MARSH ECOSYSTEM SERVICES, BENEFITS, AND PERCEPTIONS OF VALUE: CASE STUDIES IN MASSACHUSETTS, VIRGINIA, AND GEORGIA

by

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Colin Polsky, Environmental Science Program, and has been approved by the members of his supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Science and was accepted in partial fulfillment of the requirements for the degree of Master of Science.

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ABSTRACT

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Human reliance on the goods and services provided by ecosystems and the global decline in the health of many of these ecosystems, necessitates ecosystem valuation for the purposes of decision-making and conservation policy. The literature suggests that conventionally employed economic valuation methods have been unsuccessful in capturing the full scope of the benefits ecosystems provide, particularly those benefits that are considered *cultural*. This research explores public perceptions of salt marsh value through the use of focus groups in marsh-adjacent communities in Massachusetts, Virginia, and Georgia. Results suggest that in case study communities, outdoor experiences in salt marshes inspire *serenity* in Massachusetts, shape *shore and "marsh" identities* in Virginia, and promote *stewardship cultivation* in Georgia. Perceived threats to these benefits, such as the threat of residential development, industrial pollution, and increasing flood risk, together constitute the context for various community responses related to marsh protection. Results contribute to existing economic valuations.

DEDICATION

To the State of Florida. Adios.

And that pizza place in Newburyport, Massachusetts.

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LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The stock of Earth's natural capital and related ecosystem services are invaluable to human well-being, providing both direct and indirect benefits. A rapidly emerging interest in the significance of these services has encouraged a multidisciplinary approach to the development of a methodology to both classify and assess ecosystem service value (Ojea, Martin-Ortega, & Chiabai, 2012). The ability of the environment to adequately supply ecosystem services under the duress of human activity has long been a concern. The severity of this issue has been outlined in detail by the Millennium Ecosystem Assessment (MEA), a comprehensive evaluation contributing to the proliferation of published research on the matter (Fisher, Turner, & Morling, 2009). A history of inquiries into environmental degradation and more recent assessments of the fragility of associated ecosystem services and benefits acts as an impetus to continue the process of assigning value to the benefits provided to humans by natural environments. While the methodology of classifying these services and benefits remains contentious in the literature, an integrative approach is necessary to achieve this goal, drawing input from environmentalists, economists, and social scientists (Johnston & Russell, 2011). Under the lens of climate change, sea-level rise, and increasing coastal development, this call-to-arms is even more relevant.

The definition of *ecosystem services* remains muddled in the literature. Ecosystem services are commonly defined as the set of benefits that humans derive from the natural functioning of Earth's environmental systems (Barbier et al., 2011; Costanza et al., 1997; Millennium Ecosystem Assessment, 2005a). Others make the distinction between *ecosystem services* and *benefits*, suggesting that while directly related, the concepts of *services* and *benefits* are different components of human–environment systems (Boyd & Banzhaf, 2007; Fisher, Turner, & Morling, 2009). Often, distinctions are made between passive and active ecosystem services, ecosystem processes versus ecosystem functions, or intermediate and final ecosystem services; thus, the need remains to develop an agreed upon descriptive framework and set of definitions.

Additionally, there is a lack of a uniform classification system to cluster together various similar services and benefits. The MEA's framework is commonly cited in the literature, however this classification scheme has also received considerable criticism (Schröter et al., 2014). Common terminology, definitions of concepts, and classification methods are necessary to perform reliable valuations and contribute to policy development. Additionally, the conventional economic methods of assessing ecosystem service or benefit value have been criticized in the literature for their inability to assess various components of value, neglecting to adequately evaluate the perceived cultural benefits provided by ecosystem services.

As is common in academia, scientific disciplines often exist in isolation, and the process of bridging between disciplinary approaches lags behind the separate advances of each field (Redman, Grove, Kuby, & Kubyl, 2004). This practice, however, is not tenable in the advancement of ecosystem services research, as there exists an inseparable coupling between humans and natural systems (Gunderson, 2001). The burgeoning development of social science research techniques have proven to be instrumental in the evaluation of human perceptions, opinions, values, and beliefs, all of which must be integrated into more traditional economic and ecological evaluations of ecosystem services and benefits (Cordell & Bergstrom, 1999).

This research seeks to further the integrative process by considering local perceptions of ecosystem services and benefits that are typically investigated in conventional economic methods in an effort to identify gaps in existing economic techniques. To accomplish this goal, an interdisciplinary team of researchers from six institutions[1] was assembled to investigate the functioning, economic value, and social perceptions associated with marsh ecosystem services and benefits at three separate sites located within the National Science Foundation's (NSF) Long Term Ecological Research Network (LTER). Founded in 1980, the LTER network includes 25 research sites within the United States, Antarctica, the Caribbean, and the Pacific, including a diverse set of biomes and land use regimes; since inception, thousands of publications have emerged from research conducted in these sites (Michaels & Powers, 2011). A core component

[1] University of Virginia, Clark University, Marine Biological Lab (MBL), William & Mary Virginia Institute of Marine Science (VIMS), University of Georgia, and Florida Atlantic University

of the multi-university team that worked on this project was based out the Florida Atlantic University Center for Environmental Studies in Davie, Florida.

While the entire process of developing a methodology for establishing ecosystem value is outside the scope of this work, we seek to further this development through a qualitative assessment of local perceptions of marsh ecosystem series and benefits in communities in Massachusetts, Georgia, and Virginia. Doing so not only contributes to the development of new methods of assessing the value of ecosystem services and benefits, but also provides insight into the relationships communities have with local marshes and the factors and processes that guide those relationships.

2. LITERATURE REVIEW

2.1 Ecosystem Services and Benefits

As defined by the Millennium Ecosystem Assessment: Synthesis Report (2005), “an ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit” (p. v). The functioning of these natural systems is integral to the health of the planet and success of its species. The scope of functions provided by Earth’s varied environments is extensive, from climatic regulation and nutrient cycling to the provisioning of clean water, fuel resources, and food. These processes vary across time and space, and often differ in magnitude from environment to environment.

Salt marshes are intertidal grasslands found in the temperate zone along shorelines around the world. Their expansion poleward is limited by the destructive forces of ice, and they occur infrequently in tropical zones due to the competitive dominance of mangroves (Bertness & Shumway, 1993; Chen, Peng, Li, Lin, & Zeng, 2013). Additionally, their establishment along open shorelines is difficult because of excessive wave action; marsh ecosystems must be protected by barrier islands, peninsulas, or other sheltering land masses. They occur most commonly in bays, estuaries, and lagoons. Expansive growth is heavily reliant on gently sloping continental shelves and abundant sediment supply; however, smaller marsh ecosystems can thrive in areas where these factors limit spatial extent (Silliman, 2014).

The services and benefits provided by marsh ecosystems have long been invaluable to the success of human civilization, whether or not the complexity of the underlying processes that result in those benefits is adequately understood. Examples of these services and benefits include wildlife habitat, contributions to personal well-being, and the provision of coastal protection. Research suggests that while coastal ecosystems are among the most economically valuable biomes due to the extensive list of services they provide, they are also one of the most threatened worldwide (Millennium Ecosystem Assessment, 2005b; ten Brink et al., 2013).

2.2 Frameworks and Classification Systems

To better understand, manage, and conserve the world's ecosystems, comprehensive publications such as the MEA (2005) and The Economics of Ecosystems and Biodiversity (TEEB) (2005) have sought to define, describe, and value ecosystem services and benefits according to various typologies. Over the last several decades, academic publications on the subject have increased dramatically. Despite the various shortcomings of each individually, perhaps the greatest contribution of these publications and associated classification schemes is the emphasis on the interdependent relationships between humans and the natural environment (Carpenter et al., 2009; Costanza et al., 2014; Potschin & Haines-Young, 2011).

2.2.1 The value of natural capital.

Through an analysis of publications over the preceding decades, Costanza et al. (1997) attempted to quantify the total value of the world's ecosystem services to more adequately express their importance for policy decisions. To arrive at an aggregate value, the authors estimated the monetary contribution and total area of each of the world's biomes. The authors provided a table delineating the ecosystem services being considered in the estimate. These categories are expressed in Table 1.

Table 1: Ecosystem services classification presented by Costanza et al. (1997). Reprinted by permission from Macmillan Publishers Ltd: Nature, Costanza et al. copyright 1997.

Number	Ecosystem Service	Ecosystem Function
1	Gas regulation	regulation of atmospheric composition
2	Climate regulation	regulation of temperature, precipitation, etc.
3	Disturbance regulation	integrity of ecosystem response to environmental fluctuations
4	Water regulation	regulation of hydrological flows
5	Water supply	storage and retention of water
6	Erosion control and sediment retention	retention of soil within an ecosystem
7	Soil formation	soil formation
8	Nutrient cycling	storage, cycling, processing, acquisition of nutrients
9	Waste treatment	recovery/breakdown of nutrients and compounds
10	Pollination	movement of floral gametes
11	Biological control	trophic-dynamic regulations of populations
12	Refugia	habitat for resident and transient populations
13	Food production	gross primary production extractable as food
14	Raw materials	gross primary production extractable as raw materials
15	Genetic resources	sources of unique biological materials and products
16	Recreation	recreational activities
17	Cultural	non-commercial uses

This publication has received considerable attention in the literature, and is cited frequently as being highly influential for promoting the development of an ecosystem services classification scheme, as well as encouraging interdisciplinary discourse regarding valuation methods. However, its publication also elicited pushback from economists and ecologists alike. Critics suggest that the authors fallaciously assume the equivalence in value of all the world's grasslands, for example, neglecting their diversity. Minimal explanation is given for each service, and value is estimated solely in monetary terms, which is particularly problematic for benefits where it's difficult to express value strictly in terms of dollars. Others pose the question ecosystem service "value to whom?" (Garwin, 1998, p. 4). To adequately answer this question, greater input and feedback from a wide range of stakeholders is required.

2.2.2 Millennium ecosystem assessment.

One of the most commonly cited frameworks in the literature is that of the Millennium Ecosystem Assessment (MEA) (2005), which defines ecosystem services as "the benefits people obtain from ecosystems"—this definition essentially uses the terms *ecosystem service* and *benefit* synonymously (p. 40). The MEA classifies ecosystem services into four distinct categories in an effort to explicitly link these services to human welfare, as shown in *Table 2*. The publication highlights the need to address the value of ecosystems, their critical functions, and the overwhelming magnitude of benefits that humanity receives from the natural environment, citing this understanding as critical for the welfare of present and future generations.

Table 2: Millennium Ecosystem Assessment (2005) ecosystem services classification.

	Services	Comments and Examples
Provisioning	Food	production of fish, wild game, fruits, and grains
	Fresh water	storage and retention of water for domestic, industrial, and agricultural use
	Fiber and fuel	production of logs, fuelwood, peat, fodder
	Biochemical	extraction of medicines and other materials from biota
	Genetic material	genes for resistance to plant pathogens, ornamental species, and so on
Regulating	Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
	Water regulation (hydrological flows)	groundwater recharge/discharge
	Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
	Erosion regulation	retention of soils and sediments
	Natural hazard regulation	flood control, storm protection
	Pollination	habitat for pollinators
Cultural	Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
	Recreational	opportunities for recreational activities
	Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
	Educational	opportunities for formal and informal education and training
Supporting	Soil formation	sediment retention and accumulation of organic matter storage,
	Nutrient cycling	storage, recycling, processing, and acquisition of nutrients

Supporting services are those "that are necessary for the production of all other ecosystem services" (Millennium Ecosystem Assessment, 2005a, p. 40). They are often considered indirect, or as the underlying functions that are essential for the functioning of the other three categories. Examples include soil formation, photosynthesis, and water and nutrient cycling. In more simplistic terms, supporting services can be described as the "infrastructure that provides the necessary conditions under which inputs can be usefully combined to provide intermediate and final goods and services of value to society" (Polasky & Segerson, 2009, p. 412).

Goods that are obtained directly from ecosystems are classified as *provisioning services*, including food, raw materials, energy, or ornamental resources (Millennium Ecosystem

Assessment, 2005a). The MEA found that the quantity of these resources consumed has increased rapidly, often outpacing population growth, and often unsustainably.

Regulating services are those benefits obtained from the normal functioning of ecosystem processes, such as carbon sequestration, atmospheric gas regulation, pollination, hazard regulation, and waste decomposition (Millennium Ecosystem Assessment, 2005a). The strain on this class of service was also found to exceed sustainable levels, primarily as a result of land use changes such as development, agriculture, and deforestation.

Cultural services are defined as "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (Millennium Ecosystem Assessment, 2005a, p. 10). This category encompasses recreational, spiritual, and educational value. The assessment found that while demand for this type of service is increasing, a reduction in the availability of areas to meet this demand may have damaging consequences on both public health and economies.

The MEA was an international, four-year, 1,300-scientist collaborative effort that successfully exceeded the breadth and depth of prior investigations. While frequently targeted in the literature as over-simplified, anthropocentric, and guilty of double-counting the value of certain services, the impact this publication has made in advancing the discussion of ecosystem value is widely recognized (Fisher et al., 2009; Johnston & Russell, 2011; Polasky & Segerson, 2009). The architecture presented stands as a robust heuristic through which ecologists, economists, planners, and policy-makers can, at the very least, begin conversations concerning the connections between human well-being and ecosystem services (Carpenter et al., 2006).

2.2.3 Intermediate and final services.

Another commonly referenced typology in the literature is the intermediate–final ecosystem services framework. Under this approach, services are classified as either: *final services* that can directly enhance the welfare of a human beneficiary through the provision of benefits; or *intermediate services*, which are "those conditions or processes that only benefit humans through effects on other, final services" (Johnston & Russell, 2011, p. 2244). In other words, the *intermediate* and *final* division is used to distinguish services based on the sequence

in which they occur, and where the direct human interaction with those services takes place. The intermediate–final framework is dissimilar to both the MEA (2005) framework and the framework presented by Costanza et al. (1997) in that a clear distinction is made between *services* and *benefits*. *Services* are biophysical processes or outputs of an ecosystem prior to human inputs or interactions (for example, inputs such as human labor, capital, technology, etc.); *benefits* describe goods, experiences, or contributions to emotional or mental well-being that are derived from services. Benefits require human inputs and interactions, such as in the case of open space (the service) used for recreational experiences (the benefit), or trees (the service) processed make construction lumber (the benefit).

Using this definition, and a lake that is popular for recreational fishing as an example, nutrient cycling and heavy metal regulation that occur within the water column and benthic zone are considered intermediate services. The recreational fisherman is not directly concerned with these ecosystem services, but rather their contribution to subsequent services. The provision of fish is considered a final service; this is the service that the recreational fisherman is primarily concerned with, and the intermediate services support the provision of those fish. The act of engaging in recreational fishing, and the resulting enjoyment of that experience, are considered benefits. Table 3 illustrates these relationships to clarify the differences between intermediate services, final services, and benefits—abiotic inputs to the system are also shown.

Table 3: Examples of inputs, intermediate and final ecosystem services, and benefits (Fisher et al., 2009; Johnston & Russell, 2011).

Relationships between inputs, intermediate services, final services, and resulting benefits			
Inputs	Intermediate Services	Final Services	Benefits
Sunlight, rainfall, chemical nutrients	Water filtration, nutrient cycling	Provision clean water	Recreational fishing, use of water for crop irrigation, drinking water
	Photosynthesis, pollination	Provision of trees	Construction lumber

According to some economists, neglecting to clearly present the columns in Table 3 as separate categories can result in *double-counting* of the value of ecosystem services, and therefore overestimate their contribution to human well-being (De Groot, Wilson, & Boumans, 2002; Johnston & Russell, 2011). An argument can be made that the MEA's typology, in addition

to many others, neglects to properly delineate the difference between intermediate and final services—suggesting water purification and the provision of freshwater as separate, rather than part of the same sequence, for example—which detracts from this classification's operational value (Balmford et al., 2011). The typologies presented by both the MEA (2005) and Costanza et al. (1997) also fall short in describing the linkages between various ecosystem services and human activity, and therefore the processes through which human's benefit.

Perhaps equally important is the proposition made by the intermediate–final framework that not all ecosystem services and benefits are independent of one another, but often act sequentially in series (services provide benefits), or in parallel (multiple intermediate services may result in one final service, or multiple final services may result in a single benefit). Acknowledging these relationships, and the sequence of processes that dictate these relationships, may be useful in advancing our understanding of the role of ecosystem services in human-environment systems.

2.3 Salt Marsh Ecosystem Services and Benefits

In an effort to establish terminological clarity, this investigation agrees with much of the literature that *services* and *benefits* should be described as distinct components within a human–environment system. The following definitions are used hereafter, paraphrased from Fisher & Turner (2008), Johnston & Russell (2011), and Boyd & Banzhaf (2007): *ecosystem services* are biophysical processes and outputs that have human beneficiaries, but do not include human involvement; and *benefits* are the contributions to personal well-being or communal fulfillment derived from those processes and outputs. *Ecosystem services* are considered in this investigation to be entirely natural processes that support various realized benefits that arise from human engagement with the environment.

Examples of ecosystem services include the provision of fresh water, natural maintenance of crab or fish populations, nutrient cycling, growth of vegetation that provides habitat, and the wave attenuation provided by marshes. All if these naturally occurring processes support the realization of various *benefits* by humans. Examples of benefits include financial gain from commercial fishing (an economic benefit) and peace of mind provided through recreation (a

cultural benefit). While the intermediate–final ecosystem services conceptual framework will not be discussed at great length, it aligns well with the definitions of services and benefits presented here.

Based a thorough search of the literature, the following three broad categories were proposed as general concepts to be investigated in this research, within the context of marsh ecosystems: *wildlife and habitat, coastal protection,* and *cultural benefits*. *Wildlife and habitat* are broadly defined as species diversity and the capacity of a marsh to support those species. *Coastal protection* refers to the storm, flood, and sea-level rise buffering capacity marshes provide. *Cultural benefits* are those experiences and cognitive processes that contribute to personal well-being or communal fulfillment, with several additional stipulations to distinguish them from *benefits* in general. For the purposes of this research, the term *cultural benefits* encapsulate the non-material contributions from ecosystems, such as enjoyment of recreational experiences, appreciation of natural aesthetics, educational opportunities, and spiritual activities. *Cultural benefits* are typically hard to quantify in strictly monetary terms, and financial markets to assign value to this type of benefit do not exist. These characteristics distinguish a *cultural benefit* from other types of benefits, such as *economic benefits.* Because the realization of cultural benefits often depends on the presence of wildlife, habitat, and coastal protection, these three concepts do not exist in isolation, and very frequently overlap.

To clarify, *cultural benefit* is used here in lieu of *cultural ecosystem service*, which is the term that appears more commonly in the literature. As noted, a portion of the literature suggests that the term *service* should apply only to entirely natural processes that occur prior to human intervention. For this reason, *cultural benefit* is used instead, which more aptly describes this collection of human–environment interactions (e.g. enjoyment of recreational experiences, appreciation of natural aesthetics, educational opportunities, spiritual activities, etc.) this research seeks to investigate.

It's also important to note that benefits such as coastal protection of homes, positive influences on property values, and financial gain via commercial fishing, for example, may also contribute to personal well-being and communal fulfillment (just like cultural benefits*)*. However,

again, the monetary value of coastal protection, and ecosystem's financial impact on property value, and commercial fisheries landings has already been thoroughly investigated in the economics literature. This type of tangible benefit is more easily valued monetarily using market-pricing techniques, and will therefore be considered as partially separate from *cultural benefits* in this investigation. However, despite the establishment of these distinctions, appropriate terminology to describe services and benefits, and methodologies of assessing their value, still remains highly contested in the literature, prompting a need for further research.

While often receiving little attention in both monetary assessments of value and policy formulation, the cultural benefits derived from ecosystem services have been shown to be fundamentally important to humans, and must be adequately considered to form a complete picture of an ecosystem's worth (K. M. Chan et al., 2012; Gee & Burkhard, 2010; Orenstein & Groner, 2014). Additionally, studies specifically concerned with the significance of incorporating cultural benefits into ecosystem service assessments suggest that the exclusion of cultural benefits is detrimental to the formulation of effective environmental policy (Maraja, Jan, & Teja, 2016; Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013; Turner, Morse-Jones, & Fisher, 2010).

2.3.1 Wildlife and habitat.

The existence of adequate habitat for plant and animal species is vital due to the inextricable link between these species and the functioning of the ecosystem services in the environment (De Groot et al., 2002). Marshes are considered one of the most productive biomes in the world, maintaining high biodiversity through the support of a wide range of organisms (Barbier et al., 2011; Feagin, Martinez, Mendoza-Gonzalez, Costanza, & Luisa Martinez, 2010; UNEP, 2006). Marshes serve as breeding grounds for aquatic organisms and seasonal habitat for migratory birds and terrestrial wildlife (McKinney & Charpentier, 2007).

For over a century, marshes have been referred to in the literature as keystone environments of larger aquatic ecosystems; they are particularly important in filling the nursery role for larger systems like bays and estuaries (Beck et al., 2001; Hay, 1905). Additionally, marsh habitats are critical for the success of a variety of economically important marine life. The success of one species often determines the success of another, such as in the case of predatory fish

regulating crab populations. Crab populations, in turn, impact the population of oysters, a keystone species of many salt marshes along the Atlantic Coast (Kritzer & Hughes, 2017). Research continues to suggest that there is a direct correlation between the productivity of fisheries and the spatial extent of nearby marshes, due to the high concentration of organic detritus and the refuge provided by indigenous vegetation (Boesch & Turner, 1984).

Atlantic fisheries are largely supported by the habitat provided by coastal salt marsh ecosystems, providing the necessary nursery environment, the provisioning of food, and protection from predators. According to NOAA's 2015 annual Fisheries of the United States report, over five million residents of the Atlantic Coast participated in recreational fishing, and residents and visitors took a combined 34 million fishing trips (National Marine Fisheries Service Office of Science and Technology, 2015).

The biodiversity maintained by marshland is integral to the health of these ecosystems, and to adjacent terrestrial and oceanic environments. Biodiversity is a multidimensional concept, frequently defined as the diversity of species and the genetic variation within those species (Beaumont, Austen, Mangi, & Townsend, 2008). Because of the regulatory and food chain relationships previously discussed, the persistence of individual species is highly dependent on the successes of those around it; population declines may create environmental disturbances that impact commercial fishing, the structural integrity of some coastlines, and even cultural benefits (Borum, Duarte, Krause-Jensen, & Greve, 2004; Worm et al., 2016). Because of the overlap between the presence of wildlife, healthy habitats, and cultural benefits to humans, the categorical distinctions between these three concepts are not clear cut. This investigation seeks to explore these relationships in greater detail.

2.3.2 Coastal protection.

Most of the world's largest financial centers and more than a third of the world's population are located in the coastal zone (UNEP, 2006; Z/Yen Group, 2016). Thirty-nine percent of the U.S. population lives in a coastal county; a recent report found that these counties contribute just over half of the country's total gross domestic product (NOAA, 2013, 2016). As growth rates in these regions continue to exceed those inland, and the effects of climate change

continue to manifest as rising sea levels and more powerful storms, coastal protection will be increasingly important. Hazard mitigation techniques have traditionally relied upon hard infrastructure solutions, such as sea walls and bulkheads, to dampen the severity of these impacts. However, large engineering projects such as these can be costly to implement and difficult to adequately maintain over the long-term; research suggests that in many cases, hard infrastructure solutions can exacerbate erosion or simply transfer damages elsewhere (Pilkey & Wright, 2017).

Coastal marshes have been touted as an effective source of coastal protection because of their ability to attenuate wave energy, increase sedimentation, and reduce erosion (Shepard, Crain, & Beck, 2011; Spalding et al., 2014). Coastal vegetation serves to reduce water flow velocities to mitigate sediment loss, and root structures can effectively stabilize soils to slow erosion. Grasses in the genus S*partina*, one of the most prolific plants found in coastal salt marshes, have long been known to provide bed stabilization due to the sand- and mud-binding capacity of their roots (Roper, 2017).

Marsh loss may also have significant impacts on local property values as a direct result of the coastal protection they provide to the natural and built environment. Moreover, recreational space and the aesthetic beauty (both considered cultural benefits) provided by these landscapes has been shown to directly influence property values (Johnston, Grigalunas, Opaluch, Mazzotta, & Diamantedes, 2002). Just as in the case of wildlife and habitat, the concepts of coastal protection and cultural benefits overlap, warranting further investigation into this relationship.

2.3.3 Cultural benefits.

Ecosystems also provide less tangible benefits than those derived directly from natural habitat and coastal protection. These are described and classified variously in the literature as: socio-cultural (Wallace, 2007); aesthetic or intrinsic (Kumar & Kumar, 2008); amenities and fulfillment (Boyd & Banzhaf, 2007); or spiritual, heritage, and sense-of-place value (Plieninger et al., 2013). Here they are collectively referred to as *cultural benefits*. Much of the literature recognizes the importance of cultural benefits, but neglects to expand upon the category further, citing them as “intangible, subjective, and difficult to quantify,” which hinders further exploration

and placement within the broader discussion of ecosystem valuation (Daniel et al., 2012, p. 8813).

Some of these benefits are derived indirectly, sometimes only through the knowledge of an ecosystem's existence, and others elicit feelings or emotions that are difficult, or impossible, to describe in monetary terms. Because this type of benefit lies outside traditional markets, classical economics has struggled to adequately assess their value quantitatively (Milcu, Hanspach, Abson, & Fischer, 2013). For example, a forest may provide the familiar ecosystem service, and related benefit, trees and construction lumber; however, what is often overlooked is the provision of spiritual well-being that certain tree stands may provide to cultures deeming the forest sacred (Millennium Ecosystem Assessment, 2005a). Similarly, fisheries have been extensively researched for their contributions to the commercial fishing industry; however, what is less often recognized is the stress relief that recreational fishing in the same body of water may provide to an individual. Even in cases where the recreational benefits of an ecosystem are recognized, such as in the case of a lake frequented by swimmers, less acknowledgement may be given to the provision of scenery often sought out by photographers and painters (Gould & Lincoln, 2017). Additional examples of cultural benefits are shown in Table 4.

Table 4: Examples of cultural benefits (Boyd & Banzhaf, 2007; Nahuelhual, Benra Ochoa, Rojas, Ignacio Diaz, & Carmona, 2016).

Benefit	Description
Naturalistic	benefits related to a sense of fascination, wonder, etc. derived from nature
Aesthetic	benefit derived from appreciating the beauty of nature
Symbolic	benefit derived from the use of nature for language and reflection
Humanistic	benefit related to the emotional closeness and love of nature
Bequest	benefit related to the preservation of nature for future generations
Moralistic	benefit derived from the spiritual relationship and ethical concern for nature

2.4 Ecosystem Valuation Methods

Ecosystem valuation is the process of assigning values, monetary or otherwise, to the world's natural environments, ecosystem services, or benefits, a process that typically begins with the adoption of one of the frameworks discussed previously (or a similarly constructed typology). As an example, the MEA (2005) estimated a coastal peat bog in Sri Lanka provided $1,750 in flood protection per hectare annually. Theoretically, the value for a given ecosystem service would be derived through the summation of the individual values of each of the benefits that

service provides. Similarly, the value of an entire ecosystem would then be the summation of the value of all ecosystem services provided by the given ecosystem. Because of the complexity and overlapping nature of individual services and benefits, and the dynamic nature of perceiving value, however, this process has proven exceedingly difficult.

The need for ecosystem service valuation is multifaceted, from increasing public awareness and interest in conservation, to effective policymaking under limited budgets. There are two primary methods for assessing this value economically: *revealed preference willingness-to-pay* and *stated preference willingness-to-pay* methods. Revealed preference assessments construct value estimates based upon actual behavior (what people are actually paying), and stated preference assessments construct value through determining what people say they are willing to pay, either through directly asking or indirectly inferring. A point of contention in both academic and policy circles is the development of a proper methodology to assess overall value that accurately captures the entire scope of benefits received through ecosystem services, including hard-to-quantify cultural benefits.

2.4.1 Revealed preference methods.

The simplest approach to ecosystem service valuation is the *market pricing* method, which uses the monetary values prescribed by markets to assign ecosystem worth—this is a called a *revealed preference* method because economists can observe what is actually being paid for a given service. This is only useful for those goods and services that are actively traded, such as timber, fisheries, or freshwater used in agriculture (Turner et al., 2010). Explicitly excluded, however, are those services or benefits for which markets do not explicitly exist, such cultural benefits. Also excluded from revealed preference methods are intermediate services, such as sediment removal by a waterbody, nutrient cycling in soils, pollination, or temperature regulation.

The *travel cost* method is another revealed preference method for generating value estimates. This approach attempts to quantify the amount people are willing to pay to visit a given natural area, by relating the number of visitors to the natural area with the costs of doing so and

the distances traveled. This may include expenses like fuel, admission, licensing requirements, and other similar variables.

This method is also problematic in ecosystem valuation, as it is only applicable when the ecosystem in question is a specific destination that requires travel to reach. For example, this method is not useful in assessing the value community residents place on marshes that are directly adjacent to their homes, as no traveling is required to reach them. The travel cost method struggles to capture the full gamut of services and benefits that an ecosystem may provide, especially those that are less tangible, like cultural benefits. The method also cannot differentiate between the various individual services and benefits a given ecosystem provides, but rather an aggregate of a group of services and benefit. A family paying to access a state park may enjoy a variety of benefits while visiting, such as recreational enjoyment, stress relief, and even educational opportunities. The value obtained using the travel cost method provides a sum total value of the ecosystem services that provide those benefits, with no estimates for specific contributing benefits. Travel cost also requires a large amount of data across a broad spectrum of variables, and becomes confounding when trips are multipurpose (Turner et al., 2010).

Another approach is the *production function* method, which attempts to assess ecosystem value based on how structural changes to a given service impact human benefits—this technique is also known as *dose-response* (Turner et al., 2010). As an example, measuring the impacts of pesticide application on farm A to the process of pollination that is required for successful coffee production on neighboring farm B. Holding all else equal, the pesticide application on farm A may have detrimental effects to pollination, and therefore coffee production and profits, on farm B. Quantifying the reduction in profits due to decreased pollination provides an economic value for that pollination. Weighing the benefits of an action against the costs of potential ecosystem service degradation can help to ascertain assignable economic values to relevant ecosystem services (Bruins et al., 2016). Again, while this method is useful in specific instances, it relies on assigning solely monetary value to ecosystem services and benefits, a procedure that is difficult to employ when measuring cultural benefits.

Other revealed preference methods exist, but they generally suffer from the same shortcomings—namely, an inability to assess the value of cultural benefits.

2.4.2 Stated preference methods.

Stated preference methods are necessary in the formulation of economic estimates that attempt to capture the entire value of an ecosystem, unlike revealed preference methods, they are intended to include cultural benefits. Contingent valuation (CV) is a method of establishing nonmarket resource values, most commonly used in environmental and ecosystem service appraisals (Jones & Duignan, 2013). CV is one of the only stated preference techniques used to quantitatively assess an ecosystem's value—in other words, the value an individual or group will attach to a particular service or benefit, determined by the amount a respondent is willing to pay to maintain, protect, or repair a natural environment. This type of investigation typically uses surveys that ask respondents to select from various scenarios describing environmental conditions with costs associated with each (Carson, 2000). For example, respondents may be provided with several hypothetical conservation scenarios, each with a different cost and conservation outcome, and be asked to choose a preference: scenario A costs $B and will result in C number of acres of land preserved for D number of migrating birds; scenario W costs $X and will result in Y number of acres of land preserved for Z number of migrating birds.

The State of California used this technique to determine the economic value of maintaining water levels in Mono Lake versus drawing additional water into Los Angeles for municipal purposes. The state provided households with a photo survey displaying simulations of various water levels in the lake, tied to the costs associated with maintaining those levels. The survey was intended to consider changes to public visitation to the lake, as well as projected implications of water level reduction to native bird populations. While drawing additional water from the lake would be cheaper than sourcing supplies from elsewhere, results from the survey indicated that the benefit of maintaining higher water levels was greater than the outsourcing costs (Loomis, 1987).

CV has been widely used for over 50 years in environmental contexts, in both academic and policy settings (Carson, 2000). However, methodological criticisms highlight several flaws,

namely the difficulty in validating results and the hypothetical nature of determining values, both of which decrease the scientific rigor of the results. Results can be difficult to validate in scenarios such as in the example of Mono Lake—water managers were unable to realistically test results of the CV study by manipulating water levels and recording data via the revealed preference method, i.e. the difference in number of people that traveled to the lake for recreational purposes to visit a full lake versus an empty lake. The hypothetical nature of the scenario may also create problems because respondents may be unable to fully visualize their options; in this example, they were only provided with a single simulated photograph of the lake under different conditions.

A similar problem, the free-riding effect, describes a situation where respondents may underreport the value they assign to a benefit if they feel they may actually be charged for that benefit when it was previously free (even if they do value it). On the other hand, respondents may overstate the value "if they believe they will not actually have to pay their [declared] willingness to pay, but hope to influence the provision of the benefit in question" by assigning a higher monetary value (Hackl & Pruckner, 2005, p. 2). Additionally, some people may exhibit the warm glow effect, which describes the propensity for certain people to be generous, regardless of the benefit being valued (Arrow et al., 2001).

In 1993, NOAA convened a panel of economists to gauge the efficacy of CV. The panel published results in 1995, finding that CV methods could be highly effective in eliciting stated preferences that aligned with revealed preferences for market goods (Arrow et al., 2001). For example, a study found that stated willingness-to-pay values for strawberries aligned well with revealed willingness-to-pay values ascertained via market pricing (Dickie, Fisher, & Gerking, 1987). However, translating this example to non-market ecosystem services CV is problematic for numerous reasons; validation with market prices is not possible in the case of cultural benefits where markets do not exist (e.g. spiritual well-being, aesthetic appreciation, intrinsic love of wilderness—these benefits do not appear on financial exchanges), and respondents often have difficulty with the concept of monetizing the cultural benefits they receive from ecosystems (Chan, Satterfield, & Goldstein, 2012). For example, attempting to quantify in monetary terms the

transformative value of ecosystems—in other words, how experiences in nature impact a person's worldview—is extremely difficult (Norton, 2012).

The NOAA panel reported that shortcomings likely exist when respondents were asked to consider hypothetical markets—most notably, "that the CV technique is likely to overstate 'real' willingness-to-pay" (Arrow et al., 2001, p. 8). However, the results of a meta-analysis comparing 616 values of quasi-public use goods derived from 83 studies found that stated preferences determined via CV were actually less than values determined via various revealed preferences methods such as travel-cost and market pricing (Carson, Flores, Martin, & Wright, 1996). In an Australian CV study attempting to quantify the existence value of an endangered bird species, over half of the respondents indicated they would be unwilling to contribute to a fund supporting the birds' protection; however, over 80% indicated that they would be upset with the birds' extinction (Zander, Ainsworth, Meyerhoff, & Garnett, 2014). These results cast additional doubt on the ability of CV to adequately assess the value of ecosystems, services, or benefits—in this case, the endangered birds. If the vast majority of respondents indicated they would be negatively impacted by the loss of endangered bird species, why would they not be willing to pay to preserve them? Perhaps the full range of benefits provided by natural environments cannot be valued in purely monetary terms.

By definition, stated preference values determined via CV are intended to consider cultural as well as market benefits, and should therefore exceed those as determined by revealed preference methods that *cannot* assess value for the entire spectrum of cultural benefits. However, as in the above examples, they often do not, which indicates significant value may exist outside of the conventional economic monetary interpretation of value garnered from CV.

Despite a general acceptance in the scientific community and a growing legacy of research utilizing CV methods, problems persist in proper execution of the method as well. Participants' concrete understanding of the concepts being discussed is considered a prerequisite for effective CV analyses; without proper survey development, such as the survey testing done via focus groups discussed in Johnston et al. (1995), proposed scenarios can be confusing to respondents. Additionally, the public has a poor understanding of complex underlying ecosystem

functions, such as nutrient cycling, and concepts such as biodiversity, if they are not explicitly explained using colloquial terminology (Beaumont et al., 2008). This in no way indicates that the public does not care about these services, but rather suggests proper interview design is imperative. Studies show that when well-constructed, surveys and interviews can yield results that indirectly indicate perceived value (Christie et al., 2006). For example, respondents may indicate that they place high value on viewing a variety of wildlife found in marsh ecosystems, regardless of their ability to express this as biodiversity.

Other suggestions appearing in the literature include: in-person surveying; full descriptions of the context in which the good or service is being valued (for example, if the survey is for policy development, explain that it is being used to gauge opinion regarding public spending to fund conservation); and debriefing questions to glean additional information regarding the motivations behind specific answers, and a respondent's understanding of the questions (Arrow et al., 2001; Carson, 2000; Johnston, Weaver, Smith, & Swallow, 1995). These suggestions all point to a glaring shortcoming of CV techniques, as previously discussed, in determining ecosystem service value—a lack of deliberative conversation with respondents and *qualitative, discourse-based valuation techniques*.

2.5 Policy Implications of Stakeholder Input in Ecosystem Valuation

Qualitative methods of ecosystem value research have steadily gained traction in the literature, both as a supplemental technique to traditional quantitative research (Amin, Zaehringer, Schwilch, & Koné, 2015; Busch, La Notte, Laporte, & Erhard, 2012), and as a robust methodology in its own right (Carson, 1998; Johnston et al., 2002; Kaplowitz & Hoehn, 2001). While opinions on approach and study requirements vary, it's clear that the input of stakeholder preferences and opinions regarding ecosystem services and benefits is a useful contribution, and in most cases absolutely necessary, in capturing the complexity of values that can be assigned to ecosystems. The inclusion of qualitative methods can likely yield improved estimations of value beyond purely monetary estimates, and have meaningful ramifications in the development of environmental policy (Felipe-Lucia et al., 2015).

The complex nature of environmental issues and the diversity of benefits provided by ecosystem services necessitates stakeholder input for effective environmental decision-making, and has been an increasingly sought after contribution to policy development (Reed, 2008). Use of the ecosystem services and benefits concept continues to gain traction in the policy realm, as it's been proven helpful in communicating the importance of ecosystem conservation to human well-being (Hauck, Görg, Varjopuro, Ratamäki, & Jax, 2013; ten Brink et al., 2013). This is perhaps due to its anthropocentric focus, highlighting the inherent human dependencies on ecosystem goods and services—for example, the economic co-benefits of marsh conservation on fisheries sustainability. The literature also shows that the inclusion of stakeholder input in assessing environmental vulnerabilities, values, and priorities is invaluable in the actual development of adaptive solutions and management policies (Reed, Dougill, & Baker, 2008; Spalding et al., 2014). Additionally, stakeholder inclusion throughout the decision-making process can increase public interest and support, effectively bolstering both the quality and the durability of environmental policy (Chess & Purcell, 1999; Millennium Ecosystem Assessment, 2005a; Partelow & Winkler, 2016). It has been suggested that without targeted participatory efforts to ensure that the scientific results are both desired by the local public and viewed as feasible by elected decision-makers, even the most robust scientific findings may go unheeded, and therefore fail to make meaningful long-term contributions to human–ecosystem sustainability (Sutton & Kemp, 2006).

3. RESEARCH QUESTIONS

3.1 Research Questions

Ecosystem classification typologies, such as those presented by Costanza et al. (1997), MEA (2005), and Johnston et al. (2011) provide meaningful contributions to the process of valuing ecosystems and associated services and benefits, however their consideration for the value of cultural benefits falls short when used solely in conjunction with traditional economic valuation. While CV continues to produce increasingly meaningful valuations for a range of ecosystem services, CV methods also fail to adequately capture the true complexities of the cultural benefits provided by ecosystems. Without the adequate inclusion of discourse-based qualitative assessments, the full gamut of these cultural benefits, and therefore value of ecosystem services and entire ecosystems, remains obfuscated.

The marsh ecosystems and related services discussed herein are largely considered public goods, and it is therefore unlikely that the actions of free markets will be sufficient to maintain their long-term health. Additionally, because of the disconnect that presently exists between the public value placed on marsh ecosystems and the policies that are in place to preserve them, it is unlikely that current conservation is sustainable in the long-term. The research presented here seeks to apply a methodology for advancing ecosystem valuation methods via a qualitative approach, field tested in communities in Massachusetts, Georgia, and Virginia. Results of such an investigation can meaningfully contribute to sustainable ecosystem conservation policies affecting community–marsh systems.

This research explored the following questions pertaining to ecosystem services and benefits, local perceptions of their value, and the resulting human-environment relationships:

3.1.1 Perception of Ecosystem Services and Benefits

I. What ecosystem services and benefits are locally perceived to be supplied by coastal salt marshes?

a. How valuable are these ecosystem services and benefits perceived to be? What are the major motivations behind these perceptions?
b. Do perceptions of value differ from community to community? What factors influence these differences?

3.1.2 Human–Environment Interactions: Processes, Relationships, and Implications

II. What are the processes by which these benefits are supplied?
    a. Do residents perceive a relationship between their own well-being and the health of local salt marshes?
    b. Do residents have concerns regarding sea-level rise, development, or other threats as they relate to the provision of marsh ecosystem services or benefits?
    c. What contributions can feedback from local residents provide in advancing the ecosystem services framework discussion?
    d. What processes occur during the realization of ecosystem benefits?
    e. What are the policy implications of these findings?

4. METHODS

4.1 Site-Specific Backgrounds and Previous LTER Research

The research for this study, taking place under the umbrella of a more comprehensive, transdisciplinary, multi-university NSF Coastal SEES (Science, Engineering, and Education for Sustainability) grant, will be conducted in three different LTER sites and their surrounding communities: Plum Island Ecosystems (PIE), the Virginia Coast Reserve (VCR), and Georgia

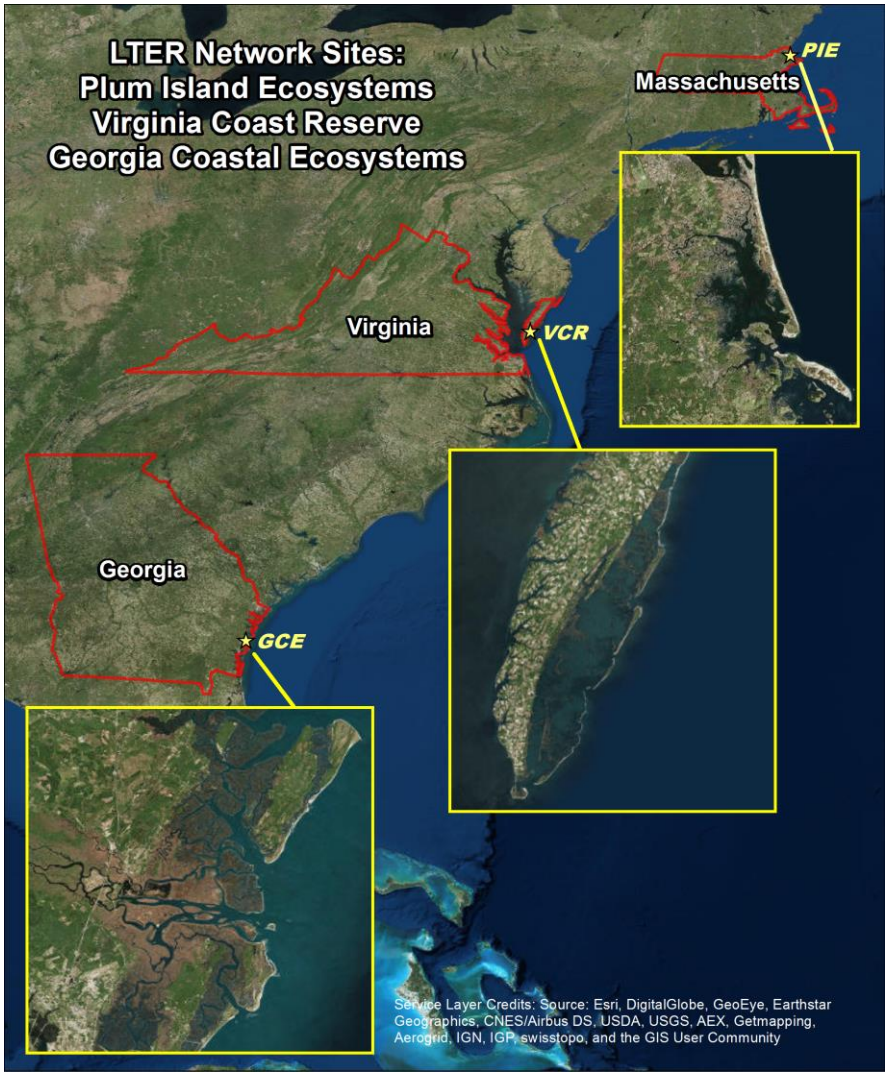


Figure 1: PIE, VCR, and GCE LTER sites.

Coastal Ecosystems (GCE). These locations are shown in Figure 1. The three sites encompass similar salt marsh ecosystems across diverse geographies on the Atlantic coastline, all of which presently face similar threats from sea-level rise, exacerbated by human use and development. Research across a broad spectrum of disciplines has been conducted at each of these sites; over the last decade, an increasing number of publications have resulted from this transdisciplinary research, focusing on long-term marsh sustainability under the threats of coastal development and sea-level rise (Michaels & Powers, 2011). Despite this, a search for the terms “cultural ecosystem services” and “cultural ecosystem benefits” returns zero results on the list of publications for each site.[2]

4.1.1 Plum island ecosystems.

The PIE area is located on the coast of northern Massachusetts and is the largest salt marsh in New England, colloquially referred to as The Great Marsh. The site was designated as part of the NSF’s LTER network in 1998, and is primarily composed of the estuary and the Boston Metropolitan region’s watersheds of the Rowley, Ipswich, and Parker Rivers—a combined drainage basin of over 600 square kilometers (LTER Network & National Science Foundation, 2016). Most the LTER research sites in PIE are located within or directly adjacent to the salt marshes in the towns of Newburyport, Newbury, Rowley, and Ipswich. The marshes here have supported economic activity in the region via commercial fishing and clamming, recreational activities, and haying (the harvest of marsh hay for insulation, mulching, and livestock feed) for hundreds of years (Buchsbaum et al., 2009). For demographic data, see Appendix 9.5.

4.1.2 Virginia coast reserve.

The VCR is located within Accomack and Northampton Counties at the southern tip of the Delmarva Peninsula on Virginia’s Eastern Shore, and is bounded by the Chesapeake Bay to the west and the Atlantic Ocean to the east. Many of the small towns in the region are designated state historic districts and seek to maintain their historic architecture and small-town feel, in contrast to the booming tourist beaches in the nearby Hampton Roads area to the southeast. The

[2] As of writing, February 2017.

most recent Comprehensive Economic Development Strategy prepared by the Accomack–Northampton Planning District Commission identified agriculture, food processing, chemical production and other manufacturing, defense and security, and entertainment and recreation as some of the region's primary economic clusters. While historically higher than they are at present, both Accomack and Northampton Counties have substantial commercial fishing industries (Virginia Economic Development Partnership, 2015). For demographic data, see Appendix 9.5.

4.1.3 Georgia coastal ecosystems.

Established as an LTER site by the NSF in 2000, the GCE area is located within Glynn and McIntosh Counties, located centrally along Georgia's Atlantic coastline. The area consists of the upland Altamaha River estuary, lagoonal estuaries, intertidal marshlands, and barrier islands. The communities in the region have a rich history of shrimping and commercial fishing, and maintain one of the most productive seafood industries on the east coast. The coastal salt marshes are a focal point for recreation and community activities, and alongside the many historic sites, have long contributed to the cultural heritage of the region. Hunting, fishing, and boating are all popular recreational activities for residents and tourists alike. For demographic data, see Appendix 9.5.

4.2 Focus Group Planning

As discussed previously, a core component of this research revolves around the use of qualitative, discourse-based data for advancing ecosystem valuation methods—focus groups serve as an ideal vehicle for achieving this goal. Focus groups are defined as "a way of collecting qualitative data, which—essentially—involves engaging a small number of people in an informal group discussion (or discussions), 'focused' around a particular topic or set of issues" (Wilkinson & Silverman, 2004, p. 179). While first formally used outside of academia in military applications and marketing, focus groups began to emerge as a robust method for conducting scientific qualitative data collection and research in the 1980's (Bacigalupe, 2005; Bloor, Frankland, Thomas, & Robson, 2000).

The format of this investigative method was particularly useful for our purposes because it allowed for the collection of individual, as well as group, insights that may not have otherwise

been revealed through quantitative data collection methods. Qualitative social science approaches are often able to gain insight into motivations and perspectives that can neither be directly observed nor quantified in monetary terms (Kaplowitz & Hoehn, 2001). In a study seeking to advance discourse-based ecosystem valuation techniques, researchers found that small discussion groups yielded a greater breadth of information than individual interviews generally did. It was observed that respondents were more forthcoming with controversial information in individual interviews, but because of the topics of this investigation are relatively innocuous, this was of little concern (Wilson & Howarth, 2002).

We held 3 focus group discussions (FGDs) in each state, for a total of 9 groups. All FGDs took place in proximity to their respective LTER Network sites. Massachusetts groups were held near the PIE site—the *adjacent community* in which these groups were held will hereafter be referred to as *MA*. Similarly, Virginia's FGDs were held near the VCR site, and Georgia's FGDs were held near the GCE site; the communities in which these FGDs took place will hereafter be referred to as *VA* and *GA*, respectively. Nine FGDs was determined to be a sound number based on the methodologies described in similar ecosystem services studies published recently (Kaplowitz & Hoehn, 2001; Kosoy, Corbera, & Brown, 2008; Sousa, Lillebø, Gooch, Soares, & Alves, 2013). Recruiting was conducted over the course of several weeks prior to the convening of each FGD and was handled by GreatBlue Research, a firm specializing in this type of recruitment for academic research.[3] Because this research is academic in nature, GreatBlue had access to contact lists, or sample, outside of those used in typical advertising- or marketing-based FGDs, effectively mitigating career focus grouper bias.[4]

According to the literature, more demographically homogenous FGDs provide more comfortable sharing environments, encouraging attendee discussion; however, a lack of diversity can also result in a narrow range of viewpoints and rapid feedback saturation (i.e., information begins to frequently reoccur, and "the collection of more data appears to have no additional

[3] http://www.greatblueresearch.com/
[4] The term "career focus grouper" refers to individuals that routinely seek out and attend focus groups as a source of income.

interpretive worth"), obscuring additional perspectives (Greenwood, Ellmers, & Holley, 2014; Onwuegbuzie, Dickinson, Leech, & Zoran, 2009, pg. 4). However, the literature also suggests ideal group make-up is highly topic dependent. For these reasons, and to broaden the potential sample population, thereby increasing the chances of achieving 12-person groups, few recruitment guidelines were developed. We advised GreatBlue that participants should have been residents of the area for at least six months, and no participant is to attend more than one group (Appendix 9.1).

FGD guidelines generally dictate that groups should be comprised of between 8 and 12 participants and last between 60 and 90 minutes (Cronin, 2009; Morgan, 1997). We planned for 75-minute groups (some ran for 90)—we found this to be ample time to address each specific goal of the investigation, without inadvertently inducing fatigue in the participants by running longer. Turnout rates are shown in Table 5.

Table 5: Actual number of participants out of the total intended (12), per group, and composite turnout rates, by state.

Focus Group Discussion Attendance, by State			
	MA	VA	GA
FGD1	11/12	12/12	10/12
FGD2	12/12	10/12	11/12
FGD3	12/12	12/12	10/12
Total % for the state	97%	95%	86%

FGDs were held in May (MA) and June (VA and GA) of 2017 at public, centrally located, easily accessible, venues (e.g. libraries, schools, and the LTER research sites). They were scheduled in the evening during the week to encourage participation by those who work or would be otherwise occupied during the day or on weekends. Venue choice was guided by locally-based research teams working on other aspects of the project, in addition to venue availability, amenities, room size, and privacy. Participants received a consent form outlining the purpose of the research and a confidentiality statement regarding data security prior to the day of each FGD (see Appendix 9.2). These were again reviewed with participants at the start of each group by the moderator. Refreshments and light snacks were provided, and attendees were compensated $85 cash at the completion of each FGD.

4.3 Focus Group Data Collection and Processing

Prior to holding the FGDs, we developed sample focus group questions—henceforth referred to as the *focus group instrument* (FGI)—based on the goals of the research and guidelines set forth in the literature (Morgan, 1997; Punch, 2014). The FGI was informally tested during the spring of 2017 to various groups of graduate students and staff at Florida Atlantic University, and refinements were made based on test participant feedback, perceived comprehension of content, and general direction of the dialogue. The final FGI sought to elicit responses pertaining to attendees' interest in local marshes, perceptions of the marshes' value, perceived threats, and common usage (such as recreation, etc.). The same FGI was used in all 9 FGDs (see Appendix 9.3).

In addition to proper FGI development, the experience and competency of the moderator is frequently cited as paramount to the success of the group (Bacigalupe, 2005; Balch, 1999; Belzile & Oberg, 2012). Maintaining the trajectory of the FGDs is essential for pertinent data collection, revealing a variety of viewpoints, and exploring appropriate depth of certain concepts and motivations. The FGDs were moderated by primary investigators (PIs) from Florida Atlantic University and Clarke University, both with extensive experience moderating FGDs for academic purposes.

FGDs were audio recorded and notes were taken by investigators that were not actively moderating; this additional documentation served to supplement the audio with a record of gestures, facial expressions, emphasis, and other cues that may not otherwise be captured in the audio alone (Cronin, 2009). At the close of each FGD, attendees were asked to complete a voluntary demographics survey (Appendix 9.4); additional data regarding race/ethnicity, gender, age, education, income, and zip code of residence may serve to provide insight into discussion content during the analysis phase (Greenwood et al., 2014).

After each group's completion, audio recordings were transcribed by a small team of graduate researchers with the aid of ExpressScribe Pro.[5] In order to ensure both accuracy and

[5] Distributed by NCH Software (http://www.nch.com.au/scribe/)

consistency in transcription method, all 9 groups were first transcribed by one researcher verbatim. This was followed by a two-step verification process, in which two additional researchers each made a pass over the entire transcript alongside the original audio, making adjustments where necessary. While the names of attendees were not collected, dialogue was referenced by speaker (represented numerically). Bracketed insertions were made in the transcripts wherever relevant, such as in the case of special emphasis or non-verbal cues, based upon notes taken during the groups. All data is kept on PI-owned personal computers, accessible via a protected shared network drive, and any hard copies remain inside locked file cabinets when not in use.

4.4 Data Analysis Using Grounded Theory

Qualitative research methods are best suited to inquiries of human perceptions, opinions, subjective understanding of personal experiences, and other assessments where quantitative data alone is unable to adequately explain the intricacies of a given phenomenon (Ratner, 2012). Grounded theory (GT) has emerged in recent decades as a qualitative methodology, that when conducted using appropriate scientific rigor, can yield meaningful theoretical insights into human behavior (Charmaz & Belgrave, 2002). Initially established in 1967, this method seeks to develop "theory from data" and a "nuanced understanding of the lived experience" (Glaser & Strauss, 1967, p. 6; Hsieh & Shannon, 2005, p. 1281). To clarify, GT is a specific methodology that maintains rigorous standards in investigations of qualitative data. The result of GT's application is a newly developed understanding (hence the term "theory" in the name) of a previously under-researched subject matter.

Researchers using GT are tasked with approaching their analyses of qualitatively derived data, such as transcripts from FGDs, with as little bias as possible to inductively develop theory based solely on the information before them (Charmaz & Belgrave, 2002). In conforming to this principle, hypotheses are intentionally absent from this research proposal, replaced only with the identification of a gap in the literature and accompanying research questions. Rather than researchers testing results against existing theories and models, GT is intended to assist in

developing new theories to explore phenomena that remain inadequately documented or poorly understood.

In the years since its development, the founders of GT have split into two distinct schools of thought—one maintaining a classical interpretation requiring a less structured methodology, and the other suggesting more rigid guidelines in the development of applicable theory. This investigation adopts principles primarily from the latter, as described by Corbin and Strauss (1997, 2015), as well as additional principles introduced by Charmaz (2006), described in greater detail in the following sections. While the procedure discussed here can be completed by hand, the availability of software that specializes in qualitative data management makes sorting and analyzing qualitative data a much more efficient process. This analysis uses NVivo 11 Pro to "code" the raw FGD discussion transcripts, a methodological step that is commonly used in a variety of qualitative analysis methods.[6]

The first phase of the process is *open coding*. Punch (2014) describes this process as "a first level of conceptual analysis with the data," the idea is "to open up the theoretical possibilities in the data" (p. 180). Open coding is the most exploratory phase of the GT progression; it involves assessing each line in a transcript and assigning conceptual labels according to the themes presented (Corbin & Strauss, 1990). As an example, in a study investigating the values community leaders place on various landscapes, researchers labeled, or *coded*, text according to the specific natural resource asset being referenced (e.g., a discussion of "surface water" or "runoff" was coded as *water quality*) (Hatton MacDonald et al., 2013). Open codes are intended to be short, paraphrased versions of the concepts presented in the text, using the same wording wherever possible.

Various schools of thought exist regarding the specifics of the open coding phase of GT analysis. *Line-by-line* open coding is a common method where the researcher systematically assigns a code to each line of text within the transcript; here, each *line* of text serves as an arbitrary unit of content, which helps the coder ensure all concepts are captured in the coding

[6] Formerly known as NUD*IST, distributed by QSR International (http://www.qsrinternational.com)

process. We chose to use *incident-to-incident* open coding, where the coder assigns codes based on complete concepts that appear in the transcript (Charmaz, 2006). As an example, a line in a transcript reading “we really enjoy fishing on the out in the marshes… we’ve been going on trips on the weekends with our neighbors for a long time, and just really love getting out there” may be open coded as *enjoys group recreational fishing in marsh*, regardless of how many lines constitute this quote in the transcript. This method of open coding allowed us to capture a greater degree of context within a single code, and encouraged the use of longer code names. Longer codes retain their meaning more effectively than shorter, less descriptive codes.

GT is an iterative process, dictating that as the researcher proceeds through the data, they take specific note of thematic recurrences. In the event that initial codes do not consistently appear in the data, alterations can be made to account for the possibility that the researcher misinterpreted an earlier portion of the transcript (Corbin & Strauss, 1990; Hatton MacDonald et al., 2013). Occasionally, a concept would appear early on in a transcript and would be misinterpreted by the coder, a realization that was made later on in the coding process when a participant more adequately explained what they had been referring to.

The second phase of the process, known as *axial coding*, is described as sorting the open codes to encourage an emergence of broader themes from the data. In a hierarchical sense, axial codes are the individual branches upon which the leaves (i.e. open codes) hang (Cullity, 2010). During this phase, coders begin to cluster open codes into groups, slowly establishing slightly broader explanatory themes drawn directly from the open codes within. Coders are once again tasked with assessing the validity of their open codes based on the incidence rate of a given theme—if sufficient open codes cannot be reasonably assigned underneath a broader axial code, there is likely not enough data to support the broader theme the axial code is intended to represent. Strauss and Corbin (1990) describe this process as a reconstruction of the data after the open coding process to begin formulating new connections and novel insights.

The third phase is known as *selective coding*, defined by Corbin and Strauss (1990) as “the process by which *all* categories are unified around a ‘core’ category, and categories that

need further explication are filled-in with descriptive detail," and usually occurs after significant progress has been made in both the first and second phases of the progression (p. 14). The final selective codes represent the overarching phenomena observed in the study, explained in greater detail by the tiers (axial codes, followed by open codes) beneath it. To once again refer to the tree analogy, the broadest thematic concepts developed during the selective coding process represent the tree trunks. Depending on the topic of research, specific questions, and data content, this process may result in one or more selective codes. NVivo manages this conceptual hierarchy as a series of coding echelons; selective codes (themes) contain the explanatory axial codes (subthemes) within, and axial codes contain the explanatory open codes within. This hierarchy is shown in Figure 2.

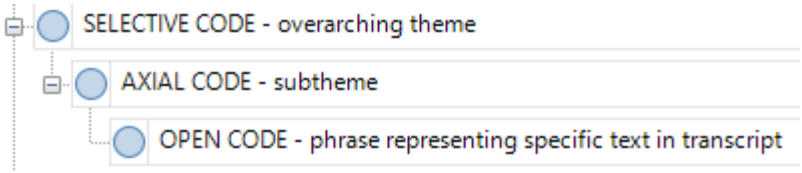


Figure 2: NVivo's coding hierarchy user interface; open codes are stored within axial codes, which are stored within selective codes.

Several techniques are recommended in the literature to help ensure the reproducibility of coding results, including employment of multiple coders from a diversity of academic backgrounds (Potter & Levine-Donnerstein, 1999; Stevens, Lyles, & Berke, 2014). To confirm that all relevant themes were captured in the coding process and to mitigate against coder partiality to certain concepts, each transcript was coded once by three different graduate researchers, each from a different primary field of study. Coding was done in isolation to limit biases that could be introduced inadvertently through discussion of the data or coding process. Weekly meetings were held to discuss general progress and ensure procedural consistency.

Each state's transcripts were coded in the two weeks following the corresponding FGDs so as to retain as much familiarity with the original content as possible, and to avoid inadvertently translating a concept from one state to the next. Intermittently throughout the coding process, from open to selective coding, sets of codes from specific transcripts were compared with others from the same state, as well as across the other two states. In some cases, this comparison step

lead to the merging, renaming, or re-coding of certain concepts to establish new themes. In this way, GT is not a linear process, but rather an iterative one involving constant comparison between different data sources and the three hierarchical coding echelons that constitue the method. This process is represented graphically in Figure 3.

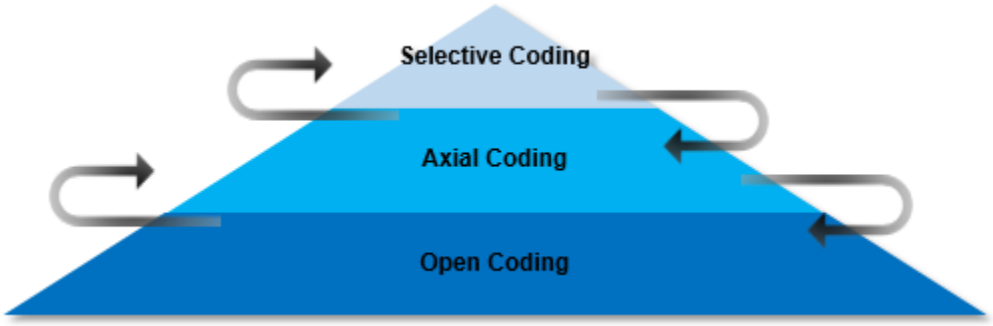


Figure 3: The iterative process of constant comparison prescribed by the grounded theory methodology. Arrows indicate the resorting and renaming that is expected in GT. For example, axial codes that appear to initially emerge may be dissolve later on, the open codes underneath being moved to other axials or forming new ones. The tiers of the pyramid represent increasing abstraction, from individual open codes (generally a large number of codes) to the broad themes developed during the selective coding state (much smaller, refined number of codes).

We then merged the three sets of codes for each FGD; for example, the three different versions of the first FGD in MA, one from each of the three coders, were combined into a single file. This is an automated process completed by NVivo. Following the merge function, we resorted and renamed codes wherever necessary. This was a team-oriented exercise where different interpretations and hierarchical organizations were discussed before final decisions were made. The final step was merging the individual FGD sets of codes from each state into unified sets of codes representing the three FGDs from a given state, an operation once again performed automatically by NVivo. This generated one composite file for each state; a visual guide to what this process looked like is shown in Figure 4.

We edited each of the three state files again, ensuring the same code names were referencing the same concepts, our hierarchies were supported by the data, and all duplicate information potentially introduced in the file merge process had been eliminated. This resulted in a total of 2418 codes in the MA file, 2316 in the VA file, and 2658 in the GA file.

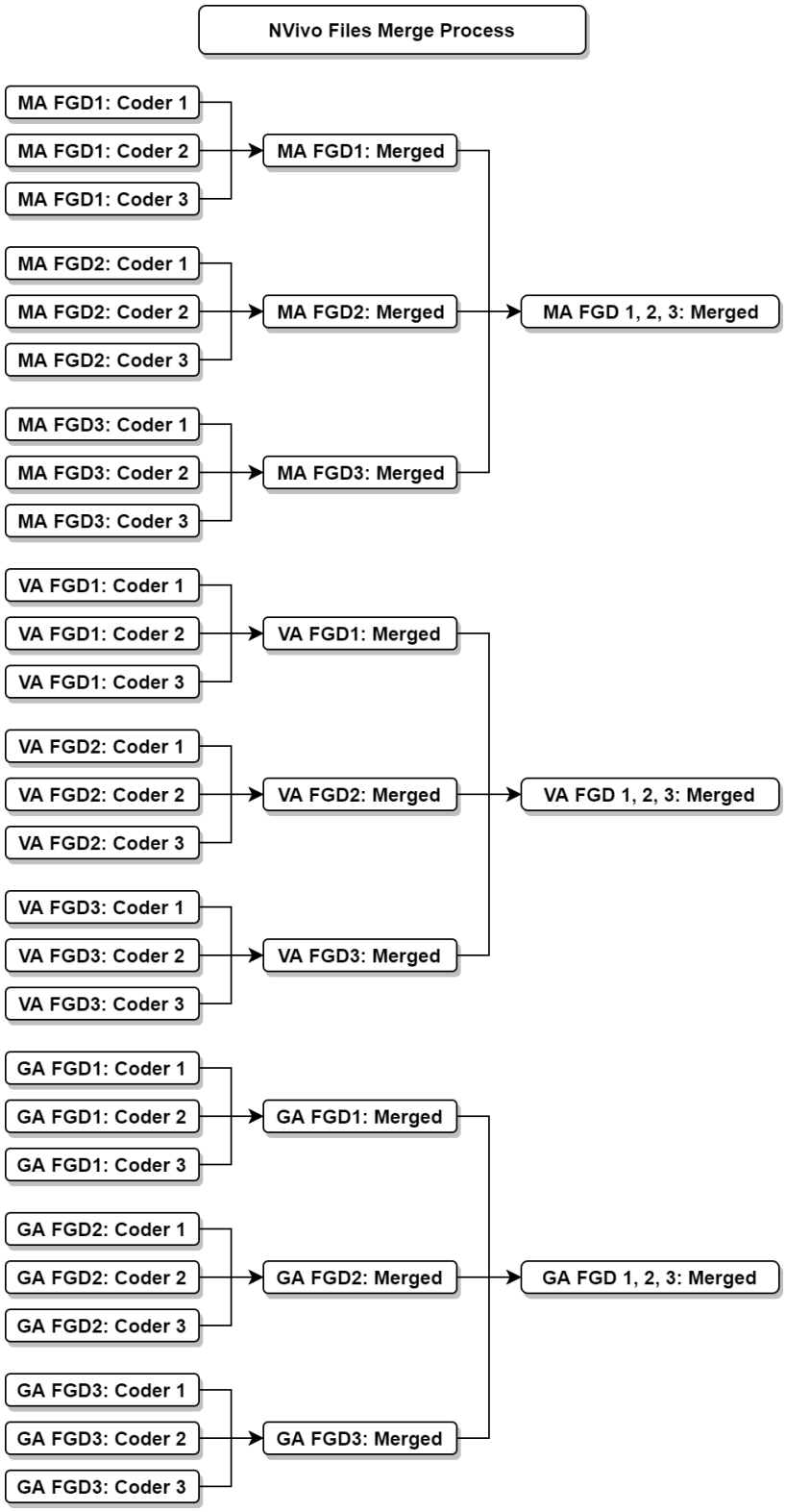


Figure 4: Merge process for each state, beginning with the merge of each coder's interpretation of a single focus group, followed by a merge of each state's individual FGDs, for a single, composite, representative set of codes for each state's three FGDs.

5. RESULTS

5.1 Themes: Major and Minor

Through the coding process, a handful of selective codes representing overarching themes emerged, each rooted directly in the concepts that were discussed during the 9 FGDs. Some of these themes (and underlying subthemes) we consider ecosystem services or benefits, some of them we consider ecosystem threats or general concerns, and others are simply topics of interest; many of the relationships between these themes and subthemes will be explored.

Some themes are supported by more content than others (i.e. more time was spent during the FGDs discussing those themes), warranting the separation of themes into those that appear as *major*, and those that appear as *minor*. Following this separation, we investigated the subthemes (axial codes) that appear within those major themes. Through an analysis of the major themes and constituent subthemes within each, we developed *summary descriptors* for each state, deriving language from the original transcripts wherever possible. The summary descriptors seek to explain the processes through which various benefits are experienced and threatened in MA, VA, and GA. These processes are explored in the Discussion section. The steps and components of the analyses and results presented in the Results section are summarized in Figure 5.

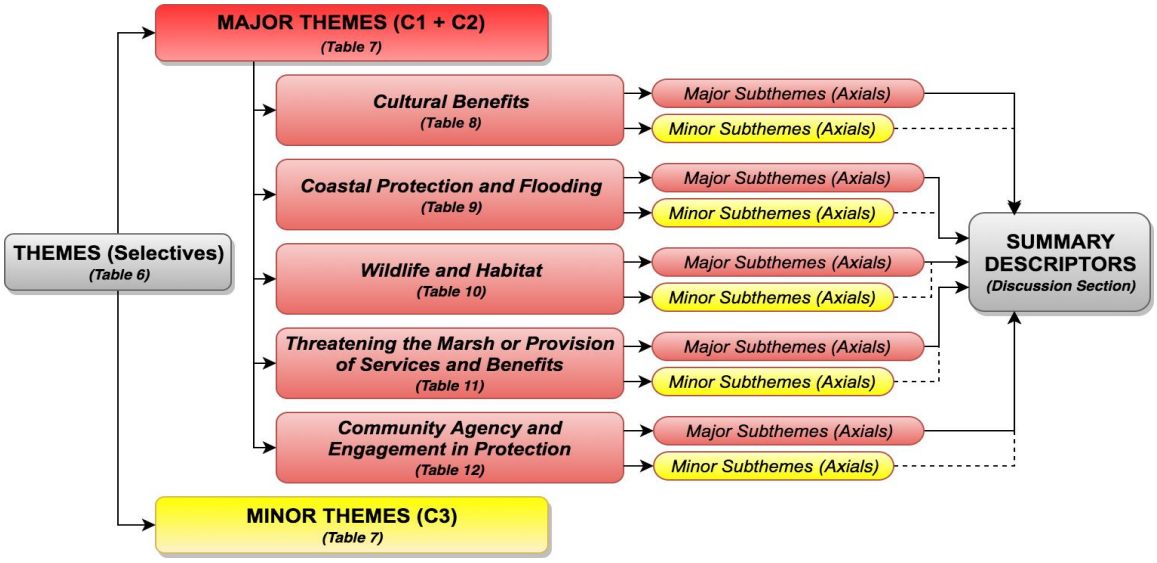


Figure 5: Results section table of contents map displaying the development of each state's summary descriptor (presented in the Discussion section). Descriptors are rooted in major themes and subthemes, supported where appropriate by concepts within minor themes and subthemes. Table numbers refer to specific tables within this text.

Table 6 presents the prominence of the distinct overarching themes from each set of three FGDs in MA, VA, and GA. Descriptions of these themes, developed directly from the interpretations of the underlying subthemes, and an exemplary quotation of each are provided. Quotation identifiers used in the final column of Table 6 and hereafter are formatted as follows:

> *Formula:* [state] [FGD 1, 2, or 3 from that state].[participant number]: [direct quotation]
> *Example:* MA 3.7: We enjoy spending time…

Prominence values are defined as the percentage of total open codes that have been grouped into a given theme; in other words, the amount of content related to a given theme, divided by the total content, during any of the three FGDs in a given state. As an example, ~18% of the content in the three FGDs in MA was grouped into the theme *wildlife and habitat*—so roughly 18% of the discussion dealt with material related to this topic. The dash (–) in Tables 6–12 indicates a given theme or subtheme did not emerge from the data in a particular state. A color scheme has been applied to represent the relative prominence of each theme *within a given state*, red indicating most prominent, orange indicating intermediate prominence, and yellow indicating least prominent. This classification process is further explained by referring to Table 7.

Table 7 displays the same distinct themes presented in Table 6, reclassified based on the prominence of these themes into three *clusters* per state. Cluster 1 (C1) contains primary themes

describing the largest portion of content from each of the FGDs in the given state, cluster 2 (C2) contains less prominent secondary themes, and cluster 3 (C3) contains the least prominent, and in some cases negligible, tertiary themes. Themes were generally grouped into clusters based on natural breaks in the data; any theme with a prominence value of less than 10% (<10%) was automatically classified as C3. Total cluster prominence is displayed in the final column of Table 7.

Using MA as an example, ~39% of the total content in the three FGDs was in reference to topics that have been grouped into the theme *cultural benefits* (see Table 6). Because this value is significantly larger than the next closest (a natural break in the data), the *cultural benefits* theme exists as the only constituent of MA C1. MA C2 is comprised of *community agency and engagement in protection* (20%), *wildlife and habitat* (18%), and *threatening the marsh or provision of services and benefits* (12%). While these values suggest the three themes in C2 are important concepts in MA, prominence for each of these is markedly lower than that of *cultural benefits.* MA C3 follows this pattern, consisting of the other four distinct themes from Table 6 (one of which does not emerge at all in MA, as previously discussed).

Table 6: Percent prominence, descriptions, illustrative quotations, and cluster assignment for all themes, by state; cluster 1 themes in red (darkest shade in B&W publications), cluster 2 themes in orange, cluster 3 themes in yellow (lightest shade in B&W publications).

All Themes – Clusters 1, 2, and 3					
Selective Code	Description	MA	VA	GA	Illustrative Quotation
COASTAL PROTECTION AND FLOODING	Concerns regarding flooding and storms, and appreciation of the coastal protection provided by the marsh.	**9%**	**15%**	**9%**	MA 3.7: …if we didn't have the marshes we would've been flooded just like a lot of other areas that build in the marshes just like a lot of areas.
COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	The ways in which local communities or individuals are interested and/or active in protecting their local environment.	**20%**	**20%**	**15%**	GA 1.2: On a local level, we can continue to show up at the zoning board meetings and the commission meetings and let our voice be known.
CULTURAL BENEFITS	Experiences and cognitive processes that contribute to personal well-being or communal fulfillment.	**39%**	**20%**	**30%**	MA 3.11: …the lack of light pollution here, the gorgeous sunsets being able to see so many shooting stars, watching storm clouds rolling in, all of that is just, it's just priceless to me…
ECONOMIC DEPENDENCE	Industries and livelihoods that are dependent on the marsh, coast, and inland natural resources.	**1%**	**6%**	**4%**	GA 1.7: …if it's not for the marsh, these communities along the coast would be ghost towns. Literally.
FEELING DISAVOWED BY GOVERNMENT	Concern for indifference, corruption, or a lack of appropriate funding or support from federal, state, and local governments.	–	**3%**	**8%**	VA 1.1: …with all the cutbacks that's goin' on in Washington DC now, we just spittin' in the wind.
KNOWLEDGE OF ECOSYSTEM FUNCTIONS	The ways in which the community understands provisioning, regulating, and supporting ecosystem services.	**2%**	**3%**	**2%**	GA 1.1: They pollinate the marsh grass. Without those sand gnats, we wouldn't have any shrimp. So we gotta put up with them.
THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	Anthropogenic factors contributing to a decline in marsh ecosystem health or provision of services.	**12%**	**15%**	**16%**	VA 1.9: …runoff where you get chemicals in the ground, it goes right to our water source so it kills our fish, shellfish, everything.
WILDLIFE AND HABITAT	Presence, characteristics, and changes in wildlife and habitat.	**18%**	**18%**	**16%**	MA 1.5: I've seen changes with, you know with the fish populations over the years…we had baby blue fish up this way a couple years ago and I've never seen them up here before.
	Total	100%	100%	100%	

Table 7: Thematic cluster classification and aggregate prominence values, by state.

All Themes by State – Cluster 1, 2, and 3 Aggregate Prominence Values				
MA Clusters	C1	CULTURAL BENEFITS	39%	**39%**
	C2	COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	20%	**50%**
		WILDLIFE AND HABITAT	18%	
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	12%	
	C3	COASTAL PROTECTION AND FLOODING	9%	**12%**
		KNOWLEDGE OF ECOSYSTEM FUNCTIONS	2%	
		ECONOMIC DEPENDENCE	1%	
		FEELING DISAVOWED BY GOVERNMENT	–	
VA Clusters	C1	CULTURAL BENEFITS	20%	**58%**
		COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	20%	
		WILDLIFE AND HABITAT	18%	
	C2	COASTAL PROTECTION AND FLOODING	15%	**30%**
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	15%	
	C3	ECONOMIC DEPENDENCE	6%	**12%**
		FEELING DISAVOWED BY GOVERNMENT	3%	
		KNOWLEDGE OF ECOSYSTEM FUNCTIONS	3%	
GA Clusters	C1	CULTURAL BENEFITS	30%	**30%**
	C2	WILDLIFE AND HABITAT	16%	**47%**
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	16%	
		COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	15%	
	C3	COASTAL PROTECTION AND FLOODING	9%	**24%**
		FEELING DISAVOWED BY GOVERNMENT	8%	
		ECONOMIC DEPENDENCE	4%	
		KNOWLEDGE OF ECOSYSTEM FUNCTIONS	2%	

The added level of abstraction generated via the clustering operation is useful in separating distinct themes that appear as *major* (C1 and C2), and those that appear as *minor* (C3). To explore the overarching concepts that these themes reveal, it is helpful to further investigate themes that emerge as major.

5.2 Subthemes: Major and Minor

The complete list of themes presented in Table 6 are each comprised of a larger number of underlying concepts that have been grouped together to form those themes. To more effectively explain the major themes that emerged through the clustering process, many of those underlying concepts, hereafter referred to as *subthemes*, were explored. Referring back to Table

7, subthemes within the major themes (C1 and C2) *cultural benefits*, *wildlife and habitat*, *coastal protection*, *threatening the marsh or the provision of services and benefits*, and *community agency and engagement in protection* are discussed in sections 5.2.1–5.2.

5.2.1 Cultural benefits.

Cultural benefits emerged as the sole constituent of C1 in both MA and GA, and as the most prominent constituent (of equal value to *community engagement in protection*) of C1 in VA, indicating this theme warrants further investigation. Table 8 presents the *subthemes* that comprise the broader *cultural benefits* theme in MA, VA, and GA—in the case of this particular theme, the subthemes presented in Table 8 are considered specific examples of cultural benefits. Hereafter, the specific cultural benefits that appear in Table 8 are referred to as CBs. Each row represents a unique CB (16 in total) that appeared in at least one of the 9 FGDs; prominence values are shown for each, by state. A description of each benefit and an illustrative quotation is provided.

In the analyses presented in Tables 8–12, subthemes that emerged with prominence values greater than or equal to 10% (≥10%) in a given state are considered *major*, and those that emerged with prominence values in a given state of less than 10% (<10%) are considered *minor*. A modified version of the classification scheme used in Table 6 has been applied—the middle orange tier has been eliminated. In Table 8, red cells indicate CBs in the given state that are considered major, and yellow cells indicate CBs in the given state that are considered minor. Minor CBs should not immediately be considered insignificant, as many have been discussed at great length in the literature as meaningful concepts in the cultural benefits framework. Minor CBs will simply not be explored in greater detail here.

In MA, 5 CBs, a*esthetics of* engagement (16%), *educational value* (14%), *recreational value* (28%), *restorative value* (12%), and *sense of place* (11%) appear as major constituents of the broader *cultural benefits* theme. In VA, 3 CBs, *educational value* (16%), *recreational value* (27%), and *sense of place* (16%) appear as major constituents. In GA, 4 CBs, *aesthetics of engagement* (16%), *educational value* (20%), *recreational value* (17%), and *sense of place* (13%) appear as major constituents. Several CBs did not appear in all states; this is indicated by a dash

(–). The last row in Table 8 shows a composite prominence value of all major CBs for each state within the broader *cultural benefits* theme. This reveals that a substantial portion of the FGD content within the *cultural benefits* theme in MA (80%), VA (65%), and GA (67%), was dedicated to discussing a small subset (i.e. those classified as major) of all documented CBs.

Table 8: Percent prominence of subthemes for CULTURAL BENEFITS theme, by state; major subthemes in red, minor subthemes in yellow.

CULTURAL BENEFITS Subthemes – Major and Minor					
Axial Node	Description	MA	VA	GA	Illustrative Quotation
AESTHETICS OF ENGAGEMENT	Multisensory (sight, sound, smell) engagement or interaction with aesthetics.	16%	8%	16%	GA 1.1: …in the summertime it's beautiful deep green, and in the winter, it's gold and when the light shines on it…And it's breathtaking.
BEQUEST BENEFITS	Preserving the environment for future generations.	0%	2%	1%	GA 2.1: It doesn't matter to me, protecting the environment for future generations, I'm willing to pay the price.
CULTURAL HERITAGE	Connection of the marsh to local history and culture.	1%	3%	8%	VA 2.6: I think it plays a lot into it and Eastern Shore has always been agriculture, fishing pretty much, that tie is really strong. We're now going from natural fisheries to aquaculture, but it's still living on the wetlands…
ECOSYSTEM DISSERVICES	Features of the ecosystem to which residents are averse.	5%	5%	3%	VA 2.8: I just kinda avoid it because the mosquitoes and the flies are awful, so I avoid it.
EDUCATIONAL BENEFITS	Environmental respect and stewardship through community education; or the educational opportunities provided directly by the marsh.	14%	16%	20%	MA 2.6: I'm a teacher and I think that you know there's a million studies about how beneficial it is for kids to just you know get out in nature and to take them, you know, to the marshes and things like that...
SPIRITUAL OR RELIGIOUS BENEFITS, SENSE OF WONDER	Marshes inspiring transcendental feelings.	1%	–	1%	GA 3.7: ...almost a religious experience, having the biggest flock of egrets you can imagine come right at me, and then take a turn on the way to somewhere else. I mean, it's like something out of uh, an African safari or something…
ARTISTIC BENEFITS	Marshes inspiring creative expression through painting, poetry, or other forms of art.	4%	0%	1%	MA 3.9: I'm an oil painter, so I love painting the marshes, and I, like I said, I live in the mouth of the river and there are photographers that stop regularly in front of my house to take pictures of the sunsets over the marshes...
INTERCONNECTEDNESS	The empathetic and holistic connection between residents and the marsh.	–	–	3%	GA 2.8: So they're not tied to the land. And I think that once that tie is connected, and they see that we're connected, then I think that makes a difference…

Table 8. Continued

INTRINSIC VALUE	The value of the marsh in and of itself.	5%	4%	4%	VA 2.3: You know it's beautiful natural resource you know so...it's… can't ever be replaced, it's very special.
MEDICINAL BENEFITS	Physical healing provided by the marsh.	–	–	1%	GA 2.5: they would even teach us that the salt water was good for some of the ailments that we would have.
OBSERVING WILDLIFE MIGRATION	Time spent viewing migrating wildlife.	–	1%	–	VA 1.5: Yeah, so I tried to especially with the migrating shore birds and all, so they are always migrating through the marsh, I use that as much as I can.
RECREATIONAL BENEFITS	Spending time outdoors.	28%	27%	17%	MA 3.4: I've done that for many years and so you walk into the marshy areas and pick the, the uh, cranberries that's a lot of fun.
RESTORATIVE BENEFITS	Feeling at peace, relieved of stress or troubles.	12%	5%	5%	MA 1.1: I think it really helps my quality of life, just to live near a thriving marsh and know that it... feel that it is important to the people around me.
SENSE OF PLACE	Emotional bonds with places, or the contribution of places to personal identity.	11%	22%	13%	GA 3.1: And uh hospitable, and, and, connected to, to nature, because of the marsh and it's having been unspoiled here, which it is really.
TRANSFORMATIVE BENEFITS	Experiences in the marsh that shape one's worldview or conceptualization of marsh value.	3%	2%	6%	MA 2.11: I sometimes wonder too uh did we come here because of the environment because it attracts a certain kind of people or do people that wind up here change their viewpoint because it's so beautiful and they don't when they see it or what's the combination of it?
WILDERNESS CONCEPT	Positively conceptualizing nature as separate and distinct from civilization.	0%	4%	2%	VA 3.7: I think, you know, we need them to take a look at the fact that we have a very unique ecosystem, unmatched probably in the world as far as the pristine nature…
	Total of all CBs	100%	100%	100%	
	Total of major CBs	81%	65%	66%	

5.2.2 Wildlife and habitat.

Wildlife and habitat appears as a recurring constituent theme of C1 or C2, and is therefore classified as a major theme in all three states. Subthemes are presented in Table 9. The same classification scheme used to assess significance for CBs in Table 8 has been applied: subthemes within *wildlife and habitat* that emerged with prominence values greater than or equal to 10% (≥10%) in a given state are considered *major*, and those that emerged with prominence values in a given state of less than 10% (<10%) are considered *minor*. The same color scheme is also used to denote this classification—major subthemes are shown in red, minor subthemes are shown in yellow.

In MA, *biodiversity* (61%), *habitat* (15%), and *observing environmental change* (19%) emerged as major subthemes of the *wildlife and habitat* theme. In VA, *biodiversity* (49%), *habitat* (17%), *health of habitat or environment* (17%), and *observing environmental change* (14%) emerge as major subthemes. In GA, biodiversity (44%), and habitat (17%), health of habitat or environment (19%), and observing environmental change (16%) emerged as major subthemes. The final row in Table 9 shows aggregate prominence values for all major subthemes within the *wildlife and habitat* theme, by state. Based on this aggregate prominence value, 95% of content from MA, 97% of content from VA, and 96% of content from GA within the *wildlife and habitat* theme is subthematically major.

Table 9: Percent prominence of subthemes for WILDLIFE AND HABITAT theme, by state; major subthemes in red, minor subthemes in yellow.

WILDLIFE AND HABITAT Subthemes – Major and Minor					
Axial Node	Description	MA	VA	GA	Illustrative Quotation
BIODIVERSITY	The variety of plants and animals present in an ecosystem.	61%	49%	44%	VA 2.1 A greater variety of birds that I've ever seen I think.
HABITAT	Ability of the marsh to provide shelter and nourishment to plants and animals.	15%	17%	17%	MA 1.6: Yeah that's what I thought of, wildlife, and birds, plants, and of course those first things that came to my mind, of how they provide habitat for those things.
HEALTH OF HABITAT OR ENVIRONMENT	Current health or conditions of the marshes and surrounding environment.	5%	17%	19%	GA 2.6: So we have a lot of environmental concerns, and what you said the Turtle River is true, you cannot eat the fish in there.
INDIVIDUAL GAME MANAGEMENT	Managing nuisance animal populations.	–	3%	–	VA 1.8: There are times when I do kill em, um, it seems like, well I also have chickens, and it seems like when they want chickens, they're gonna try to break in the chicken coop at night.
MIGRATORY PATHWAYS	Importance of habitat as it pertains specifically to migrating wildlife.	–	–	1%	GA 3.1: Because we are in a migratory pathway, right here, and so the diversity of birds that… the flocks of birds that come through, it's just magnificent sight.
OBSERVING ENVIRONMENTAL CHANGE	Observing changes in the ecosystem, or changes to ecosystem's health over time.	19%	14%	16%	MA 1.2 I would think that they've improved because it seems that people eat the clams, the longneck clams… The general state of it seems cleaner.
RESILIENCY OF THE MARSH	Ability of the marsh to naturally resist change, or rebound after detrimental externalities.	–	–	3%	GA 1.1: …but I gotta say, it's really resilient because it's come back, it's come back but it took it twenty years.
	Total of subthemes	100%	100%	100%	
	Total of major subthemes	95%	97%	96%	

5.2.3 Coastal protection and flooding.

Coastal protection and flooding appears as a major theme only in VA (C2), emerging as a minor theme in both MA and GA (C3 in both). However, due to the weight this ecosystem service is often given in the literature, this service will be explored in greater detail. Constituent subthemes of the *coastal protection and flooding* theme are presented in Table 10. The same classification scheme used previously is once again applied here.

In MA, *adapting to flooding* (12%), *coastal protection* (31%), and *concern regarding flooding and storms* (56%) emerge as major subthemes of the *coastal protection and flooding theme*. In VA, *adapting to flooding* (21%), and *concern regarding flooding and storms* (46%) emerge as major subthemes. In GA, *coastal protection* (16%), and *concern regarding flooding and storms* (57%) emerge as major subthemes. The final row in Table 10 shows aggregate prominence values for all major subthemes within the *coastal protection and flooding* theme, by state. Based on this aggregate prominence value, 100% of content from MA, 77% of content in VA, and 72% of content in GA within the *coastal protection and flooding* theme is subthematically major. To reiterate, it is important to note that content classified as minor is not necessarily *insignificant*, it will simply not be explored in greater detail in this assessment.

Table 10: Percent prominence of subthemes for COASTAL PROTECTION AND FLOODING theme, by state; major subthemes in red, minor subthemes in yellow.

COASTAL PROTECTION AND FLOODING Subthemes – Major and Minor					
Axial Node	Description	MA	VA	GA	Illustrative Quotation
ADAPTING TO FLOODING	Measures taken to mitigate against, or adapt to, flooding.	12%	21%	–	VA 2.11: ...they just built a bulkhead out from Saxis where the, um, water was taking away part of the land…
COASTAL PROTECTION	The marsh acting as a buffer against flooding and storms.	31%	9%	16%	MA 2.10: There was a huge rainstorm on Mother's Day ten or fifteen years ago in Salisbury, it was all flooded, but Newburyport wasn't because we have the marsh, it absorbed everything.
CONCERN REGARDING FLOODING AND STORMS	Concern regarding flooding and storms.	58%	46%	57%	GA 3.5: And the people that live right a sea level, just a heavy rain can get in there, can just come in their, you know, pantry, I mean in their kitchen.
DAMAGED INFRASTRUCTURE	Reports of damaged infrastructure as a result of flooding or storms.	–	3%	–	VA 1.10: It seems like more and more bridges are being washed out all the time and having to be replaced.
DRAINAGE PROBLEMS	Flooding exacerbated by poor condition of drainage infrastructure.	–	–	8%	GA 2.4 Flooding is an issue primarily because the counties don't do a proper job of drainage.
HIGH WATER TABLE	Depth of water table as it relates to flooding concerns.	–	2%	–	VA 2.7: That's a lot of trouble we have on the shore when it rains because our water table is almost right there anyway.
FLOOD INSURANCE	Opinions regarding mandatory flood insurance.	–	4%	8%	GA 1.7: But when you do get the flood insurance, like he says, it's hard to get it because of where we live, but then it's mandatory and it's so expensive you can't afford it when you do get it.
FLOODING NOT AN ISSUE IN CERTAIN AREAS	Indications that flooding is not uniformly problematic.	–	1%	6%	GA 3.8: I haven't seen that much flooding in Darien area…
PROPERTY VALUES	Impacts of the marsh on residential property values.	–	5%	–	VA 1.1: I mean people who are moving in here for the, um, the natural whatever, and if I mean, we're paying money for it, so if it deteriorates, then our property values go down, it's very simple.
TIDAL FLOODING	Flooding exacerbated by coincidence with high tides.	–	8%	–	VA 2.1 Some of the times the tide comes up well into the town…
	Total of subthemes	100%	100%	100%	
	Total of major subthemes	100%	77%	72%	

5.2.4 Threatening the marsh or the provision of services and benefits.

Threatening the marsh or the provision of services and benefits appears in C2, and therefore is a major theme, in all three states. For this theme, constituent subthemes can be more aptly referred to as specific *threats* to the marshes, or the ability of the marsh to provide services or benefits such as healthy habitat for wildlife (a service) or enjoyment of recreation (a benefit). The same classification scheme denoting major and minor subthemes (in this case those subthemes are specific *threats*) has been applied in Table 11. Across all three states, the threat of *development* appeared most significant.

In MA, *development* (56%) and *pollution* (10%) emerge as major *threats* within the *threatening the marsh or the provision of services and benefits* theme. In VA, *development* (41%), *runoff and lawn chemicals* (24%), *water supply* (11%), and *climate change and sea level rise* (10%) emerge as major threats. In GA, *pollution* (31%), and *development* (31%) emerge as major threats. The final row in Table 11 shows aggregate prominence values for all major subthemes within the *threatening the marsh or the provision of services and benefits* theme, by state. Based on these aggregate prominence values, 66% of content from MA, 85% of content in VA, and 64% of content in GA within the *threatening the marsh or the provision of services and benefits* theme is subthematically major, referencing a small subset of threats deemed to be especially significant from a larger list of all threats identified.

Table 11: Percent prominence of subthemes for THREATENING THE MARSH OR THE PROVISION OF SERVICES AND BENEFITS theme, by state; major subthemes in red, minor subthemes in yellow.

THREATENING THE MARSH OR THE PROVISION OF SERVICES AND BENEFITS Subthemes – Major and Minor					
Axial Node	Description	MA	VA	GA	Illustrative Quotation
CLIMATE CHANGE AND SEA-LEVEL RISE	Concerns regarding climate change and sea-level rise.	7%	10%	9%	VA 3.12: Global warming, with the poles melting, sea levels gonna rise, there is no way to stop that…
DDT, DOT, AND DIESEL HARMING THE MARSH	Distinct historical and traceable pollution issues which have been resolved.	–	–	2%	GA 1.1: I've seen bad things happen here like uh I remember once we had a big diesel spill up when they were building I-95 that killed 30,000 acres of marshland, marsh grass land, that kinda freaked everybody out, and uh, and I saw the government kinda try to cover that up.
DEVELOPMENT	Impending or existing development's impact or perceived impact on the marsh.	56%	41%	31%	MA 2.11: You're fighting money, there's a builder in Newburyport particularly and people have been fighting back against his desire to build along the water…
ECOLOGICAL IMPLICATIONS OF CLEARCUTTING	Damage to the marsh as a result of timber industry.	–	–	5%	GA 1.4: …they cut, they go under and they drain the hardwood swamps, Buffalo Swamp up there, swamp out there off Kate Road, that swamp would hold water in it all year round and gradually release it back into the creeks. Now it rains, and it just, it got a ditch cut through there on the side of 95, and all the fresh water just runs out the hardwoods in there, and right on out the river.
EROSION	Damage to the marsh as a result of erosion.	9%	4%	–	MA 3.1: …it was really nice, but then comes speedboats. And they cut away at the sides of the wetlands, and then that falls down, and then its' a cycle, so it continues…
FRESH WATER INFLUX	Changes to habitat from increasing amounts of freshwater in the marsh.	–	1%	–	VA 2.7: Because that changes the life in it you know from oysters to mussels to certain fish you know, in fact I think we're getting more fresh water fish and I think they are changing the fish around here.
INVASIVE SPECIES	Invasive species management problems.	7%	–	–	MA 3.4: …they're trying desperately to save marshes from phragmites…
LITTER	Damage to the marsh from non-industrial trash.	5%	–	9%	MA 3.11: ...so crabby when you find garbage…

Table 11: Continued

NOISE AND CONGESTION	Enjoyment of natural landscapes hindered by excessive public access.	2%	–	–	MA 3.2 …places where there's no public access are in pretty pristine condition, it's really the areas where there's public access that are, I think, of concern…
OVERFISHING	Declining fish populations due to commercial fishing.	–	2%	–	VA 1.6: …the biggest problem with the Chesapeake Bay is the harvesting of the menhaden. They should pull that back a lot, because you [lose] the menhaden, the water gets worse…
PESTICIDES	Damage to the marsh as a result of pesticide application.	4%	–	–	MA 3.6: …there's a scientist that explains the glyphosate in Roundup is what's causing a lot of disease in young children.
POACHING	Illegal hunting or capture of wildlife in the marsh.	–	–	7%	GA 1.6: Well I saw in the paper here the last few years, with this guy was caught twice.
POLLUTION	Concerns about pollution's damage to the marsh.	10%	8%	33%	GA 3.8: Yeah, those plants have been polluting the marshes for decades.
RUNOFF AND LAWN CHEMICALS	Damage to the marsh from industrial and residential chemicals.	–	24%	–	VA 1.9: I've seen us get enough rainfall here on the shore and all the runoff killed the bass, right out of the pond.
SALTWATER INTRUSION	Concern for increased salinity in water sources.	–	–	1%	GA 3.6: the salt levels are goin' up in some of the, some of the wells…
SEAFOOD ADVISORY	Pollution leading to contaminated fish populations.	–	–	4%	GA 2.6: Plant McManus is uh really, you know, they say you can eat one or two fish, but I don't want to eat none of 'em.
WATER SUPPLY	Concern for limited freshwater resources.	–	11%	–	MA 1.11: This is a real interesting problem to have water, water everywhere and not a drop to drink…
	Total of threats	100%	100%	100%	
	Total of major threats	66%	85%	64%	

5.2.5 Community agency and engagement in protection.

Community agency and engagement in protection appears in C1 in MA and GA, and C2 in VA, and therefore as a major theme, in all three states. The same classification scheme denoting major and minor subthemes has been applied in Table 12. *Community activism and engagement*, *partners in protection the marsh*, *restrictions or support for restrictions*, and *supporting protection* appear as major subthemes in all three states.

In MA, *supporting protection* (27%), *restrictions or support for restrictions* (20%), *partners in protection the marsh* (15%), and *community activism and engagement* (11%) emerge as major *subthemes* within the *community agency and engagement in protection* theme. In VA, *supporting protection* (24%), *partners in protecting the marsh* (22%), *community activism and engagement* (15%), *desiring education, research, and monitoring* (15%), and *restrictions or support for restrictions* (11%) emerge as major subthemes. In GA, *supporting protection* (23%), *partners in protecting the marsh* (22%), *apathy or disrespect for the environment* (11%), *restrictions or support for restrictions* (11%), and *community activism and engagement* (10%) emerge as major subthemes. The final row in Table 12 shows aggregate prominence values for all major subthemes within the *community agency and engagement in protection* theme, by state. Based on this aggregate prominence value, 73% of content from MA, 86% of content in VA, and 77% of content in GA is subthematically major, referencing a small subset of subthemes considered to be especially significant.

Table 12: Percent prominence of subthemes for COMMUNITY AGENCY AND PROTECTION theme, by state; major subthemes in red, minor subthemes in yellow.

COMMUNITY AGENCY AND PROTECTION Subthemes – Major and Minor					
Axial Node	Description	MA	VA	GA	Illustrative Quotation
ACCESSING THE EASTERN SHORE	Generally limited access to the VA Eastern Shore and marsh.	–	2%	–	VA 3.4: Um, new and pristine, hard and expensive to access.
APATHY OR DISRESPECT FOR THE ENVIRONMENT	Disregard for the marsh's health by some in the community.	–	2%	11%	GA 1.1: if I was a shrimp fisherman, I would worship the marsh and the river, if it came to that, but they don't.
HUMAN-ENVIRONMENT BALANCE	Balance between preservation and access to the marsh.	3%	–	–	MA 3.4: ...so with the more public access, the more, and I want everybody to be able to enjoy it because it is so magical and beautiful, but I wish people would pay attention to like how they treat the area
COMMUNITY ACTIVISM AND ENGAGEMENT	Community involvement in land stewardship and local marsh-related issues or events.	11%	15%	10%	VA 3.4: ...but another piece is just helping people who are here, and want to be involved, figure out how to get elected to places where they can make a difference.
DESIRING EDUCATION, RESEARCH, AND MONITORING	Interest in receiving information about the condition of the marshes via continual research.	–	15%	–	VA 3.4: More education, um probably legal advice and data collection…
FORGING CONNECTIONS WITH THE MARSH TO VALUE IT	Establishing an understanding and realization of benefits from the marsh in order to fully appreciate its value.	–	–	4%	GA 3.10: You know the difference may be simply those that were born and raised here have a better appreciation and are more aware of it as opposed to those of us who came from other places
HOLDING BIG INDUSTRY ACCOUNTABLE	Support for greater supervision and regulation of industries that have been deemed to be harmful for marsh health.	–	–	3%	GA 1.7: More filtration regulations for these companies up and down the coast.
LACK OF INFORMATION AND AWARENESS	A lack of engagement in marsh-related issues within the community.	–	4%	4%	GA 3.1: Yeah those plants have been polluting the marshes for decades. And that we don't see it of course, but it is hurting us? I don't know.
LAMENTING POOR MANAGEMENT	Reflections on past marsh management missteps.	7%	–	–	MA 2.7: ...there was a time that, you know, people had things running right into the marsh and everything else…

Table 12: Continued

PARTNERS IN PROTECTING THE MARSH	Organizations, governments, or other groups that are actively involved.	15%	22%	22%	MA 2.6: I'm on the Wetlands Committee, the wetlands board is our authority is to protect endangered species and the tiger beetle is one of 'em.
RECYCLING	Recycling as means of involvement in marsh protection.	–	–	4%	GA 1.2: They're not aware that recycling is a good thing, it doesn't cost you anything…
REQUESTING DEVELOPMENT BE PLANNED AND HONEST	Support for greater supervision and regulation of development that have been deemed to be harmful for marsh health.	–	–	5%	GA 3.6: Well planned, but uh, also once it's planned it's somebody that makes the developer stick to the plan. The approved plan by the people that had the integrity at the start to begin with and do it correctly.
RESTORATION EFFORTS	Interest in marsh restoration.	–	6%	2%	VA 1.6: Replant the marshes they got destroyed, but they were very successful.
RESTRICTIONS OR SUPPORT FOR RESTRICTIONS	Existing restrictions or support for additional restrictions intended to support marsh protection.	20%	11%	11%	VA 3.1: I think the biggest setbacks, which become much larger making people with property build further away from the wetlands has been very good to the wetlands.
SUPPORT FOR INCREASED POLICING	Interest in increasing fine enforcement in the marsh.	3%	–	–	MA 3.9: and even though it is a no wake zone, they speed right through like nobody's business, and nobody's, they're not patrolled enough, it's taking its toll on the marsh.
SUPPORTING PROTECTION	General support for marsh protection.	27%	24%	23%	MA 2.12: I think that we need to see the value in it, and do whatever we have to protect it.
TRUSTING OR APPRECIATING GOVERNMENTS AND LOCAL ORGANIZATIONS	Faith that local governments and agencies are actively and effectively protecting the local marshes.	7%	–	–	MA 1.5: Did we mention Greenbelt? Essex County Greenbelt. Its uh, we're pretty lucky in this area to have so many effective organizations in this realm.
VARYING SUPPORT FOR COMMUNITY SPENDING	Interest in additional spending for marsh protection, coupled with concerns about increasing taxes.	6%	–	–	MA 1.4: Open space would be, it's a local issue in town, have a town meeting, we just had a vote, a local the money is spent the taxes go up its the price of admission, that's what you have to do.
	Total of all subthemes	100%	100%	100%	
	Total of major subthemes	73%	86%	77%	

5.2.6 Summary of results: major themes and subthemes.

Table 13 is a restricted version of Table 7, presenting only major themes; minor themes, shown previously in yellow, have been removed. New aggregate percentages have been calculated, showing total prominence values for all major themes (C1+C2), separated by state (i.e. the 4 major themes in MA, the 5 major themes in VA, and the 4 major themes in GA). Table 13 also summarizes the subthemes presented previously in Tables 8–12. Only the major subthemes are provided. Each is listed adjacent to their corresponding theme by order of prominence within the given state. These major themes and underlying subthemes shape the summary descriptors for each state. Summary descriptors seek to explain participants' realization of various benefits, associated threats to those benefits, and resulting community outcomes.

Table 13: Major theme clusters (C1 and C2, red and orange respectively), aggregate prominence values for all major themes, and major subthemes (ordered by prominence), by state.

MA Major Themes	C1	CULTURAL BENEFITS	39%	**89%**	recreational benefits; aesthetics of engagement; educational benefits; restorative benefits; sense of place
	C2	COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	20%		supporting protection; restrictions or support for restrictions; partners in protecting the marsh; community activism and engagement
		WILDLIFE AND HABITAT	18%		biodiversity; observing environmental change; habitat
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	12%		development; pollution
VA Major Themes	C1	CULTURAL BENEFITS	20%	**88%**	recreational benefits; sense of place; educational benefits
		COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	20%		supporting protection; partners in protecting the marsh; desiring education, research, and data monitoring; community activism and engagement; restrictions or support for restrictions
		WILDLIFE AND HABITAT	18%		biodiversity; health of habitat or environment; habitat; observing environmental change
	C2	COASTAL PROTECTION AND FLOODING	15%		concerns regarding flooding and storms; adapting to flooding
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	15%		development; runoff and lawn chemicals; water supply; climate change and sea-level rise
GA Major Themes	C1	CULTURAL BENEFITS	30%	**77%**	educational benefits; recreational benefits; aesthetics of engagement, sense of place
	C2	WILDLIFE AND HABITAT	16%		biodiversity; health of habitat or environment; habitat; observing environmental change
		THREATENING THE MARSH OR PROVISION OF SERVICES AND BENEFITS	16%		pollution; development concern
		COMMUNITY AGENCY AND ENGAGEMENT IN PROTECTION	15%		supporting protection; partners in protecting the marsh; restrictions or support for restrictions; apathy or disrespect for the environment; community activism and engagement

6. DISCUSSION

6.1 Process Modeling

Following the analysis performed on the emergent themes using the major–minor classification scheme applied in our methodology, we developed *summary descriptors* for each state. These descriptors are meant to highlight the most salient benefits, threats to the provision of those benefits, and associated community responses within each state, as identified by the FGD participants. This information is presented in detail in Tables 8–12 and concisely summarized in Table 13. By exploring the relationship between these three concepts (benefits, threats to their provision, and the associated outcomes), rather than simply investigating each in isolation, we acquire insight into the processes through which local residents engage with, and value, local marsh ecosystems. These descriptors are intended to encapsulate the majority of discussion content from each state (89% in MA, 88% in VA, and 77% in GA).

To aid in explaining the prevailing processes of human–environment interaction in MA, GA, and VA, we developed graphical representations of each summary descriptor in the form of *process maps* for each state. In conforming to the tenets of GT, (i.e. developing a phenomenological understanding that is rooted directly in the data, rather than assigning a pre-conceived process to the data), the generalized process map presented in Figure 6 was developed *after* the major processes were investigated in each state. State-tailored process maps are shown in Figures 7–9.

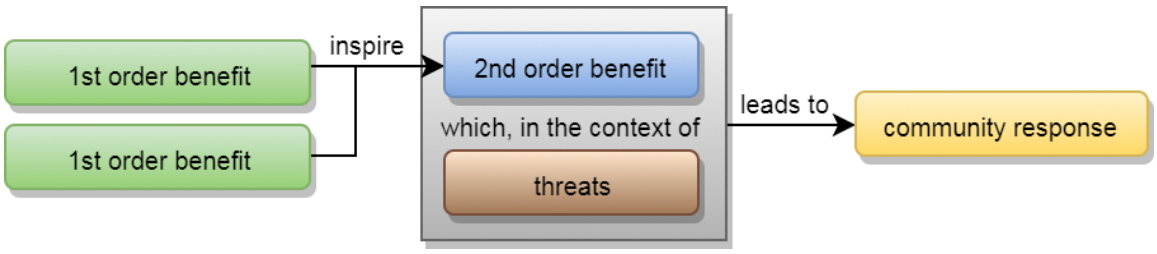


Figure 6: Base process map displaying various components that explain resident engagement with local marsh ecosystems.

The initial inputs to the system, represented in the green boxes, are *first order cultural benefits* (1CBs). The green 1CBs boxes are representative of a selection of the most frequently discussed benefits provided by the marshes. Green boxes are mostly representative of CBs; however, it is important to note that in some cases these representative 1CBs boxes also capture less prominent economic benefits, and in many cases, are intertwined with participants' explicit recognition of ecosystem services as well, such as the provision of wildlife or habitat.

1CBs boxes in the process maps represent the benefits participants experience through direct interactions with marsh ecosystems—for example, joy felt through recreational experiences or stress relief felt through viewing scenic marshes or wildlife. Some of these 1CBs are passive (e.g. appreciating beautiful marsh scenery from a distance), and some are more active (e.g. fishing or engaging in other recreational activities). 1CBs are realized by directly engaging with the marshes. In each state, these 1CBs contribute to, or inspire, additional secondary benefits—here we refer to them as *second order cultural benefits* (2CBs), displayed in the blue box. 2CBs describe a broad set of benefits that are derived from a collection of individual 1CBs. Experiencing 2CBs does not require (although do not necessarily exclude) direct interaction with the marshes; we define them as the cumulative benefits realized over a period of time from frequently experiencing 1CBs. For this reason, 2CBs are considered mostly indirect.

For example, in a hypothetical community where the previously mentioned example 1CBs (*recreation*, *aesthetics*) are most important, over time the community may develop a sense of place based around the environments that provide these 1CBs. In this example, *sense of place* is derived from the cumulative benefits provided through the individual 1CBs. 2CB *sense of place* may include feelings of pride and community cohesion, which may lead to the organization of community events and a general interest in the environment. Experiencing 2CB *sense of place* also does not *require* direct interaction with the environment; the community pride felt by residents likely does not switch on and off depending on whether they are actively recreating, for example. This scenario is purely illustrative of the types of relationships and processes that participants described in MA, VA, and GA. While the processes may be similar in other geographic locations, the relationships between specific 1CBs and 2CBs are likely not

generalizable from community to community—the *process maps* presented here are based exclusively on the qualitative data collected via the FGDs in each state.

Threats to the marshes or the provision of services and CBs are represented by the brown box. As described in Table 11, FGD participants in each state identified various threats to their local marshes, and perhaps more importantly, threats to the provision of valued marsh ecosystem services and benefits. 2CBs and threats have been grouped together inside the gray box in the process map in Figure 6, and in subsequent state-specific process maps in Figures 7–9, to denote the interaction between these two variables. In all three states, participants expressed the belief that 2CBs (and underlying 1CBs) are vulnerable to a set of threats. The significance of this dynamic relationship resulted in participants identifying (either explicitly or implicitly) various outputs; we've termed these final outputs *community responses* (CRs). CRs are shown in yellow boxes in Figure 8 and the subsequent state-specific process maps in Figures 7–9.

The CRs identified in each state generally relate to the theme *community agency and engagement in protection* and its underlying subthemes, shown in Table 13. CRs are rooted in the existence of salt marsh ecosystems, an appreciation for the 1CBs and 2CBs those marshes provide, and concern regarding various perceived threats in each community. The CRs established here involve engagement with the marshes or marsh-related issues as a community to promote increased conservation, and generally result in feelings of increased community cohesion and personal well-being. For these reasons, CRs are addressed in the process maps presented in Figures 7–9 as integral components of the broader ecosystem service–benefit–response relationships that emerged in MA, GA, and VA.

To illustrate the development of a CR, we will continue the use of the previous hypothetical scenario. In the event that the local marsh ecosystem, and therefore residents' enjoyment of perceived 2CB sense of place, is perceived as threatened by sea-level rise, the community may rally around this threat in an effort to preserve the marsh that provides that 2CB. This could include a surge of public support for dune improvement projects intended to reduce flooding, increased preservation of open space to maintain available recreation areas, or

measures to maintain existing marsh grasses that deemed aesthetically pleasing. Collectively, these outputs can be referred to as CRs. To reiterate, CRs are an outcome of the interplay between 2CBs and the perceived threats to the provision of those 2CBs.

6.2 MA: Ecosystem Benefits, Threats, and Responses

Using the base process map framework presented in Figure 6, and the major themes and subthemes summarized in Table 13, we present the following summary descriptor to explain the major prevailing human–environment interactions in MA, the individual components of which are segmented out in Figure 7.

> *Recreational experiences in beautiful marsh and open water landscapes inspire serenity, which, in the context of residential development, leads to conservation support.*

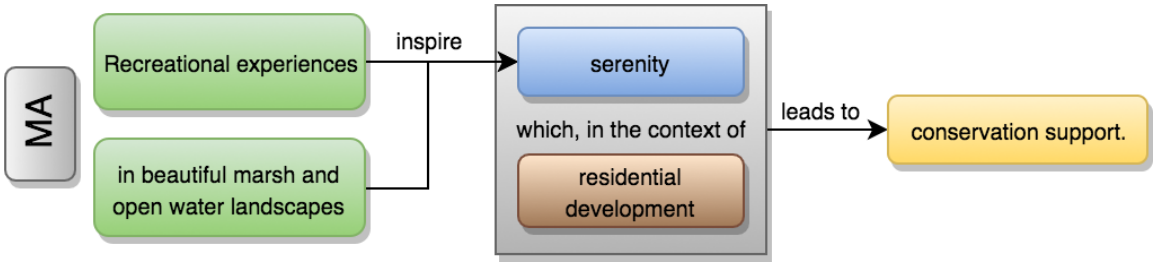


Figure 7: Process map describing the prevailing ecosystem benefits, threats, and responses in MA.

6.2.1 1CB and 2CB: recreation in aesthetic marsh landscapes inspires serenity.

As detailed in Table 8, the most prominent CBs recognized in MA were *recreational benefits* and *aesthetics of engagement*. We considered these 1CBs, represented in the green boxes in Figure 7, because they reflect direct human interaction with the environment. Participants in the three FGDs in MA described recreational experiences in the marshes and surrounding coastal areas as providing valuable benefits; many participants expressed their gratitude for the provision of natural space for these experiences.[7]

> MA 2.4: You can do birding, kayaking, you can through the marshes through the little—what's it called? A channel, or um…?—which is, I thought, pretty amazing, to just have that.

[7] Divider bars in quotation sections indicate discontinuities in the original transcripts.

> MA 1.6: I couldn't, uh, *not* live near the coast, I think. It's very relaxing to walk along the ocean, along Newburyport Waterfront… and as a kid, I grew up in the marsh, we had marshlands behind my house, so we used to go out and explore as kids.

> MA 1.5: But since I've been up here in Massachusetts, I've pretty much always had a small boat, and I fish the marshes and uh, you know, always been around the waterfront.

Participants expressed the enjoyment derived from walking along the marshes, beaches, and waterfronts; many noted it was particularly enjoyable to walk their dogs in these areas. Boating, from solo kayaking or canoeing trips, to group tours and powerboat outings, was also described as a commonly enjoyed recreational experience.

> MA 1.7: …kayaking with a group out of Essex, this group, and uh, we go out about once a month, from June through September, and uh, we get guided through all these lovely marshes in Essex and Gloucester and Ipswich, it is nice.

> MA 3.4: …in the marsh you see a lot because you go around the corner in your kayak and it's all quiet, you know, all the birds are walking, and they're all very busy eating…it's lovely.

Spending time in the marshes digging for clams, collecting oysters, fishing, and lobstering were also mentioned frequently. Some indicated these were often group activities, signifying the importance of recreation as a family experience.

> MA 2.8: …have a boat now and I fish and I lobster and I clam, so I take advantage of the marsh ad wetlands, uh, both for gathering stuff as well as enjoying it and going out to Plum Island, um, which I particularly enjoy, both by boat and by foot, so it's quite unique, great.

> MA 3.2: …our kids do the sailing program and boating out to Plum Island, but in the winter we go for walks, um oystering in Ipswich, clamming in the summer. So, as much as we can get out there, we're out there.

Birding was also identified as popular recreational activity within the community. One participant suggested that the area has some of the best birding spots in the country. Another suggested that while not previously a birder, they took up the pastime after moving into the area. Others mentioned they enjoyed viewing birds out of their car windows while driving, often slowing down for a better view; several remembered a large group of cars parked on the side of the road, the occupants observing birds nesting in nearby trees.

> MA 1.1: The birding is incredible.

> MA 1.11: …and we saw a ton of cars parked, like they do on the sides of the road, and I don't know what they were but…these giant white birds were like all like clinging, hanging on trees…

Aesthetics of engagement, was described as another important 1CB in MA. This CB collectively describes the benefits people receive through multi-sensory engagement with the marsh—viewing scenic marsh landscapes and appreciating various sounds and smells associated with the marsh (Berleant, 2010). Participants noted the pleasant views of the marsh from their homes, while driving in their cars, during recreational experiences, and even when taking the commuter train. The landscape was described using a variety of words indicating the appreciation of this visual stimulus, including "beautiful," "gorgeous," "scenic," and "pretty." An interesting component of *aesthetics of engagement* that was identified several times in MA was the stark difference between the natural marsh landscapes and the highly developed urban landscapes of metropolitan Boston.

> MA 1.4: I live right on the Great Marsh, my property abuts conservation land, and it's, it's absolutely gorgeous.
>
> MA 1.2: And taking the train into Boston obviously, the prettiest part of the ride is, you know, through the marshes. And then you get into Chelsea, and it's yeah, you know, you really respect the contrast.
>
> MA 3.4: I appreciate the federal reserves, um, I look at it and then I look at Hampton and I see the beauty of allowing us to have one area that's totally left to its own devices.

Many appreciated the pleasant smells of the marsh, noting how "clean things smell," and others noted the nice sounds emanating from marsh, particularly at night. This indicates that much of the aesthetic appreciation for marsh landscapes in the area is rooted in multisensory engagement, and not limited to visual appreciation.

> MA 2.3: But then again, it's kinda nice to hear the animals at night.
>
> MA 3.11: …the sounds at night, I find to be, listening to the owls, coyotes, the peepers. It's just, it's unbelievable. I love sleeping with my windows open.

Embedded within both of these 1CBs—*aesthetics of engagement* and *recreation*—is an appreciation for the wildlife present in the marsh and coastal areas. We use the term *biodiversity* to describe this affinity. Unlike the primary 1CBs identified, *biodiversity* is considered a *service* rather than a *benefit*. Many of the recreational experiences described in the MA FGDs were reliant on the presence of wildlife, such as fishing trips and birdwatching. Additionally, a significant portion of the FGD content that described pleasing aesthetics, also contains references to wildlife. This indicates that the two primary 1CBs and the ecosystem service

biodiversity are closely related in MA, often overlapping, and none of the three can be fully discussed without exploration of the others. This is an important relationship, and one that is not always made clear in the literature in research that seeks to create lists of specific ecosystem services. This relationship between services and benefits will be explored again later.

These two 1CBs and ecosystem service *biodiversity* (in addition to a small handful of minor ecosystem services and benefits detailed throughout Tables 8–12), represent a variety of interactions that MA residents have with the local marshes. To interpret the aggregate importance of these 1CBs and ecosystem service (primarily *biodiversity*), and to describe the full set of aggregate benefits that are provided as a result, we use the concept of 2CBs. In MA, the primary 2CB is s*erenity*, described by participants as marsh contributions to feelings of peacefulness, tranquility, and relaxation. This concept is represented in Figure 7 in the blue box. Participants indicated, both explicitly (stating so) and implicitly (indicating they preferred marsh landscapes to hectic cityscapes, for example), that they experience feelings of serenity through engagement with the marshes, most often as a result of recreational experiences in aesthetic landscapes.

> MA 2.2: …I take my dog for walks a lot out there. It's just a peaceful place to be.
>
> MA 1.1: I think it really helps my quality of life, just to live near a thriving marsh and know that it… *feel* that it is important to the people around me.
>
> MA 3.4: Yeah, it helps with sense of well-being, it's a de-stressor, really just to go outside and…
>
> MA 3.6: Yeah, stress, yeah.
>
> MA 1.5: Yeah when you asked for the two words, the first one that came to mind for me was scenic, you know, kinda to his point, yeah, and it's just very comforting to look out on the marsh…

While the benefits from 1CBs tended to be described as relatively temporary, received during direct engagement with the marsh, the 2ES *serenity* was described as more pervasive, providing a sense of well-being and peace even when participants were not directly engaged with the marsh. Participants explained that the marsh "makes the area wonderful." Gratitude "that I'm able to live here" was a shared sentiment, in addition to the feeling that "everyone really appreciates where we live."

6.2.2 Threat: residential development.

In addition to identifying a number of ecosystem services and benefits provided by the marshes in MA, participants identified perceived threats to the marsh or the provision of those services and benefits (detailed in Table 11). Development was the most prominent of these threats, shown in Figure 7 in the brown box. The relationship between the identified 2CB *serenity*, and the threats to the provision of this benefit, is indicated via the grouping of these two boxes inside the larger gray box.

At several points during all three MA FGDs, often without prompting from the moderator, participants indicated that they had significant concerns about current and future development in the area, particularly residential development. This was especially concerning when the residential development was taking place immediately adjacent to the marshes.

> MA 1.5: I'm really glad you brought that up, 'cause I go in and out of Ipswich all the time, and I don't know if you're aware of this house? This thing, awful, huge house was built to replace what used to be a little cottage or something, and it's so off the charts you can't even imagine it…
>
> MA 2.2: I'd say that just about everybody is on the same page with that, they don't want it to turn into the Jersey Shore, you know? You don't want it to be a bunch of houses on top of each other…
>
> MA 2.5: If we didn't protect the marsh, we would have some developer building houses on stilts in the middle of the marshes.

Concerns were also expressed about developers and wealthy individuals getting around existing building restrictions, even when those restrictions were generally believed by participants to be effective in most cases. Participants indicated that they were supportive of existing guidelines restricting development within 50- and 100-foot buffers, regulations concerning the use of septic tanks, and unspecified "zoning laws." The Massachusetts Wetlands Protection Act establishes a set of guidelines that seek to "protect wetlands and the public interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fishers, and wildlife habitat" (MassDEP, 2017). The Wetlands Protection Act is administered locally by conservation commissions in marsh-adjacent communities, members of which are appointed by each local city council. The provisions of the law regulate a variety of activities that may occur in proximity to the marsh, including vegetation

removal, regrading, and the construction of commercial buildings, homes, decks, driveways, and similar projects.

> MA 2.5: I know in Rowley, to have a building permit, you have to go through almost every agency, you know, from the light department, the water department, the conservation department, etc. And the conservation department, they're the ones that are really out there overlooking the marshes, so if you're on marsh areas or not on marsh areas… and you have to be back so many feet or something like that.
>
> MA 2.8: So, somebody wants to come and plunk down a big mansion, and if they got a lot of money then the town is like, you know… Newbury and Ipswich, they only got so much money to go, you know, get the lawyers, to pay the lawyers, and some guys got big, big bucks. They'll keep going and fighting and the town ends up giving up because they don't have the money to fight the big buck lawyers.

The interplay between the threat of residential development and the marsh's provision of serenity was made clear throughout the MA FGDs. Benefits and threats were identified as closely related concepts, and participants readily identified the direct linkages between encroaching development and a diminution of the 2CB they deemed most valuable—*serenity*.

> MA 3.2: …I know so many people upset by that house that's been developed because it's not what we're here [for], most people are here for the marshes, and now it's sort of an eye sore.
>
> MA 3.11: I think we're, our sense of wellbeing that's linked to this beautiful open space knows, that's why I get so crabby when you find garbage and ATVs and the giant houses.
>
> MA 2.8: …the clammer would be, you know, up a creek if, you know, all of a sudden everybody had, uh, shore front property, and "that part of it is mine." And uh, now you're, you know, clams aren't going to be there and oysters and stuff like that.

It is apparent through the participants' descriptions of fondness for recreating in beautiful marsh landscapes that they care about the provision of these ecosystem services, and they clearly feel that the serenity that they enjoy as a result is potentially being threatened by pressure from residential development.

6.2.3 CR: community conservation support.

An interest in preserving 2CB *serenity* from the threat of residential development prompted the participants to identify an output: *conservation support*. Referring back to Figure 6, because this concept emerges as an output from the interaction between a 2CB and a threat, we identify it as a CR. Conservation support in MA is characterized by: a general support for environmental protection, regulations, and other measures that are intended to provide protection

to the marsh; and confidence in the ability of governments and local organizations to manage the marsh. The majority of this content was classified under the *community agency and engagement* theme, the full details of which are presented in Table 12.

Participants noted with conviction that the community is exceptionally environmentally conscious, mindful of the value provided by the marshes, and aware of the threats that may impinge upon their enjoyment of marsh ecosystem services. The connection between their own well-being, and the health of the marsh and surrounding coastal environments, was readily understood. One participant noted that even though they personally were not well-versed in many aspects of marsh-related environmental issues, they had faith in the community as a whole, and felt comfortable standing by those outspoken individuals that were better-informed.

> MA 2.12: I think it's something, you know, um, we can easily see, you know, the end of, but I think that we need to see the value in it, and do whatever have to, to protect it.
>
> MA 1.7: I think having lived in other places, both inland, uh, I'm impressed that people in this part of… really care about the environment.
>
> MA: 1.7: I just think we need to fit in with nature in keeping these marshes healthy, I don't think we can supersede nature and do what we want. We learned that about 50 years ago with the expansion of industry.
>
> MA 1.10: Oh yeah, I'm just saying this place is spectacular, I'm saying you can't build here unless you get so much permission. It makes people less want to build there, that's good.
> MA 1.7: If you go to the Ipswich town meetings, it's the only one I know, it cuts across—everybody cares about the environment.

When asked what non-profits, local governments, or other organizations the community could reach out to for support in managing the marsh and coastal environment, participants readily provided an extensive list. The overwhelming majority of these responses were positive, indicating a high degree of trust in these organizations within the community. Without much prompting, participants noted that local, state, and federal governments were all active in various facets of marsh protection.

> MA 3.2: …just how we feel that it, that, the marsh is in good condition. For me, I just feel like there's so many organizations that are working for the good of the marshes that, you know… I mean, in Ipswich there's, the town did a river cleanup…
>
> MA 3.6: Parker River [Wildlife], yeah.
> MA 3.4: Which is federal…
> MA 3.6: Now, the fact that they're there that, that is a presence of, it seems like they're trying to protect this area, so that, that's really good that they're there.

> MA 1.7: I think with the federal government and the state government here is heavily involved, so even if things are changing with the federal government, I think… I think we're in a really entrenched area…

Participants also identified a substantial number of non-profit organizations that are active in marsh protection in the region, including the Essex County Greenbelt Association, Coastal Zone Management, the Massachusetts Audubon Society, The Trustees of Reservations, and the Plum Island Field Station (an LTER network affiliated site). The most prevalent feeling expressed was that these organizations have the community's best interests in mind, which may be partially traceable to Massachusetts' long history of environmentally-conscious decision-making and wetlands protection. In 1963, Massachusetts led the country's growing interest in wetlands preservation by enacting the first set of wetland development guidelines, seven years prior to the establishment of the EPA (Adler, 2004). Participants expressed that residents in the area are eager to work with local organizations and governments to achieve a common goal: conservation of the marsh to maintain the provision of valuable ecosystem benefits—chiefly, a ubiquitous sense of *serenity*.

6.3 VA: Ecosystem Benefits, Threats, and Responses

Referencing the base process map framework in Figure 6 and the major themes and subthemes summarized in Table 13, we present the following summary descriptor to explain the major prevailing human–environment interactions in VA, the components of which are segmented out in Figure 8:

Recreational experiences and water-based livelihoods inspire a marsh and "shore" identity, which, in the context of industrial agriculture and growing flood risks from rain and storm surge, leads to community activism and conservation needs.

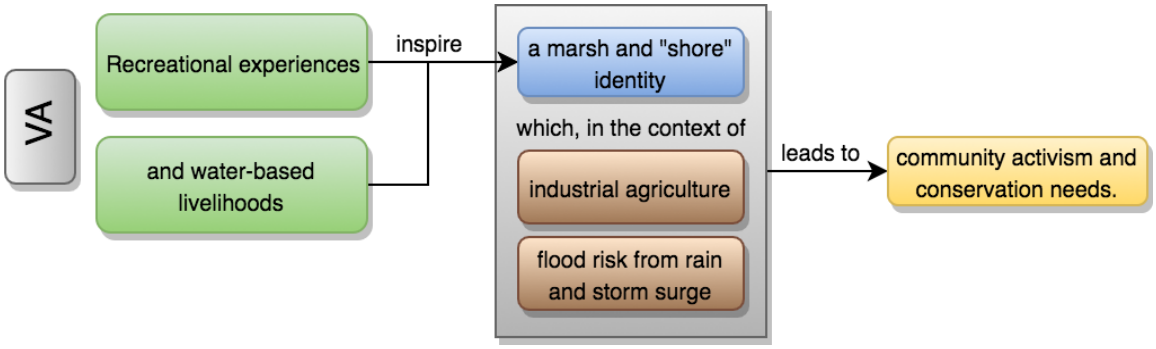


Figure 8: Process map describing the prevailing ecosystem benefits, threats, and responses in VA.

6.3.1 1CB and 2CB: recreation and livelihoods inspire marsh and "shore" identity.

A prominent CB identified by participants in VA was *recreational benefits*, represented as a 1CB in Figure 8. Participants indicated that they enjoyed a variety of recreational experiences in and around the marshes, including, fishing, birdwatching, hunting, and other experiences that generally involved engaging with the community-adjacent marsh.

> VA 2.10: I've seen um, hummingbirds migrate here and observing them and how beautiful they are and the blue herons, and um, kind of just the different wildlife, I love, you know, watching, observing them come through each season.
>
> VA 2.6: That was another thing we went out on the marshland for, hunting quail.
>
> VA 3.Moderator: …the first two words that come to your mind when you think of these, the wetlands and the marshes here, just the first two impressions that come to your mind?
> VA 3.12: Crabbin' and fishin' (laughter)!

Boating was key component of many of the recreational activities that residents in VA engage in. Participants stated that they enjoyed going on fishing excursions, family outings, and even camping on their boats. Because much of the marsh is not easily publically accessible, including the undeveloped barrier islands offshore, access to a boat was often identified as a precursor to other recreational experiences; there are 34 publically maintained water access points in Accomack and Northampton Counties combined (Accomack County Public Works, 2017). Local excursions in kayaks and canoes were also identified as common pastimes.

> VA 2.3: My experience has been pretty much recreational, um, we would come over and go off the public dock here, the public ramp, and take a number of boats and families and go out to Cobb Island for the day—shell, and just walk the islands and boat around and, you know, get lost one time when it was almost dark…it's very special.
>
> VA 2.Moderator: How about you? A memorable experience?

> VA 2.6: Um, probably running a boat out here back in Myrtle Island at this place called Mint Creek, which is a little tight, twisty creek…when the tides up, all the marshes, just all the productivity and stuff living out there.
>
> VA 2.3: …when we were launching and going through the marshy area, there were all these, I think they were called…they're the one-arm crabs, they're the fiddler… there were so many of them on the side of the marsh, we were paddling through it…it was very, very cool.

The marsh's support for *water-based livelihoods* was also identified as a 1CB in VA, appearing as a green box in Figure 8. Much of the FGD content supporting the value of this 1CB was originally classified under the *economic dependence* theme, which alone, did not emerge as a major theme. However, we argue that a great deal of content supporting 1CB *water-based livelihoods* appears in the background of many of the major themes and subthemes. Here, we use the term *livelihoods* to represent not only the economic benefit provided by the marsh, but also participants' identification of other individual CBs that fulfill the needs of VA residents. Concepts constituting 1CB *water-based livelihoods* include: an interest in the educational opportunities provided by the marshes; engagement in aquaculture, fishing, and crabbing; and the recognition of the *sole source aquifer* designation on the VA Eastern Shore.[8]

> VA 1.9: Well, I live off, uh, seafood. So, you mess with that, you gonna mess with everything.
>
> VA 1.12: And I used to, up until a couple of days ago, own an oyster ground in the Chincoteague area, so I also, I'm very familiar with uh, the uh, marine culture and love the water, so, I'm in the water, on the water…
>
> VA 3.8: Yeah, my son earns his, uh, income between college years working for a clam farmer in Willis Wharf that is entirely dependent on clean water that is filtered by our salt marsh.

Over the last decade, Virginia's shellfish hatchery production has increased dramatically. Output increased from ~100 million units in 2005 to well over 4 billion in 2016; much of this growth is attributed to the growth of the industry on Virginia's Eastern Shore (Hudson, 2017). Willis Wharf, known colloquially as Clam Town USA, has continued to engage with the Accomack–Northampton Planning District Commission (ANPDC) to develop zoning codes that support aquaculture along the waterfront. The ANPDC found that residents supported aquaculture as an integral component in their goal of preserving the community's "historical, rural, cultural, and

[8] The EPA uses the *sole source aquifer* designation to describe areas heavily reliant on a single aquifer, where no alternate sources of drinking water exist.

natural heritage, while maintaining the quality of ground and surface waters to support resident with ecologically friendly seafood, farming, ecotourism, and related industries" (Accomack-Northampton Planning District Commision, 2015, p. 3). In addition to aquaculture, several participants explicitly mentioned the expanding eco-tourism industry in the region as well, indicating this as an additional component of 1CB *water-based livelihoods*.

While clean water is not a requirement unique to VA, participants indicated that residents in the area are particularly aware of the value of this ecosystem service (clean water as an *ecosystem service*) because of the region's heavy reliance on agriculture and the clean water required for successful aquaculture (use of that clean water in aquaculture is a *benefit*). Many participants also made reference to the use of personal wells. Because of this, participants appeared to place a higher value on the provision of clean water, as compared to communities primarily reliant on large, multi-source municipal tap water infrastructure. The educational value of the marsh was also noted, including a number of research institutions in the region and opportunities for residents to learn about local wildlife, habitat, and other ecological aspects of the marsh.

These two 1CBs, *recreational benefits* and *water-based livelihoods*, represent a broad set of the most significant interactions that VA residents have with the marshes and coastal environments in the area, as identified by the VA participants. Embedded within both of these 1CBs are elements of the ecosystem service *biodiversity*, a major subtheme in VA. Without the presence of wildlife, residents' ability to experience 1CB *recreational value* (e.g. birding, fishing, and hunting) and 1CB *water-based livelihoods* (e.g. aquaculture, educational opportunities) would diminish.

Collectively, these 1CBs inspire a 2CB *sense of marsh and "shore" identity*, a process represented graphically in Figure 8. Much of the FGD content that illustrates the value of this 2CB appears in the subtheme *sense of place* in Table 8, which we define as emotional bonds with places, or the contribution of places to personal identity. The term "shore" was used abundantly in all three VA FGDs, usually in direct reference to the geographic region, but we adopt the term

here as descriptive of a mindset and way of life, based primarily in recreational opportunity and the support of water-based livelihoods.

> VA 2.Co-moderator: So some people have mentioned heritage and history, how much does the marsh play into heritage and history for you all on the Eastern Shore?
> VA 2.6: I think it plays a lot into it, and Eastern Shore has always been agriculture, fishing pretty much, that tie is really strong. We're now going from natural fisheries to aquaculture, but it's still living on the wetlands.
> VA 2.Co-moderator: Would you say that you have an identity as a community that is related to, or centers around that?
> VA 2.10: Yes, it's a very unique area, I mean, we came here for a reason and that's because of the rich history and just the natural beauty of it and…
> VA 2.2: Fishing
>
> ---
>
> VA 3.6: Well I live on the water on the bayside, and we have a shack out in the marsh between Smith Island and Myrtle Island and we spent many a weekend, and our kids will go and our grandkids and just fishing, clamming, swimming… it's just a delightful place to live.
>
> ---
>
> VA 2.12: The shore 50 years ago, I noticed that, reading the newspaper and listening to the conversations that are on the shore, nobody wanted to change, they wanted to stay strictly agriculture and fishing… aquacu-, fishing and crabbing… and I know that the town of Saxis is built on crabbing, and I mean, if it wasn't for that, we wouldn't have Saxis.

The importance of the 2CB *marsh and "shore" identity* permeated a significant portion of the VA FGDs. Participants referenced the affectual benefits of this 2CB by directly expressing the elation derived from repeated social interactions and family-oriented recreation in the marsh, and pride associated with the long term communal benefits of marsh-related resources and industries. These reactions result in a shared 2CB experienced within the community, manifested as a general friendliness and sense and belonging. One participant asked us if we had noticed the proclivity of other drivers on the Eastern Shore to wave when driving past in the opposite direction; several other participants agreed this was a cultural norm. While our evidence of this is only anecdotal—we had.

6.3.2 Threat: industrial agriculture and flood risk from rain and storm surge.

As in MA, participants in the three VA FGDs identified an array of threats that they perceived to be particularly concerning, a complete list of which can be reviewed in Table 10 and Table 11. Of these, rapidly expanding *industrial agriculture*, especially the poultry industry, and *increasing flood risk* from rain and storms appeared as most prominent, shown in the brown box in Figure 8.

Participants spoke with passion about their general disdain for the factory-style poultry industry; colloquially, they are referred to as “chicken houses” or “chicken farms.” They expressed concerns primarily with the pollutants often associated with chicken houses, and suggested that members of the community feel as though they are being taken advantage of by corporate interests. It’s important to note here that participants were critical of industrial operations specifically; several noted that the community is supportive of small, local farmers and agriculture operations.

> VA 1.6: Yeah, but what I don’t like the… the big chicken houses, you get those big companies that build 15 houses and, and they take all the money, and you get stuck with all the mess.
>
> VA 3.9: I was just thinking, you know, there seems like, where I live in Accomack and, uh, Wachapreague, it seems like special interests in, that are in the dark, they’re not really saying who, and what, um, with the chicken houses… it feels very in the dark, and that it’s up for grabs financially.

Many of these operations are classified by the EPA as concentrated animal feeding operations (CAFOs), a designation given to agriculture operations that involve exceptionally dense confinement of animals. Participants’ concerns for the environmental implications of CAFOs are justified; the EPA and others have found that pollutants associated with CAFOs often have grave repercussions on human, water, and ecosystem health (C. Rice, M. Monti, & R. Ettinger, 2005; Copeland, 2003). The connection between the provision of ecosystem services and the threat of pollution from chicken houses was recognized—specifically as it relates to damaging marsh landscapes, impacting water quality, and disrupting the success of local aquaculture.

> VA 3.7: It’s a sobering fact that Accomack County, when they finish building the houses that are permitted, will have the most industrial poultry houses per square mile of any county in the nation.
> VA 3.12: That’s true.
> VA 3.7: That is the truth. This is why anything you drop on the ground in Accomack County of Northampton County is gonna end up on the seaside of the bayside, and it’s gonna affect, you know, the wetlands and the salt mashes’ nutrient loading. It’s gonna be devastating, and it’s happening.
>
> VA 3.12: But it’s gonna affect, you know, affect the bay, it’s gonna affect [the] ecosystem here, it’s gonna be really bad.
> VA 3.4: It’s gonna affect aquaculture.

Participants made it clear that their concerns regarding chicken houses were rooted in their perceptions that industrial pollution would negatively impact the quality of the marshes they enjoy spending time in, in addition to the success of aquaculture operations. These concerns

were identified as being shared by the community, and not exclusive to those that actively participated in aquaculture operations. The same can be said regarding concerns about general degradation of the salt marsh ecosystem; this is not only troubling for those *actively* participating in recreation, but rather a continuous concern for many in the community. This leads us to conclude that concerns regarding chicken houses and associated pollution are not only damaging to 1CBs *recreational value* and *water-based* livelihoods, but more broadly based in the fear that this threat will negatively impact the provision of 2CB *sense of marsh and "shore" identity*.

Participants in VA were also concerned about the threat of increasing *flood risk from rain and storm surge.* Most of this content was classified within the *coastal protection and flooding* or the *threatening the marsh or the provision of services* theme, both which emerged as major themes in VA. During the three FGDs, it became clear that flooding was a recurring issue in the community, as a direct result of heavy rains, storms, and the low-lying topography along the coast. Several participants commented on the torrential downpour that occurred prior to the start of the first FGD.

> VA 3.10: I was about to say, one of the problems we have here is flooding on the Eastern Shore. The Eastern Shore is, uh, a very low-lying are, only a few feet above sea level…
>
> VA 2.1: You know, the town of Cape Charles is what I'm familiar with, and they have drainage, uh, street drainage, storm drainage and whatever, but when it rains like it did yesterday, I mean, I can't remember when it was, but the whole center of town was underwater.
>
> VA 1.9: I mean, you got a 20-foot wave coming and you're only seven feet above ground, think about it. That's the highest point in Melfa, is seven feet. You get a 20-foot wave…

Participants also recognized the looming threat of sea-level rise, suggesting that parts of their community may be lost, and potentially parts of the marsh as well.

> VA 2.11: They say that in 30 years, Saxis will be underwater.
>
> VA 3.7: In '95 they built a four-foot seawall, and that was good 'til about 2000 or 2001 when the water started coming regularly up around the back of the house. So, I talked her into selling that house in 2006 because I knew that by 2020, that house would be gone. 2008 that house was condemned. So, the water, the rise, the sea-level rise was so dramatic from 2002 to 2006 it was measurable.
>
> VA 2.6: Not everywhere, the marshes on the seaside, they're measuring them in Brownsville—last 17, actually 20 years—they're keepin' up with sea-level rise.

> There is enough accretion keeping pace with sea-level rise and they're not disappearing.[9]
> VA2.7: We've got them areas around here, and we're losin' some. It's critical.

In a white paper released in 2016, the EPA reported that climate change was contributing to relative sea-level rise rates on Virginia's Eastern Shore, that in conjunction with regional subsidence, are some of the highest in the country (EPA: Climate Change Division, 2016). The report also suggested that loss of both marsh and beach habitat, salt water intrusion, and increased rainfall were likely implications of climate change.

While not explicitly noted as a concern by participants, it's likely that sea-level rise, increasing damage from storms, and marsh loss will also negatively impact aquaculture operations along the coast. From the content presented here and similar concerns expressed in all three FGDs, participants made clear that increasing flood risk threatens the communities and the surrounding marsh, a valuable ecosystem that contributes to their 2CB *sense of marsh and "shore" identity*.

6.3.3 CR: community activism and conservation needs.

In response to the interface of 2CB *sense of marsh and "shore" identity* and the threats of *industrial agriculture* and *flood risk from rain and storm surge* (this relationship is expressed in Figure 8 by the grey box), participants expressed there had been a swell of community activism, and identified a number of additional conservation needs. Figure 8 presents *community activism and conservation needs* as a CR.

Community activism in VA was characterized by participants as substantial local involvement in marsh-related issues. VA Eastern Shore residents are active in events like Clean the Bay Day, engaging with local leaders in policy decisions, and supporting environmental education programs.

> VA 3.7: A lot of people at that time, this was just a year ago it must be, looked at what the Eastern Shore was, looked at what Northampton County was, and said "we want to fight for it," and they did, and it cost a lot of money. We didn't hire lawyers, we did boots on the ground, and everyone has, I think, a new appreciation for what we almost lost, cause we were gonna lose it, it was gonna go. Accomack County didn't, and they're in trouble.

[9] Whether accretion of VA salt marshes can keep pace with sea-level rise is currently being investigated by partner institutions funded by the same NSF grant as this research.

> VA 2.10: I feel though it would be great for the community, people here on the Eastern Shore to be educated, and maybe even vote, you know, what we would like to see, you know, here to protect the marshes and the land here.
>
> VA 2.6: There's also master naturalists and master gardeners, although they're more upland-type stuff, they're still involved. And there's Citizens for a Better Eastern Shore.
>
> …
>
> VA 2.6: Yeah, they tend to promote environmental advocacy things, not just wetlands, but in general, they're active.
>
> VA 3.7: And the community rose up and said "we want our coastal floodplains, we want the salt marshes, this is what we came here for," and we beat that down and we threw two people off the board of supervisors, we sued the board of supervisors, and turned it around. Accomack County didn't do the same thing, and there's 220 poultry houses, industrial poultry houses coming that way.

Participants were enthusiastic about the concept of *community activism*, and they felt that most of the actions they had taken had been effective in increasing awareness about marsh-related issues and general community accountability for marsh protection. They also identified several *conservation needs*, often in the form of more effective restrictions, increased data collection and research, or simply support for even greater levels of activism within the community.

> VA 3.1: I think the biggest setbacks, which become much larger, making people with property build further away from the wetlands, [which] has been very good to the wetlands.
>
> VA 3.4: More education, um, probably legal advice and data collection… what rules already exist is always tricky, but another piece is just helping people who are here and want to be involved figure out how to get elected to places where they can make a difference. I think that sometimes it seems like somebody else is in charge of it. Or you show up for fund-…everything on the Shore is a fundraiser. Whether it's an oyster roast, a pig roast, or any other kind of roast it's always raising money for something. But um, sometimes it's that guidance piece I think to where your actions can do the most good.
>
> VA 1.12: …last year even, I tried to contact different sources to see if we could get shells over that we could pay for, that we would plant in the waters to increase the number of shells. Because with increased, you know, oysters for sure, and that's what this area, Chincoteague, is known for, their salt oysters. Plus they clean the water, you know, there's a multitude of reasons for doing that, and it doesn't seem as though this area gets a lot of support as far as that goes.

The participants' passionate statements about the value of CR *community activism* in the region are indicative of an appreciation of the 1CBs and the 2CB identified in VA. The insistence on additional research and data collection, policies to restrict chicken houses, and greater education to support marsh protection echo this appreciation.

6.4 GA: Ecosystem Benefits, Threats, and Responses

The summary descriptor for GA and accompanying process map are shown in Figure 9.

Childhood experiences in expansive marshes inspire stewardship cultivation, which, in the context of industrial pollution and residential development, leads to regulatory enforcement needs.

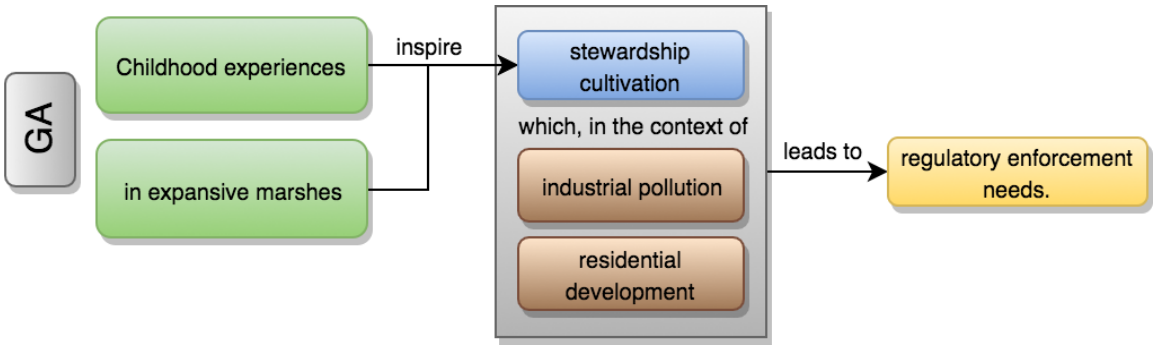


Figure 9: Process map describing the prevailing ecosystem benefits, threats, and responses in GA.

6.4.1 1CB and 2CB: childhood experiences in marsh inspire stewardship cultivation.

Childhood experiences and *expansive salt marshes* emerged as 1CBs in the GA, represented in the green boxes in the process map in Figure 9. 1CB *childhood experiences* is representative of two individual CBs in GA, identified in Table 8: *educational benefits* and *recreational benefits*. In addition to being the two most prominent benefits in GA, we found significant overlap between these two individual CBs in the FGDs, and therefore group them together here as 1CB *childhood experiences*.

Participants affectionately discussed the communal recreational value of the marsh in GA, expressing fondness particularly through the recollection of childhood experiences. Many recalled fishing with family, exploring with friends, and observing wildlife.

> GA 2.3: We would go out into it, to the hammocks—that's what they call them little islands out there, hammocks—and play, build forts, um, got stuck out there at high tide one time (laughs), it was interesting. But uh, there were many hammocks out by the marsh behind where we lived, and we went to every one of them, and there was something different on each one.
>
> GA 1.6: …so we'd put a piece of chicken on a string and let the kids feel the crabs tug at it, and pick it up, and then we would have some hot dogs and baked beans or something on the grill, and that was fun.

Throughout the FGDs, it was clear that many of the participants had valuable memories of interacting with the marsh as children; there was also a support for their own children, and other children in the community, being able to have the same experiences.

Participants eagerly explained the link between many of these childhood experiences and the educational opportunities they provide. It was explained that older generations in the community typically pass on a sense of respect for the marshes to the younger generations, and marsh-related education in schools is seen as important.

> GA 2.8: Um, growing up as a child, um, we spent time there because that's where we played, and of course as I said before, the elders taught us respect for the marsh. It was also a place where they would even teach us that the salt water was good for some of the ailments that we would have…
>
> GA 2.6: As a teacher, I work as a teacher in preschool, we like to take the fiddler crabs and the periwinkle snails and just put little buds of *Spartina* grass in an aquarium, and bring it into the classroom and let the children see it, and start teachin' them to the respect the marsh, and how those little creatures fit into the ecosystem.
>
> GA 2.8: When you first asked the question about bringing those memories from childhood so that I'd be able to connect to it that has to happen. Um, if my grandfather hasn't instilled in me the importance of why, and I get an appreciation for the land, and appreciate the beauty of it, it would not make sense to me. I have friends that have moved away and declared that they're never comin' back. So, they're not tied to the land. And I think that once that tie is connected, and they see that we're connected, then I think that makes a difference, and that's why I said education is important.

Often discussed in parallel with childhood recreational experiences and educational benefits was an appreciation for the aesthetically pleasing views provided by the marsh landscape; *aesthetics of engagement* emerged as the most prominent CB in GA after *educational benefits* and *recreational benefits* (Table 8). *Aesthetics of engagement* is represented as a 1CB in Figure 9 as the green box labeled "in expansive marshes." Roughly a half million acres of salt marsh exist along Georgia's 100-mile coastline, constituting one third of the salt marshes on the U.S. east coast (Schoettle, 2016). Participants in the GA FGDs were aware of the marsh's considerable extent, often describing the vastness of the marshes within the context of the vegetation changing colors with the seasons. We use the term "expansive," an adjective appearing in the GA transcripts, to capture this sentiment.

> GA 2.4: We drive along and look at it, and I really enjoy the view.
>
> GA 1.12: Every night is different, every sunset, it's just gorgeous. Sometimes you just look at all the different colors and it's amazing.
>
> GA 1.1: …in the summertime it's beautiful green, and in the winter it's hold and when the light shines on it, I mean, when it turns brown—it doesn't die, it just turns brown—and it just turns, every time you look at it, it's a different color. And it's breathtaking. And it's the biggest marsh estuary anywhere I think.

Participants also used words like “breathtaking,” “magnificent,” and “gorgeous” to describe aesthetically pleasing marsh landscapes; others mentioned that they enjoyed the soothing sounds and smells emanating from the marsh.

> GA 1.6: I still love to go to relax, it’s just relaxing, just listening to the water.
>
> GA 3.7: Auditory. It’s very noisy, and it’s fabulous. It’s, somebody was mentioning the seasons earlier, and you can tell when spring is coming, or here, because suddenly there’s croaking everywhere… and it’s, it’s loud and wonderful.
>
> GA 2.8: The salt water, the salt water marsh, from my remembrance was strong. I mean you can tell when you were near the water.
> GA 2.11: It was strong, that’s right.

Participants also enjoyed seeing wildlife in the marsh, a common component of 1CB *childhood experiences* and 1CB *expansive views*; in particular, participants noted that they enjoyed watching migratory birds.

Throughout the GA FGD, participants alluded to the influence these 1CBs have on the provision of an additional benefit: *stewardship cultivation*. This appears as a 2CB in Figure 9; while the 1CBs *childhood experiences* and *expansive views* were described as beneficial primarily while actively engaging with marsh landscapes, these experiences also provided long-lasting benefits, affecting participants in a profound way. Because 2CB *stewardship cultivation* was expressed as being continuously influential within the community, and derived directly from the aggregate influence of component 1CBs, we describe *stewardship cultivation* as a 2CB.

As described by participants, 2CB *stewardship cultivation* in GA manifests as deep feelings of connectedness with the marsh, fostered primarily by childhood experiences and education in aesthetically pleasing landscapes. The concepts of respect and guardianship also emerged.

> GA 2.8: So, I still go back to, um, environmental issues and education. And um, my granddaughter is seven, and that’s something that they’re beginning to teach them in school, and until we understand that there’s a direct link between us and… um, when you asked the question about the marsh, and “does it have any health benefits?” I think that’s, we’re gonna learn that we’re all connected. And we’re 80% water, then, there’s a connection.
>
> GA 3.8: Well what my takeaway would be is that I need to educate myself more, and after I’ve educated myself, then I need to tell somebody else, and that somebody else tells somebody else, and they can make it… make it our priority to let them know that there’s a connection between us and the marsh.

The feelings of stewardship espoused by the participants were largely identified as being important even prior to the discussion of various threats present in GA. While certainly providing a foundation for activism in response to threats to the marsh or the marsh's provision of services, we also understand *stewardship cultivation* to be a benefit in its own right within the community.

6.4.2 Threats: industrial pollution and residential development.

Referring back to Figure 9, participants indicated that a host of threats to the marsh are present in GA, shown in the brown boxes. The two primary threats identified were *industrial pollution* and *residential development*, both of which have the capacity to impact 1CBs *childhood experiences* and *expansive marshes*, and ultimately, 2CB *stewardship cultivation.*

Participants acknowledged a long history of negligent industry and associated pollution in the region, much of which resulted in long lasting impacts to the environment. Attracted to Coastal Georgia by an "abundance of groundwater and surface water, seaport facilities, climate, an available labor force," and an initially receptive attitude in the region, the chemical and paper industries have contributed significantly to the region's economy (National Parks Service, 2005). This is not without consequence however; of the three locations in this investigation, GA is the only one that contains Superfund sites (EPA, 2017). Concerns regarding industrial pollution revolved around impacts to air quality, heavy metals in the water, and long-term damage to marsh and wildlife health.

> GA 1.12: …and there's Superfund sites and they just didn't seem to care about what they did to the natural environment in this area, and now from what I understand they're talking about possibly drilling for oil offshore here, which would again affect the waters and the marshes.
>
> GA 1.7: Because these corporations, it cuts into their bottom dollar, yes, but they're still makin' a profit. And like some of these companies kill the marsh, they're killin' the people. They're killin' the people, they're killin' their own business.
>
> GA 1.1: …it's just a pollutant, they just dump it into the Altamaha River, the largest fresh water river estuary east of the Mississippi River in the United States, and they dump it in. And for a couple miles down the stream, the water is actually just red, and just nasty, and it smells.

Concerns regarding industrial pollution were firmly rooted in the feeling that the resulting damage to the marsh would impact the community's ability to enjoy the ecosystem services provided by the marsh. Several participants mentioned concerns about poor water quality affecting habitats and impacting fish health, which reduces the enjoyment derived from recreational fishing. Since

at least 2000, Georgia has issued comprehensive seafood advisories providing recommendations to recreational fisherman to provide guidance on safe consumption, citing high levels of mercury and PCBs in some waterbodies (Georgia Department of Natural Resources, 2013). Participants indicated that despite an ingrained sense of stewardship within most of the community, they felt they were at the mercy of poorly enforced industrial regulations and pollution. Essentially, the benefits received via 2CB *stewardship cultivation* (e.g. communal sense of responsibility for the marsh) are being threatened in GA.

Residential development was also identified as a threat by GA FGD participants. Concerns were primarily a result of increasing population density, loss of public lands, and property management by homeowners.

> GA 2.1: We're certainly witnessing a diminution of public lands, and the public access, that's what, I mean, property being sold off. Nobody's talking about what happened at Jekyll Island, that was really upsetting to me, that development they permitted. Jekyll Island. So you've got pollution, sellin' off what was public land. Now, how did what was ours get sold without our permission?
>
> GA 2.4: Your major issue is you've got millions of people in the Atlanta area and they all want to come down to the coast, either to vacation or retire, and there's just not enough land down here for all ten million of them that out there.
>
> GA 1.1: We just came up with a new, uh, what's it called? The buffer rule? Where you gotta' drop back 25 feet from the… which is a good deal, I just hope everybody will adhere to it because a lot of people are goin' out there wanting to put sea walls, to put filter cloth in, and fill it in with dirt to dig, plant grass on, and uh, that's not good.

While motivated by different threats, participants expressed their primary concerns as stemming from the loss of valuable marsh ecosystem benefits, either due to land development or declining health from industrial pollutants. The diminishing quality or quantity of marsh ecosystems in GA will result in a declining provision of the benefits the community receives from 2CB *stewardship cultivation.*

6.4.3 CR: regulatory enforcement needs.

Participants identified an outcome of the interaction between 2CB *stewardship cultivation* and the threats of *industrial pollution* and *residential development*: CR *regulatory enforcement needs*. This is shown in the yellow box in the process map presented in Figure 9. The recognition by participants that they require additional protection of the local marsh ecosystem is an extension of the feelings of stewardship that are deeply rooted in the community.

Despite existing regulations, such as the Coastal Marshlands Protection Act and the EPA's Clean Water Act, participants felt that the threat of industrial pollution and encroaching residential development were still significant factors in the current and future degradation of the GA marsh. As a result, participants identified a number of *needs* to address these issues. Most of the content supporting CR *regulatory enforcement needs* was classified within the *community agency and engagement in protection* theme (see Table 12). One proposed solution was implementing additional accountability measures for local industry that frequently deemed to be untrustworthy.

> GA 2.6: I would that uh, Georgia Power things that they are doing something by closing the plant, but they have, they have dug up a bunch of marsh (laughing) and destroyed a lot of things in order to do that. And I think it remains to be seen, I'm a little skeptical myself, still gonna get my water tested (laughs), just to make sure, but um, it remains to be seen. I don't trust the industries very much.
>
> GA 1.7: More filtration regulations for these companies up and down the coast.

Participants were also interested in seeing additional supervision for residential development, suggesting that present oversight is not sufficient in preventing damage to the marsh. Others commented that follow-through was equally important, ensuring that developers adhere to approved plans from start to finish. Some felt that GA does not have sufficient protections in place to prevent detrimental alterations to the local environment.

> GA 2.Moderator: Restrictions on development then? Is that something you…?
> GA 2.2,3,5,11: (Nodding in agreement)
> GA 2.1: Well it's not just development, but the whole manufacturing industry that comes in.
>
> GA 2.11: You know the saddest thing for me is when I meet people from Vermont, Massachusetts, all of those northern states, and they'll say "you know, it's against the law to cut the trees where I'm from, don't ya'll have a law down here?" And I said "no, we don't, unfortunately we don't."
>
> GA 3.10: Responsible development. Planned development.
> GA 3.6: Well planned, but uh, also once it's planned it's somebody that makes the developer stick to the plan, the approved plan, by the people that had the integrity at the start to begin with, and do it correctly. Then everything works out.

Many were also concerned about wealth and political corruption that permits the circumvention of regulations by both developers and industry—many used the term "good ol' boy politics" to describe this phenomenon. Throughout the discussion, participants indicated that this is a widespread problem, not confined to a small handful of bad actors, but potentially ingrained in

the politics of the region. A lack of both adequate funding and political will was also cited as a related problem.

> GA 3.8: Well it's... there's, there's favors. It's this, it's that, and that sort of thing needs to be controlled, and I don't want to have anything…
> GA 3.10: It's the "good ol' boy" network to the 'nth-degree.
> GA 3.11: That's what it is.
>
> GA 3.6: I think the problem with that though is the [county] extension services are so desperately underfunded, that where they used to have a county agent in each and every county, now there's county agent that runs six counties or something like that, I mean spread all over the place, and it's very difficult to… to utilize that as they were originally planned to be used.
>
> GA 3.10: …but uh, again, you know, federal agencies generally are much smaller than they need to be, don't run as efficiently as they should run, and they're underfunded.
> GA 2.3: And sometimes your local officials are the worst.
> GA 2.2: They don't really care.
> GA 2.3: They don't care.

Participants identified a number of organizations that were actively engaged in marsh-related issues in the region, such as 100 Miles, the Glynn Environmental Coalition, NOAA, and the local commission and zoning boards, among others. However, the overarching sentiment in all three GA FGDs was that their community still had additional *regulatory enforcement needs* that were not currently being met. Some participants suggested that even within the community, some residents did not display the level of stewardship and respect that the marsh deserved. Based on the insistence that the community requires additional support in achieving its marsh protection goals, which we consider a CR called *regulatory enforcement needs*, it is apparent that the participants that attended the GA FGDs place a high value on the marsh and 1CBs and 2CB that are provided.

6.5 Cross-site: Parallels and Differences

While the underlying ecosystem benefits, threats, and responses that shape the relationships communities in MA, VA, and GA have with local marshes vary, the overall processes through which these relationships develop are similar, as represented in Figures 7–9.

6.5.1 1CBs and 2CBs: MA, VA, and GA.

In all three study sites, participants indicated that residents in their communities derive a variety of benefits from direct interactions with local marsh ecosystems; we describe the benefits from these interactions as 1CBs. The majority of constituents of these representative 1CBs are

classified as *benefits* (e.g. *recreational benefits, aesthetics of engagement,* and *educational benefits*), however participants also described *aquaculture* (components of which are economic benefits in VA) and *biodiversity* (in MA, GA, and VA), an ecosystem *service*, as being valuable.

Of the major CBs, *recreational benefits,* is presented as being a prominent 1CB in MA, GA, and VA. Participants in all three locations indicated that recreational experiences in the marsh, and adjacent to the marsh, were extremely valuable to their communities, providing enjoyment, relaxation, and opportunities to socialize with friends and family. Experiences such as boating, fishing, and exploring were all commonly mentioned. In GA, however, a greater portion of the FGD content reflected childhood recreational and educational experiences, and the importance of these experiences as they pertain to a sense of marsh stewardship later in life.

Aesthetics of engagement appeared as a CB in all three locations, however only as major in MA and GA. Participants in MA and GA were consistently enthusiastic about the beautiful views, calming sounds, and aromatic smells they experienced while visiting the marshes. GA participants felt the vastness and expansive wilderness areas without development were somewhat unique to their local marshes, a concept that did not arise in MA. VA residents were also enthusiastic when discussing the beauty of marsh landscapes; however, this particular CB was less prominent in VA than in the other locations.

Participants in all three locations also expressed a great deal of interest in the local wildlife, and how the existence of that wildlife was integral in many of the recreational and aesthetic benefits they felt were important in their communities. For example, participants in all three locations expressed gratitude that they were able to observe a variety of bird species, fish, crustaceans, and mollusks. Mammals were also identified in all three locations, however a greater number were identified in VA and GA than in MA. MA participants did, however, readily discuss a great diversity of plant species, including both varieties they deemed valuable, and those they considered invasive and possibly problematic to marsh habitat.

1CB *water based livelihoods* was uniquely prominent in VA. While MA participants briefly mentioned some farmers in their community engaging in salt marsh hay harvesting, the *economic dependence* theme appeared with near-negligible prominence. Participants in GA discussed the

economic benefits of the marsh with greater passion, discussing the long history of shrimping in the region. However, this concept rarely permeated other parts of the GA FGDs, and was often referenced as an industry that was important to a specific segment of the population, rather than the community as a whole. In contrast, involvement in aquaculture was expressed to be a valuable concept in VA, an industry that participants expressed to be influential on feelings of community pride. In conjunction with the aquaculture industry, VA participants discussed how parts of their community were built around the crabbing and fishing industries, and generally reliant on the provision of fresh water for their livelihoods.

In all three locations participants also identified additional ecosystem services that were provided by the continued provision of 1CBs. Realization of these benefits usually occurred over time, did not necessarily require constant interaction with the marshes to experience, and tended to be more omnipresent. Because this type of ubiquitous benefit is derived through a series of repeated experiences with 1CBs, we use the term 2CBs. The process through which these 2CBs were provided was similar across all three states.

In MA, participants shared that repeated experiences in aesthetically pleasing marshes contributed to 2CB *serenity*. They expressed that these feelings, to various degrees, permeated other aspects of their life, and were not felt exclusively when engaging in recreational activities. The same can be said for VA participants in their description of 2CB *sense of marsh and "shore" identity*. VA participants identified this representative benefit as being valuable to residents of the community, and including components of community belonging, personal attachment to the Eastern Shore, and advancement of social relationships with friends and family. GA residents also identified a 2CB that arises in their community as a result of repeated interaction with the marshes: *stewardship cultivation*. 2CB *stewardship cultivation* in GA, in many ways, appear similar to 2CB *sense of marsh and "shore" identity* in VA. GA participants expressed that through childhood experiences and recreation in aesthetically pleasing marsh landscapes and education about the value of the marsh, residents nurture communal feelings of guardianship for the marshes. We collectively term these benefits "*stewardship cultivation."*

6.5.2 Threats: MA, VA, and GA.

In all three locations, FGD participants were passionate about addressing the various threats within their communities that they perceive to be damaging to the health or the provision of ecosystem services and benefits provided by the marsh. *Development* emerged in all 9 FGDs, often without prompting from the moderator, and in nearly all cases, participants were passionately in opposition to forms of development that they perceived would be significantly damaging to the environment. The type of development that participants felt to be most concerning, however, varied from state to state.

FGD participants in MA were most concerned about residential development, especially in the context of large houses being built in proximity to the marshes. Participants indicated that residents in their community were anxious about residential development encroaching into natural areas, the impacts to the quality of the marsh, and the potential damage to the aesthetic beauty of the marsh. GA participants also shared that they were concerned about residential development, particularly in the context of increasing population in the area. This was a result of anxieties about the loss of undisturbed natural space where many of them recalled spending time as children, and a general aversion to dramatic changes to local marsh landscapes.

Participants in both VA and GA were concerned about the impacts of industry on the health of local marshes, and by translation, the provision of ecosystem services deemed valuable in their communities. In GA, these concerns pertained mostly to the negative externalities of the local chemical and paper plants, such as the contamination present in Superfund sites and the implications for marsh quality and wildlife health. Participants in VA had similar concerns, stemming from the abundance of industrial chicken houses, and how contaminants introduced into the marsh via runoff may have long lasting impacts on marsh health, aquaculture viability, and recreational opportunities. In MA, VA, and GA participants expressed the unsettling feeling that wealthy individuals and unscrupulous developers were able to avoid existing regulations on development. In VA and GA, these concerns were more elevated, and participants in both states indicated they feared the involvement of unscrupulous politicians and greedy special interest groups in marsh-related decision-making.

While not unique to VA, concerns about *increasing flood risk* appeared as major in the VA FGDs, and less of an issue in both MA and GA. Throughout the VA FGDs, participants conveyed feeling anxious about flooding caused by heavy rains and storms. Some suggested they were fearful about losing entire portions of their community to sea-level rise, which may have lasting effects on their sense of identity.

6.5.3 CRs: MA, VA, and GA.

As expressed in Figures 7–9, the interface of 2CBs and various threats in MA, VA, and GA result in the provision of additional benefits through CRs. In MA, the interface of 2CB *serenity* and the threat of *residential development* inspires CR *conservation support*; in VA, the interface of 2CB *sense of marsh and "shore" identity* and the threat of *industrial agriculture* inspires *conservation needs*; and in GA, the interface of 2CB *stewardship cultivation* and the threat of *industrial pollution* and *residential development* inspire CR *regulatory enforcement needs*. All of these CRs are characterized by community cohesion and a sense of purpose, which often leads to community engagement in a common problem: threats to the marsh and associated benefits. In all three communities, participants indicated that residents of their communities were interested in involvement in sustained or increased marsh protection.

When describing conservation support, the participants of the MA FGD were optimistic about their involvement in marsh protection, indicating that the numerous government agencies and non-profits in the region were extremely effective in providing protection to the marsh through restrictions on development and conservation programs. Participants in VA and GA were as eager to be involved in marsh conservation, but were less convinced of their current success, and felt they had less support from governments and local organizations. Participants in FGDs in both VA and GA indicated they still required considerable increases in funding, government support, research and monitoring, and general activism within the community.

6.6 Contributions to the Ecosystem Services Terminology Discussion

As discussed previously, there are a variety of classification systems and definitions that appear in the ecosystem services literature, each attempting to contribute to the development of a common framework and terminology for discussing ecosystem services. Because of its ubiquity in

the literature, many authors in the ecosystem services field adopt the MEA (2005) definition, which states that ecosystem services are the "benefits people obtain from ecosystems" (p. 40). This definition, as mentioned, tends to use the terms *service* and *benefit* synonymously, and can therefore be confusing. A similar sentiment is expressed in much of the ecosystem services literature, where it is suggested that the ecosystem services definition presented by the MEA (2005) does not adequately make the distinction between various components, namely services and benefits, of the of human–environment interactions within the ecosystem services discussion (K. Chan, Satterfield, & Goldstein, 2012).

Distinguishing between these two concepts clarifies some of the results presented in this investigation. The following definitions are reiterated: *ecosystem services* are biophysical processes and outputs that have human beneficiaries, but do not include human involvement; and *benefits* are the contributions to personal well-being or communal fulfillment derived from those processes and outputs. *Cultural benefits* is a category of benefit that encompasses less tangible contributions to human welfare, and those benefits that have proven difficult to value in monetary terms using traditional economic methods. The same ecosystem service can also provide multiple types benefits. For example, the natural provision of fish is an *ecosystem service*, and the contributions to human welfare derived from fishing are *benefits*. In the case of recreational fishing, the enjoyment derived can be considered a *cultural benefit*. In the case of commercial fishing, the financial gain derived can be considered an *economic benefit*—in the event that a commercial fisherman develops a personal identity based around this livelihood, that can be considered a *cultural benefit.*

Because of the complex interrelationships between ecosystem services and various types of benefits, terminological clarity is imperative. In keeping with the goals of this research, these definitions are most effective, and firmly grounded in the data collected in the MA, VA, and GA FGDs. Because these distinctions are made in the economics literature, these definitions are also helpful in bridging the gap between qualitative and quantitative methods of ecosystem valuation.

6.7 Contributions to Ecosystem Service and Benefit Valuation and Policy Implications

Because the distinction between services and benefits is made in the economics literature, using these definitions here is also helpful in bridging the gap between qualitative and quantitative methods of ecosystem valuation. As discussed previously, ecosystem valuation is the process of assigning value (typically monetary) to ecosystems or specific ecosystem services. While not always the case, it's often theoretically appropriate to value a given ecosystem service by summing the values of all the benefits provided by that ecosystem service (Turner, Morse-Jones, & Fisher, 2010). Similarly, an aggregate value for an entire ecosystem can be derived by then summing the value of each of the individual services. In practice, however, this is extraordinarily difficult, if not impossible, because of the complexity of ecological systems and the innumerable benefits that they provide.

Regardless of this hurdle in implementation, the current methods of valuation are still conceptually problematic. This is primarily due to the fact that many CBs, such as the CBs identified by the participants in this investigation, cannot readily be assigned a monetary value. CBs have are therefore often overlooked in assessments of ecosystem service value; the fundamental problem with this is that only a small subset of the benefits provided by a given ecosystem service are aggregated to achieve that ecosystem service's total value. This issue is displayed visually in Figure 10.

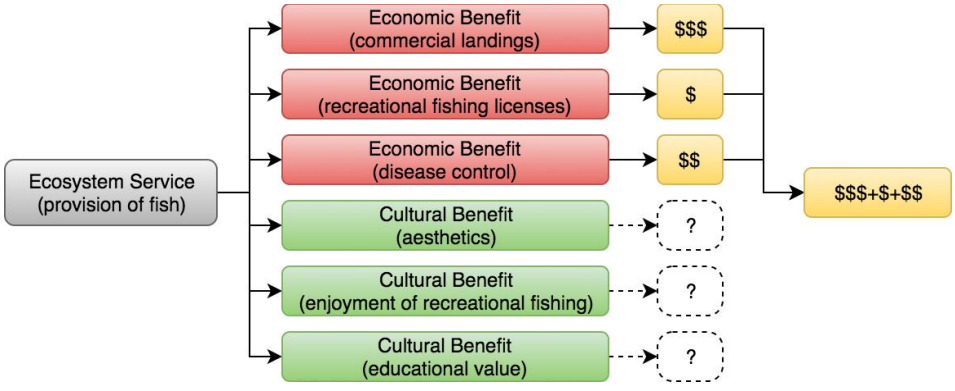


Figure 10: Simplified example of ecosystem service valuation and the inherent problems of assessing value in strictly monetary terms.

The model shown in Figure 10 is a simplified example of the process of ecosystem service valuation—in practice, there may be a greater number of associated benefits, and the

interrelationships of various ecosystem services may need to be considered. Additionally, in some cases ecosystem services can be valued directly, without the aggregation of specific benefits; as an example, calculating the cost of artificially replicating an ecosystem service, as in the case of carbon sequestration (Melaku Canu et al., 2015). Nevertheless, this model provides a simplified visualization of the problems inherent in traditional economic valuations.

The results of this research and similar investigations have made substantial contributions in rectifying this problem however. By engaging in qualitative, discourse-based assessments of value, researchers and various stakeholder groups have the capacity to enhance ecosystem valuations through the inclusion of a broader range of benefits. What remains is the process of aggregating monetary units of value and non-monetary units of value into a meaningful output—the first step however, is simply the recognition of that non-monetary value.

The lack of consideration for CBs in policy decisions has increasingly been identified in the literature as a problem that needs addressing. As research into public perceptions of ecosystem benefit value continues to emerge, particularly the processes through which CBs are valued at the community scale, scholars have argued that an understanding of these processes can serve as helpful avenue in policy generation (Daily et al., 2009; De Vreese, Leys, Dendoncker, Van Herzele, & Fontaine, 2016). Results from investigations of social–ecological systems, such as the one presented here, have been shown to be a meaningful tool in fostering discourse between researchers, stakeholders, and policy-makers (Hauck et al., 2013).

Environmental scientists have thoroughly documented the ramifications of ecological degradation on human well-being. The scientific publications through which these findings are expressed, however, are often difficult to access, and frequently more technical than is optimal for reaching a general audience. The ecosystem services and benefits concept “has proven helpful in communicating the benefits of ecosystem conservation to diverse stakeholder groups” (Hauck et al., 2013, p. 13). It has been suggested this is a direct result of the anthropocentric framing of the ecosystem services discussion (i.e. ecosystem services provide benefits to *humans*), which provides a justification for environmental conservation and support for sustainability based on humans’ dependence on goods and services provided by ecosystems (Reid et al., 2006).

Successful dialog between researchers, stakeholders, and policy-makers is heavily reliant upon the consistent use of commonly understood terminology and the implementation of universally recognized descriptive frameworks. Developing unified descriptive language and visual models that aid in expressing human interaction with ecosystem services and benefits is critical; this process is inherently embedded in the multidisciplinary research that seeks to bridge the gap between qualitative assessments of value and classical economics. This developing standardization is largely due to the process of engagement with stakeholders, such as in the case of this study, where the definition of concepts and process models were based largely on feedback from the general public. The logical continuation of ecosystem service research is greater engagement with decision-makers. The next steps in the larger umbrella NSF Coastal SEES grant under which this research takes place involves engaging with local policy-makers and decision makers in MA, VA, and GA.

Feedback from local officials regarding our interpretations of the FGD data and development process maps will enhance future investigations and the usability of results. By obtaining a more complete picture of the priorities of their constituents, in addition to the true value of ecosystems, policy-makers can contribute to more effective conservation policy. For example, MA participants were convinced that non-profits and governments had their best interests in mind. While this is likely due to a variety of reasons, ranging from a long history of environmental protection to abundant funding, it may also be due to a greater engagement between officials and residents. If given the opportunity, residents in most communities will likely express a variety of ecosystem benefits that they deem valuable—many of which may not presently be accounted for in conservation policy. This may not be through the fault of local decision-makers; as expressed in Figure 10, without a complete picture of ecosystem value, the crafting of successful policy is difficult. The upcoming charrettes within the larger SEES investigation that are intended to share the results of this study with local leaders will likely answer many of these questions.

7. CONCLUSIONS

7.1 Ecosystem Services and Benefits in MA, VA, and GA

As one of the most economically valuable and biologically productive environments on the planet, salt marsh ecosystems have been widely studied for the multitude of benefits they provide through the provision of ecosystem services, from coastal protection and fisheries support, to carbon sequestration and impacts on property value. However, what is often excluded from these economic assessments is an investigation into the cultural value provided by marshes, and the ways in which local residents engage with these ecosystems to perceive cultural value.

As many of the cultural benefits provided by marsh ecosystems cannot be measured in purely monetary terms, the collection of qualitative data is necessary to augment traditional economic methods of valuation in order to achieve a more complete assessment of value. This research utilized focus group discussions as a means of engaging with local residents of three different marsh-adjacent communities to better understand the processes through which the general public assigns value to marsh ecosystems. When transcribed and processed using grounded theory, we found the content of these focus group discussions be insightful in identifying a substantial list of ecosystem services, many of which are typically given little weight in conventional economic investigations.

Results showcase the most prominent ecosystem services that focus group discussion participants perceived as being supplied by local marsh ecosystems, and many of the relationships that they have with these services. Through our investigations in three communities, one each in Massachusetts, Virginia, and Georgia, we found that while the specific inputs and outputs of each human–environment system may vary, many of the processes that define these relationships are similar. In all three locations, participants identified a number of ecosystem services and benefits which they perceive as valuable, followed by a set of threats to the provision of those services and benefits, and finally, the resulting community responses to the

interface of those services, benefits and threats. In MA, the interface of the second order ecosystem benefit *serenity* and threat *concerns regarding residential development* led to widespread conservation support within the community. In VA, participants felt that the second order ecosystem service *sense of marsh and "shore" identity* were being threatened by industrial agriculture and increasing flood risk, which inspired community activism and the identification of a variety of additional conservation needs within the community. Participants in GA identified *stewardship cultivation* as a second order ecosystem service, which they felt was threatened by residential development and industrial pollution.

7.2 Continuing the Conversation

Increased insight into the processes through which the general public engages with the ecosystem services they deem most valuable, and the relationships between those services, are invaluable in advancing the ecosystem services valuation conversation. The literature suggests that the incorporation of stakeholder engagement is critical to the development of effective public policy. The methodology presented here serves as a case study for investigating public perceptions of ecosystem service value and associated processes. Similar investigative methods should be utilized during the decision-making process to ensure policy goals are suitably aligned with public preferences.

While the results showcased here provide insights into the understanding of the public's perception of marsh ecosystem service value, additional work is required. Qualitative assessments alone are not enough to adequately assess ecosystem service value, and an integration of qualitative methodologies with conventional economic models will provide an even more robust picture of the processes though which humans interact, and value, ecosystems. Concurrent research is being performed by other investigators within the larger Coastal SEES grant to achieve these goals. Forthcoming results of that work will compare traditional quantitative economic valuations with the qualitative prominence measures obtained in this study. Charrettes with local officials and policy-makers will be conducted during the summer of 2018 to showcase the results of the both qualitative and quantitative studies, which will further advance the process of integrating ecosystem service valuation into policy-making.

8. APPENDICES

8.1 Appendix A: Focus Group Recruiting Prompt

[INTRODUCTION]
Hello, may I speak with _____? My name is _____, and I'm calling from GreatBlue Research, Inc., a professional market research firm. We are looking for a limited number of people to join us for a focus group research session sponsored by Florida Atlantic University and Clark University to be held in your local area. The goal is to learn about how local residents like you think about and use the environment along the coast, and how coastal areas should be managed.

If you qualify to take part in the study and choose to participate, you will be joining a 90-minute, in-person focus group at a facility in LOCATION TBD on DATE/TIME TBD. All participants will receive $85 for their time.

Would be interested in answering a few questions to see if you qualify? This is not a sales contact – no one will attempt to sell you anything. The only purpose of the focus group is to learn your opinions.

SCREENING QUESTIONS: [RECRUITER READ]
When was the last time, if ever, you participated in a market research discussion at a research facility?

Less than 6 months	( ) Thank and terminate
6 months to less than 1 year	( ) Continue
1 to less than 5 years	( ) Continue
5 or more years	( ) Continue
Never	( ) Continue

What category best describes your age:
[RECRUITER NOTE: RECRUIT A MIX]

18 to 24	( ) Continue (Recruit 1-3)
25 to 34	( ) Continue (Recruit 1-3)
35 to 44	( ) Continue (Recruit 1-3)
45 to 54	( ) Continue (Recruit 1-3)
55 to 64	( ) Continue (Recruit 1-3)
65 or older	( ) Continue (Recruit 1-3)

What is your gender?
[RECRUITER NOTE: RECRUIT A 50/50 MIX]

Male	( ) Continue (Recruit 6 for each group)
Female	( ) Continue (Recruit 6 for each group)
Other	

What town do you live in? [RECORD AND RECRUIT A MIX OF TOWNS] _____

And, what county do you live in? [RECORD AND RECRUIT A MIX OF COUNTIES] _____

[RECRUITER NOTE, IN GEORGIA – Recruit 2-3 from McIntosh County, Recruit 2-3 from Glynn County]
[RECRUITER NOTE, IN VIRGINIA – Recruit 2-3 from Northampton County, Recruit 2-3 from Accomack County (southern part)]

Based on your answers, you do qualify! We'd like to ask you to participate in a 90-minute focus group at LOCATION TBD on DATE/TIME TBD. This research seeks to gain an understanding of people's uses, purposes, and perceptions of marshlands in your area. Participation is voluntary, and as a token of appreciation for participating, you will receive an $85.00 cash incentive. No one will attempt to sell you anything at all, and you may decline to answer any question that you do not wish to answer. All responses will be confidential, and your name will not appear on any of the focus group recordings or transcripts. Before the focus group begins, you will be given a consent form that includes additional information and light refreshments will be provided.

There's nothing to prepare or bring except for your own opinions. Most people find these groups to be interesting and fun – I'm sure you'll enjoy it.

Would you be willing to participate in this focus group?
(CHECK SCHEDULE FOR QUOTAS AND AVAILABILITY)

1.	YES	RECORD RESPONDENT INFORMATION ON NEXT PAGE
2.	NO	THANK AND TERMINATE

DATE: TBD
TIME: TBD

PROVIDE PARTICIPANT WITH INFORMATION BELOW:
LOCATION: [READ] As I mentioned, we will be conducting the focus group at TBD.
[READ] Please plan on arriving about 15 minutes before your scheduled interview time so that we may begin promptly at TBD.

START TIME: TBD

APPROXIMATE LENGTH OF INTERVIEW: [READ] The focus group should take about 90 mins to complete.

READ:
We will send you directions to the focus group location and confirmation of these arrangements via e-mail and we will also call to remind you about your participation a few days before your scheduled group. So that we can send you the directions and confirmation, please provide me with your contact information. May I have your…

NAME _____

PRIMARY PHONE _____ SECONDARY PHONE _____

EMAIL _____

TOWN _____ ZIP CODE _____

8.2 Appendix B: Focus Group Consent Form

The signing of this form constitutes consent to participate in a 90 minute focus group discussion being conducted by Professors Robert Johnston from Clark University and Colin Polsky from Florida Atlantic University, in collaboration with **[insert local LTER name here].** A focus group is a small group discussion with 6-12 participants. You will be engaged in a moderated, informal discussion about perceptions and opinions regarding government policies that affect coastal communities. The purpose of this study is to understand your preferences for coastal flood, sea level rise, and erosion protection. You are being paid $85 for being in this focus group, and your participation may impact society by helping us to better manage and protect important coastal resources.

The focus group will be audio taped and transcribed. Your participation in this study is entirely voluntary. You are free to terminate your participation in this research at any time without penalty, or to refuse to answer any questions to which you don't want to respond.

Your participation in this study is confidential. Neither tapes nor focus group transcripts will contain names or any other information allowing identification of individual participants; participants will be identified by code number only. To help ensure confidentiality, please do not mention your name, or the name of any other participant during the focus group. Please do not discuss the details or participants in this focus group outside of the session.

Signed consent forms will be stored in a locked storage area in the Center for Environmental Studies at Florida Atlantic University accessible only to Professor Polsky and his research assistants, separate from audio recordings and transcripts. Focus group recordings (the digital recorder) will be stored in a locked file cabinet in the office of the project leader (Robert Johnston or Colin Polsky) accessible only to them. Transcripts and copies of recordings will be stored in electronic form only, on Professor Johnston's and Polsky's password protected computers. Access to these data will be limited to Professors Johnston and Polsky and their student research assistants. Focus group recordings will be erased within one year after completion of the four year project. Password protected transcript files will be retained indefinitely, in accordance with standard data requirements for economic research. You will be given a copy of this consent form to take home with you.

If you have questions or concerns about this study, you may contact Robert J. Johnston at 508-751-4619 or rjohnston@clarku.edu or Professor Colin Polsky at 954-236-1088 or cpolsky@fau.edu.

By signing below, I verify that I have read this consent form and agree to participate in this focus group. I also agree to be audio recorded during this focus group.

_____ (Signature) _____ (Date)

_____ (Printed Name)

This study has been approved by the Clark Committee for the Rights of Human Participants in Research and Training Programs (IRB). Any questions about human rights issues should be directed to the IRB Chair, Dr. James P. Elliott (508) 793-7152.

8.3 Appendix C: Focus Group Instrument

Introductory Questions:

1. What experiences do you have with the marshes in your local area? What can you tell me about these areas?
2. When people in your community talk about the marsh, what types of things do they say?

Key Questions:

1. What brings you to the marshes? How much time each year do you spend there?
    a. Do you use the marsh for recreation or other purposes? If so, please describe those uses.
    b. How and why are recreation or other uses important to you or your community?
    c. What types of plants and animals do you encounter near the marsh?
    d. How does the marsh or its wildlife make you feel?
2. What are any other reasons why you or others value marshes in this area, particularly compared to other potential uses for the land?
    a. What natural features come to mind when you think about the marsh in the area?
    b. Please write down the first two or more words or feelings that come to mind when you think about your local marshes.
    c. Think back to the most memorable experience you've had at or alongside the marsh. Please share this experience with us.
3. Is the quality or condition of the marsh important to you or the general community?
    a. How do you know if these areas are healthy or not?
    b. What are the benefits associated with healthy marshes in the region? Do you benefit personally?
    c. Have you noticed any changes to these environments?
    d. Do you think the health of these environments and your own well-being are connected in any way? If so, can you describe that link?
4. In your experience, is this area frequently threatened by storms or flooding? What effects have occurred as a result of these floods?
    a. How frequently do storms or flooding occur?
    b. How concerned is your community about storms or flooding? Do people take these storms and floods seriously and how do they respond?
    c. What does your community do to prevent flood damage and how effective do you think it is?
    d. Do you see storm or flooding events as being related in any way to the marsh in the area?
5. Are you aware of any actions being taken in your area to protect natural areas such as marshes—for example, from loss due to flooding or erosion?
    a. Can you explain what actions have been taken to protect these natural areas?
    b. From what you can see, have these actions been effective? What have the effects been?
    c. Do you favor actions to protect the marsh?
    d. Would you favor restrictions on development or your community spending money to protect marshes? Can you think of other *tradeoffs* like this?
    e. How high a priority is the protection of coastal areas such as marshes to you?

Wrap-Up Questions:

1. If you were interested in receiving support in your community for managing the marshes, who would you reach out to? Non-profits, small business, large industry, local government, faith based organizations, universities or other groups?
2. Of all the things we discussed, what do you think is the most important?

a. Is there anything additional you'd like to share with us about marshes in your area that you think we have not discussed this evening?

Closing Statement

That's all the questions we have for you, we appreciate you setting aside some of your time today and sharing your thoughts and opinions with us.

8.4 Appendix D: Optional Attendees Demographics Survey

Please fill out this survey for our research. Your answers are completely voluntary and you may skip any questions that make you feel uncomfortable.

Location: Georgia [McIntosh or Glynn] Virginia [Accomack or Northampton] Massachusetts

To which group(s) do you identify? Check all that apply.

- ☐ African-American or Black
- ☐ Asian/Pacific Islanders
- ☐ White/Caucasian
- ☐ Latino or Hispanic
- ☐ Native American
- ☐ Other: _____

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer
- ☐ Other: _____

What is your age?

- ☐ 18-29 years old
- ☐ 30-49 years old
- ☐ 50-64 years old
- ☐ 65 years old and over

What is the highest level of education you have completed?

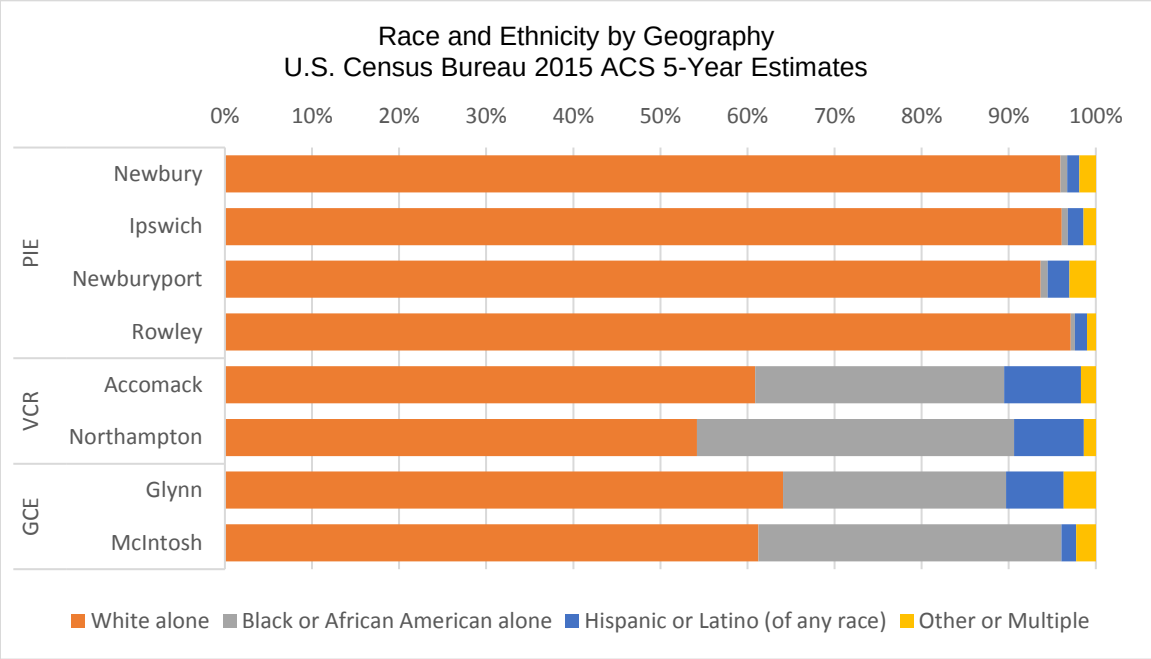
- ☐ Less than High School
- ☐ Some High School
- ☐ High School Graduate
- ☐ Some College
- ☐ Trade/Technical/Vocational Training
- ☐ College Graduate
- ☐ Post Graduate Degree

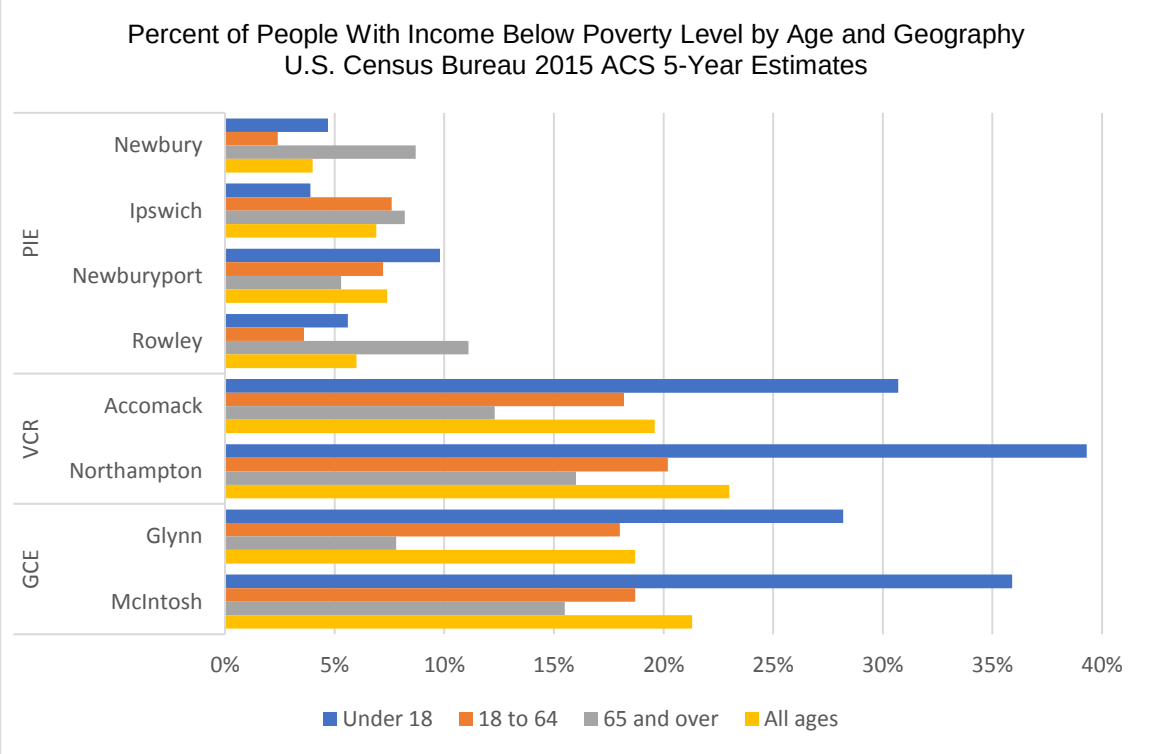
What is your total household income?

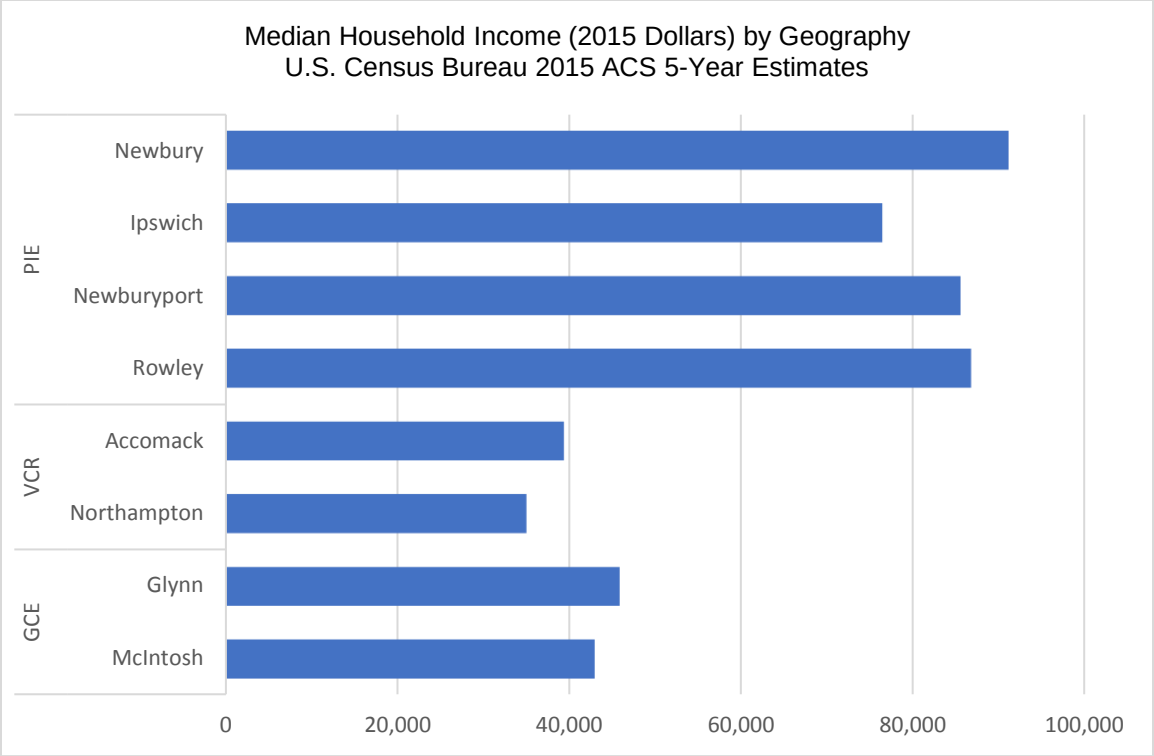
- ☐ Less than $10,000
- ☐ $10,000 to $19,999
- ☐ $20,000 to $29,999
- ☐ $30,000 to $39,999
- ☐ $40,000 to $49,999
- ☐ $50,000 to $59,999
- ☐ $60,000 to $69,999
- ☐ $70,000 to $79,999
- ☐ $80,000 to $89,999
- ☐ $90,000 or more

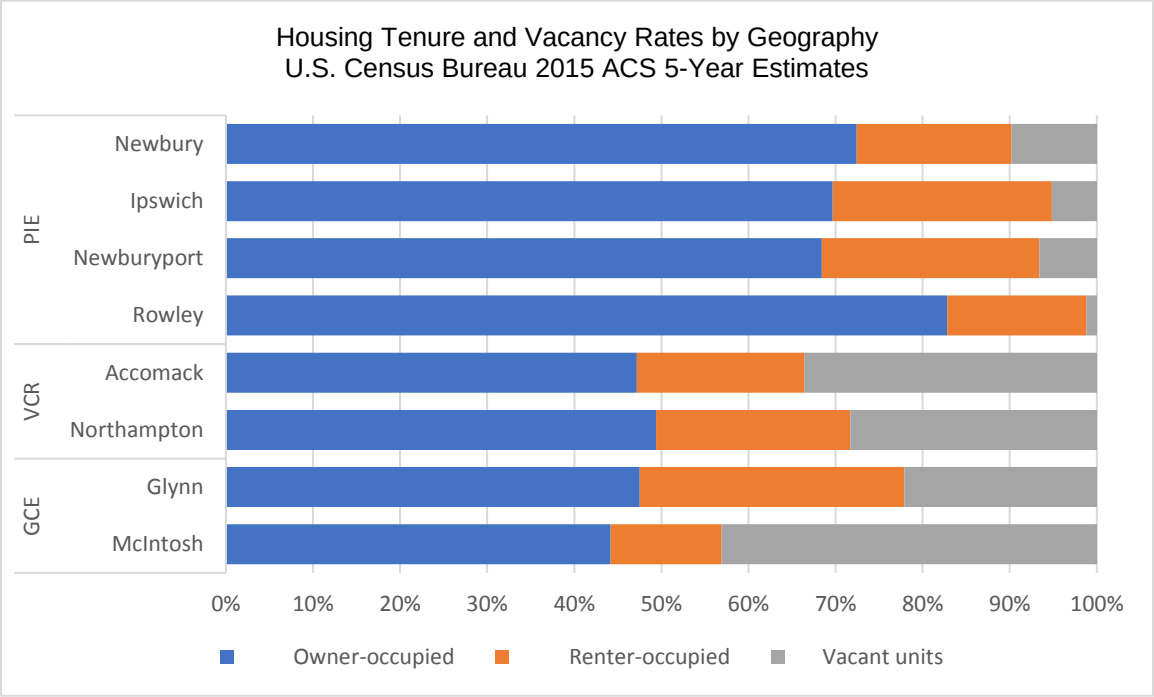
What is your zip code? _____

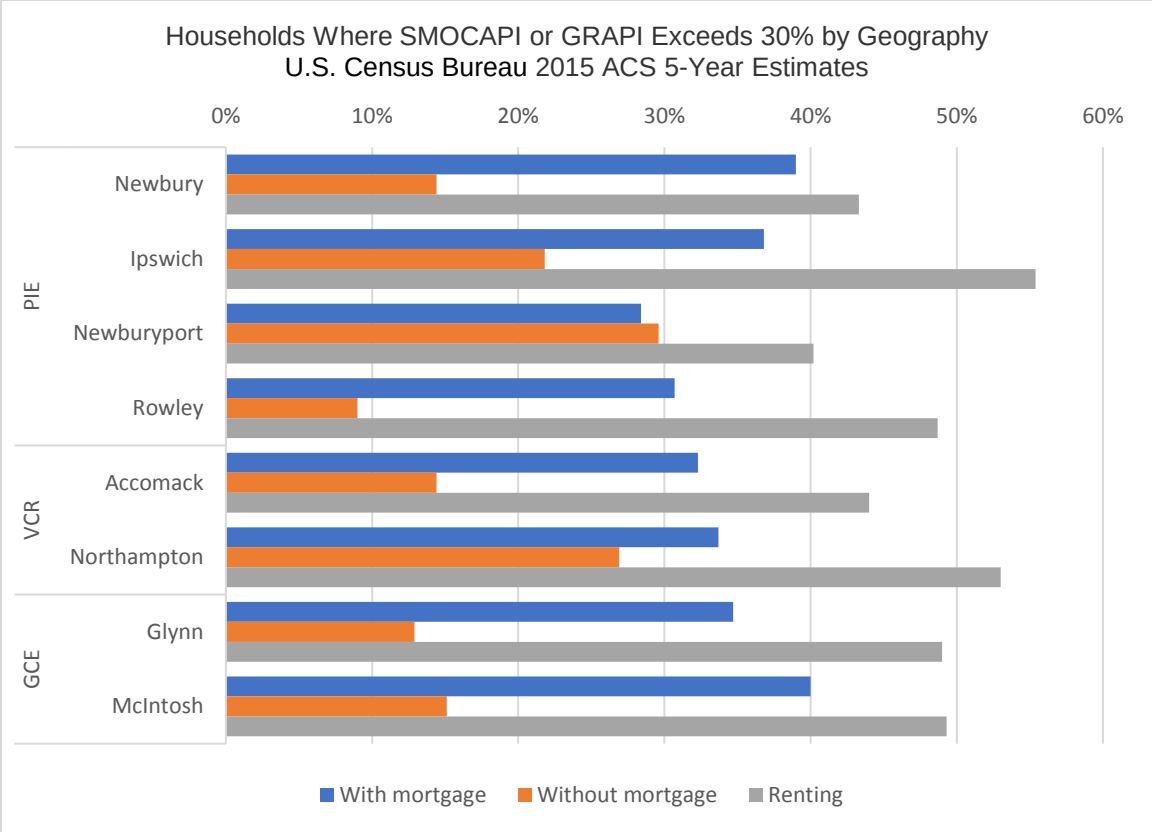
8.5 Appendix E: MA, VA, and GA Census Demographic Data

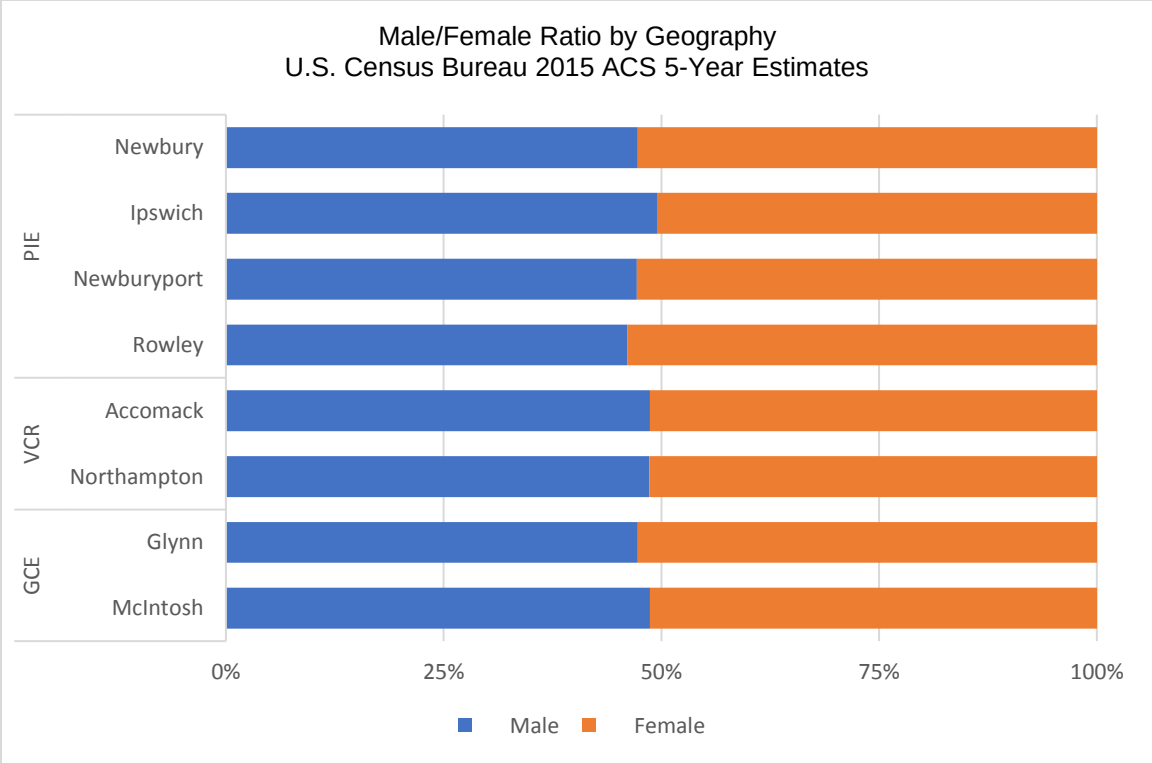


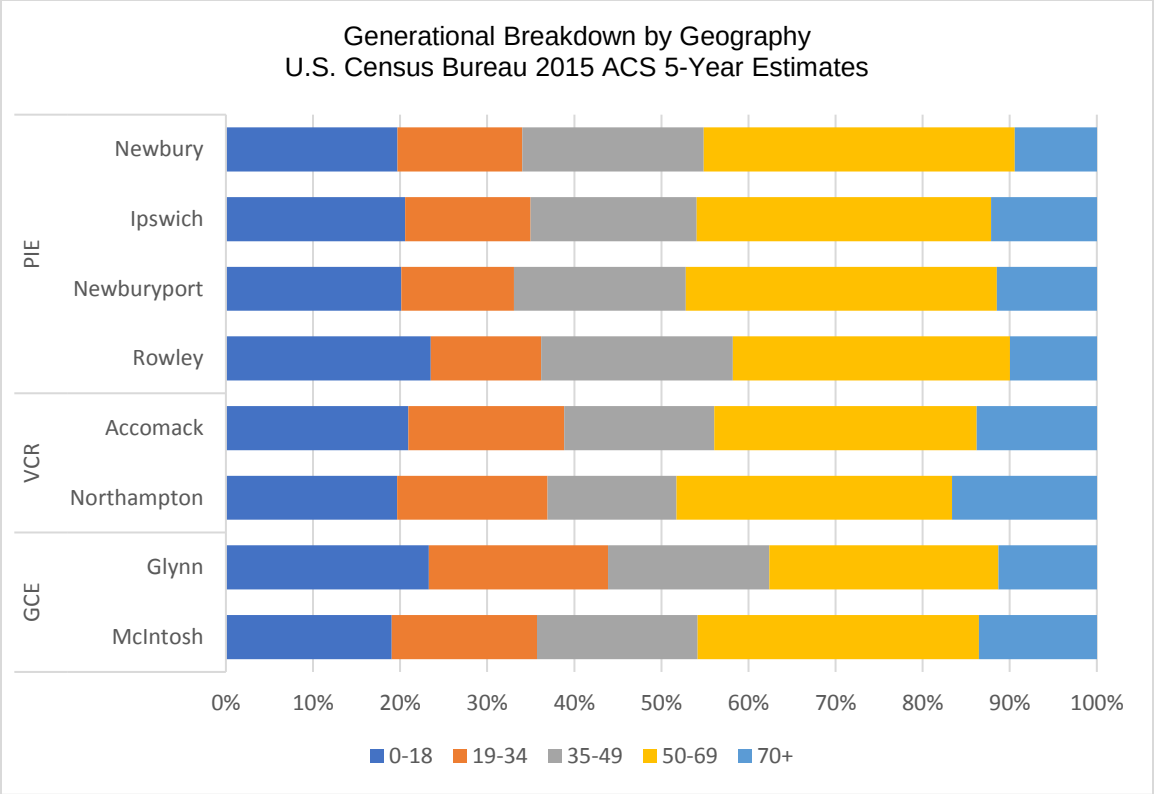


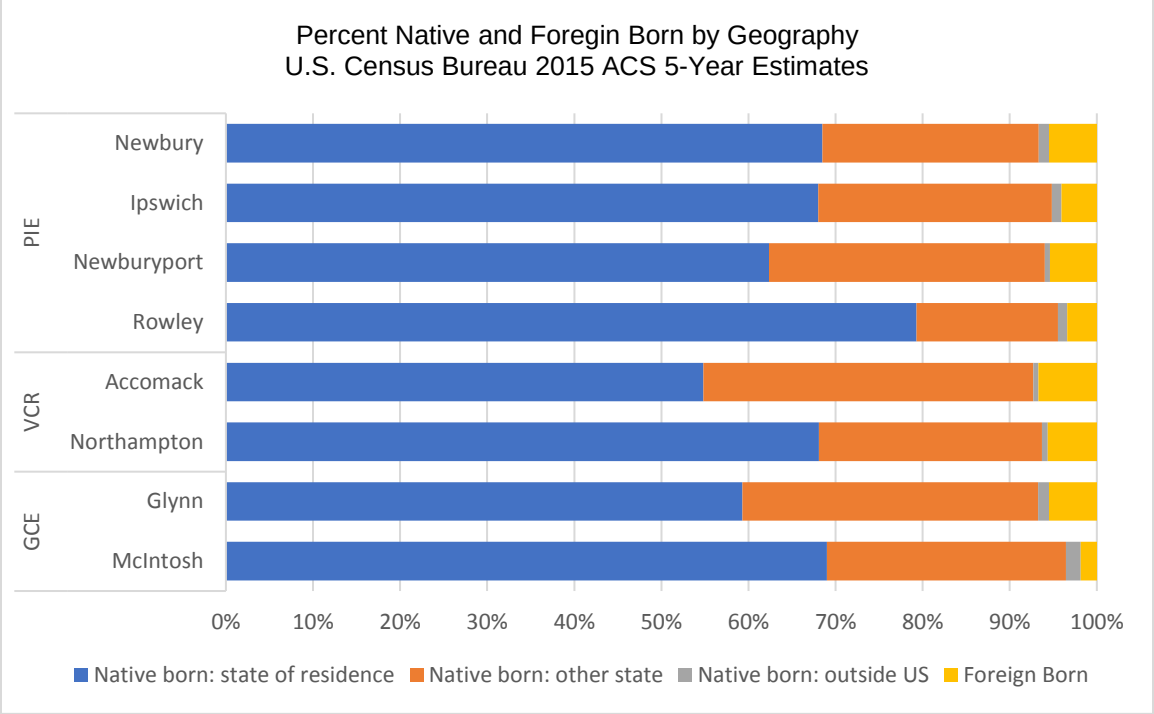

Median Household Income (2015 Dollars) by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
VCR
GCE
Newbury
Ipswich
Newburyport
Rowley
Accomack
Northampton
Glynn
McIntosh
0
20,000
40,000
60,000
80,000
100,000

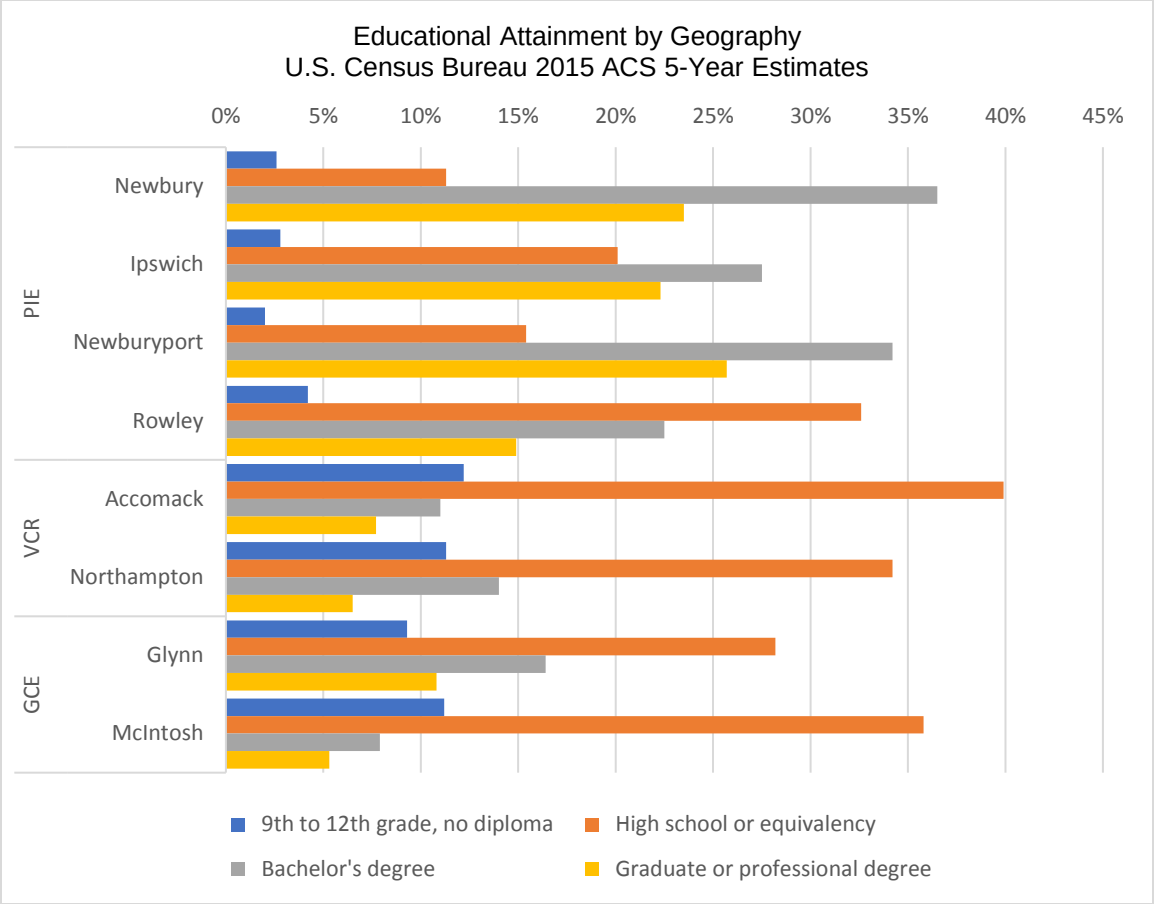

Housing Tenure and Vacancy Rates by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
VCR
GCE
Newbury
Ipswich
Newburyport
Rowley
Accomack
Northampton
Glynn
McIntosh
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Owner-occupied
Renter-occupied
Vacant units

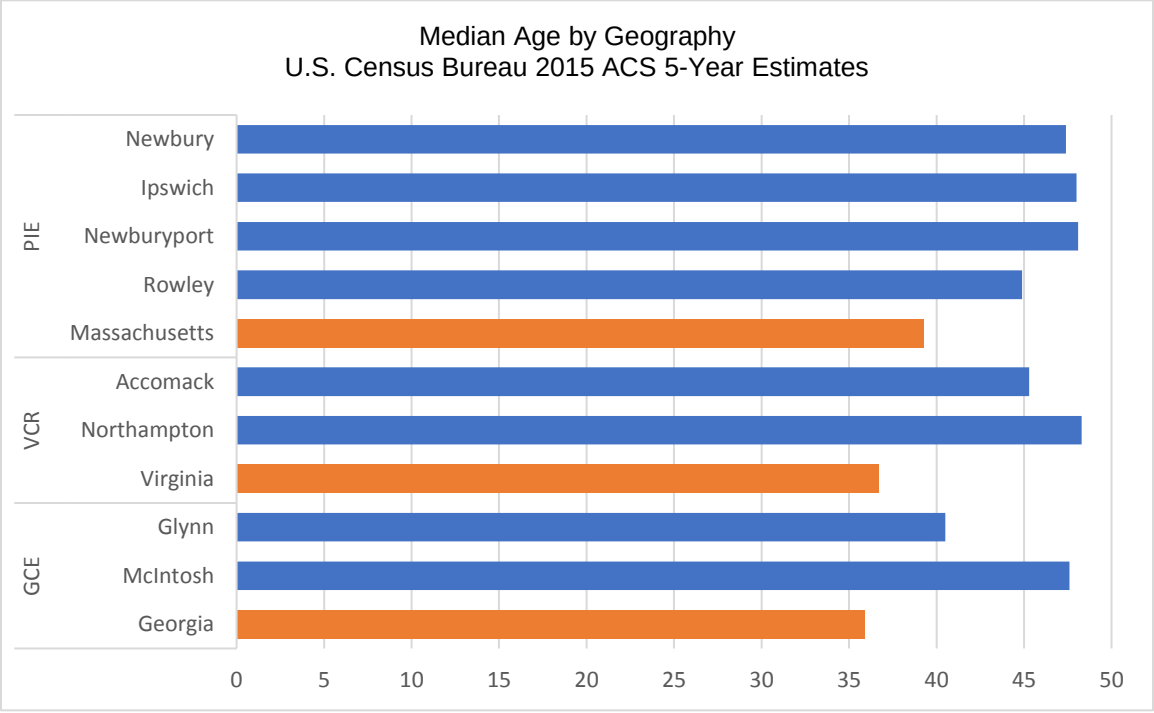

Households Where SMOCAPI or GRAPI Exceeds 30% by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
0%
10%
20%
30%
40%
50%
60%
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
With mortgage
Without mortgage
Renting


Male/Female Ratio by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
0%
25%
50%
75%
100%
Male
Female


Generational Breakdown by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0-18
19-34
35-49
50-69
70+


Percent Native and Foregin Born by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Native born: state of residence
Native born: other state
Native born: outside US
Foreign Born


Educational Attainment by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
9th to 12th grade, no diploma
High school or equivalency
Bachelor's degree
Graduate or professional degree


Median Age by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
Ipswich
Newburyport
Rowley
Massachusetts
VCR
Accomack
Northampton
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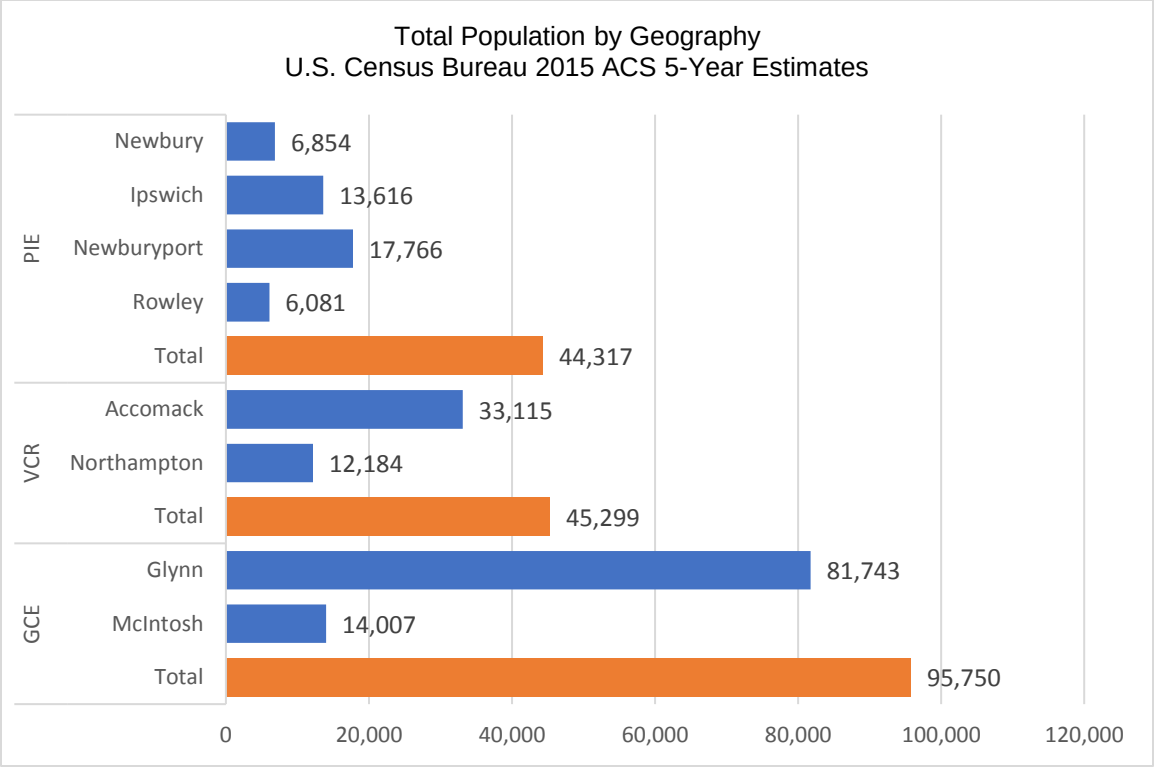
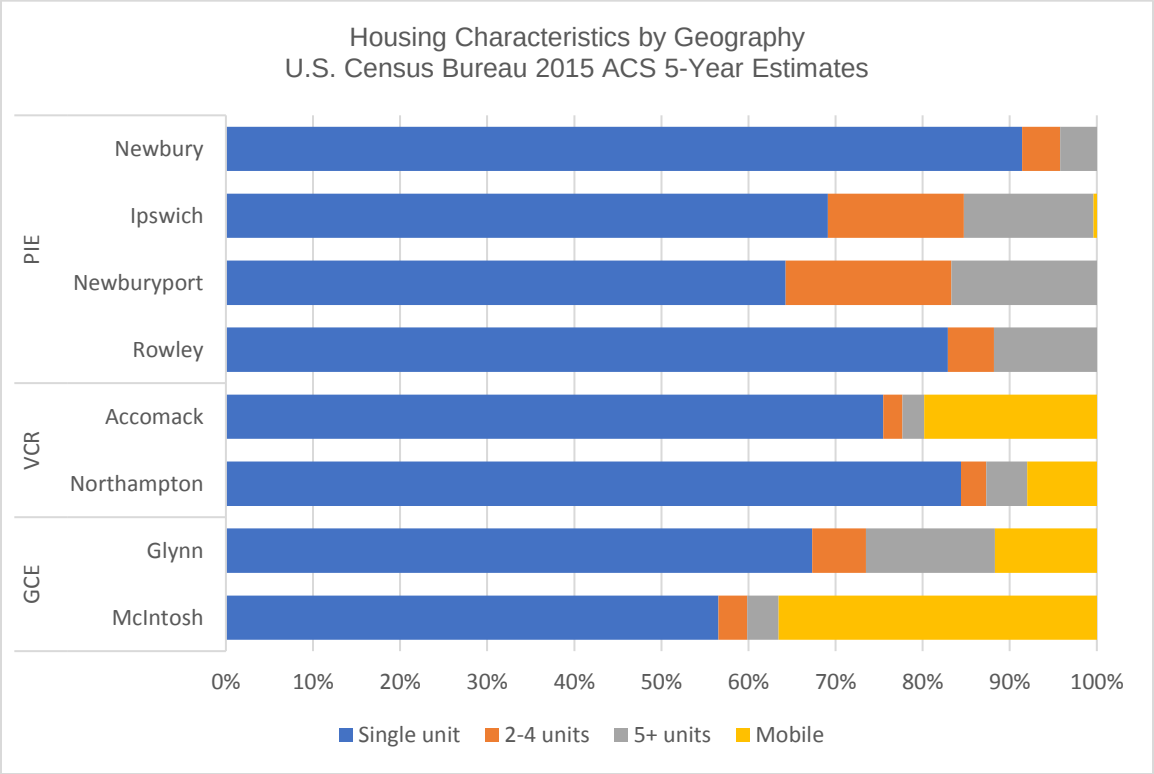
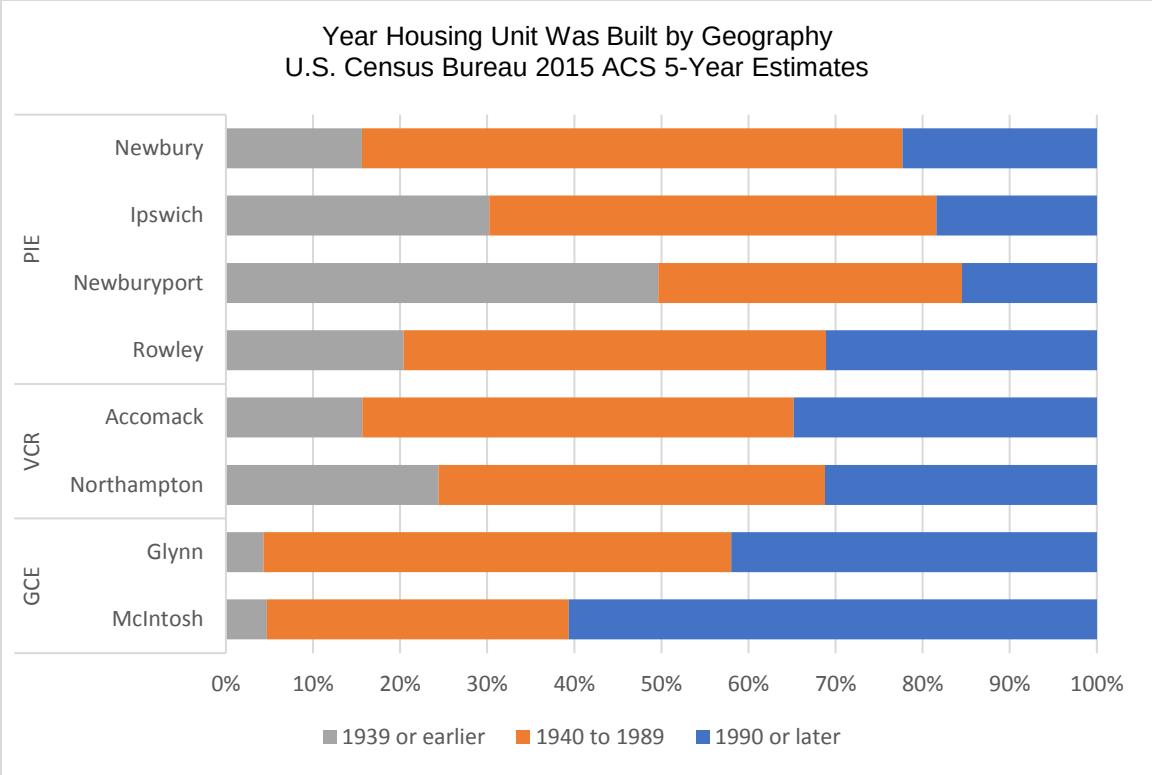
McIntosh
Georgia
0
5
10
15
20
25
30
35
40
45
50


Total Population by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
6,854
Ipswich
13,616
Newburyport
17,766
Rowley
6,081
Total
44,317
VCR
Accomack
33,115
Northampton
12,184
Total
45,299
GCE
Glynn
81,743
McIntosh
14,007
Total
95,750
0
20,000
40,000
60,000
80,000
100,000
120,000


Housing Characteristics by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
Newbury
Ipswich
Newburyport
Rowley
VCR
Accomack
Northampton
GCE
Glynn
McIntosh
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Single unit
2-4 units
5+ units
Mobile


Year Housing Unit Was Built by Geography
U.S. Census Bureau 2015 ACS 5-Year Estimates
PIE
VCR
GCE
Newbury
Ipswich
Newburyport
Rowley
Accomack
Northampton
Glynn
McIntosh
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1939 or earlier
1940 to 1989
1990 or later

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Services	Comments and Examples
Provisioning	
Food	production of fish, wild game, fruits, and grains
Fresh water[a]	storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	production of logs, fuelwood, peat, fodder
Biochemical	extraction of medicines and other materials from biota
Genetic materials	genes for resistance to plant pathogens, ornamental species, and so on
Regulating	
Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	groundwater recharge/discharge
Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	retention of soils and sediments
Natural hazard regulation	flood control, storm protection
Pollination	habitat for pollinators
Cultural	
Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	opportunities for recreational activities
Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
Supporting	
Soil formation	sediment retention and accumulation of organic matter
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients

[a] While fresh water was treated as a provisioning service within the MA, it is also regarded as a regulating service by various sectors.

Table 1, page 2:

I have reformatted the table as follows, in order to conform to the thesis formatting guidelines of my university:

	Services	Comments and Examples
Provisioning	Food	production of fish, wild game, fruits, and grains
	Fresh water	storage and retention of water for domestic, industrial, and agricultural use
	Fiber and fuel	production of logs, fuelwood, peat, fodder
	Biochemical	extraction of medicines and other materials from biota
	Genetic material	genes for resistance to plant pathogens, ornamental species, and so on
Regulating	Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
	Water regulation (hydrological flows)	groundwater recharge/discharge
	Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
	Erosion regulation	retention of soils and sediments
	Natural hazard regulation	flood control, storm protection
	Pollination	habitat for pollinators
Cultural	Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
	Recreational	opportunities for recreational activities
	Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
	Educational	opportunities for formal and informal education and training
Supporting	Soil formation	sediment retention and accumulation of organic matter storage,
	Nutrient cycling	storage, recycling, processing, and acquisition of nutrients

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Figures	Table 1. Ecosystem services and functions used in this study
Author of this NPG article	no
Your reference number	
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9. REFERENCES

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