource management, which claims social consideration should be equal to traditional biophysical understandings, and models based on Progressive ideals is that the latter generally emphasizes a narrow ecological, expert-based approach to decision-making, while the former emphasizes a broader societal values approach.

Progressive-style natural resource management was adequate for a period defined by a smaller, less environmentally-involved population with relatively few use conflicts. However, these conditions no longer exist. More than fifty percent of the U.S. population now lives near a coast in an area making up only 17% of the nation's contiguous land area (NOAA, 2005). If we look at global populations, around 50% of the people worldwide live in the "coastal interaction zone", which makes up just 12% of the total landmass (Crossland, Kremer, et al., 2005). Additionally, the technology revolution along with increases in leisure time following World War II, particularly in the

US, have resulted in new, and often conflicting, ways in which to enjoy and benefit from coastal and marine ecosystems (Jennings, 2007).

Progressivism in resource management is now truly untenable: agencies must adapt to managing for a broad range of social values, preferences, and desires (Bengston 1995; Degnbol et al. 2006; Lackey, 1998; Meine 1995; Smith 1995). By speaking the language of ecological and biophysical discipline experts through CMSP, specifically developing and integrating data layers modeling that depicts social values as quantifiably connected to underlying environmental characteristics (i.e., SolVES), it is possible for sociological implications to gain an equitable position alongside traditional decision variables. That agencies must adapt to new realities was inevitable, given increases in population and the diversity of resource use observed today which is only intensified within coastal and marine ecosystems. There are now simply too few management scenarios wherein solutions to ecological problems do not concurrently violate social or economic constraints (the reverse is also true).

Thus, marine and coastal resources can no longer be managed for historic conditions (Weinstein and Reed, 2005) or narrowly defined as the preservation of the environment; we have fully entered the age of determining how to allow the current generation to use and enjoy resources while simultaneously conserving some acceptable level of maritime ecological function (Roe and van Eeten, 2002). Since there is no divine guidance regarding acceptable function, and since ecosystems can be functional at various levels of impact, the question “what ecosystem at what costs and with what trade-offs?” is answered only by incorporating social norms, standards, and preferences (Lackey, 1998; 2004). One place we can look, and indeed should, is relevant legislation that provides the baseline for how to begin to integrate this new data. While there are a number of policies to be highlighted, what follows is an outline of legislation which is specifically relevant to the context of this study (i.e., Sarasota Bay) and directed explicitly at coastal as opposed to general environmental-resource management (i.e., broader environmental legislation such as the National Environmental Policy Act and Clean Water Act are not covered albeit having relevance to coastal contexts).

Beginning at the local-regional scale, the most immediate policy requirements relevant to this particular study area are derived from a portion of it falling within the Sarasota Bay National Estuary, a designation made through the National Estuary Program (a 1987 amendment to the Clean Water Act). Through development of the Comprehensive Conservation Management Plan that the legislation requires, administrators of the estuary must manage not only the biophysical health and sustainability of the estuary but also socially important attributes of the resource such as its economic, recreational, and aesthetic values held by the public. Similar mandates can be found in related and similar types of coastal and marine management designations, for instance the National Marine Sanctuary Program that seeks to identify marine environment areas of national significance as determined by their resources and human use value.

Beach access is also an issue for local policy and regulation directly tied to the social values of coastal communities and a predominant quality of life issue that drives migration toward the coastline, the focus of this study. This issue is especially important in contexts such as Sarasota Bay where there is a high level of development and corresponding population density, including large amounts of private (and therefore restricted) shoreline. Many states, including Florida, address problems of public access, which represents an important social value, through a wide range of regulatory, statutory, and legal systems (Beatley, Brower, and Schwab, 2002) that can benefit from spatially explicit social value data.

On the Federal level, the Coastal Zone Management Act is the cornerstone in protecting and managing the coastline in the US. This legislation incentivizes state governments to create coastal management programs, with one of the primary goal of the planning process being protection of and access to public beaches (Section 306(d)(2)). In addition, coastal management objectives as defined by Congress include the call to preserve and protect areas valued for recreational and aesthetic purposes, both of which can firmly be considered social values of ecosystem services. Lastly, a 1990 Congressional expansion of the CZMA called the Coastal Zone Enhancement Program included a number of socially oriented objectives such as expanding beach access opportunities and formulating and implementing Special Area Management Plans (SAMP). The SAMP program specifically seeks to establish a balanced management framework to protect public or socially important resources while allowing for appropriate continued use of these resources.

In closing, the substantive contributions to related policy responsibilities that focus on the need to consider social variables in coastal management, it would be remiss to not mention the myriad of different local government, grass roots, and non-profit based initiatives aimed at ensuring social and cultural sustainability within these environments. Many of the daily planning and management decisions affecting coastal resources are made at the local level amongst county, city, and town governments alongside a large number of locally oriented grass roots organizations (Beatley, Brower, and Schwab, 2002). It has been argued that local level resource use and comprehensive planning can be most responsive to the desires (interests and needs) of relevant stakeholders and special management issues of local concern. It stands to reason that further development of research such as that presented here (i.e., SolVES modeling) will greatly benefit local involvement with resource decisions through integration of stakeholder social values into management processes.

Future Research

In summarizing future research derivative of this study there are two distinct paths to be highlighted: extension of e-Delphi methodologies within natural resource and environmental management contexts, particularly within social value assessment and outdoor recreation management, respectively; and development, refinement, and extension of SolVES modeling within coastal ecosystems and beyond (i.e., across the terrestrial-marine divide). For clarity each is addressed separately below. There are indeed far more avenues for extending this research than could be included here, however, this abridges some of the more immediate efforts to be undertaken and looks ahead to potential additional possibilities.

e-Delphi Methodologies

With the use of and success with the e-Delphi method in this study, I am encouraged to use it in looking further into the topic of social values of ecosystem services and extend it to investigate other topics of interest, mostly related to outdoor recreation. In regard to the former, a simultaneous inquiry was made during development of the social value typology, as reported above in chapter four, about an *a* *priori* list of coastal resource issues and a working definition of “social values of ecosystem services”. While preliminary results were captured with respect to these two topics, an immediate avenue for future research would be to study them in more detail. The increasing prevalence of ecosystem service discourse in combination with initiatives for more comprehensive CMSP signifies that future development is needed. Separately, the attainment of quality results from the Delphi exercise in this study has caused me to envision additional avenues for its use within my personal area of expertise, outdoor recreation management and policy.

Understanding the social values of ecosystem services

As alluded to throughout the above text, there remains a gap in this regard when it comes to viable social data related to ecosystem services, particularly linking that data to the underlying biophysical systems that produce them. With that, one of the first questions that arises, alongside how to adequately measure (i.e., spatially quantify) relevant variables, is one of universally defining what is meant by the “social values of ecosystem services”. At the conclusion of the e-Delphi, a working definition was put forth: the human importance of places, landscapes, and the resources or services they provide, defined by individual and/or group perceptions and attitudes toward a given ecosystem. Through further refinement of that definition, there is potential to gain more widespread consensus of what is meant when referencing SVT, making it possible to turn the lens back on the typology that was created (which included 16 distinct values) to improve its effectiveness in measuring social values.

Throughout the development and use of the SVT, it was repeatedly noted that there was a large amount of overlap between variables. As such, it is important to revisit the typology and analyze where some values could be combined, eliminated, or modified. One way of doing that, if we look again to the discussion of relevant policy above, would be to limit inquiry in a future case study to only those values explicitly called for in relevant policy. There are a few distinct values across a number of relevant pieces of legislation specifically noted as important for managers and officials to consider in decision making (most commonly recreation, culture, and aesthetic; coinciding with findings reported in chapter four and in other SolVES applications, see Sherrouse et al., 2011, and van Riper, in press).

Alongside the working definition of social values of ecosystem services, the e-Delphi also generated an *a priori* list of issues of importance to coastal management and policy. Similar to discussion of overlap within the SVES typology, many expert panelists noted the same within the issues that were listed. Much like reaching a broader consensus on the definition of social values of ecosystem services, further inquiry through an e-Delphi could be made to refine and update the list of resource issues moving forward. As it appears that the trend of coastal migration shows no signs of slowing, it will be important for there to be widespread understanding and agreement on the most important issues to address as populations rise in these areas and climate change affects coastlines, and bring with them increasing resource pressures and associated social conflicts.

e-Delphi in outdoor recreation and social impact research

Applying the e-Delphi methodology used in this study to issues of outdoor recreation management and policy is ripe with potential. As a method that fits best for working toward consensus where none exists or forecasting trends where baseline historical data is absent, there are a number of immediate possibilities for its application. There are two distinct topic areas that are of interest to me in applying the e-Delphi method: planning and management of emerging recreation usage on public and private lands; and assessment of social impacts (such as recreation or culture) resulting from large scale landscape change, particularly dam removal/construction and other alternative energy development projects (e.g., wind farms, solar arrays, tidal energy).

With regard to the former, there are a number of emerging forms of recreation that appear to be trending upward in popularity and as such will become of increasing concern to public and private land managers. A good example, derived from new legislation, is the Ski Area Recreational Opportunity Enhancement Act that provides an updated list and official Federal definition of appropriate recreational use of Federally-leased ski area property: zip lines, ropes courses, Frisbee golf courses, and mountain bike terrain parks and trails. With the emergence and increase in these and other activities, there are a number of questions that need to be answered in order for managers to safely and effectively integrate them into the current usage milieu; the e-Delphi offers an ideal methodology for gaining consensus amongst managers on how to do so.

When it comes to the latter (i.e., social impacts of large scale landscape change related to dam deconstruction and alternative energy development), the increase in such projects provides ample opportunity for inquiry using the e-Delphi method. Similar to above discussions about the missing social side of CMSP, these types of projects have produced abundant data on the biophysical and economic impacts to the detriment of social value considerations. This is a case, like issues of emergent forms of recreation, where there appears a dearth of information on what exactly the social impacts will be and is therefore an inquisitive situation perfectly suited for an e-Delphi exercise. An immediate opportunity would be to conduct a study following Donohoe's (2011) Delphi inquiry into defining cultural sensitivity in ecotourism to one of ecological restoration. Similar to that study, pertinent inquiry, into say a large dam removal project, would include defining social value sensitivity within ecological restoration, its role within the relevant planning process, and the development of tools for evaluating its application.

Corollary studies could be conducted, via an e-Delphi, within a number of alternative energy development projects. Large scale projects, such as offshore wind farms and tidal energy projects, will undoubtedly have wide-ranging societal impacts to culture, recreation, and aesthetics, to name a few, that must be considered in planning and management. In these instances not a lot of data has been generated, nor processes defined, for considering these social impacts and are therefore suited to the Delphi method.

Developing and Extending Spatial Social Values Modeling

An even more immediate extension of this research, relative to the above section, will be development, extension, and refinement of the SolVES model within coastal contexts and across terrestrial-marine ecosystems. While chapter four indicates initial efforts into model refinements specific to this project (i.e., environmental data layer determination and improvement to model efficiency), this section focuses on five areas of immediate future development and extension of the SolVES tool:

1. Application of the value transfer model to other coastal zones
2. Leveraging of data from survey sections not currently used by SolVES
3. Integration of findings with management planning and relevant policy
4. Development of robust data collection processes, analysis methods, and outcome usefulness (e.g., creating a SolVES module, conducting a longitudinal study)

Value transfer modeling

As a geospatial model that seeks to explicitly link social values to underlying environmental characteristics, the ultimate goal of SolVES is to predict spatially-based social values across landscapes based on biophysical variables where primary data is not available. As a pilot study in a coastal context, testing this predictability is the next step in its application. To do this, immediate application will be in transferring the landscape metrics, derived from the primary data collected that links the social values and biophysical variables, to the adjacent sections of Sarasota Bay extending south to Venice Inlet. As a similar ecosystem, this area will provide a good test of the model's predictive capability and hopefully reveal points for improvement.

In combination with further development leading to the most efficient mix of environmental data layers (see chapter four), it will be possible to further test the predictability in other, similar coastal contexts. As an urban, highly developed environment, it will be important to test the model's predictive validity and reliability, using Sarasota Bay data, in similar ecological contexts that are rural and less developed. Fortunately, there are a number of ongoing studies generating primary data for these types of places that provide a number of opportunities to cross compare value predictions. For instance, model metrics derived from this study could be used to predict the spatial values in the ACE Basin in South Carolina where primary data is currently being generated, and vice versa with the application of that data into social value prediction across Sarasota Bay. In this way, it will be possible to further refine the landscape metrics (i.e., what data layers are most efficient in predicting spatial distribution and density) by testing the predicted value maps against the maps generated from primary data.

Leveraging sense of place and management perceptions within SolVES

Data from survey sections in the current study, particularly place attachment and management perception variables, which are not currently used by SolVES, could also be leveraged in the future. As noted by Sherrouse et al. (2011), analysis of the survey data describing respondents' familiarity with the area (place attachment) or perceptions of management decisions could prove useful in identifying selection bias that might influence the weights and locations of values marked across the landscape. Additionally, information about the social, economic, and demographic status of survey respondents could assist in matching the socio-cultural contexts of ecosystem services to provide a stronger basis when applying the value transfer functionality in land- and seascapes for which primary survey data is not available.

While SolVES' current structure relies on favoring versus opposing a particular resource use when subgrouping respondents and displaying respective social value dispersion, managers could also be interested, for instance, in the differences between people who agree versus disagree with a particular management action or policy. Similarly, there is a building body of literature regarding the impact of place attachment on perceptions of value across landscapes; using the sense of place data generated through this study within SolVES analysis could provide additional insight and advancement for that emerging body of knowledge.

Integrating SolVES with management planning and policy

Up to this point not much has been done to directly address the influence or use of outcomes from the SolVES model to decision making within management and policy processes. Once model refinement and database development takes place via the above strategies, it will be prudent to explore how managers can use the information generated when making decisions and deciding between management alternatives. Fostering relationships forged with local managers in the Sarasota Bay area throughout the project will be the logical place to start. As the area with primary data, engaging relevant managers, showing and explaining findings, and seeking their assistance in tying model outcomes to existing and future management issues will be critical to the applicability of the model within Sarasota Bay and elsewhere.

In a related manner, it will be important to share the information with interested parties, particularly those who have contributed to the research through participation, by way of public education and outreach. SolVES output in the form of social value maps provide an ideal visual medium from which to convey results in ways that are understandable to layman and experts alike. As a form of PPGIS, it is crucial to share this data, potentially even using it as a way to spur on further discussion between stakeholders and resource managers.

An immediate avenue to explore in integrating the data generated with management specific to the coastal zone is seal level rise. With the advances in spatial modeling that depicts potential scenarios from sea level rise, it would take minimal effort to apply the social value maps and related landscape metrics generated from this project to various likelihoods in terms of coastline impacts. Sarasota Bay in particular has been proactive in this regard and a large amount of related data is currently being generated with potential for use in this regard.

Another avenue, related to an idea originally put forth by Alessa et al. (2009), is using the aggregated social value maps that are generated to identify hotspots across the landscape that may be important for managers to consider. These hotspots could be areas of value conflict or value congruence, both important when making management and policy decisions.

Building SolVES tool application

One of the biggest achievements of this study is the development of an online, interactive mapping survey used to collect the data necessary for SolVES analysis. Working to advance this interface could lead to large advances in the widespread application of the tool across contexts and in a variety of ecosystems. While the online survey currently produces a digital database of mapped points and corresponding tabular data, eliminating the need for both heads-up digitizing and paper to digital data conversion (which greatly reduces workload), a major improvement could be made by creating a sort of “SolVES module” to more closely tie the survey and model data formats. This SolVES module would take the responses entered by stakeholders through the online mapping survey, convert them into the format required for SolVES, and input them into the model automatically. With this type of functionality, it would then be possible to further create an interface where participants could see model outcomes in real time, compare their entries next to all others, and even query SolVES for information that is important to them.

From a management perspective, this would allow individuals the opportunity to conduct a SolVES analysis by simply adding a map of their particular area of interest along with questions of concern to them specifically (i.e., relevant resource use or management perception questions for respondent subgrouping) into the module with minimal burden in terms of time and effort. For example, if a manager in Alaska responsible for the management of a particular area, say, Prudhoe Bay, wanted to do a SolVES analysis, all that would be required is delineation and input of a study area map and corresponding questions of local concern (e.g., controversial resource uses or management action issues) into the module. From there, that individual would reach out to local stakeholders, indicate the web address where the mapping survey could be completed (similar to what was done in this study), and retrieve model results once responses were generated and the model was run. By making it this seamless, there is widespread potential for its application in both marine and terrestrial environments, along with the possibility for conducting ongoing or longitudinal studies of a particular area over time and through various ecosystem changes.

Conclusion

This dissertation research project extended a comprehensive understanding of social values as they relate to ecosystem services and applied that consideration to spatial modeling within the coastal zone. Initial focus was placed on advancing Delphi methodologies through the use of internet technologies to develop a social values typology of ecosystem services specific to the coastal zone. After establishing an inclusive list of 16 social values through an e-Delphi exercise, that typology was applied to a coastal and marine spatial planning effort in Sarasota Bay, Florida through the utilization of a geographic information system modeling tool called Social Values of Ecosystem Services.

As with all good doctoral research, I can honestly say that the project created a great many more questions than it answered. As such, research dealing with the social values typology and its application in planning and management of coastal resources will continue. I am encouraged and excited about the avenues that this endeavor has opened for me and hope that the theoretical, substantive, and practical contributions resulting from this research will find wide spread application across disciplines.

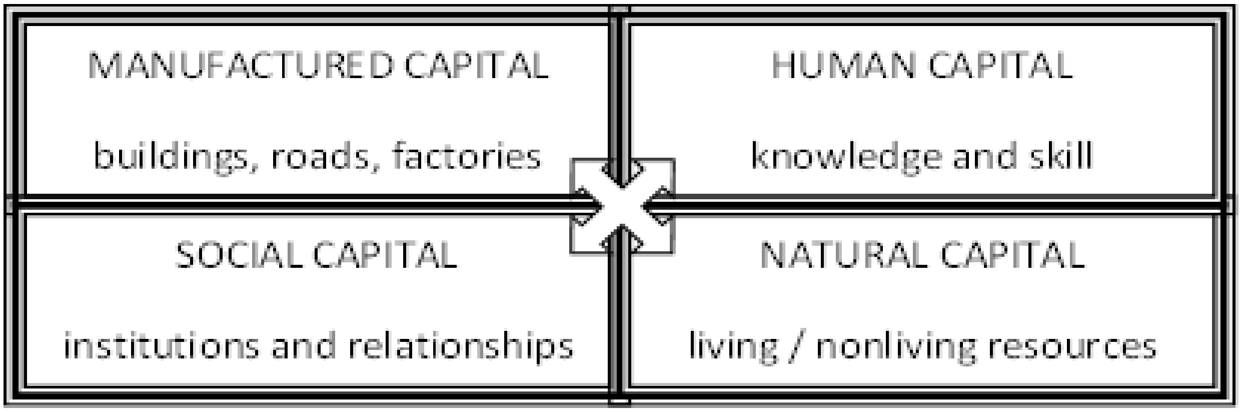


Figure 5-1. Global capital sources.

APPENDIX A
ESSAY: DELPHI AND NATURAL RESOURCE MANAGEMENT

The Delphi method has been used extensively in the context of natural resource management (NRM), ranging from issues of air pollution (de Steiguer and Pye, 1990) to environmental agency effectiveness (Yasamis, 2006). Bunting (2010) describes the Delphi method to be particularly useful in facilitating the interactive participation of varied and conceivably hierarchical, and often antagonistic, stakeholder groups that are inherent to most NRM processes. Issues in NRM, especially in reference to the coastal zone with its high stakeholder heterogeneity and increasing resource pressure via population and development, can be distorted by groups with markedly different agendas and relationships to the relevant resources. As such, an approach that reaches out to the stakeholders explicitly, what Bunting (2010) calls a stakeholder Delphi, is an improvement in NRM contexts over traditional Delphi methods more commonly used. Delphi processes provide information not accessible from either conventional questionnaire or interview methodologies common in NRM assessment (Egan, Jones, Luloff, and Finley, 1995) and can contribute to a more refined joint analysis-consensus in complex social and institutional settings. These attributes are especially valuable in coastal zone management and planning where multiple demands of stakeholders must be reconciled in the development of co-management strategies and environmental protection of land, wetland, and marine ecosystems. In addition, the Delphi technique applies due to the uncertainty and lack of general consensus regarding understanding and mitigation of human impacts on and perceptions of the environment in the coastal zone.

Natural resource management regimes in the United States, both generally and in coastal management and planning specifically, are well rooted in traditional ways of doing business (i.e., command-and-control management [Holling and Meffe, 1996]). The Delphi offers opportunities for stakeholders, whether they be managers or members of society, the chance to step outside the status quo considerations and understandings of natural resource use and explore alternatives which may not fit into applicable institutions (i.e., agency mandates, laws, regulations, etc.). Research literature is replete with examples of the disparity in conceptions of natural resource management between managers themselves and the public they purport to serve; the Delphi represents the ability for disparate parties to reach a consensus on issues that undoubtedly reach across lines. Common efforts to garner public opinion regarding natural resources, such as surveys or public comment on proposed plans, has fallen short of gathering a diversity of relevant opinion. The freedom of anonymity offered by the method allows participants to challenge entrenched, disciplinary assumptions that are often inherent to agencies, stakeholder groups, or even accepted scientific understandings (Donohoe and Needham, 2009).

APPENDIX B
DELPHI SCOPING CONTACTS

Company, Organization, and Government Contacts

American Academy of Environmental Engineers
American Sportfishing Association
American Wind Wildlife Institute
America's Wetland Foundation
Antarctic and Southern Ocean Coalition
ARCTUROS
Assoc of Fish and Wildlife Agencies
Australian Marine Conservation Society
Bay of Islands Marine Park
Bellona International
Bloom Association
Blue Frontier Campaign
Blue Wedges Coalition
Californa Coastal Coalition
California State Coastal Conservancy
Central California Council of Diving Clubs, Inc.
Centro de Conservacion Cetacea
Clean Ocean Foundation
Coalition Clean Baltic
Coalition to Restore Coastal Louisiana
Coast Fish Club (CA)
Coast Watch Society
Coastal America
Coastal and Estuarine Research Federation
Coastal Conservation Association Florida
Coastal Environmental Rights Foundation
Coastal Habitat Alliance
Coastal Observation and Seabird Survey Team
Coastal States Organization
Coastal Watershed Institute
Coastwalk California
Coastwatch Europe
Conservancy of Southwest Florida
Conservation Foundation of the Gulf Coast
Consortium for Ocean Leadership
Consortium for Oceanographic Research and Education
CRAG Law Center
Cuban and Caribbean Studies Institute
Deep Wave
GOBI
GoM Fishery Management Council
Groupe d'Etude des Mammiferes Marins
Gulf of Mexico Alliance
Gulf of Mexico Research Initiative
Haribon Foundation
Instituto de Conservacion de Ballenas
International Collective in Support of Fishworkers
International Game Fish Association
International Ocean Institute
Inter-Tribal Environmental Council
Joint Ocean Commission Initiative
Living Oceans Society
Manatee County Audubon Society
Manatee-Sarasota Group of the Sierra Club
Mangrove Coast Fly Fishers
Mar Brasil
Marine Conservation Institute
MarViva
National Marine Manufacturers Association
National Registry of Environmental Professionals
Nature Canada
North Coast Land Conservancy
Northwest Florida Environmental Conservancy
Ocean Conservancy
Ocean Futures Society
Ocean Trust
Oceana
Oregon League of Conservation Voters
Oregon Surfrider Foundation
Orissa Marine Resources Conservation Consortium
PacMARA
PEMSEA
Raincoast Research Society
Reef Ball Foundation, Inc.
Republicans for Environmental Protection
Salem Sound Coastwatch
Sarasota Audubon Society
Save Our Seas

Company, Organization, and Government Contacts (cont'd)	
Earth Island Institute	Save the Bay (San Francisco)
Eastern Bay of Islands Preservation Society Inc	Sea Turtle Protection Society of Greece (ARCHELON)
ECOP - Marine	Seas at Risk
Florida Center for Environmental Studies	Seasearch
Florida Local Environmental Resource Agencies	SeaWeb
Florida Marine Science Educators Association	Sharklife Conservation Group
Florida Oceanographic Society	Society for Dolphin Conservation Germany
Florida Shore and Beach Preservation Association	Society for Ecological Restoration
Florida Shorebird Alliance	Surfrider
FLOW	The Coastal Society
Friends of Nelson Haven & Tasman Bay Inc.	The Fisheries Secretariat
Friends of the Bahamas	The Oceanographic Society
Friends of the Harbour (Hong Kong)	The Pembina Institute
Friends of the Legacy Trail	The Waterfront Center
Fundacion Cethus	Whale and Dolphin Conservation Society
GEOTA	Zeitz Foundation
Global Water Policy Project	

Journals Reviewed	
Coastal Management	Journal of Coastal Research
Environmental Management	Ocean and Coastal Management
Estuaries and Coasts	Society and Natural Resources

APPENDIX C
PROJECT DELIVERABLES

Topic	Authorship*	Type	Completed, Ongoing, or Planned
Project overview: Valuation of ecosystem services using SolVES in the Gulf of Mexico	Coffin, Swett, Cole, Sherrouse, and others	USGS Fact Sheet	Completed
Internet-based Delphi Research: A case based tutorial	Cole, Donohoe, and Stellefson	Journal article	Completed – *Environmental Management*
Ecosystem services in the coastal zone: A social values typology for comprehensive assessment	Cole, Holland, and Donohoe	Journal article	Completed – *Coastal Management*
Social value orientation of ecosystem services in Sarasota Bay, FL: Findings from SolVES modeling	Cole, Coffin, Swett, and Holland	Journal article	Completed
Stakeholder inventory	Cole	Text file (.txt/.csv)	Completed
Sarasota Bay survey data	Cole	Text file (.txt/.csv)	Ongoing
SolVES 2.0 geodatabase (coastal)	Coffin, Cole, and Swett	USGS data series (.gdb)	Ongoing
Environmental datasets	Coffin, Cole, and Swett	USGS data series (.shp, .img, .grd)	Ongoing
Social value orientation of ecosystem services: Adaptation of SolVES for a coastal environment	Cole, Swett, Coffin and others	Journal article	Planned
Applying the SolVES ecosystem service valuation tool for coastal planning in Sarasota Bay	Swett, Cole, Coffin and others	Journal article	Planned
Social values transfer mapping of coastal ecosystem services	Coffin, Swett, Cole and others	Journal article or USGS publication	Planned
Ecosystem service valuation mapping in Sarasota Bay, FL	Coffin, Cole, and Swett	Joint USGS/FSG fact sheet	Planned
The Sarasota Bay ecosystem services valuation pilot study	Cole, Swett, and Coffin	Joint USGS/FSG Scientific Investigations Report	Planned
Spatial links between place attachment and social values of ecosystem services	Cole	Journal article	Planned

*Authorship is tentative

APPENDIX D
PROJECT PRESENTATIONS

Conference presentations:

Hindsley, P. and **Cole, Z.D.** (2012) Panel Discussion: Economic valuation of Sarasota Bay. *Sarasota Bay Watershed Symposium,* Sarasota, FL, USA.

Cole, Z.D., Holland, S., and Coffin, A. (2012) Social values and ecosystem services in coastal environments: The case of Sarasota Bay, FL. *4th International Eco Summit, Ecological Sustainability: Restoring the Planet's Ecosystem Services,* Columbus, OH, USA.

Coffin, A.W., **Cole, Z.D.,** Swett, R.A., and Sherrouse, B.C. (2012) Coastal SolVES: Adapting a terrestrial-based GIS tool for the non-monetary, spatial evaluation of ecosystem services in a coastal environment. *4th International Eco Summit, Ecological Sustainability: Restoring the Planet's Ecosystem Services,* Columbus, OH, USA.

Cole, Z.D. (2012) Mapping the human coast: Shaping natural resource management through stakeholder collaboration. *18th International Symposium on Society and Resource Management (ISSRM)*, Edmonton, Alberta, CA.

Cole, Z.D. (2012) The human side of sustainability: Developing a typology of social values of ecosystem services in the coastal zone. *18th International Symposium on Society and Resource Management (ISSRM)*, Edmonton, AB, CA.

Cole, Z.D. (2012) Modeling social values of ecosystem services: Non-monetary, spatial evaluation in a coastal environment. *32nd Annual National Recreation Resource Planning Conference,* Baton Rouge, LA, USA.

Cole, Z.D., Donohoe, H., and Holland, S. (2012) Going online: Advancing e-Delphi methodologies within coastal resource management. *Inaugural College of Health and Human Performance Student Poster Session,* Gainesville, FL, USA.

Cole, Z.D., Coffin, A.W., and Swett, R. (2012) Mapping social values of coastal use relative to ecosystem services in Sarasota Bay. *Sarasota Bay Watershed Symposium,* Sarasota Bay, FL, USA.

Cole, Z.D., Donohoe, H., Coffin, A., and Swett, R.S. (2012) Social value and resource use in Sarasota Bay: Using e-Delphi to uncover spatial variables. *Social Coast Forum,* Charleston, SC, USA.

Cole, Z.D. (2012) Ecosystem services of rivers: Exploring the potential for quantifying and mapping social values. *11th Biennial River Management Society Symposium: From Intimate Creeks to the Infinite Sea,* Asheville, NC, USA.

Lovelace, S., Semmens, D., Sherrouse, B., Coffin, A., DiDonato, E., van Riper, C.J., **Cole, Z.D.,** and Loerzel, J. (2012) Problem SoLVE-ing: Understanding Social Valuation of Ecosystem Services (SolVES) for better Coastal Management. *The Coastal Society's 23rd International Conference- Our Coasts, Our Heritage: Ecosystem Services for the Common Good,* Miami, FL, USA.

Cole, Z.D., Coffin, A.W., Swett, R.S., Sherrouse, B.C., and Semmens, D.J. (2011) Mapping social values of coastal use relative to ecosystem services in Sarasota Bay. *Emerging Management of Enclosed Coastal Seas: Managing for Results in our Coastal Seas,* Baltimore, MD, USA.

Community presentations:

Cole, Z.D., and Moore, R. (2012) Interview with Zachary Cole, University of Florida: http://sarasotabaytoday.com/2012/03/interview-with-zachary-cole-university-of-florida/ (*Sarasota Bay Today).*

Sarasota Bay Estuary Program: Citizens Advisory Committee – Project Overview (January 2012)

FL Sea Grant: Manatee County – Project discussion w/ John Stevely (December 2011)

Sarasota County Planning Department – Project overview w/ JP Gellerman (November 2011)

Sarasota Bay Estuary Program: Public Outreach coordination w/ Sara Kane (November/December 2011; February/March 2012)

Sarasota Bay Estuary Program: Technical Advisory Committee – Initial Findings (June 2012)

APPENDIX E
MAPPING SURVEY (PRINT VERSION)

Mapping the Social Value of Coastal Uses in *Greater Sarasota Bay*

Linking Public Knowledge with Coastal Planning

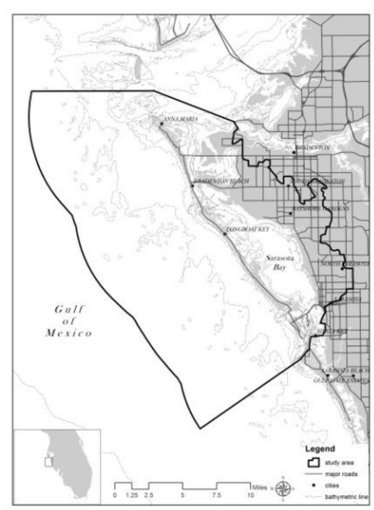
Sarasota Bay is an estuary of local and national significance. As a resident of the *Greater Sarasota Bay* area, you have a voice in how these important resources are managed. We hope you will take advantage of this opportunity to make your voice heard by completing this survey. The information you provide may be useful in the future to inform management decisions and help establish the goals and priorities relevant to *Greater Sarasota Bay's* vital resources. This data collection effort supports dissertation research being conducted at the University of Florida in partnership with Florida Sea Grant and the United States Geologic Survey.

<u>Area of Interest</u>: We seek your help to determine the importance (or value) you place on natural spaces in and around Sarasota Bay. This area includes the watershed, bay, barrier islands and nearshore Gulf waters (ranging out to 9 nautical miles offshore) extending from Anna Maria Sound in the north to Siesta Key in the south. We refer to this entire region as "*Greater Sarasota Bay*" for the purposes of this survey. A reference map is included below to orient you to the area of focus for this study.

Please answer all the questions if possible. Average time to complete the questionnaire is 20 minutes, including identifying important places on the maps. Your responses will be kept confidential. We very much appreciate your participation and thank you in advance for your thoughtful responses.

The purpose of this survey is to:

- Understand your beliefs about important topics regarding *Greater Sarasota Bay* in the next 10-15 years (Part 1)
- Understand what uses of *Greater Sarasota Bay* you favor or oppose (Part 2)
- Explore your familiarity with *Greater Sarasota Bay* (Part 3)
- Discover in what ways you use *Greater Sarasota Bay* and where those uses occur (Part 4)
- Discover in what ways you value *Greater Sarasota Bay* and where in the area those values are represented (Part 5)
- Learn about you and your community (Part 6)



Part 1: Policy/Management
This section asks your opinion about important topics regarding natural resources and publicly accessible areas of *Greater Sarasota Bay*.

For questions 1-4 indicate your level of agreement/disagreement with each statement. (Please circle one response for each)

Q1: I am interested in what happens in *Greater Sarasota Bay* over the next 10-15 years. (Please circle one response)

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Q2: The natural environment of *Greater Sarasota Bay* has improved over the last 20 years.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Q3: There are more opportunities to recreate and enjoy *Greater Sarasota Bay* than there were 20 years ago.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Q4: Private waterfront residential, condominium, and hotel development has reduced my access to and enjoyment of *Greater Sarasota Bay*.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5	4	3	2	1

Q5: In your opinion, what role should the public play in the management of *Greater Sarasota Bay's* natural and cultural resources? (Please circle one response)

1 None.
2 The public should provide suggestions for public officials and resource managers to consider.
3 The public should be full and equal partners with public officials and resource managers in planning and management decisions.
4 Planning and management decisions should be based solely on public opinion.
5 Don't know.

Q6: Public access to coastal waters and waterways is a priority management issue. From your perspective, how adequate is existing public access to *Greater Sarasota Bay* via the following facilities? (One response per line)

Access Types	Very Adequate	Adequate	Neutral	Inadequate	Very Inadequate
Public boat ramps	5	4	3	2	1
Public marina berths	5	4	3	2	1
Public dry storage berths	5	4	3	2	1
Restaurants with boat dockage	5	4	3	2	1
Public beaches	5	4	3	2	1
Beach access points (dune walkovers)	5	4	3	2	1
Beach access parking spots	5	4	3	2	1
Waterway nature trails	5	4	3	2	1
Scenic view points	5	4	3	2	1
Nature trails adjacent to water	5	4	3	2	1
Public, natural swimming areas	5	4	3	2	1
Boardwalks	5	4	3	2	1

Q7: Please indicate your level of agreement with each statement as it relates to the current state of *Greater Sarasota Bay*. (One response per line)

Statements	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Increasing amounts of debris/trash in the water	5	4	3	2	1
Seagrass acreage is decreasing	5	4	3	2	1
Too few fish to catch	5	4	3	2	1
Mangrove habitat is disappearing	5	4	3	2	1
Too many derelict vessels	5	4	3	2	1
Shoreline erosion is a problem	5	4	3	2	1
Birds and wildlife populations are in decline	5	4	3	2	1
Inadequate public access to water/beaches	5	4	3	2	1
Too much congestion at water/beach access sites	5	4	3	2	1
Not enough parking spaces at water/beach access sites	5	4	3	2	1
Too many boats	5	4	3	2	1
Too many boaters not practicing safe navigation	5	4	3	2	1
Loss of restaurants and other shoreline recreational opportunities is a problem	5	4	3	2	1
Wildlife habitat is decreasing	5	4	3	2	1
Increasing frequency of red tide	5	4	3	2	1
Natural shoreline is decreasing due to development	5	4	3	2	1
Inadequate channel marking	5	4	3	2	1
Inadequate waterway maintenance (canals, channels, passes) for boating	5	4	3	2	1
Inadequate boater education	5	4	3	2	1

Q8: Local communities have identified goals to guide management decisions that affect *Greater Sarasota Bay*. Please indicate your level of agreement with each of the goals listed below. (One response per line)

Goals for the Future	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Improve Sarasota Bay water quality.	5	4	3	2	1
Manage the quantity and improve the quality of stormwater runoff to Sarasota Bay.	5	4	3	2	1
Restore wetlands and natural shoreline habitats.	5	4	3	2	1
Eliminate further loss of shoreline and wetland habitats.	5	4	3	2	1
Restore and sustain fish stocks and other living marine resources in *Greater Sarasota Bay*.	5	4	3	2	1
Provide increased levels of public access to *Greater Sarasota Bay* and its resources.	5	4	3	2	1
Increase the resilience of coastal communities to natural and human-induced disasters (e.g., hurricanes, rising seas).	5	4	3	2	1
Incorporate local social and cultural heritage into management of *Greater Sarasota Bay* resources (e.g., public input, community advisory boards).	5	4	3	2	1
Increase understanding of human-use patterns that influence resource sustainability (e.g., commercial development, recreation).	5	4	3	2	1
Integrate understanding of human uses with knowledge of natural processes.	5	4	3	2	1
Purchase additional non-wetland areas to add to publically owned lands adjacent to or close to Sarasota Bay.	5	4	3	2	1

Goals for the Future	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Create “fishery reserve areas” in *Greater Sarasota Bay* where no fishing would be allowed.	5	4	3	2	1
Create limited to no-wake zones for motorized craft to encourage non-motorized craft use.	5	4	3	2	1

Part 2: Resource Use Perceptions

This section asks your opinion about various uses or activities that occur or could occur within, on, or near *Greater Sarasota Bay*, as well as activities that occur in other Gulf of Mexico coastal communities and nearshore environments.

Q9: Please indicate whether you favor or oppose the uses and activities listed below occurring within, on, or near *Greater Sarasota Bay*. (One response per line)

RECREATIONAL ACTIVITIES	Strongly Favor	Favor	Neutral	Oppose	Strongly Oppose
Sight-seeing (viewing the Bay and Gulf waters from an automobile)	5	4	3	2	1
Shore/Pier fishing	5	4	3	2	1
Recreational boat fishing	5	4	3	2	1
Scallop/shellfish harvesting	5	4	3	2	1
Scuba diving/snorkeling	5	4	3	2	1
Motorized recreational boating	5	4	3	2	1
Non-motorized recreational boating (e.g., canoes, kayaks, SUPs)	5	4	3	2	1
Personal watercrafts (i.e., jet skis)	5	4	3	2	1
Birdwatching	5	4	3	2	1
Walking/Jogging along shorelines	5	4	3	2	1
Picnicking	5	4	3	2	1
Swimming	5	4	3	2	1
Golfing and golf courses	5	4	3	2	1
Hiking	5	4	3	2	1
On-shore beach activities	5	4	3	2	1
COMMERCIAL, INDUSTRIAL, AND RESIDENTIAL USES	**Strongly Favor**	**Favor**	**Neutral**	**Oppose**	**Strongly Oppose**
Agricultural land use (e.g., crops, orchards, nurseries, ranching)	5	4	3	2	1
Aquaculture (fish farming)	5	4	3	2	1
Commercial fishing (including shellfish)	5	4	3	2	1
Commercial forestry	5	4	3	2	1
Shore development that hardens natural shoreline (e.g., building concrete seawalls to protect property from erosion)	5	4	3	2	1
Shore development that retains natural shorelines (beach, mangroves)	5	4	3	2	1
Beach nourishment	5	4	3	2	1

Canal /navigational dredging	5	4	3	2	1
Commercial marine port	5	4	3	2	1
Commercial shipping (e.g., cargo ships, tankers)	5	4	3	2	1
Marinas and boat ramps	5	4	3	2	1
Mooring fields	5	4	3	2	1
Charter Boat fishing	5	4	3	2	1
Private dock development	5	4	3	2	1
Tour Boats (sightseeing)	5	4	3	2	1
Waterborne passenger transportation (e.g., ferries, water taxis)	5	4	3	2	1
Off shore oil/gas exploration/drilling	5	4	3	2	1
Offshore alternative energy development (e.g., wind, solar)	5	4	3	2	1
Power generation plant and energy infrastructure (e.g., power lines)	5	4	3	2	1
High-rise condominium construction	5	4	3	2	1
Transportation infrastructure (e.g., roads, railways, bridges, causeways)	5	4	3	2	1
Desalinization plant/water treatment	5	4	3	2	1
Industrial manufacturing or processing (e.g., refinery, pulp mill)	5	4	3	2	1
ECOLOGICAL AND ENVIRONMENTAL OPPORTUNITIES	**Strongly Favor**	**Favor**	**Neutral**	**Oppose**	**Strongly Oppose**
Conservation easements	5	4	3	2	1
Manatee protection zones	5	4	3	2	1
Artificial reef development	5	4	3	2	1
Fish/wildlife habitat expansion	5	4	3	2	1
Commercial fisheries regulations	5	4	3	2	1
Recreational fisheries regulations	5	4	3	2	1
Development setbacks to sustain natural shoreline vegetation for protection from storm damage and erosion.	5	4	3	2	1

Part 3: Familiarity with *Greater Sarasota Bay*

This section asks about your connections to, experience with, and knowledge of *Greater Sarasota Bay*.

Q10: What are your connections to *Greater Sarasota Bay*? (One response per line)

My connection to *Greater Sarasota Bay*…	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
My family's income or livelihood depends on *Greater Sarasota Bay*.	5	4	3	2	1
Greater Sarasota Bay is important in protecting air quality.	5	4	3	2	1
The tourism dollars that *Greater Sarasota Bay* attracts are essential to my community's economy.	5	4	3	2	1
I identify strongly with the *Greater Sarasota Bay* area	5	4	3	2	1
My community takes great pride in *Greater Sarasota Bay*	5	4	3	2	1
Greater Sarasota Bay is the best place to satisfy my outdoor recreation needs.	5	4	3	2	1
Greater Sarasota Bay means a lot to me.	5	4	3	2	1
Greater Sarasota Bay represents a way of life in my community.	5	4	3	2	1
Many important memories of my family are tied to *Greater Sarasota Bay*.	5	4	3	2	1
Greater Sarasota Bay is important for providing habitat for fish and other wildlife.	5	4	3	2	1
Greater Sarasota Bay is very special to me.	5	4	3	2	1
Greater Sarasota Bay is the best for what I like to do.	5	4	3	2	1
Greater Sarasota Bay is a special place for my family.	5	4	3	2	1
I am very attached to *Greater Sarasota Bay*.	5	4	3	2	1
Greater Sarasota Bay has helped put my community on the map.	5	4	3	2	1
I get more satisfaction out of visiting *Greater Sarasota Bay* than any other place.	5	4	3	2	1

Few people know *Greater Sarasota Bay* like my family does.	5	4	3	2	1
What I do in/around *Greater Sarasota Bay* is more important to me than doing it in any other place.	5	4	3	2	1
No other place can compare to *Greater Sarasota Bay*.	5	4	3	2	1
In any development plan, it is important to consider protecting the environment of *Greater Sarasota Bay*.	5	4	3	2	1
I depend on *Greater Sarasota Bay* for income or livelihood.	5	4	3	2	1
Visiting *Greater Sarasota Bay* says a lot about who I am.	5	4	3	2	1
My community's economy depends on the natural resources of *Greater Sarasota Bay*.	5	4	3	2	1
I feel a sense of pride in my heritage when I am in *Greater Sarasota Bay*.	5	4	3	2	1
I enjoy what I do in/around *Greater Sarasota Bay* more than any other place.	5	4	3	2	1
My community's history is strongly tied to *Greater Sarasota Bay*.	5	4	3	2	1
Greater Sarasota Bay ties the generations of my family together.	5	4	3	2	1
Greater Sarasota Bay contributes to the character of my community.	5	4	3	2	1
Greater Sarasota Bay is a special place for my community to be located.	5	4	3	2	1
Greater Sarasota Bay is important to preserve/conserve various natural and unique ecosystems.	5	4	3	2	1
I feel *Greater Sarasota Bay* is a part of me.	5	4	3	2	1
Greater Sarasota Bay is important in protecting water quality.	5	4	3	2	1

Q11: What is your level of knowledge regarding different elements of the *Greater Sarasota Bay* area? (One response per line)

My knowledge of *Greater Sarasota Bay*…	**Excellent**	**Good**	**Fair**	**Poor**	**N/A**
Policy	5	4	3	2	1
Ecology	5	4	3	2	1
History/Culture	5	4	3	2	1
Recreational Opportunities	5	4	3	2	1

Q12: What is your experience with *Greater Sarasota Bay*?

My experience with *Greater Sarasota Bay*…			
How many years have you lived in the Sarasota Bay area (including the entirety of Manatee and/or Sarasota Counties)?	___________ years		
I am a **seasonal** / **permanent** resident (circle one).			
Do you consider yourself an advocate for the *Greater Sarasota Bay* environment?	Yes	No	Somewhat
Did you grow up in/around Sarasota Bay?	Yes	No	

Part 5: How You Value *Greater Sarasota Bay*

Q15: Each person values *Greater Sarasota Bay* resources differently. We would like to know how you value *Greater Sarasota Bay*.

Imagine that you could "spend" $100 to ensure that what you value about *Greater Sarasota Bay* is preserved or enhanced. You may spend or allocate the $100 in any way you like (but the total must not exceed $100). For example, you might spend all $100 on one value (and $0 on all others), or you might spend $50 on one value, $25 on another value, and $25 on yet another value. How you "spend" your $100 is up to you.

Please note that our reference to money is made solely for the purposes of this exercise and does not relate to any proposed or actual expenditures.

Amount	**Value (abbrev.) –** Definition of the value.
$	**Aesthetic Value (A)** – I value *Greater Sarasota Bay* because I enjoy the sights, sounds, and smells.
$	**Recreation Value (R)** – I value *Greater Sarasota Bay* because it provides a place for my favorite outdoor recreation activities.
$	**Cultural Value (C)** – I value *Greater Sarasota Bay* because it represents a place for passing down wisdom, knowledge, and traditions
$	**Spiritual/Novel Experience Value (SN)** – I value *Greater Sarasota Bay* because it represents a sacred, religious, unique, deep, and profound place where reverence/respect for nature is felt/experienced.
$	**Life Sustaining Value (LS)** – I value *Greater Sarasota Bay* because it supports life, human and non-human, through the production, preservation, cleansing, and renewal of air, soil, and water.
$	**Learning Value (L)** – I value *Greater Sarasota Bay* because we can learn about the environment through scientific exploration, observation, discovery, and experimentation.
$	**Biodiversity Value (B)** – I value *Greater Sarasota Bay* because it provides a variety and abundance of fish, wildlife, and plant life.
$	**Wilderness Value (W) –** I value *Greater Sarasota Bay* because it represents minimal human impact and/or intrusion into natural environment.
$	**Subsistence Value (S)** – I value *Greater Sarasota Bay* for its provision of basic human needs, such as reliable, regular food supply from seafood.
$	**Historic Value (H)** – I value *Greater Sarasota Bay* because it provides places and things of natural and human history that matter to me.

$	**Identity/Symbolic Value (IS)** – I value *Greater Sarasota Bay* because I identify a sense of community and belonging symbolic of the “culture of the sea/coast”
$	**Future Value (F)** – I value *Greater Sarasota Bay* because it allows future generations to know and experience healthy, productive, and sustainable coastal environments.
$	**Therapeutic Value (T)** – I value *Greater Sarasota Bay* because it makes me feel better, physically and/or mentally.
$	**Economic Value (E)** – I value *Greater Sarasota Bay* because it provides fisheries (commercial), minerals, and tourism resources that support livelihoods.
$	**Intrinsic (I)** – I value *Greater Sarasota Bay* in and of itself, whether people are present or not.
$	**Access (AC)** – I value *Greater Sarasota Bay* as a place of common property free from access restrictions or exclusive ownership/control.
Total: $100	**Additional comments:**

Mapping *Greater Sarasota Bay* Social Values

Q16: In this mapping exercise, you will locate places in the natural environment of *Greater Sarasota Bay* that have special meaning to you. While built environments (for example museums, restaurants, and city streets) can indeed be valuable to you, the focus of this project is to identify locations of value within the natural environments of *Greater Sarasota Bay* (for example parks, beaches, and waterways). To identify the places that are important to you, follow these two steps:

Instructions:

What places within *Greater Sarasota Bay* do you think of when you reflect on each of the values to which you allocated money in question 15? We want you to mark these places on a map. For each value, we ask that you mark no more than four places on the map using the following procedure:

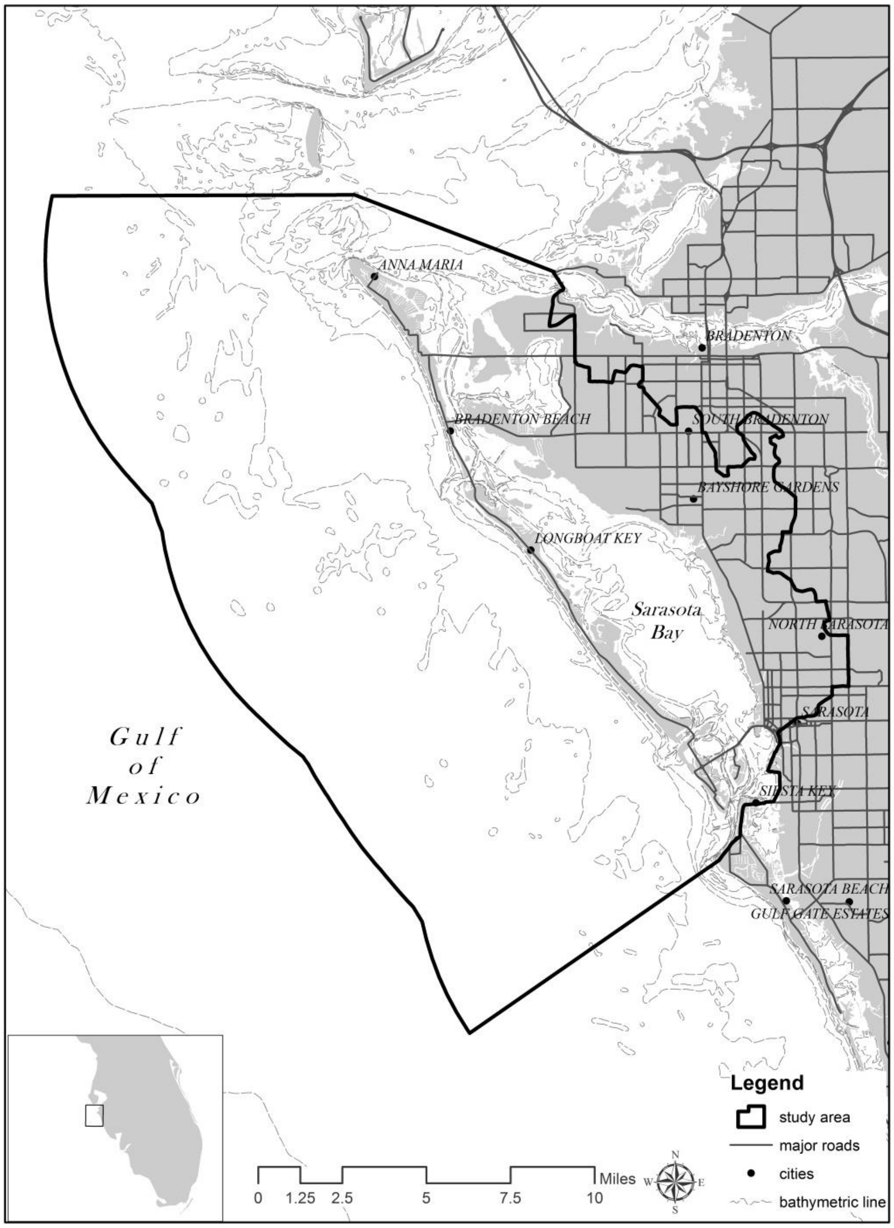
- Using a pen, mark on the map a place that represents one of your important values (those you allocated money to in question 15).
- After placing a dot, mark what Value each place represents by using the value abbreviations that followed the name of that Value in question 15 or by referring to the same Value abbreviations listed on the map.
- Then give each place you marked a number of 1 through 4. This is now the Value Mark.

Example: You indicated Aesthetic Value (A) in question 15 as one of your important values related to Sarasota Bay. When you think of Aesthetic Value, you think of two places: Thompson Pass and Mirror Shore (imaginary places). You make two dots on the map: one where you think Thompson Pass is located, and you Value Mark it with “A1” for Aesthetic Value, Place number 1. You make another dot where you think Mirror Shore is located, and you Value Mark it with “A2”, for Aesthetic Value, Place number 2. Follow Step 1 for each Value you allocated money to in question 15.

Step 2: Please list in the table on the next page each Value Mark you made along with its corresponding Place name. If you don’t know the specific name of these Places, then write down an approximate location, e.g., “the mangrove shore just north of Bayside Inlet”.

- You only need to mark dots for the values for which you allocated money in question 15, up to four for each.
- It is not necessary for you to have visited or used the location(s) where you place your dots. Some Values may be related to bay use while others may not.
- If you allocated to more than 8 values in Question 15, please add them to the list on the last page in this packet.

List of Values			
Value Mark	**Place Name/Description**	**Value Mark**	**Place Name/Description**
Value 1:		**Value 5:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 2:		**Value 6:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 3:		**Value 7:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 4:		**Value 8:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	


ANNA MARIA
BRADENTON
BRADENTON BEACH
SOUTH BRADENTON
BAYSHORE GARDENS
LONGBOAT KEY
Sarasota Bay
NORTH SARASOTA
SARASOTA
Gulf of Mexico
SIESTA KEY
SARASOTA BEACH
GULF GATE ESTATES
Legend
study area
major roads
cities
bathymetric line
0
1.25
2.5
5
7.5
10
Miles
N
W
E
S

Part 6: Participant Demographics

Your identity will be kept confidential and your answers below will not be associated with your name or any other personal identifiers. We are collecting this information to ensure our sample reaches a diverse enough audience to be representative of all stakeholders.

Q17: Do you or anyone in your household earn income from the sale of *Greater Sarasota Bay* products or from commercial services (including hospitality) that depend on access to those resources?

1 Yes. Please describe the source of the income:___________________________

2 No

3 Unsure

Q18: If you answered yes to question 17, what percentage of your household's income comes from use of or access to *Greater Sarasota Bay* resources?

1 1-25%

2 26-50%

3 51-75%

4 76-100%

Q19: If a percentage of your household's income comes from *Greater Sarasota Bay* resources, does your business or income vary based on the number of tourists attracted to *Greater Sarasota Bay*'s natural resources?

1 Yes

2 No

3 Unsure

Q20: Were you or any of your immediate family economically affected by the 2010 BP Gulf oil spill?

1 Yes

2 No

Q21: Did you or any of your immediate family change Gulf vacation or *Greater Sarasota Bay* water related recreational activities due to the 2010 BP Gulf oil spill?

1 Yes

2 No

Q22: Year of birth?

Q23: Are you?

Male Female

Q24: What is the highest level of education you have completed? (Please check one response).

___Less than high school diploma | ___High school diploma or GED | ___Vocational/technical degree

___4-year college degree | ___Some graduate work | ___One or more graduate degrees

Q25: What is your approximate annual household income before taxes? (check one response).

___Less than $10,000 | ___$25,000-$49,999 | ___$75,000-$99,999

___$10,000-$24,999 | ___$50,000-$74,999 | ___$100,000-$124,999

___$125,000-$149,999 | ___$150,000 or more

Q26: What is your occupation?____

Q27: In what ethnic group (A) and race (B) would you put yourself?

A. Ethnicity ___Hispanic/Latino ___NOT Hispanic/Latino

B. Race ___Asian American ___Black/African American

___Native American ___Native Hawaiian/Pacific Islander

___White ___Other______________________

Q28: What is your address? (This information will only be used to ensure adequate distribution of the survey and your street address will not be shared with anyone outside of this research project – if you prefer not to give us your street address, you can just tell us your ZIP code)
Street:
City/State:
Zip Code:

Q29: Can you see the waters of Sarasota Bay or the Gulf from your residence?
Yes No

Q30: Does your daily commute allow you to view Sarasota Bay or the coast for some duration of your commute?
1 Yes (if yes, about how many minutes per round trip) __________
2 No

List of Values (continued)			
Value Mark	**Place Name/Description**	**Value Mark**	**Place Name/Description**
Value 9:		**Value 13:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 10:		**Value 14:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 11:		**Value 15:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	
Value 12:		**Value 16:**	
__1		__1	
__2		__2	
__3		__3	
__4		__4	

APPENDIX F
DELPHI SUMMARY REPORTS

ROUND 1 SUMMARY
Social Values of Ecosystem Services and Resource Uses in the Coastal Zone

Title of the study: Mapping Social Values of Coastal Use relative to Ecosystem Services

This report contains the Round 1 survey results summary. For each of the three survey questions, results are described and the key messages are presented. In total, fifty-eight coastal ecosystem service experts from over a dozen countries completed the survey (45% response rate).

QUESTION 1: *List and describe the four most important issues or controversial resource uses facing contemporary coastal and marine management and policy.*

Results: Through content analysis thirty-six contemporary coastal management and policy issues were identified. Their importance is established by the frequency in which they appear in the survey response data. The frequency tabulation (number of references to each issue) was independently completed by two researchers. The inter-coder reliability, that is, the congruency between the two independent tabulations, was 87% (satisfying the most stringent measure of reliability). On the basis of this tabulation, the issues are ranked and the top twenty-two issues (60%) are identified (Table 1). Key concerns regarding each issue are also described. The remaining fourteen identified issues are also listed.

Table 1 – Question 1 Summary: Contemporary Coastal Issues (in rank order)

1. **Fisheries Overharvesting:** Rate/method of harvest considered unsustainable; issues include: uncertain stock assessment, tragedy of the commons, regulation enforcement, and habitat loss/degradation.
2. **Coastal Development:** Global migration toward coastlines coupled with population growth has increased building and associated infrastructure expansion; issues include: stormwater runoff from impervious surfaces, settlement in hazard prone areas, loss in ecological resilience, and habitat destruction.
3. **Pollution:** Proliferation of coastal development (see issue #2) has caused increases in point and non-point source pollution; noted sources include: fertilizer, trash/litter (marine debris), oil spills, sediment, sewage, industrial waste, and pesticides.
4. **Competing Interests/Resource Uses:** Competition for finite resources from industry, government, and local stakeholders; issues include: public vs. private interest, conflicting uses (i.e., commercial vs. recreational fishery), and the ongoing debate between conservation and development.
5. **Sea Level Rise:** Advances in the understanding of the potential impacts has outpaced adaptation to predicted changes of consequence to natural and built environments along the coastline; issues include: property rights, public access, coastal erosion, habitat shifts, and lack of mitigation investment.

6. **Sectoral Management:** Outdated laws and regulations coupled with the influence of political climates on the integration of science-based ecosystem management/policy has created an environment of disparate operating frames in coastal and marine decision making; issues include: lack of international cooperation, and competing national vs. local mandates.
7. **Habitat Loss:** Occurring as a result of both natural (i.e., erosion) and anthropogenic (i.e., shore development, boating) factors; issues include: sea level rise (see issue #5), loss of ecosystem resiliency, ecological alteration (natural and human-induced), and pollution (see issue #3).
8. **Oil/Gas Exploration:** Continually expanding efforts into increasingly difficult and fragile environments (i.e., deep sea drilling, arctic expansion); issues include: enhanced subsidence, increased dredging, and pipeline construction (along with other transport infrastructure).
9. **Climate Change:** Impacts beyond those resultant of sea level rise (see issue #5); issues include: increasing frequency/strength of hazard events (i.e., storms), changing hydrologic cycles, and altered habitat/biodiversity structures.
10. **Public Education:** The increasing investment and need to educate stakeholders at all levels of society regarding coastal science and management/policy practices; issues include: conveying scientific uncertainty, enhancing public trust, and translation of technical knowledge.
11. **Alternative Energy:** Increasing development/expansion (wind, tidal, solar, etc.) in the coastal zone requires better understanding of associated benefits and costs; issues include: aesthetic impacts, adverse habitat/species effects, regulatory hurdles, and public education (see issue #10)
12. **Freshwater Inflow:** Overexploitation of ground and surface water due to development in coastal areas (see issue #2); issues include: saltwater intrusion, changes in freshwater delivery regimes to wetland/estuarine ecosystems, and subsequent alteration to species composition.
13. **Biodiversity:** Large scale ecosystem change in coastal areas (natural and anthropogenic) leading to significant declines in species variety and abundance; issues include: overexploitation, development, habitat loss, and climate change.
14. **Shore Hardening:** Increasing coastal development (see issue #2) resulting in property protection via elimination of natural buffers (i.e., mangroves, accretion/erosion); issues include: species impacts (e.g., sea turtle nesting), habitat loss/ degradation, and high cost of artificial nourishment (and lack of effectiveness).
15. **MPA Management:** Disparate strategies/frameworks, lack of enforcement, and issues of jurisdiction causing variable effectiveness; issues include: public misconceptions, tragedy of the commons, and absent consideration of associated socio-economic impacts.
16. **Water Quality:** Increasing degradation of upland inflow coupled with development (see issue #2) and pollution (see issue #3) with wide ranging negative effects on coastal ecosystems; issues include: high cost of pollution control, nutrient over-enrichment, and unsustainable growth strategies.
17. **Public Access:** Shifts in natural coastal environments coupled with expanding

private shoreline ownership/development has served to limit customary access points to general population; issues include: need for public/private planning, assurance/regulation of shoreline access, and control of restrictive development.

18. Wetland Loss: Development pressure (see issue #2), pollution (see issue #3), sea level rise (see issue #5), and decreasing freshwater inflow (see issue #12) all contributing to accelerating loss rates.

19. Beach Nourishment: Concerns over cost, effectiveness, impact, and sustainability of practice; issues include: who should pay, economic/ecological feasibility, and frequency of nourishment.

20. Enforcement Efficacy: Existence of laws and regulations does not assure adherence, seen at all levels of policy from international to local; issue include: deficient personnel, minimal prosecution, and unsustainable harvest designations.

21. Resource Capture: Business interest driving coastal politics and decision making resulting in unsustainable practices and large-scale negative ecological impacts; issue include: tragedy of the commons, overharvesting (see issue #1), and lack of enforcement (see issue #20).

22. Unsustainable Management/Policy: Decisions making based on short term gain without consideration of long term implications; issues include: resource capture (see issue #21), lack of enforcement (see issue #20), and reactive vs. proactive planning.

Other Identified Issues: Erosion; Eutrophication; Lack of Consistency in Shoreline Designation; Lack of Funding for Coastal Management; Loss of Cultural Resources; Mariculture Impacts; Ecosystem Service Valuation; Hazard Mitigation; Lack of International Cooperation; Lack of Social Science in Coastal Management/Policy; Issues of Management/Policy Scale; Nutrient Loading; Population Growth; and Sedimentation

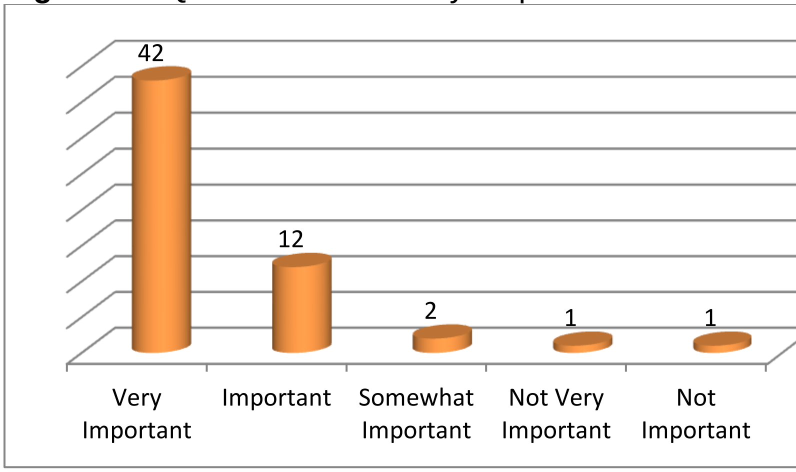
In reviewing these issues, a set of issue categories naturally emerge: Category A – issues related to coastal/marine development, Category B – issues related to coastal ecology, and Category C – issues related to coastal management. Though the categories, and indeed the issues within each, are not mutually exclusive, they allow us to consider the issues from a different perspective.

Table 2 – Contemporary coastal issues by Category (see Table 1 for issue definitions)

Issue	Rank Order
Category A – Issues related to coastal/marine development	
Coastal Development	2
Habitat Loss	7
Oil/Gas Exploration	8
Alternative Energy	11
Shore Hardening	14
Public Access	17
Lack of Consistency in Shoreline Designation	25
Loss of Cultural Resources	27
Population Growth	35
Category B – Issues related to coastal ecology	
Fisheries Overharvesting	1
Pollution	3
Sea Level Rise	5
Climate Change	9
Freshwater Inflow	12
Biodiversity	13
Water Quality	16
Wetland Loss	18
Beach Nourishment	19
Erosion	23
Eutrophication	24
Mariculture	28
Nutrient Loading	34
Sedimentation	36
Category C – Issues related to coastal management	
Competing Interests/Uses	4
Sectoral Management	6
Public Education	10
MPA Management	15
Enforcement Efficacy	20
Resource Capture	21
Unsustainable Management/Policy	22
Lack of Funding in Coastal Management/Policy	26
Ecosystem Service Valuation	29
Hazard Mitigation	30
Lack of International Cooperation	31
Lack of Social Science in Coastal Management/Policy	32
Management Scale	33

QUESTION 2: *How important is it for ecosystem service valuation to be inclusive of social values alongside traditional metrics of economic and ecological values?*
Results:

Figure 1 – Question 2 Summary: Importance of Social Value Assessment



Answer	Response
Very Important	42
Important	12
Somewhat Important	2
Not Very Important	1
Not Important	1
Statistic	**Value**
Mean	1.43
Variance	0.66
Standard Deviation	0.81

A majority agree that it is very important for ecosystem service valuation to be inclusive of inherent social values alongside economic and ecologic value metrics (Table 3). However, the analysis also reveals that social values of ecosystem services are still cloaked in conceptual vagueness; there appears a lack of clarity about what social values are with regard to contemporary conceptions of ecosystem services. Pertinent questions include: how to measure the social values of ecosystem services, what it means for assessment to be inclusive of inherent social values, who is required to consider them in decision making, and when to do so. On one end of the response spectrum, some contend that valuation of ecosystem services is a futile practice without equitable inclusion of all the value types – economic, ecological, and social. Others argue that social values are indeed the most important factor to consider within decision making frameworks and stand as the least developed in terms of their ability to be quantified (relative to economic and ecologic valuation paradigms). And at the other end of the spectrum, participants make clear that while social values are an important element in valuing ecosystem services they are either not as important or serve as an input to economic and ecologic assessments. This spectrum confirms the need to clarify what is meant by "social values of ecosystem services" and how it is to be defined and measured in coastal management and policy.

Table 3 – Question 2 Summary: Representative Comments

Very Important 72%

"An inability to quantify and articulate simple, market-driven, economic values for ecosystem services and the associated social values handicaps policy and funding discussions at local, state, national and international levels."

"It is not easy to attach a monetary value to the benefits nature provides us with. However, it is even more difficult to explain the social values attached to each ecosystem service. These are necessary for several reasons. First and foremost, we need to inform our stakeholders of the importance of ecosystem services and to do that we need to make them understand what the social values are. Also, social values would be of utmost importance for natural resource managers in their decision making process."

"Several of the issues impacting on ecosystem services stem ultimately from human behaviour and social values. Any 'solutions' that ignore this element are leaving out an important part of the picture - social values need to be considered as (i) a potential part of the solution to issues we face, and (ii) as a root cause of the problem too. It is also unethical to ignore social concerns while prioritizing ecological and economic dimensions - sustainability is, after all, also about people's wellbeing."

"The very concept of ecosystem services is rooted in social values so to leave them out makes the measurement of ecosystem services using only economic and ecological values less comprehensive and thereby, less meaningful. In fact, if all value is reduced to economic, there are a number of critical services that may be lost entirely. Moreoever, if we are actually interested in the values humans place on ecosystems, then we actually need to take an inclusive approach to how humans value things. While social values are certainly more complex to quantify, this is no reason to reduce all human value to economic. People and society, as a whole, is far more complex. Our valuation should reflect this complexity."

"Traditional methods of valuing coastal ecosystems have concentrated on economic worth. It is very important to develop social metrics so that these resources can be assessed in a way that includes their intangible, as well as tangible value."

"Nothing can exisit in isolation. Whenever ecosystem services are discussed, we have to be cognizant to one of the most important part that is the social values. Though economic and science are great, if the social values are not incorporated, it is not wholesome."

Important 21%

"Ecosystem valuation is important, but a difficult concept for the general public to grasp. Having accurate assessments of ecosystem values helps decision makers with funding allocations and decisions regarding use patterns. Social values estimation must be done as well. But the quantitative methods used must provide for comparable estimates and must be done in a manner that does not encourage bias and overestimation. The latter issues are a common problem."

"Social values can often drive decision-making in directions that are counter to best solutions. Lack of accounting for social values can destroy resources vital to community and resident functions in favor of outside speculation."

"The social value provides the selling point to everyone not receiving either an economic or environmental benefit. It provides a broader based ownership of the services provided."

"Social values are an important consideration with ecosystem valuation, particularly during project planning, however social values are difficult to use in project ranking. Therefore social values become qualitative considerations rather than quantitative economic considerations or ecological values that often are reduced to quantitative values. If social values can be defined and then normalized in some manner to economic and ecological values project planning would benefit."

Somewhat Important 3%

"I consider the social values to be somewhat important, instead of very important, because they are much harder to quantify, and enter into the decision-making process with much less impact. That is, decision-makers, regardless of the strength or time spent discussing social issues, tend to make decisions based largely on perceived or real cost-benefit ratios."

Not Very Important < 2%

"While social values can be important, ultimately I think the ecological values to a degree, but more importantly, the economic values will adequately capture this. If coastal resources are valued for aesthetic reason and represent a social value of entertainment or enjoyment, then society will place more value on more enjoyable resources and the economic indicators realted to how people choose to use those resources will reflect that. Restated simply, I believe the social values are inputs to the ecological and economic values and need not be broken out."

Not Important < 2%

"Economic and ecological values are not well defined or there are no broadly accepted methods for computing them - at least no method accepted by the public or managers outside of the "valuation" community. So we can't even agree on metrics for relatively objective things, how can we possibly agree on soft, social value metrics and valuations. Therefore, we should remove the social value issue completely from the ecosystem services valuation process and have a separate system, such as democracy."

QUESTION 3: *List and describe up to four social values of ecosystem services specific to coastal and marine contexts.*

Results: Through content analysis nineteen social values of ecosystem services in the coastal zone were identified. Their importance is established by the frequency in which they appear in the survey response data. The frequency tabulation (number of references to each issue) was independently completed by two researchers. The inter-coder reliability, that is, the congruency between the two independent tabulations, was 93% (satisfying the most stringent measure of reliability). On the basis of this tabulation, the issues are ranked and defined using an aggregate of response descriptions (Table 3).

Table 3 – Question 3 Summary: Emergent Typology of Social Values of Ecosystem Services

1. **Recreation:** Provision/context of favorite/enjoyable outdoor recreation activities.
2. **Aesthetic:** Provision/context of enjoyable scenery, sights, sounds, smells, etc.
3. **Cultural:** Place for passing down the wisdom, knowledge, traditions, and way of life of my ancestors.
4. **Spiritual:** Sacred, religious, or spiritually special place where reverence and respect for nature is experienced.
5. **Economic:** Provision of fishery (commercial/recreational), minerals, and tourism industry that supports livelihoods.
6. **Identity:** Spaces that engender a sense of place, community, and belonging representing shared values, goals, and pride that contribute to individual and group identity.
7. **Intrinsic:** Right to exist regardless of human presence, value based on existence (being rather than place).
8. **Life Sustaining:** Macro-environmental processes (i.e., climate regulation, hydrologic cycle, etc.) that support life, human and non-human.
9. **Therapeutic:** Place that enhances feelings of well-being (e.g., “an escape”, “stress relief”, “comfort and calm”, etc.).
10. **Learning:** Provision/context of educational value through scientific exploration, observation, discovery, and experimentation.
11. **Natural/Wilderness:** Spaces that are preserved in a state representative of minimal human impact, related to intrinsic (see value #7) and future (see value #12).
12. **Subsistence:** Provision of basic human needs, emphasis on reliable, regular food/protein source from seafood.
13. **Future:** Allowance for future generations to know and experience coastal ecosystems as they are now.
14. **Access:** Places of common property free from access restrictions or exclusive ownership/control.
15. **Biodiversity:** Provision/context of a variety and abundance of fish, wildlife, plant life, etc.
16. **Symbolic:** Places that represent the distinctive “culture of the sea”, highly related to cultural (see value #3) and identity (see value #6).
17. **Historic:** Places of natural and human history that matter to individuals, communities, societies, and nations.

18. **Novel Experience:** Provision/context of unique, deep, and profound human experience unable to be replicated.
19. **Transportation:** Ease of personal, recreational, military, and commercial transport of people and goods.

In comparing the typology presented here to those formerly developed we find that fourteen (74%) have been previously noted. The five emergent concepts include: identity, access, symbolic, novel experience, and transportation. While these are not necessarily unique values found only in the coastal zone it is interesting to note their definitions relative to terrestrial environments as many would not translate very well to, say, forest environments from which most previous typologies have been developed.

ROUND 2 SUMMARY
Social Values of Ecosystem Services and Resource Uses in the Coastal Zone

Title of the study: Mapping Social Values of Coastal Use relative to Ecosystem Services
This report contains the Round 2 survey results summary. For each of the four survey questions, results are described and the key messages are presented. In total, thirty-eight coastal ecosystem service experts completed this survey round (66% response rate).

QUESTION 1:

A) *The top 22 issues identified in Round 1 are listed in accordance with the group's rank order (beginning with the most important as determined by frequency). In order to provide us with additional information and to move the group towards a consensus set of issues, please rank the issues from most important to least important by clicking and dragging to rearrange the order. (1 = most important / 22 = least important)*
B) *Please provide any additional insight into the issues, their rank importance, or other. Also, in your opinion do any of the following issues, identified in round one, deserve to be in the list above and if so, why?*

Results: Table 1 provides a summary of the issue reordering (1A; numbers in parenthesis represent the mean rank order and rank order change from Round 1 to Round 2, respectively). As pointed out by a number of participants, the value in this exercise derives not from a concrete consensus on the rank order of these issues but instead an acknowledgement of these being *a priori* issues for coastal resource management. The researcher acknowledges that after Round 1 it was clear that many of the issues initially listed did indeed have a sizable amount of overlap (lacked mutual exclusivity); Round 2 respondents provided a number of interesting insights into which could be reasonably combined for clarity. In order of mentioned frequency, issues to be combined included: sea level rise/climate change, habitat loss/wetland loss, pollution/water quality, and unsustainable management/sectoral management.

Table 1 – Question 1 Summary: Reorder of Coastal Issues
(parenthesis indicate response average and direction/degree of change, respectively; #@*^ indicates combined issue recommendations)

1. Coastal Development (3.62; +1)	11. Public Education (11.71; -1)
2. Habitat Loss (5.26; +4)#	12. Sectoral Management (12.24; -6)^
3. Pollution (5.91, 0)@	13. Freshwater Inflow (12.32; -1)
4. Fisheries Overharvesting (6; -3)	14. Unsustainable Management/Policy (12.38; +8)^
5. Competing Interests/Resource Uses (6.35; -1)	15. Oil/Gas Exploration (13.91; -7)
6. Sea Level Rise (8.74; -1)*	16. Shore Hardening (14.85; -2)
7. Water Quality (9.15; +9)@	17. Alternative Energy (15.47; -6)
8. Climate Change (9.85; +1)*	18. Public Access (15.56; -1)
9. Decreasing Biodiversity (10.94; +4)	19. Enforcement Efficacy (16; +1)
10. Wetland Loss (11; +8)#	20. Beach Nourishment (16.38; -1)

In addition to calls for combining some of these issue categories, as outlined above and in Table 1, there were three notable observations regarding supplements to listed topics and divergence of opinion concerning the level of importance certain issues have (see Table 2 for example comments). First, a large number of comments focused on the role population growth plays in driving most the issues listed, most notably the role of coastal development and its corresponding impacts. Second, there were two additional issues which received prominent attention: 1) a general lack of funding for research and management aimed at dealing with coastal management issues; and 2) the loss of cultural resources, particularly its lacking consideration as a priority issue in coastal policy. Lastly, there were distinct divergent opinions regarding the fit of public access and public education issues in this priority listing. Some respondents noted them as the “foundation for how society understands the issues and then responds to issues with policy solutions and public action” while others felt they did not fit, necessarily, as issues on par with the others.

Table 2 – Question 1 Summary: Representative Comments

“Human population growth and loss of cultural resources should be in the Top 20. As scientists, it behooves us to at least acknowledge it as a potential root cause for many (all) of the issues listed above. In many, if not most conversations, any discussions along these lines are oft considered taboo. Why? Likely, because it is 1 major driver in the system of which we have absolutely no control...”
“Population - an overarching issues that affects many of the currently listed especially development and competing uses (2 of the ‘biggies’).”
“Lack of funding and international cooperation both speak to the ‘tragedy of the commons’ - everyone owns...no one responsible which is an issue as far as management.”
“Loss of cultural resources should be included in the list - it is an often overlooked aspect of coastal management. I had some trouble with some issues in the list which to be either overlap (e.g., habitat loss/decreasing biodiversity) or which are not necessarily 'problems' (such as public education). Indeed, my top two ranked issues (unsustainable management/sectoral management) are very intertwined - part of the problem with management being unsustainable is that is focused too much on sectors and not enough on the big picture.”
“Living without the advantages of a benevolent dictatorship, I ultimately felt compelled to move public education to the top of the list. If the public does not know there is a problem or understand the ramifications of it or their role in it, then improvements are not likely to be implemented. Also note that in my mind some of these issues as listed are duplicative. For example, wetland loss is a type of habitat loss.”
“I placed unsustainable management policy and public education (scientific knowledge and awareness) as #1 and # 2 respectively because they are the foundation for how society understands the issues and then responds to issues with policy solutions and public action.”
“Public education and access can inform people about many issues lower in the table and how these are changing with time or policies. The social science component in management policy is vital in making more informed policy decisions. Population growth and associated anthropogenic effects are major factors in the equation regarding resource availability, use, and sustainability.”
“Loss of cultural resources should be added to the list above. Cultural resources are 100% non-renewable. Once they are destroyed, they are gone forever.”

QUESTION 2:

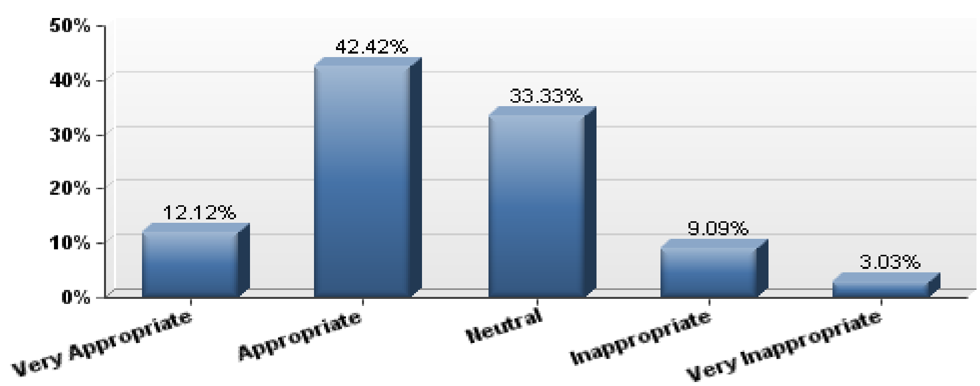
A) *Please comment on the appropriateness of this working definition of "social values of ecosystem services":*
'The ways is which humans value landscapes and the places therein for reasons ranging from instrumental value (e.g., places that provide sustenance) to symbolic value (places that represent ideas) and which fall outside utilitarian, market-based assessment of the monetary value derived from ecosystem services; not the economic value an ecosystem provides but instead the values which are present intrinsically (regardless of humans) and instrumentally (as human resources) in a given ecosystem.'

B) *Please provide additional comments or suggestions to improve this definition.*

Results:

Figure 1 shows that a majority of participants felt the definition used was either appropriate or very appropriate. It also shows that nearly as many respondents felt neutral or less about its appropriateness, meaning that there exists a need to further refine what is meant by the "social values of ecosystem services" for a more universally accepted understanding and differentiation from other value types.

Figure 1 – Question 2 Summary: Appropriateness of "Social Values of Ecosystem Services" Definition



The predominant critique of the definition was its advanced complexity, i.e., "confusing and quite academic in nature", "very clumsy", "too hard to follow…too many words", "OK for scientists but cumbersome for stakeholders", etc. As such, respondents expressed a need for simplification of the definition, broad enough to capture all social values inherent to ecosystem services while being succinct and agreeable to layman understanding that differentiates it from other value types. Many of the comments drew attention to the exclusionary aspects of the definition as being a limiting factor in its application. For instance, one respondent noted the following:

> "With your definition it appears there is an attempt to exclude values such as utilitarian and monetary, but for some, if not many (most), this is exactly what they equate to the term. The definition should capture these, BUT ALSO include the various other aspects you have provided. Exclusion seems contradictory, self-defeating, elitist, secular, alienating, etc.

> whereas inclusion of the utilitarian and monetary aspects would/should result in the greatest coverage of all peoples. It doesn't seem appropriate or relevant to alienate some portion or segment of the 'target' population by excluding 'their values' even if it is solely based on utilitarian needs or for monetary reasons."

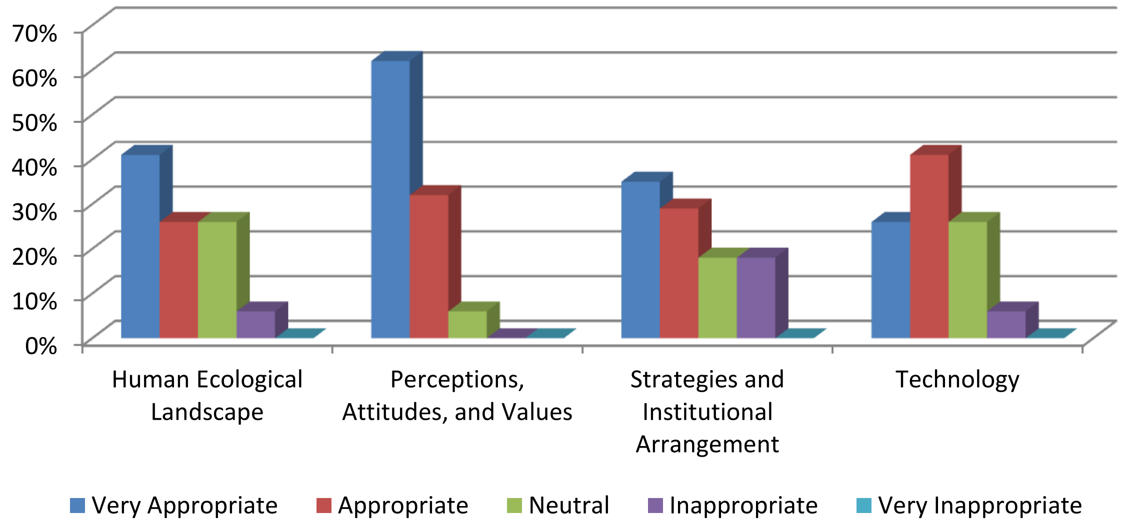
In that same vein, others made recommendations such as "don't lose the economic value element of ecosystem services—may want to talk about both economic valuation and social valuation as two sides of the coin" or "it seems artificial to me to separate social values from other values (e.g., biodiversity). All values have their foundation in how we as humans perceive and value the environment and other aspects of life." From this, the noted challenge is creating a definition that is simultaneously inclusionary, succinct, and basic enough for broad understanding and clarity of focus. In forecasting this level of ambiguity and a need for definitional refinement, the question that followed presented four variables/attributes to provide the discussion with direction and points from which to build consensus about necessary elements to be included.

QUESTION 3:
To ensure that resource management and environmental policy includes social values assessment along economic and ecologic measures of ecosystem services, what variables or attributes need to find expression in the definition? As a starting point for discussion, please review the variables listed below and comment on their appropriateness.

A) *HUMAN ECOLOGICAL LANDSCAPE: Noteworthy human activities, artifacts and impacts, and biophysical environments.*
B) *PERCEPTIONS, ATTITUDES, AND VALUES: Societal and individual understanding of social relations and cultural norms. Understanding determined by experiential knowledge.*
C) *STRATEGIES AND INSTITUTIONAL ARRANGEMENT: Decision-making infrastructure composed of customs, laws, policies, management practices, and the agencies and actors needed to plan and manage relevant resources/landscapes.*
D) *TECHNOLOGY: The ways, means, and tools used by individuals/societies to develop and adapt to changing conditions in the state of the natural and human environments. Hard (alternative engineering/assessment instruments) and soft (alternative behaviors or ways of coping and/or adapting) technologies are needed.*

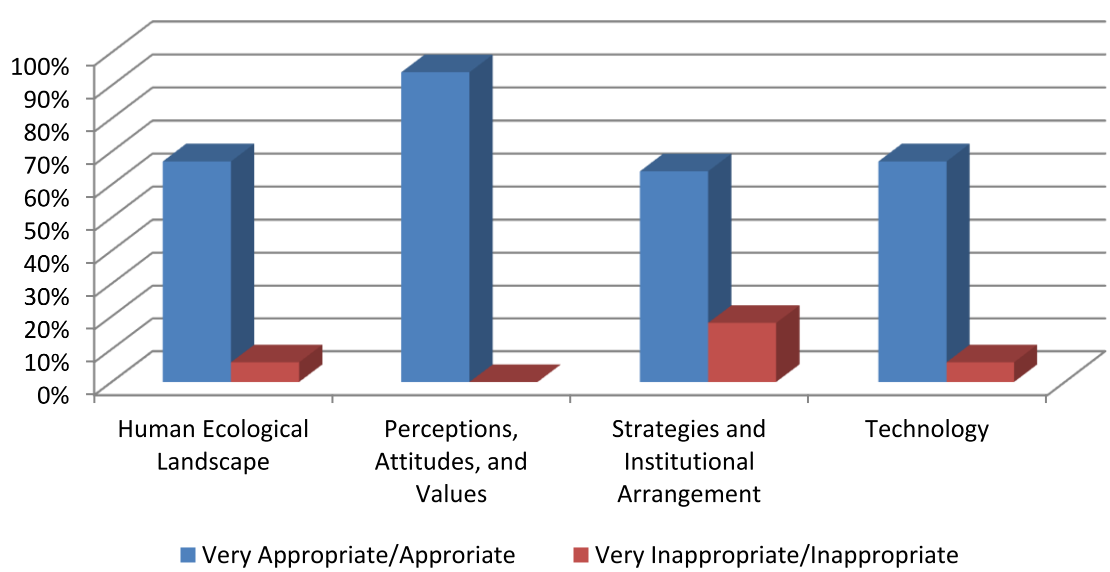
Results: The following figures (Figures 2 and 3) show perceptions of appropriateness for each of the above variables/attributes for finding expression within a refined definition of "social values of ecosystem services". As noted in the Question 2 summary, the main critique of the definition used in Round 1 was its advanced complexity, need for simplification, and a desire for it to be more inclusionary while remaining succinct and understandable to a broad audience of stakeholders. These variables/attributes were chosen to provide direction in reaching a more widely applicable definition of "social values of ecosystem services".

Figure 2 – Question 3 Summary: Level of Appropriateness for each Variable/Attribute



By aggregating the positive perceptions categories (very appropriate and appropriate) and the negative perceptions categories (inappropriate and very inappropriate), respectively (Figure 3), we can prioritize their inclusion into a refined definition of "social values of ecosystem services". In other words, we can answer the questions of which variables/attributes are most important to include in a modified definition in light of the recommendations from Question 2. Figure 3 shows that Perceptions, Attitudes, and Values have the highest importance for inclusion, followed by Technology and Human Ecological Landscape (whose priority order is interchangeable), and lastly Strategies and Institutional Arrangement. It is also important to note the predominance of the Perceptions, Attitudes, and Values variable/attribute over the other three as their appropriateness versus inappropriateness are relatively analogous to one another. defined

Figure 3 – Question 3 Summary: Appropriateness versus Inappropriateness of Variables/Attributes



QUESTION 4:

A) *The top 19 social values of ecosystem services identified in Round 1 are listed in accordance with the group's rank order (beginning with the most frequent response). In order to provide us with additional information and to move the group towards a consensus typology of social values, please rate the relevance of each related to ecosystem service valuation.*

B) *The social values of ecosystem services in the coastal zone listed above are not mutually exclusive of one another. Please note any that could be combined and provide justification for doing so. Also, the explanations given for each value represents an aggregate of Round 1 response descriptions, if desired please comment and provide suggestions for clarification regarding the provided definitions.*

Results: Table 3 represents the order of social values per mean relevancy scores (5 – Very Relevant to 1 – Very Irrelevant) for each value that emerged in Round 1. It is clear that all held a relatively high relevance with regard to ecosystem service valuation in coastal environments. However, it should be noted that four of the five newly emergent concepts, highlighted by asterisks, have the lowest mean scores in terms of relevancy. What materialized in the comments regarding this typology (Question 4B) was that a number of these could/should be combined with previously existing/other social values.

Table 3 – Question 4 Summary: Relevancy of Social Values to Ecosystem Service Valuation

1. Aesthetic (4.79)	11. Identity* (4.35)
2. Recreation (4.71)	12. Future (4.32)
3. Cultural (4.65)	13. Therapeutic (4.21)
4. Spiritual (4.56)	14. Economic (4.18)
5. Life Sustaining (4.53)	15. Intrinsic (4.15)
6. Learning (4.47)	16. Access*(4.09)
7. Natural/Wilderness (4.41)	17. Symbolic* (4.09)
8. Subsistence (4.41)	18. Novel Experience* (3.97)
9. Biodiversity (4.41)	19. Transportation* (3.58)
10. Historic (4.38)	

There were three predominant suggestions regarding ways to refine the typology by collapsing social values categories. Those recommendations included: Natural/Wilderness-Biodiversity; Spiritual-Novel Experience; and Identity-Symbolic. In addition, it was stressed by multiple experts that Transportation would be inherently captured within other values, such as Economic and Recreation, and could therefore be removed from the typology.

There were a number of other suggestions regarding modifications of the descriptions used for each social value, most notably the Future value, for example: "'Future: Allowance for future generations to know and experience coastal ecosystems as they are now' is a very different service value than 'Allowance for future generations to know and experience healthy, productive and sustainable coastal ecosystems'. The social importance for restoration of natural ecosystem service values should not be lost when we discuss a 'preferred future'."

FINAL SUMMARY
Social Values of Ecosystem Services and Resource Uses in the Coastal Zone

Title of the study: Mapping Social Values of Coastal Use relative to Ecosystem Services

This report contains the final results summary from three iterative Delphi rounds. These sequential questionnaire rounds have focused on developing three themes specific to the coastal zone: 1) a typology of social values of ecosystem services, 2) a priority listing of resource management issues, and 3) a workable definition of social values of ecosystem services. Results and key messages are presented below. In total, thirty-seven coastal ecosystem service experts completed the final survey round (97% response rate).

THEME 1: Social Values of Ecosystem Services

Table 1 – Social Values Typology (alphabetical order)

Access	Places of common property free from access restrictions or exclusive ownership/control.
Aesthetic	Enjoyable scenery, sights, sounds, smells, etc.
Biodiversity	Provision of a variety and abundance of fish, wildlife, and plant life.
Cultural	Place for passing down wisdom, knowledge, and traditions.
Economic	Provision of fishery (commercial/recreational), minerals, and tourism industry that support livelihoods.
Future	Allowance for future generation to know and experience healthy, productive, and sustainable coastal ecosystems.
Historic	Place of natural and human history that matter to individuals, communities, societies, and nations.
Identity/Symbolic	Places that engender a sense of place, community, and belonging; represent a distinctive "culture of the sea".
Intrinsic	Right to exist regardless of presence; value based on existence (being rather than place).
Learning	Place of educational value through scientific exploration, observation, discovery, and experimentation.
Life Sustaining	Provision of macro-environmental processes (i.e., climate regulation, hydrologic cycle, etc.) that support life, human and non-human.
Recreation	Place for favorite/enjoyable outdoor recreation activities.
Spiritual/Novel Experience	Places of sacred, religious, unique, deep, and/or profound experience where reverence/respect for nature is felt.
Subsistence	Provision of basic human needs, emphasis on reliable, regular food/protein source from seafood.
Therapeutic	Place that enhances feelings of well-being (e.g., "an escape", "stress relief", "comfort and calm").
Wilderness	Place of minimal human impact and/or intrusion into natural environment.

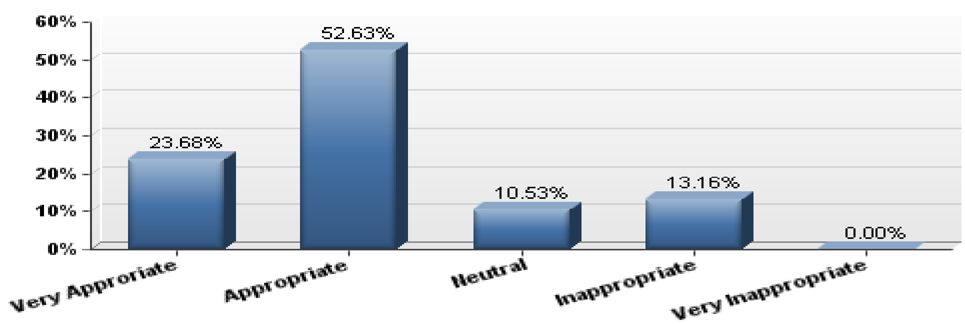
THEME 2: Important Resource Management Issues

Table 2 – Coastal Zone Issues (rank order)

1. Coastal Development	11. Public Education
2. Habitat Loss	12. Sectoral Management
3. Pollution	13. Freshwater Inflow
4. Fisheries Overharvesting	14. Unsustainable Management/Policy
5. Competing Interests/Resource Uses	15. Oil/Gas Exploration
6. Sea Level Rise	16. Shore Hardening
7. Water Quality	17. Alternative Energy
8. Climate Change	18. Public Access
9. Decreasing Biodiversity	19. Enforcement Efficacy
10. Wetland Loss	20. Beach Nourishment

THEME 3: Workable Definition of Social Values of Ecosystem Services
Working Definition Presented: *"The ways in which humans value landscapes and the places therein for reasons ranging from instrumental (e.g., places that provide sustenance) to emblematic (e.g., places that represent ideas) and intrinsic (regardless of humans) to contributory (as human resources), with consideration of the human ecological landscape as defined by individual and group perceptions, attitudes, and values toward a given ecosystem."*

Figure 1 – Appropriateness of Working Definition



Key Critiques:
- Too academic/obtuse/complex/wordy
- Jargon falls outside understanding of general public
- Circular (i.e., using value in the definition)
- Limiting terminology (e.g., landscape, human ecological landscape)

Final Working Definition:
- *"The human importance of places, landscapes, and the resources or services they provide, defined by individual and/or group perceptions and attitudes toward a given ecosystem."*

APPENDIX G
SUPPLEMENTAL DELPHI SUMMARY FINDINGS

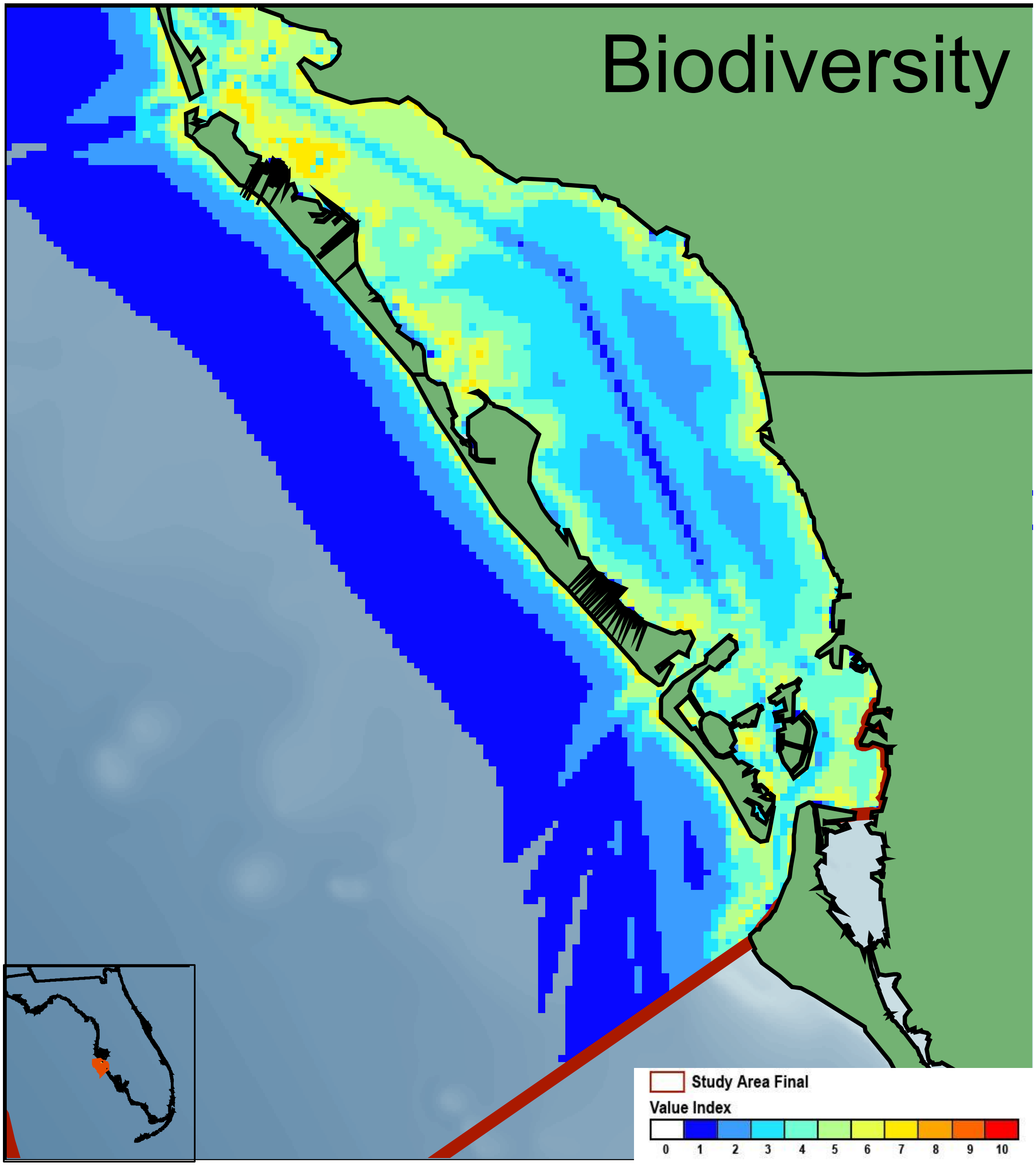
A priori list of coastal resource management and policy issues (average rank; direction and degree of change between round one and round two) (#@*^ indicates respective respondent noted issue combinations)

1. Coastal Development (3.62; +1)	11. Public Education (11.71; -1)
2. Habitat Loss[#] (5.26; +4)	12. Sectoral Management[^] (12.24; -6)
3. Pollution[@] (5.91, 0)	13. Freshwater Inflow (12.32; -1)
4. Fisheries Overharvesting (6; -3)	14. Unsustainable Management/Policy[^] (12.38; +8)
5. Competing Interests/Resource Uses (6.35; -1)	15. Oil/Gas Exploration (13.91; -7)
6. Sea Level Rise* (8.74; -1)	16. Shore Hardening (14.85; -2)
7. Water Quality[@] (9.15; +9)	17. Alternative Energy (15.47; -6)
8. Climate Change* (9.85; +1)	18. Public Access (15.56; -1)
9. Decreasing Biodiversity (10.94; +4)	19. Enforcement Efficacy (16; +1)
10. Wetland Loss[#] (11; +8)	20. Beach Nourishment (16.38; -1)

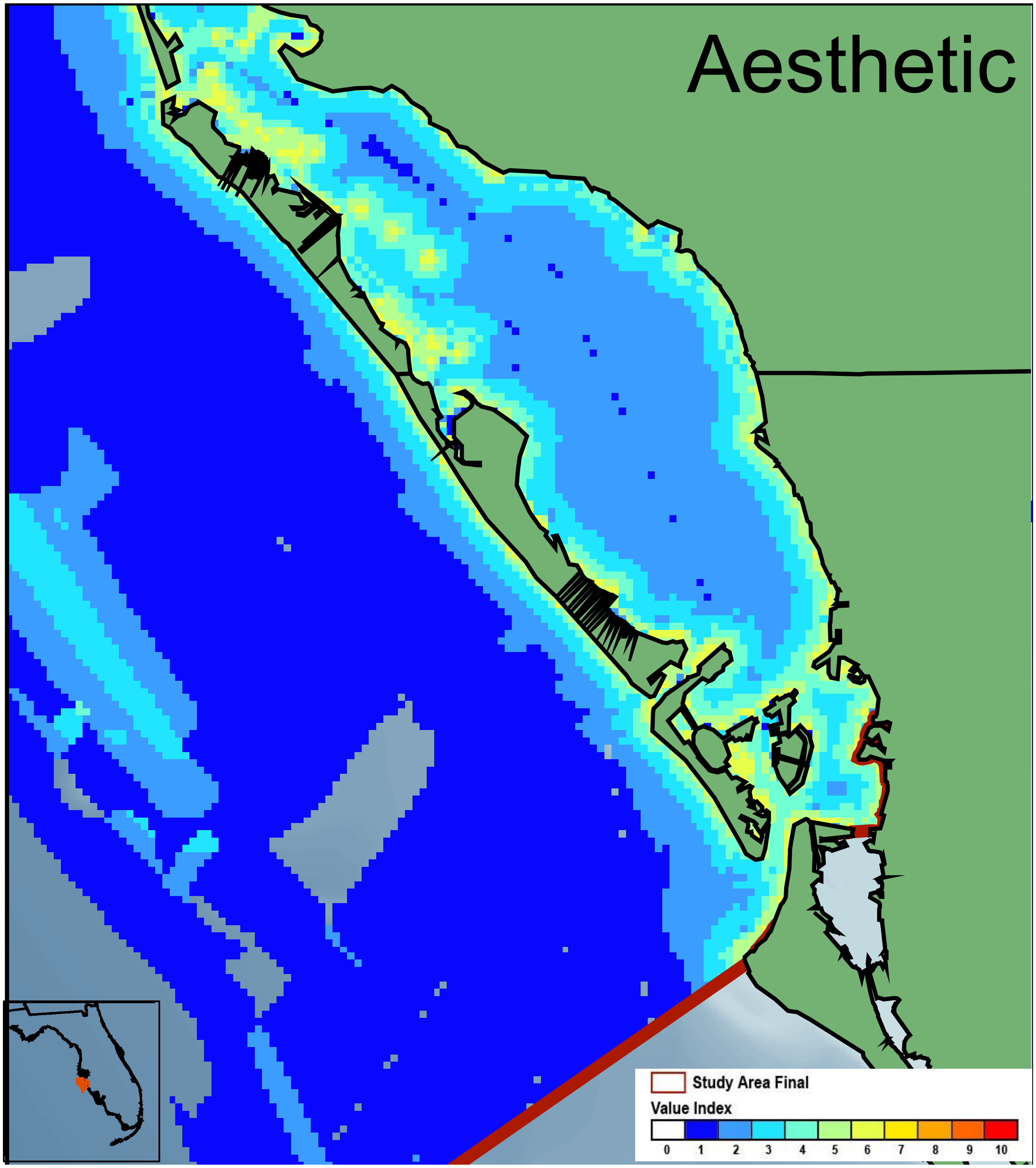
Definitional appropriateness measured on a 5-point Likert scale.

Round	% Very appropriate (5)	% Appropriate (4)	% Neutral (3)	% Inappropriate (2)	% Very Inappropriate (1)	Mean score	Standard deviation
Two	12.1	42.2	33.3	9.1	3.0	2.5	.92
Three	23.7	52.6	10.5	13.16	0.0	3.9	.92

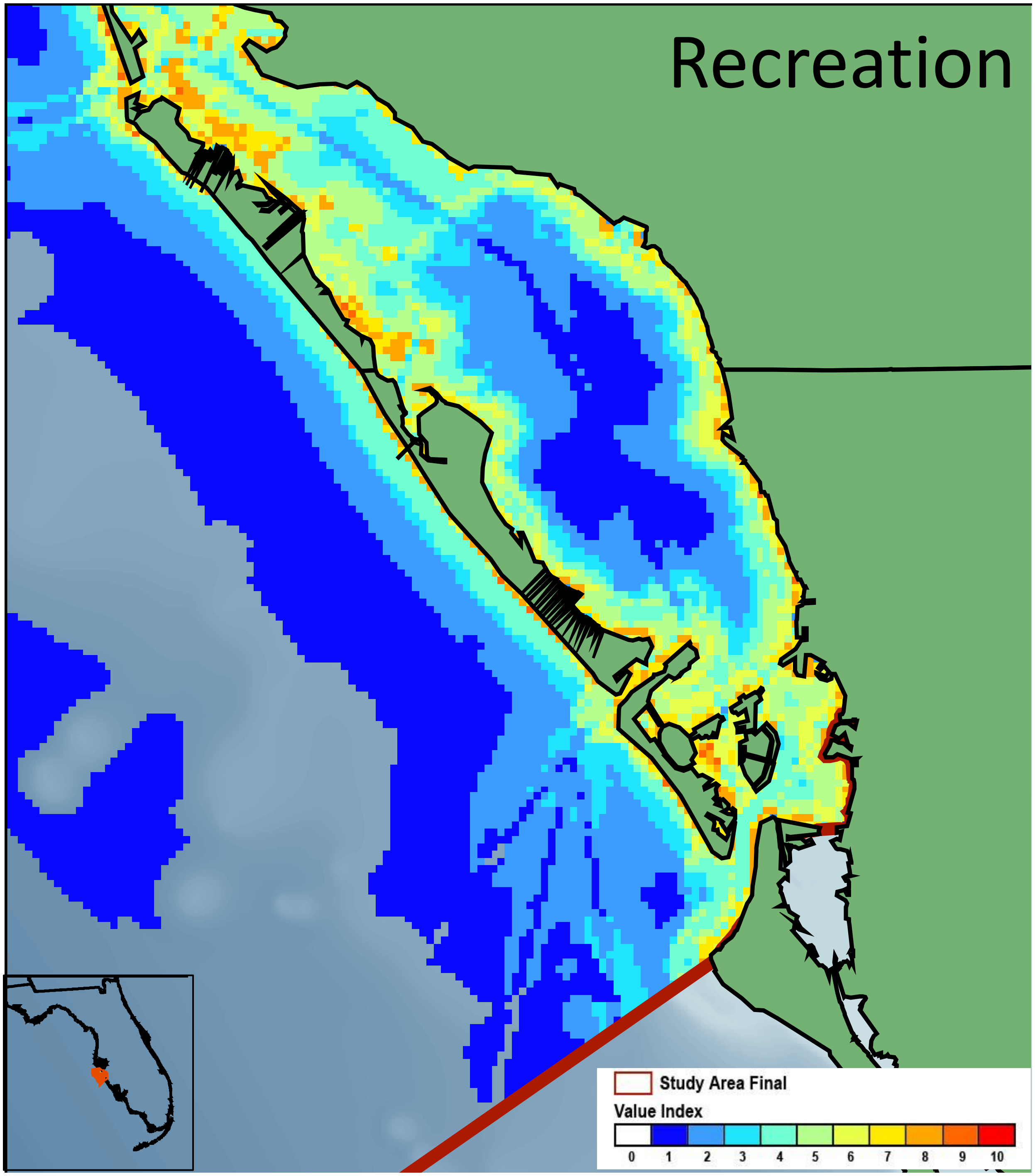
APPENDIX H
BIODIVERSITY VALUE MAP



APPENDIX I
AESTHETIC VALUE MAP



APPENDIX J
RECREATION VALUE MAP



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BIOGRAPHICAL SKETCH

Zachary Cole is a native of Washington State. He attended the University of Florida, where he received a Bachelor of Science in parks, recreation, and tourism in 2005, and Arizona State University where he received a Master of Science degree in recreation and tourism studies in 2009. Over 10 years of experience working in parks and recreation concurrent to academic studies has provided Zac a strong professional foundation. This coupled with a profound affinity for natural places and an ambition to better understand humans' connection to them has provided his inspiration to pursue a Doctor of Philosophy (Ph.D.) degree from the University of Florida in the Department of Tourism, Recreation, and Sport Management. He began his Ph.D. program in August 2009 and completed August 2012. He intends on continuing his work on stakeholder mapping and spatial quantification of social values within ecosystem management.