This dissertation is dedicated to my family.
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# TABLE OF CONTENTS

ACKNOWLEDGMENTS ........................................................................................................ iv

LIST OF TABLES ................................................................................................................. viii

LIST OF FIGURES ............................................................................................................... ix

LIST OF OBJECTS ............................................................................................................. xi

ABSTRACT .......................................................................................................................... xiii

CHAPTER

1 INTRODUCTION ........................................................................................................ 1
   Problem Statement ......................................................................................................... 1
   Protecting the Coastal Commons ................................................................................. 3
   The Estuarine Context ................................................................................................. 5
   Study Area ...................................................................................................................... 7

2 LITERATURE REVIEW ............................................................................................... 17
   Fundamental Concepts and Tools of Land-Use Regulation ....................................... 17
   Comprehensive Planning ............................................................................................ 17
   Zoning .......................................................................................................................... 19
   The Police Powers and the Public Trust Doctrine ..................................................... 19
   Geographic Information Systems (GIS) in the Marine Environment ....................... 21
   The Analytic Hierarchy Process (AHP) ...................................................................... 24
   Environmental Zoning: Definition, Evolution, Conflicts, and Weaknesses ............ 26
   Environmental Zoning in the Terrestrial Environment ............................................. 26
   Environmental Zoning in the Estuarine and Marine Environment ......................... 27
   Regulating the Water—Case Studies ........................................................................... 30
   The Oregon Estuary Plan Book .................................................................................. 30
   Ocean Zoning in the Gulf of Maine ......................................................................... 33
   Water Dependent Uses Study in St. Johns County, Florida ..................................... 34
   Conclusion .................................................................................................................... 35
# 3 METHODS

- Characterizing the Legal Authorities for Estuary Planning ............................................. 37
- Describing the Estuarine Environment ................................................................. 37
- Inventorying Coastal Human Use .............................................................................. 40
  - Survey Goals ....................................................................................................... 41
  - Survey Analyses .................................................................................................. 42
  - Survey Instrument and Data Collection .................................................................. 42
  - Survey Implementation .......................................................................................... 42
- GIS Methods with Survey Data .................................................................................. 43
- Estuary Planning: Synthesizing Legal, Human Use and Ecological Research .......... 44

# 4 RESULTS

- Federal Legislation, Regulations, and Authorities ..................................................... 49
  - The Antiquities Act ............................................................................................. 50
  - The National Marine Sanctuaries Act .................................................................. 53
  - Executive Order 13158 .......................................................................................... 55
  - The Oceans Act .................................................................................................... 57
- State Level Legislation and Estuary Planning Programs ............................................. 59
  - The State of Oregon’s Estuary Planning Program .............................................. 59
  - Ocean Planning in the Gulf of Maine .................................................................... 61
  - The Albemarle-Pamlico Estuary Study, North Carolina ..................................... 62
- Legislative Authority in Florida ................................................................................ 64
- Local Authority Over Coastal, Estuarine, and Marine Areas ....................................... 72
  - Comprehensive Planning ...................................................................................... 73
  - Carrying Capacity Studies in Comprehensive Planning ........................................ 75
  - Zoning and Overlay Districts ................................................................................ 77
- Development of an Estuary Use Plan for the GTMNERR ......................................... 80
  - Operational Objectives and Actions for the Estuary Use Plan for the GTMNERR .................................................................................................................. 81
  - Procedural Objectives and Actions for the Estuary Use Plan for the GTMNERR .................................................................................................................. 82
- Results from the Estuarine Habitat Inventory and Analysis ....................................... 83
- Results from the Human Use Surveys in the GTMNERR ........................................... 85
  - Human Use Inventories ......................................................................................... 85
  - Human Use Density Analysis ................................................................................ 87
- Estuarine Habitat and Use Conflict Analysis .............................................................. 87
- Establishing Determinant and Nondeterminant Factors for Estuary Use Zones ......... 88
- Estuary Use Zones for the GTMNERR ...................................................................... 89
- Policy Implications of the Estuary Use Zones for the GTMNERR ............................. 91

# 5 DISCUSSION

- The Importance of Estuary Use Planning ................................................................. 122
  - The GTMNERR Estuary Use Plan Analysis .......................................................... 123
  - Local Level Estuary Use Planning ......................................................................... 124
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Land uses in the northern section (Tolomato and Guana River system) of the GTMNERR</td>
</tr>
<tr>
<td>1-2</td>
<td>Land uses in the southern section (Matanzas River system) of the GTMNERR</td>
</tr>
<tr>
<td>1-3</td>
<td>Lands in public ownership in the GTMNERR</td>
</tr>
<tr>
<td>2-1</td>
<td>Marine zones, their description and associated management strategies for the Florida Keys National Marine Sanctuary</td>
</tr>
<tr>
<td>2-2</td>
<td>Descriptions of management units used by the Oregon Estuary Plan Book</td>
</tr>
<tr>
<td>3-1</td>
<td>Pairwise comparison scale used to evaluate the suitability of estuarine habitat for human use</td>
</tr>
<tr>
<td>3-2</td>
<td>Estuary use categories in the GTMNERR</td>
</tr>
<tr>
<td>4-1</td>
<td>Description of water classifications in Florida</td>
</tr>
<tr>
<td>4-2</td>
<td>Acreage of identified estuarine habitats in the GTMNERR and surrounding areas</td>
</tr>
<tr>
<td>4-3</td>
<td>Raw and final rankings for the suitability of motorized use in estuarine habitats</td>
</tr>
<tr>
<td>4-4</td>
<td>Raw and final rankings for the suitability of nonmotorized use in estuarine habitats</td>
</tr>
<tr>
<td>4-5</td>
<td>Raw and final rankings for the suitability of extractive use in estuarine habitats</td>
</tr>
<tr>
<td>4-6</td>
<td>Raw and final rankings for the suitability of passive use in estuarine habitats</td>
</tr>
<tr>
<td>4-7</td>
<td>Surveyed human uses occurring in the GTMNERR and surrounding areas</td>
</tr>
<tr>
<td>4-8</td>
<td>Determinant, nondeterminant factors and geographical analysis data layers</td>
</tr>
<tr>
<td>4-9</td>
<td>The ideal zones for preservation of estuarine resources based on the surveyed responses of biologists</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Biodiversity, the least common denominator of the global commons.</td>
<td>4</td>
</tr>
<tr>
<td>1-2</td>
<td>Regions of an estuarine system.</td>
<td>6</td>
</tr>
<tr>
<td>1-3</td>
<td>Guana Tolomato Matanzas National Estuarine Research Reserve comprised of the northern and southern sections.</td>
<td>14</td>
</tr>
<tr>
<td>1-4</td>
<td>Northern section of the Guana Tolomato Matanzas National Estuarine Research Reserve.</td>
<td>15</td>
</tr>
<tr>
<td>1-5</td>
<td>Southern section of the Guana Tolomato Matanzas National Estuarine Research Reserve.</td>
<td>16</td>
</tr>
<tr>
<td>2-1</td>
<td>ESI map symbology.</td>
<td>22</td>
</tr>
<tr>
<td>2-2</td>
<td>Marine use zones established in the Florida Keys National Marine Sanctuary.</td>
<td>28</td>
</tr>
<tr>
<td>3-1</td>
<td>The overall organization of research methods.</td>
<td>36</td>
</tr>
<tr>
<td>3-6</td>
<td>The organization of the coastal human use inventory.</td>
<td>41</td>
</tr>
<tr>
<td>3-3</td>
<td>Ecological data used to describe the GTMNERR and surrounding areas.</td>
<td>46</td>
</tr>
<tr>
<td>3-4</td>
<td>Political boundaries used to describe the GTMNERR and surrounding areas.</td>
<td>47</td>
</tr>
<tr>
<td>3-5</td>
<td>Physical data used to describe the GTMNERR and surrounding areas.</td>
<td>48</td>
</tr>
<tr>
<td>4-1</td>
<td>Final rankings of suitability of estuarine habitats for motorized use based on scientific opinion.</td>
<td>94</td>
</tr>
<tr>
<td>4-2</td>
<td>Final rankings of suitability of estuarine habitats for nonmotorized use based on scientific opinion.</td>
<td>95</td>
</tr>
<tr>
<td>4-3</td>
<td>Final rankings of suitability of estuarine habitats for extractive use based on scientific opinion.</td>
<td>96</td>
</tr>
<tr>
<td>4-4</td>
<td>Final rankings of suitability of estuarine habitats for passive use based on scientific opinion.</td>
<td>97</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>4-5</td>
<td>Surveyed travel routes (n= 127) for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-6</td>
<td>Surveyed point data (n= 175) for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>Total use density for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-8</td>
<td>Motorized use density for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-9</td>
<td>Nonmotorized use density for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-10</td>
<td>Extractive use density for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-11</td>
<td>Passive use density for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-12</td>
<td>Motorized use conflict surface for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-13</td>
<td>Nonmotorized use conflict surface for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-14</td>
<td>Extractive use conflict surface for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-15</td>
<td>Passive use conflict surface for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-16</td>
<td>Determinant factors for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-17</td>
<td>Nondeterminant factors for the GTMNERR and surrounding areas</td>
<td></td>
</tr>
<tr>
<td>4-18</td>
<td>Preservation zones for the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-19</td>
<td>Preservation zones for the southern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-20</td>
<td>Conservation zones for the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-21</td>
<td>Conservation zones for the southern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-22</td>
<td>Active recreation zones for the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-23</td>
<td>Active recreation zones for the southern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-24</td>
<td>Conflict zones for the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-25</td>
<td>Conflict zones for the southern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-26</td>
<td>All EUP zones for the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-27</td>
<td>All EUP zones for the southern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>4-28</td>
<td>Conflict zone present around Pine Island in the northern section of the GTMNERR</td>
<td></td>
</tr>
<tr>
<td>Object</td>
<td>page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Larger image of Figure 1-3. ..........................................................14</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Larger image of Figure 1-4. ..........................................................15</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Larger image of Figure 1-5. ..........................................................16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Larger image of Figure 3-3. ..........................................................46</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Larger image of Figure 3-4. ..........................................................47</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Larger image of Figure 3-5. ..........................................................48</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Larger image of Figure 4-1. ..........................................................94</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Larger image of Figure 4-2. ..........................................................95</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Larger image of Figure 4-3. ..........................................................96</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Larger image of Figure 4-4. ..........................................................97</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Larger image of Figure 4-5. ..........................................................98</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Larger image of Figure 4-6. ..........................................................99</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Larger image of Figure 4-7. .........................................................100</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Larger image of Figure 4-8. .........................................................101</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Larger image of Figure 4-9. .........................................................102</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Larger image of Figure 4-10. .......................................................103</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Larger image of Figure 4-11. .......................................................104</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Larger image of Figure 4-12. .......................................................105</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Larger image of Figure 4-13. .......................................................106</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Larger image of Figure 4-14. .......................................................107</td>
<td></td>
</tr>
</tbody>
</table>
The idea of marine ecosystem management is becoming reality. Endorsed by the federal government, several coastal states are seeking ways to implement comprehensive marine ecosystem management programs. Surprisingly, the State of Florida is on the sidelines, constrained by a decentralized approach to managing coastal areas and a non-existent approach to managing submerged resources.

My study explores estuary use planning and proposes an estuary use plan (EUP) for the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR). The overarching goal of the EUP seeks to manage, through estuary zoning, estuarine resources while providing for human use of the estuary. The final EUP for the GTMNERR includes four zoning categories — preservation, conservation, active recreation and conflict zones — simple in definition, but based on solid science and
public input. Preservation zones protect sensitive and significant estuarine resources in estuarine areas not frequently used for water-based recreation. Conservation zones help to manage significant estuarine resources in areas moderately used for water-based recreation. Active recreation zones delineate areas of moderate to high human use in areas of low to moderate ecological significance. The presence of a conflict zone informs estuarine managers and local governments that there is significant potential for user and resource conflicts in the area. Once described, government authorities responsible for the GTMNERR can implement policies appropriate to these zones, and management entities can prescribe ways to educate users and enforce zone regulations.

The most significant contribution of my research is the estuary use planning methodology, and the transferability of EUP methodology to other estuarine and marine areas. The methodology is unique because it gathers current data about human use and analyzes it based on the ecology of the area. In addition, the EUP methodology incorporates scientific opinion about habitat suitability for human use, using the Analytical Hierarchy Process, into the final estuary-zoning plan. The final estuary use zones are created by examining factors such as land use, coastal infrastructure, and sensitive estuarine resources.

Currently, there is no comprehensive approach to evaluating and monitoring Florida’s coastal, estuarine, and marine resources. This research provides the methodology needed to create a comprehensive network of estuarine sites described by standard estuary zoning categories, which can be applied to Florida’s significant estuarine areas.
CHAPTER 1
INTRODUCTION

With the passage of the Oceans Act of 2000 and the issuance of Executive Order 13158, the concept of comprehensive marine planning is becoming a reality. The development and coordination of a national system of marine protected areas (MPAs) is on the horizon, and the federal government is in the early stages of planning a National Ocean Council (NOC) in the Executive Office of the President. The federal government is also organizing a National Ocean Policy Framework, which includes recommendations for improving federal leadership for oceans and coasts, as well as providing better coordination and management of the ocean (U.S. Commission on Ocean Policy 2004).

Several coastal states have begun research into, drafting, and implementation of comprehensive coastal and marine planning programs. In some cases, ecosystem boundaries (rather than political ones) define the programs.

The idea of marine ecosystem management is picking up steam. Several coastal states (with the endorsement of the federal government) are seeking ways to implement marine ecosystem management. Surprisingly, the State of Florida, whose coastline stretches farther than that of any other state in the continental U.S., is on the sidelines, constrained by a decentralized approach to managing coastal areas and a nonexistent approach to managing submerged resources.

Problem Statement

Florida largely depends on its coastal areas to generate income for the state. Of Florida’s 16 million residents, 60% live within 10 miles of the coast, and Florida’s
coastal systems attract 10 million tourists each year (FCMP 2000). Florida's beaches are an integral part of the state's economy, attracting tourists from around the world. Beach tourism generates about $15 billion a year¹ of the state’s economy (State of the Coast Report 1998). Despite these facts, Florida attempts to manage its coastal and submerged resources under the auspices of several state agencies.² The majority of management responsibility is ultimately given to coastal counties and other units of local government, some of which have no resources to manage activities on the land, let alone on the water.

Scientists and the public are beginning to call for marine zoning, as noted in a recent article in the Washington Post (Ferdinand 2001:A07): “The concept of mediating conflicting uses—industrial, commercial, recreation and conservation—has a familiar ring because it would apply to open waters what cities and towns have long used to regulate activities on land: zoning.” The intent of my study was to identify the issues associated with mismanagement of Florida’s estuaries, and to research and propose a solution by applying land-use planning tools and principles to estuarine systems.

The overall rationale for bringing land use planning tools and principles to bear on estuarine resources is twofold; first, there is currently no mechanism (scientific, legislative or managerial) in place to plan for and protect the marine environment (including estuaries and coastal areas), and second, gaps in scientific data exist for these areas. By establishing a methodology to plan for estuaries and their adjacent marine areas, specific data needs can be identified and filled. Comprehensive planning, zoning,

¹ DEP, About the Beach Management Program <http://www.dep.state.fl.us/beaches/programs/about.htm> Last updated 09/06/02

² DEP’s Coastal and Aquatic Managed Areas (CAMA) and the Bureau of Beaches and Wetland Resources, the Florida Coastal Management Program and the Florida Division of Historic Resources
and overlay districts have been successful in planning for and controlling land uses, and my study hypothesized that the same tools can be used to plan for resources and control activities on the surface waters of estuaries. My study also aimed to identify a zoning scheme specifically for estuarine waters; and to establish zones where sensitive estuarine areas are protected, and coastal recreation experiences are enhanced.

Although marine zoning and estuary planning are being explored in some coastal contexts, no one has yet established a nexus between zoning for resources, planning for sustainable use, and providing legal foundations for such management. The value of such a nexus exists in its ability to protect marine resources under the ever-increasing pressure of coastal development and population increase, through the creation of a planning methodology transferable to coastal and marine waters.

**Protecting the Coastal Commons**

Estuary planning seeks to balance preservation of the biotic community with the needs and desires of humankind. Coastal areas merit protection, because an ethical obligation exists to care for common resources for this and future generations, even if society does not fully appreciate the future value of these resources. There are underlying complexities when addressing the relationship between humankind and the natural world, especially since nature is largely considered a common resource, shared among all people and all generations.

English law, similar to Roman law, divided public property into two classes: one for use by the state (*res publicae*), and the other as common property (*res communes*). *Res communes* included the air, fresh water, the sea and living organisms. The sovereign held the title of “ownership” of these resources, but all such property was common for use by all people (Watt 2000, Barnes 2001). The concept of the commons raises issues of
the broadest public concern. Public opinion is redefining the commons to reflect many aspects of the natural world. Recently, people have begun to recognize a new commons, one that encompasses public lands and waters, and also such attributes as biodiversity and air quality. In fact, biodiversity can be termed the least common denominator of the commons (Figure 1-1).

Commonly held property, in the absence of property rights, is often subject to the tragedy of the commons, a scenario first detailed by Garret Hardin in 1968. Hardin defined the tragedy of the commons as “living without limit in a world that is limited.” Hardin illustrated the critical flaw of freedom in the commons: all participants must agree to conserve the commons, but any one can force the destruction of the commons (Hanson 1997). Environmental economists also refer to this problem as “free access commons” and “open access resources” (Watt 2000).

Figure 1-1. Biodiversity, the least common denominator of the global commons.

A tragedy of the commons results not from any inherent failure of common property, but rather from an institutional failure to control access to resources, and to
make and enforce decisions for collective use. Failure can occur because of the users’ inability to self-manage, or from the incursion of outsiders who do not take responsible ownership of the area. Factors such as rapid population growth and the development of new technologies can also increase the likelihood that a tragedy of the commons will occur. Ultimately, the management of common resources rests on the shoulders of every citizen. It is important that Florida’s estuaries be protected against the tragedy that befalls most common property.

The Estuarine Context

Estuaries are the interface of saltwater, freshwater, and terrestrial environments. Because an estuary is the product of three very dynamic ecosystems, clear definitions of this area can be complex. Pritchard (1967:16) gave the classic definition: “An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with freshwater derived from land drainage.” For the purposes of my study, it is important to describe not only the components of an estuary, but also the estuarine system as a whole.

Day et al. (1989) defined an estuarine system as “a coastal indentation that has a restricted connection to the ocean and remains open at least intermittently.” They further defined three regions of an estuarine system: the tidal river zone, the mixing zone, and the nearshore turbid zone (Figure 1-2). The tidal river zone represents the riverine area of an estuary, and usually has low salinity. The mixing zone is considered the estuary proper, and is characterized by dynamic gradients of physical, chemical, and biological quantities. The nearshore, turbid zone represents the marine environment, and is

3 Because estuaries are so dynamic, it is difficult to physically define these areas; however, for this research the regional definitions used by Day et al. (1989) are used in an operational context.
characterized by the seaward edge of the tidal plume (Day et al. 1989). This definition is well suited to my study, because it defines estuaries based on characteristics that can be mapped, and it incorporates adjacent coastal waters. However, the seaward limit and the location of an identifiable mixing zone are highly variable, so estuary maps may be difficult to make based on one or two points in time.¹

![Diagram of estuarine regions](image)

Figure 1-2. Regions of an estuarine system, adapted from *Estuarine Ecology* by J. W. Day, C. A. S. Hall, W. M. Kemp and A. Yanez-Arancibia, 1989

Estuaries are characterized by high biotic diversity, including macro-fauna such as fish and shellfish, and high productivity. Production and nutrient recycling occur at all trophic levels throughout the estuary (Comp and Seaman 1988). Production in estuaries often exceeds that of some artificially fertilized agricultural areas (Odum 1961).

Florida’s coastal areas provide habitats for over 1,000 species of estuarine and marine fishes (Briggs 1958, Comp and Seaman 1988).

---

¹ Dr. Clay L. Montague personal communication June 4, 2004
In addition to the invaluable ecological role estuaries play, estuaries also provide transportation routes and recreational opportunities for human populations worldwide (Hobbie 2000). Unfortunately, due to their proximity to terrestrial environments, estuaries receive large amounts of run-off from development and are prone to eutrophication. Eutrophication of an estuary can lead to decreased productivity.

Coastal systems in Florida are affected both directly and indirectly by many human activities. For example, two key intertidal coastal habitats, mangroves and salt marshes, have often been destroyed to make way for housing and other developments. In Florida, dredging and filling operations have destroyed over 23,000 acres out of the state's 469,000 acres of mangroves (Humphreys et al. 1993 and Hauxwell et al. 2001). Direct damage to coastal habitats is something to be avoided, but in many areas, indirect effects from human activities are more threatening.

In Florida, estuaries provide a vital component to the lucrative commercial and recreational fishing industry. Less than ten years ago, ninety-four percent of the value of the Gulf of Mexico commercial catch consisted of estuarine dependent species, and in 1970 ninety-eight percent of the catch was dependent on estuaries along the Gulf Coast (McHugh 1976 and Cato 1988). Tarpon, seabass, jacks, snappers, sheepshead, red drum, spotted seatrout mackerel, flounders, and snook are all examples of popular estuarine dependent species (Comp and Seaman 1988).

Study Area

In 1972, Congress passed the Coastal Zone Management Act (CZMA). This Act recognizes that coastal resources are of national significance and are rapidly

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5 For more information estuarine eutrophication see generally studies on the Chesapeake Bay, San Francisco Bay and Tampa Bay.
disappearing. The CZMA also recognizes the connectivity between uplands, tidelands, and marine areas. The coastal zone as defined by the CZMA includes all uplands to the “extent necessary to control shorelands”. Section 302 (k) of the 1990 reauthorized CZMA recognizes that coastal waters are significantly affected by land uses.6

Section 315 of the CZMA establishes the National Estuarine Research Reserve System. These reserves are to provide opportunity for long-term research, education and interpretation.7 One of the main goals of the NERRS is to help address the problem of current and potential degradation of coastal resources brought about by increasing and competing demands for these resources. However, section 315 does not create or designate any federal regulatory authority for the NERRS. In Florida, the Department of Environmental Protection (DEP) manages Florida’s reserves under exiting state statutory authority. No new regulations have been implemented because of the designation of any of Florida’s NERRS.

The Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR) is located in both St. Johns and Flagler Counties, south of Jacksonville, on the northeast coast of Florida. It is one of Florida’s unique coastal lagoon systems situated parallel to the Atlantic Coast. The GTMNERR includes approximately 65,000 acres of publicly owned uplands, tidal wetlands, estuarine lagoons, open ocean, and represents a moderately developed coastal estuarine ecosystem (DEP and NOAA 1998). Residential land use along the estuarine system is typically low or medium density, with higher

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6 “Land uses in the coastal zone, and the uses of adjacent land which drain into the coastal zone, may significantly affect the quality of coastal waters and habitats and efforts to control coastal water pollution from land use activities must be improved.”

7 15 C.F.R. Section 921.1
dynamics occurring along the barrier islands. Primary land uses found adjacent to and
within the GTMNERR are urban and transportation, agricultural, rangeland, uplands,
water, wetlands, and barren land (Tables 1-1 and 1-2). Pine flatwoods and hardwood
forests along with pine plantations are the dominant upland ecosystem, and salt marshes
dominate the wetlands (DEP and NOAA 1998).

Table 1-1. Land uses in the northern section (Tolomato and Guana River system) of the
GTMNERR

<table>
<thead>
<tr>
<th>Primary land uses</th>
<th>Percent of total land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban and Transportation</td>
<td>8.5%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Rangeland</td>
<td>3.7%</td>
</tr>
<tr>
<td>Uplands</td>
<td>37.1%</td>
</tr>
<tr>
<td>Open water</td>
<td>11.0%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>39.2%</td>
</tr>
<tr>
<td>Barren land</td>
<td>&lt;0.1%</td>
</tr>
</tbody>
</table>

Table 1-2. Land uses in the southern section (Matanzas River system) of the GTMNERR

<table>
<thead>
<tr>
<th>Primary land uses</th>
<th>Percent of total land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban and Transportation</td>
<td>20.8%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1.2%</td>
</tr>
<tr>
<td>Rangeland</td>
<td>3.3%</td>
</tr>
<tr>
<td>Uplands</td>
<td>40.1%</td>
</tr>
<tr>
<td>Open water</td>
<td>4.2%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>28.8%</td>
</tr>
<tr>
<td>Barren land</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

The Guana Tolomato Matanzas estuary complex was designated a National
Administration (NOAA) nominated the site based on its unique coastal and estuarine
attributes. The reserve comprises two coastal areas (Figure 1-3): the northern section of
the reserve is associated with the Tolomato and Guana River estuaries (Figure 1-4), and
the southern section is associated with the Matanzas River estuary (Figure 1-5). The
system contains a variety of habitats, and the diversity of habitats in the GTMNERR
provides for high species abundance and rich species diversity. A species list compiled
for the Guana River Marsh Aquatic Preserve indicates the presence of at least 20
mammal, 200 bird, 30 reptile, 7 amphibian, 75 fish, and 240 plant species (DNR 1991), and a partial list of estuarine and marine fish and invertebrates compiled by the Whitney Laboratory records 270 species (DEP and NOAA 1998).

While the GTMNERR management plan states: “the estuary represents a relatively undeveloped, coastal estuarine ecosystem” (NOAA & DEP 1998: 95), there is growing concern about the effect of current growth patterns surrounding the GTMNERR. The Office of Economic and Demographic Research reports the counties of St. Johns and Flagler have seen a 39 percent and 65 percent increase in population, respectively, since 1990, and are expecting a 39 percent and 21 percent increase by the year 2010. Consequently, the coastal areas of both counties are under urban and commercial development pressure.

The GTMNERR is affected by those activities that occur in upland areas. One of the major obstacles facing this area is adjacent development. Uplands adjacent to the reserve are in private ownership. These lands contain valuable resources such as archeological sites, freshwater wetlands, and are home to threatened and endangered species. There are also large undeveloped tracts along the Tolomato River and Pellicer Creek are yet undeveloped.

The FDEP created the Bureau of Coastal and Aquatic Managed Areas (CAMA) in 1994 to manage existing state and federal marine and estuarine resource protection programs, including the NERR program. CAMA manages the GTMNERR mainly through partnerships (NOAA and DEP 1998). In addition to three NERRS sites, CAMA

8 http://dlis.dos.state.fl.us/fgils

9 These include the GTMNERR, the Apalachicola Bay NERR (established in 1978) located in the panhandle of Florida, and the Rookery Bay NERR (established in 1979) located in southwest Florida.
also manages the State’s aquatic preserves\textsuperscript{10}, buffer preserves\textsuperscript{11} and the Florida Keys National Marine Sanctuary\textsuperscript{12}.

The lands within the boundary of the GTMNERR are entirely in public ownership, currently held by various state, local, and federal entities (Table 1-3). Therefore, a significant level of resource protection exists. One of the purposes of designating the GTMNERR was to provide a mechanism for integrated, coordinated ecosystem management (NOAA and DEP 1998). The GTMNERR management plan states that the role of the GTMNERR is to: 1) protect the natural, historic, and cultural integrity of the region, 2) promote and facilitate scientific studies of the ecology, 3) designate and implement environmental education programs, and 4) promote strong citizen stewardship of the region.

On February 11, 2003, Governor Bush and the Florida Cabinet approved the acquisition of 8,465 acres of environmentally significant land known as the Matanzas Marshes. The Department of Environmental Protection (DEP) joined with the St. Johns River Water Management District to purchase 8,465 acres north of Faver-Dykes State Park, with US1 to the west and the Matanzas River as the eastern boarder.

Protecting four tributaries that contribute to the Matanzas River and a tributary that flows into Pellicer Creek Aquatic Preserve, the tract is also the site of significant archeological and historical resources. The 16,000-acre corridor connects state-owned

\textsuperscript{10} Established in Chapter 258, FLA. STAT. aquatic preserves comprise forty-two designated sites and encompass approximately 2.5 million acres of sovereign submerged lands in Florida.

\textsuperscript{11} Established in Chapter 253, FLA. STAT. the State buffer preserves are state owned coastal upland properties totaling about 129,000 acres adjacent to or essential to the protection of the aquatic preserves.

\textsuperscript{12} Congress designated the FKNMS in 1990, and it is managed through a cooperative agreement with NOAA; this area encompasses 2,800 nautical square miles of submerged land within the Florida Keys.
Faver-Dykes State Park with the Princess Place Preserve and District-owned Pellicer Creek Conservation Area.

Table 1-3. Lands in public ownership in the GTMNERR

<table>
<thead>
<tr>
<th>Name of Property</th>
<th>Acreage</th>
<th>Administrator</th>
<th>Section of GTMNERR</th>
<th>Authorized Uses¹³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stokes Landing Conservation Area</td>
<td>286 acres</td>
<td>SJRWMD</td>
<td>North</td>
<td>HI, BI, NS, and HB</td>
</tr>
<tr>
<td>Moses Creek Conservation Area</td>
<td>2042 acres</td>
<td>SJRWMD</td>
<td>South</td>
<td>HI, BI, NS, and HB</td>
</tr>
<tr>
<td>Guana River State Park</td>
<td>2397.8 acres</td>
<td>Florida Parks Service</td>
<td>North</td>
<td>BA</td>
</tr>
<tr>
<td>Faver-Dykes State Park</td>
<td>1449.55 acres</td>
<td>Florida Parks Service</td>
<td>South</td>
<td>PI and EE</td>
</tr>
<tr>
<td>Washington Oaks State Gardens</td>
<td>399.8 acres</td>
<td>Florida Parks Service</td>
<td>South</td>
<td>CA, NS, HI, HB, FI, PB, CK HT, FI, NS, HI, BI, PB</td>
</tr>
<tr>
<td>Guana River Wildlife Management Area</td>
<td>9815 acres</td>
<td>FWC</td>
<td>North</td>
<td></td>
</tr>
<tr>
<td>Deep Creek State Forest</td>
<td>379.8 acres</td>
<td>Fi Division of Forestry</td>
<td>North</td>
<td></td>
</tr>
<tr>
<td>River-to-Sea Preserve</td>
<td>90 acres</td>
<td>Flagler County</td>
<td>South</td>
<td>HI, FI, CAP, HB</td>
</tr>
<tr>
<td>Princess Place Preserve</td>
<td>1500 acres</td>
<td>Flagler County</td>
<td>South</td>
<td>HI, FI, CAP, HB</td>
</tr>
<tr>
<td>Fort Matanzas National Monument</td>
<td>227.76 acres</td>
<td>National Parks Service</td>
<td>South</td>
<td>VH</td>
</tr>
<tr>
<td>Guana River Aquatic Preserve</td>
<td>40,000 acres</td>
<td>DEP/CAMA</td>
<td>North</td>
<td>HT, FI</td>
</tr>
<tr>
<td>Pellicer Creek Aquatic Preserve</td>
<td>505 acres</td>
<td>DEP/CAMA</td>
<td>South</td>
<td>HT, FI</td>
</tr>
</tbody>
</table>

The acquisition helps to protect water quality in the Guana Tolomato Matanzas National Estuarine Research Reserve and in the only areas consistently open for shellfish harvesting in St. Johns County, waters of the Matanzas River and its tributaries, and the Outstanding Florida Waters within Faver-Dykes State Park and Pellicer Creek. The encompassing uplands and wetlands of the property contain 17 types of natural communities and more than 70 species listed by the Florida Natural Areas Inventory.

Two eagle nest sites and a regionally significant wood stork rookery are located on the

¹³ HI = hiking, BI = biking, NS = nature study, HB = horseback riding, PI = picnicking, CA = camping, CAP = primitive camping, FI = fishing, PB = power boating, HT = hunting, VH = visiting historic sites, BA = beach activities such as sunbathing, walking, and socializing, EE = environmental education, CK = canoeing or kayaking
property. The land was purchased from Rayonier who will retain the right to remove merchantable pine trees on 639 acres for another three years. DEP’s Division of Recreation and Parks will manage a portion of the property with Faver-Dykes State Park expanding its boundary north to contain 5,700 acres. The northern section will become a new State Forest managed by the Department of Agriculture and Consumer Services’ Division of Forestry.

As the GTMNERR continues to expand its boundaries, it is important that existing and future resources be inventoried and identified for protection. My study aims to create a methodology for the protection of estuarine resources (existing and future) while providing for enhanced recreational opportunities. This methodology seeks to protect estuarine resources while accommodating increasing population growth adjacent to the GTMNERR.
Figure 1-3. Guana Tolomato Matanzas National Estuarine Research Reserve comprised of the northern and southern sections. The northern section contains approximately 44,327 acres of land and open water and is located east of interstate 95 and north of state road 16. The southern section contains approximately 20,111 acres of land and open water and is located south of state road 207 and west of state road A1A.

Object 1. Larger image of Figure 1-3.
Figure 1-4. Northern section of the Guana Tolomato Matanzas National Estuarine Research Reserve, located south of Jacksonville and north of St. Augustine, it contains the Guana and Tolomato River systems, and the Intercoastal Waterway.

Object 2. Larger image of Figure 1-4.
Figure 1-5. Southern section of the Guana Tolomato Matanzas National Estuarine Research Reserve, located south of St. Augustine and north of Palm Coast, it contains the Matanzas River system and the Intercoastal Waterway.

Object 3. Larger image of Figure 1-5.
CHAPTER 2
LITERATURE REVIEW

This literature review places the concept of estuary planning in the overall framework of land-use zoning, and discusses the application of current, functional environmental zoning to coastal areas. Current GIS modeling techniques for coastal and marine areas are examined, as well as human interactions with the coastal environment. An introduction to the Analytic Hierarchy Process, a method applied in my study, is included. Finally, case studies of various estuary planning and marine zoning programs are analyzed. Overall, a thorough examination of the literature provides a more concrete and less theoretical concept of estuary zoning.

Fundamental Concepts and Tools of Land-Use Regulation

The concept of estuary regulation is explored here and is based on the same fundamental concepts, and uses the same tools, as land-use regulation. Comprehensive planning, land-use zoning, police powers, and the public trust doctrine are some of the planning tools that can be used to manage estuaries. Another planning tool currently applied to land-use regulation is Geographic Information Systems (GIS), and GIS can be used for the planning and management of marine and estuarine systems.

Comprehensive Planning

A community that wishes to adopt local laws that regulate the environment may begin to create a legal basis for those regulations in its comprehensive plan. Since many states require local land-use regulations to conform to the comprehensive plan, such provisions help sustain environmental regulations when challenged (Rathkopf 1975).
Typically, a comprehensive plan (Platt 1996) has three main characteristics: 1) statement of goals and objectives; 2) a detailed plan supported by research and information; and 3) recommendations for plan implementation. Florida’s Growth Management Act (GMA) requires all 67 counties and 476 municipalities to adopt Local Government Comprehensive Plans that guide future growth and development. Comprehensive plans contain elements that address future land-use, housing, transportation, infrastructure, coastal management, conservation, recreation and open space, intergovernmental coordination, and capital improvements.

According to the GMA, the coastal elements of comprehensive plans must contain “the plans and principles used to control development and redevelopment to eliminate or mitigate the adverse impacts on coastal wetlands; living marine resources; barrier islands, including beach and dune systems; unique wildlife habitat; historical and archaeological sites, and other fragile coastal resources.” The GMA also states that the coastal element should also include “regulatory and management techniques that the local government plans to adopt or have adopted in order to . . . control proposed development and redevelopment in order to protect the coastal environment and give consideration to cumulative impacts.” The statute also directs local governments to “establish a process for identifying and prioritizing coastal properties that are pristine in nature or significant in terms of environmental sensitivity, as well as other policies for “effective coastal management.” In addition to the coastal element, the conservation elements of

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1 Fla. Stat. 163.3178(2) (b)
2 Id. at (j)
3 Id. at (8)
comprehensive plans must provide for the conservation, use, and protection of natural resources in the community, including "wetlands, . . . estuarine marshes, soils, beaches, shores, flood plains, rivers, bays, lakes, forests, fisheries and wildlife, [and] marine habitat." The coastal element coupled with the conservation element, provides local governments with the authority to manage local ecological resources.

**Zoning**

Classic land-use texts define zoning as the regulation, by zones or districts under the police power, of the height, bulk, and use of buildings, the use of lands, and the density of populations (Basset 1936; Bettman 1946). The theory behind zoning is that local governments can establish districts as appropriate areas for particular uses and, in addition, can prevent other uses that will impair the development and stability of that area. Although the constitutionality of land-use zoning was challenged in *The Village of Euclid v. Ambler Realty* (271 U.S. 365), the U.S. Supreme Court upheld the comprehensive zoning ordinance; in particular, the segregation of land into residential, commercial and industrial districts (Bettman 1946). Through the Euclid decision and the *Miller v. Board of Public Works of the City of Los Angeles* (273 U.S. 781), the U.S. Supreme Court ruled that land-use zoning was constitutional.

**The Police Powers and the Public Trust Doctrine**

The power to zone comes from the state; state legislatures enable local governments to zone by granting police power for regulating the use of buildings and lands (Basset 1936). The state’s basic authority to regulate its coastal zone derives from the same source as is used to enact zoning laws: police power (Archer 1994). Police

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4 Fla. Stat. 163.3177(6)(d)
power is the general legislative power to regulate persons or things for the promotion of public health, safety, order, convenience, morals, prosperity, and welfare (Basset 1936; Bettman 1946).

Some researchers have recently suggested that communities should base land and resource-use zoning on an integration of gap analysis, social and economic trends, and land-use classification (Tolisano 2000). There has also been an effort to integrate land-uses outside of protected areas into the long-term vision of that area, requiring the comprehensive zoning of acceptable and prohibited uses. Unlike land-use zoning (which largely regulates private property), estuary, or ocean zoning, governs a public resource and must balance the interests of a diverse set of resource users. It must also integrate the management functions of multiple government agencies, and moderate jurisdictional disputes.

When used in combination with police powers, the public trust doctrine provides states with a unique combination of authority over coastal zones. The public trust doctrine is fundamentally a property or ownership-based doctrine, allowing the state to regulate and protect coastal areas, even when those areas are in private ownership. Based in common law, the public trust doctrine has the inherent capacity to adapt in response to changing social conditions (Archer 1994). In addition to being based in common law, the public trust doctrine is essentially a legally enforceable trust, which is analogous to the body of private and charitable trust law developed in the United States. This allows the doctrine to set precedents for determining rights and responsibilities of states as trustees over public trust lands for the benefit of citizens, particularly in states where there is little concrete legislative or judicial application of public trust principles (Archer 1994).
Preliminary research showed substantial legal support for estuary planning and zoning. Two powerful legal principles (police powers and the public trust doctrine) legitimize the concept of estuary zoning. It is important to focus on how zoning principles incorporate environmental issues and to determine if these land-based environmental practices can be successfully applied to coastal settings.

**Geographic Information Systems (GIS) in the Marine Environment**

Managers and planners apply Geographic Information Systems (GIS) in the terrestrial environment to a variety of uses, including land-use planning and zoning; network analysis, such as determining utility service systems; environmental planning and protection, including conservation land identification; demographic analysis; and growth management. GIS has had limited application in marine environments. Although coastal environments are often included in land-use analyses, most land-use analyses stop at the water’s edge.

Coastal oil spill modeling is a common GIS application used in the marine environment. GIS provides a means of integrating spatial data inputs to numerical models and visualizing model outputs (Li 2000). In fact, in case of an oil spill, NOAA provides most coastal states with Environmental Sensitivity Index (ESI) maps, constructed from a GIS (Figure 2-1). Such maps help reduce the environmental consequences of both spills and clean-up efforts. ESI maps contain three types of

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5 The GTMNERR is composed of mainly state and federal lands, and the invocation of police powers is therefore unnecessary to justify estuarine zoning. In this case, invoking the police powers is, in effect, “self-zoning” on the behalf of the government, since it is government (with the exception of a few outparcels).
Another application of GIS modeling in the marine environment deals with fisheries management. Caddy and Carocci (1999) developed a GIS application based on the spatial allocation of fishing intensity by port-based, inshore fleets. Relying on the friction of distance approach (the theory that resources farther away from port are less liable to be exploited than those close to port) the researchers characterized port areas based on their ability to support fishing efforts. Detailed information (provided by multiple GIS overlays) was used to construct a mathematical model delineating areas of inshore fishing efforts around fishing ports.

Figure 2-1. ESI map symbology

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6 See generally, the National Ocean Service’s website about environmental sensitivity mapping at http://www.oceanservice.noaa.gov/mapfinder/products/esi/welcome.html, accessed on July 6, 2004

7 ESI maps are found at http://www.oceanservice.noaa.gov/mapfinder/welcome.html, accessed July 6, 2004
As with any spatial analysis, the propagation of errors due to inaccurate data cascading from one sub-model to another is a concern with GIS. Li (2000) determined that the quality of spatial data does have an impact on modeling outputs. They suggested revising the strategies coupling GIS and environmental models to include the implementation of quality analysis procedures (such as statistical packages) for geospatial data.

Another challenge facing regional marine planning is the scarcity of accurate benthic habitat maps for marine areas. Scientists often generalize marine habitat maps, because ground-truthing is much more difficult for submerged habitat than for land. Terrestrial habitat types, furthermore, are often classified based on the reflectivity of the habitats from satellite imagery (Cox 1994). This method cannot be used to classify marine habitat types; because current satellite imagery does not penetrate water, (these habitats reflect only dark blue or black). The development of sonar and lidar mapping techniques has allowed researchers to map benthic habitats in some marine environments. McRea et al. (1999) used modern geophysical techniques—sidescan sonar—and a GIS to map a rocky mega-habitat on the continental shelf off Mt. Edgecombe in Alaska. Using these techniques, the researchers were able to resolve the mega-habitat into eight different and potentially significant meso-habitats.

Perhaps one of the most innovative approaches to offshore planning and mapping comes from NOAA’s Coastal Services Center, where Fowler and Treml (2001) proposed building a marine cadastral information system for the United States. The authors argued that many of the cadastral components, such as adjudication, survey, and owners rights, have a parallel condition in the ocean. Property rights in the ocean are becoming an
important issue, as the advancement in technology increases the viability of offshore mineral extraction. Therefore, accurate digital delineation of marine boundaries is necessary for current maritime business. As with the mapping of any spatial data, however, some systematic and random errors exist. The fact that most marine laws and regulations do not contain the spatial components needed to accurately map their extents without some level of ambiguity further hinders the marine cadastral system. Fowler and Treml (2001) proposed that new legislation and regulation consider mapping technology when delineating marine boundaries.

**The Analytic Hierarchy Process (AHP)**

The Analytic Hierarchy Process (AHP) is a decision making process that aids in setting priorities and making decisions when both qualitative and quantitative aspects of a decision need to be considered. The AHP reduces subjective decisions to a series of one-on-one comparisons, and synthesizes the result. Saty (1980) defines the Analytic Hierarchy Process as a composite of concepts and techniques such as hierarchical structuring of complexity, pairwise comparisons, redundant judgments, an eigenvector method for deriving weights of judgments, and consistency considerations. The AHP enables decision makers to derive ratio-scale priorities or weights as opposed to arbitrarily assigning them, and allows for the incorporation of objective and subjective considerations into the decision making process (Forman and Selly 2000).

The analytic hierarchy process is relevant to natural resource management situations that require multiple opinions, multiple participants, or a complex, decision-making process; however, AHP applications in forestry, agriculture, and natural
resources are limited, concentrating on combining the AHP with GIS to examine habitat suitability\(^8\) (Schmoldt et al. 2001).

The methodology in my study uses the AHP and pairwise comparisons in order to derive weights for estuarine habitats. The AHP derives ratio-scale measures through pairwise relative comparisons, which incorporate redundancy and reduce measurement error, while producing a measure of consistency between the comparison judgments. By using redundancy, accurate weights can be derived from verbal judgments even though the verbal judgments of experts might not be very accurate. This allows for the use of words to compare qualitative factors and derive ratio scale priorities that can be combined with quantitative factors (Forman and Selly 2000).

Once the priorities or judgments are derived, the AHP automatically incorporates nonlinearity in measuring utility. Forman and Selly (2000:46) give an example of this utility measurement, “... when considering a vehicle for city driving, the preference for a vehicle with a top speed of 40 miles per hour is probably more than twice that of a vehicle with a top speed of 20 miles per hour. But the preference for a vehicle with a top speed of 100 miles per hour would be much less than twice as preferable than a vehicle with a top speed of 50 miles per hour.” The process also measures the inconsistency of each set of judgments. This measure is a by-product of the process of deriving priorities based on pairwise comparisons.

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8 Using input from experts, Kangas et al.(1993) used the AHP to estimate wildlife habitat suitability functions. Pereira and Duckstein (1993) combined the AHP with geographic information system (GIS) to study habitat suitability for Mount Graham red squirrel. Mendoza (1997) also described an integrated model combining the AHP with GIS to generate habitat suitability indices for desert tortoise.
Environmental Zoning: Definition, Evolution, Conflicts, and Weaknesses

Velden and Kreuwel (1990) defined the goal of environmental zoning as “minimizing the environmental effects of industrial noise, odor, nuisance, and the risk resulting from the dispersal of toxic compounds.” The definition of ecological and environmental zoning has evolved to include both protected and developed lands, as well as the incorporation of biological, social, economic, and cultural values. The current concept of environmental zoning calls for the demarcation of lands, including aquatic and marine systems, that should remain minimally disturbed to sustain viable populations of resident species, safeguard shrinking critical habitats, enable dispersal and migratory patterns to continue unimpaired, and protect critical biophysical services, such as watershed functions (Tolisano 2000). The context in which environmental and ecological zoning has evolved can be understood by studying the evolution of zoning in our national parks.

Environmental Zoning in the Terrestrial Environment

Yosemite Valley was the first rural, natural landscape in the country to be set aside as a park. The Yosemite Park Act of 1864, signed by President Lincoln, transferred Yosemite Valley to the State of California (O’Brien 1999). Yosemite Valley was also the first designated natural area to be embroiled in a land-use dispute. The federal government asked homesteaders to leave Yosemite Valley 10 years after the passage of the Yosemite Park Act; they did not leave and were subsequently taken to court. In *Hutchings v. Low*, the U.S. Supreme Court upheld the right of the federal government to designate the unsold, public domain for any purpose other than settlement, including for the establishment of a national public park (Runte 1990). This decision prevented homesteading in Yosemite Valley, thereby establishing the constitutionality of national
parks and all public land (Runte 1990). It was not until the establishment of Yellowstone National Park in 1872 as America’s first national park that politicians and the public began to take notice of the natural areas existing in the United States.

Even as the government established early national parks, problems that the new parks could expect in the years ahead included incompatible uses, finding ways to protect landscapes, and the tendency to put visitor accommodations ahead of park preservation and management (O’Brien 1999). Other threats to early national parks were dam construction, deforestation, and cattle grazing. However, these threats are minimal in today’s national parks due, in large part, to public outcry.

In 1988, the National Parks Service issued a set of policies, including a mandate to manage the natural systems of a park based on management zones. The management zones are broken into three categories: natural zones, cultural zones, and park development zones. The National Parks Service manages the natural zone primarily for the protection of natural resources. The management policies state that, under certain circumstances (i.e. animal breeding season), an area may be closed to visitors in order to protect the resources. The cultural zones are managed to preserve and foster appreciation of cultural resources. Park managers maintain park development zones for intensive visitor use. Roads, walkways, buildings, and other facilities usually dominate these zones (National Parks Service 1988). Today, the three management zones are in effect in all national parks.

**Environmental Zoning in the Estuarine and Marine Environment**

Environmental zoning can succeed in publicly owned coastal and marine areas. In 1997, the U.S. National Oceanic and Atmospheric Administration (NOAA) and the State of Florida initiated the nation’s first marine zoning effort in the Florida Keys National
Marine Sanctuary (FKNMS; Figure 2-2). While zoning a coastal or marine public area may not be popular at first, it provides a means of protecting fragile resources, while also allowing human uses, such as boating, fishing, and beach combing. Zones allow marine resource managers to focus the majority of their efforts on critical and diverse areas (NOAA 1996). Six marine zones were delineated in the FKNMS, each with specific management strategies (Table 2-1). Clearly, the Florida Keys National Marine Sanctuary set a precedent for marine and estuarine planning and zoning.

Figure 2-2. Marine use zones established in the Florida Keys National Marine Sanctuary

Environmental zoning has problems, as well as successes. A major issue associated with the zoning of any public area is stakeholder contention. Many park users do not want any government entity telling them what they can and cannot do in a public area. This is especially true in coastal and marine settings, as most people see fishing and

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9 Map available for download at Zones in the Florida Keys National Marine Sanctuary http://www.fknms.nos.noaa.gov/research_monitoring/map.html
boating as a right. In addition to public opposition, enforcing zoning in a public area can be difficult. While the national park service does not allow hunting within the boundaries of national parks, poaching still exists. The same is true for protected marine and coastal areas.

One way to combat some of the problems associated with marine zoning is the creation of marine protected areas. Environmentalists, public officials, and scientists have promoted marine protected areas (MPAs) as national parks in the marine environment. On May 26, 2000, President Clinton delivered Executive Order #13158, which called for the establishment of a comprehensive national network of marine protected areas (MPA News 2000). MPAs are defined as any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. This definition is broad enough to include national marine sanctuaries, fisheries management zones, national seashores, national parks, national monuments, critical habitats, national wildlife refuges, national estuarine research reserves, state conservation areas, state reserves, and many others. While MPAs are effective when enforced, the focus of the parks is solely the protection of resources, as opposed to a broader approach of protection, evaluation, and planning the use of marine resources.

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Table 2-1. Marine zones, their description and associated management strategies for the Florida Keys National Marine Sanctuary

<table>
<thead>
<tr>
<th>Type of Marine Zone</th>
<th>Description of Zone</th>
<th>Management Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife Management Areas</td>
<td>Bird nesting, resting and feeding areas</td>
<td>No access buffer zones</td>
</tr>
<tr>
<td></td>
<td>Sea turtle nesting beaches</td>
<td>No motor zones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idle speed/no wake zones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closed zones</td>
</tr>
<tr>
<td>Ecological Reserves</td>
<td>Large contiguous habitats</td>
<td>No discharge of any matter except cooling water or engine exhaust</td>
</tr>
<tr>
<td></td>
<td>Spawning and nursery grounds for marine species</td>
<td>No fishing by any means; removing, harvesting, or possessing any marine life</td>
</tr>
<tr>
<td></td>
<td>Permanent residence areas for marine life</td>
<td>No touching or standing on living or dead coral</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No anchoring on living or dead coral, or any attached organism</td>
</tr>
<tr>
<td>Sanctuary Preservation Areas</td>
<td>Heavily used areas that lead to resource degradation</td>
<td>No spearfishing, shell collecting, tropical fish collecting, fishing and other activities that result in the harvest of marine life by divers, snorkelers, and fishermen. Direct physical impact to corals in these areas is restricted</td>
</tr>
<tr>
<td></td>
<td>Shallow reefs where conflicts occur between user groups</td>
<td>Sanctuary regulations have been established to compliment existing management area regulations</td>
</tr>
<tr>
<td>Existing Management Areas</td>
<td>Areas where existing jurisdiction authority of other agencies occur</td>
<td>Permit based entry</td>
</tr>
<tr>
<td>Special Use Areas</td>
<td>Areas for scientific research and educational purposes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Areas of restricted use (commercial PWC operators and live-aboard mooring fields)</td>
<td></td>
</tr>
</tbody>
</table>

Regulating the Water—Case Studies

This section highlights some of the program and management strategies that are being or have been used to regulate coastal waters. The State of Oregon, the Gulf of Maine, and St. Johns County, Florida have all initiated various programs or studies that seek to regulate coastal waters or coastal infrastructure.

The Oregon Estuary Plan Book

Similar to marine zoning, estuary planning is not a new concept. In 1987, the Oregon Department of Land Conservation and Development (LCDC) published *The Oregon Estuary Plan Book*, which classified and mapped estuaries along the Oregon coast. The LCDC established this classification system to maintain diversity between...
and among the state's estuaries. Estuaries in Oregon are divided into three classifications: natural, conservation, and shallow and deep draft development. This classification system defines the overall level of development permitted in each estuary. Natural estuaries do not have maintained jetties or channels, and are usually not developed for residential, commercial, or industrial uses. Shorelands around natural estuaries are generally used for agriculture, forestry, recreation and other rural uses. Similar to natural estuaries, conservation estuaries do not have maintained jetties or channels, but are within or adjacent to urban areas. Development estuaries have maintained jetties and a dredged main channel (LCDC 1987).

Individual estuary plans designate appropriate uses for different management units; therefore, the uses allowed in an estuary depend on its classification (Table 2-2). Natural estuaries may only include natural management units. Conservation estuaries may include both conservation and natural management units, while development estuaries may include all three types of management units. Local comprehensive plans must review estuarine alterations to assure they are as compatible as possible with the established estuary plan (LCDC 1987).

Nagy and Siderelis (1990) applied the classification concepts from the Oregon estuarine planning effort to the waters of North Carolina, where they used GIS to develop the Water Area Use Classification System (WAUCS). The researchers defined preservation, conservation, and development water areas. A preservation water area seeks to protect significant fish and wildlife habitats, sustain biological productivity, and

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11 The management units for Oregon’s estuaries follow the classification system: natural management units, conservation management units and developed management units. These management units are nested natural management units are the most restrictive in terms of use, and development management units are the most liberal in terms of use.
provide for scientific, research and educational needs. A conservation water area designates use of renewable resources that do not require alteration to the estuary except for the purposes of restoration. The development water area provides for public, commercial, and industrial water uses. By delineating water classes on a map, “local governments can specify particular areas where certain policies apply” (Nagy and Siderelis 1990: 2).

<table>
<thead>
<tr>
<th>Management Unit</th>
<th>Areas Included</th>
<th>Management Objective</th>
<th>Permissible Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural</td>
<td>Large areas of salt marsh, tidal flats, seagrass and algae beds</td>
<td>Protection of fish and wildlife habitats, scientific research and educational needs</td>
<td>Undeveloped low-intensity, water-dependent recreation; research and educational observation; navigation aids; protection of fish, wildlife and aesthetic resources; passive restoration measures; dredging for maintenance of existing channels Uses allowed in natural management units and high-intensity water-dependent recreation, including boat ramps, marinas and new dredging for boat ramps and marinas; navigational improvements; mining and mineral extraction; aquaculture; and active restoration for purposes other than protection of habitat, nutrient, fish, wildlife and aesthetic resources; Dredge and fill; navigation and water-dependent commercial enterprises and activities; water storage areas where needed for products used in or resulting from industry, commerce, and recreation; marinas; aquaculture; extraction of resources and restoration.</td>
</tr>
<tr>
<td>Conservation</td>
<td>Smaller areas of significant habitat, recreational or commercial oyster and clam beds, habitats that are partially altered and adjacent to existing development of moderate intensity</td>
<td>Provide for long-term uses of renewable resources which do not require major alterations to the estuary, except for the purpose of restoration</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>Deep-water areas adjacent to the shoreline, navigation channels, sub-tidal areas for disposal of dredged material, and areas of minimal biological significance</td>
<td>Provide for navigation and public, commercial, and industrial water-dependent uses</td>
<td></td>
</tr>
</tbody>
</table>

Both the Oregon estuary planning effort and the North Carolina WAUCS use classes to aid in the management of estuarine resources. My study takes the concept of water use classification (with additional research into the estuarine human uses and habitat suitabilities) and applies it to the GTMNERR.
Policy-makers in the Gulf of Maine are finding that the former approach to managing offshore lands and resources is no longer adequate. Increasing use of ocean areas in the northeastern U.S. for a variety of often conflicting activities—fishing, aquaculture, transportation, submerged fiber optic cables, and oil and gas drilling, etc.—has raised the issue of whether an ocean-zoning plan should be implemented in the Gulf of Maine (Kelly 2003). The ocean zoning debate is included in the controversy over proposed offshore wind farms in Massachusetts. Nationwide, there are more than fifty proposals for offshore wind farms. The proposals have inadvertently highlighted gaps in state and federal authority to permit offshore uses and lease open space, and drawn attention to the need for government agencies to conduct planning for offshore activities. The Massachusetts wind farm would be located along the Atlantic Flyway, prompting concern that rotating blades on the 420-foot tall structures could pose a hazard to the many birds that migrate through the area. The project has also caused controversy over potential navigational hazards to airplanes and vessels, and negative effects on tourism due to the turbines ruining the aesthetics of Cape Cod's shoreline.

At the end of 2002, the Gulf of Maine Council (GOMC) identified several issues concerning the ocean-zoning proposal (Courtney and Wiggins 2003). First, designating specific areas of the marine environment for specific uses, including conservation, is a common component of coastal management in the Gulf of Maine. Second, zones for various purposes currently exist, independently and under different authorities. In addition, there is no standard process for comprehensively assessing the combined impact of these designations on marine resources. Finally, the GOMC found that ocean zoning establishes priorities among different uses of marine resources, and may redistribute
benefits and costs of management among different groups. The GOMC is now beginning to build a methodology for ocean zoning. Initial steps the Council plans to take are: 1) inventory existing jurisdictional and management conditions, 2) determine resources that need to be protected, 3) initiate small-scale pilot projects to test different ocean zoning scenarios, and 4) develop public support.

**Water Dependent Uses Study in St. Johns County, Florida**

Applied Technology and Management (ATM) recently completed a water-dependent uses and marine study in St. Johns County, Florida, as a requirement of the County Comprehensive Plan. The goals of the study included an evaluation of the suitability of the county’s waterways for additional water-use infrastructure (i.e. boat ramps, dry docks, and marinas), as well as the identification of regulatory criteria affecting the development and protection of aquatic resources (ATM 2002). In addition, the study proposed new water-dependent uses and marine land-development regulations (LDRs).

The findings of the study were based largely on the inventory of existing marine use infrastructure, projected population growth and boating demands for the county, and several analyses of site suitability for water-dependent uses. Suitability analyses were based on similar work by Florida Sea Grant (Antonini et al. 1997), and assigned a development-suitability rating, as well as an environmental-suitability rating to a predetermined region of waterway. The results included several maps depicting the suitability (poor, fair, and good) of specific regions for the development of aquatic-based infrastructure. Overall suitability scores (range: 13–32 points; 38 point maximum) for each region were also included on the maps.
Conclusion

The purpose of this literature review was to place the concept of estuary planning into the current land use planning context. The tools of land use regulation—comprehensive planning, land use zoning, GIS, environmental zoning—are used to control land uses, and can also be used to control estuary uses. The case studies of current estuary and marine planning initiatives establish successful precedent needed to move forward with an estuary plan for the GTMNERR.
CHAPTER 3
METHODS

The methodology presented consists of four components: (1) characterization of the legal authorities for estuary planning, (2) description of the estuarine environment, (3) inventory of coastal human use and (4) synthesis of the above components into an estuary plan. The first component consists of legal research aimed at clarifying the federal, state, and local laws and ordinances that support coastal and estuary planning and protection. The second component includes a survey assessing the various uses and user groups of the GTMNERR. The third component uses existing environmental GIS data to describe the ecology of the GTMNERR and surrounding areas. The final component brings together the legal, social, and environmental data to propose a plan for the GTMNERR. These four main methodological components of estuary planning are interrelated (Figure 3-1).

Figure 3-1. The overall organization of research methods
Characterizing the Legal Authorities for Estuary Planning

In order to effectively plan for coastal and estuarine resources, it is necessary to legitimize a need for such planning. Legal research at all three levels of the governmental hierarchy reveal trends in environmental legislation. Current laws and authorities support the concept of estuary planning, and thereby provide legal justification for this type of planning.

The methodology for the legal research started with the federal level. First, an analysis of general legislative authorities revealed that both the commerce clause and the public trust doctrine apply to the protection of estuarine resources. Next, federal laws that deal directly with water resources were identified from the list of all federal laws with environmental intent. Finally, legislation that addresses the preservation of exceptional areas was examined in relation to protection of coastal and estuarine areas.

Moving from federal to state authorities required an analysis of the police powers given to the states by the federal government. Standalone state environmental laws that support and affect estuarine protection were examined, as well as, regional entities that fall beneath state authorities. Finally, the role of local governmental was scrutinized, specifically programs or planning tools that directly or indirectly protect coastal and estuarine areas.

Describing the Estuarine Environment

The third component of the methodology used in this thesis was the description of coastal and estuarine ecology of the GTMNERR through existing geographical data. Data sets were identified that develop an overall ecological picture of the GTMNERR (Figure 3-2). The data sets described the ecology of the area, highlighted political
boundaries, and delineated physical environmental zones (Figures 3-3, 3-4, and 3-5), and formed a component of the overall estuary use analysis and conflict use analysis.

Figure 3-2. Data sets used to describe the GTMNERR and surrounding areas.

For the purposes of this study, the boundary of the estuarine environment was determined to be the boundary of the GTMNERR. Estuarine habitats were defined within the GTMNERR boundaries, and used as base maps for the evaluation of the human use data. Comparing the ecology, political and physical aspects of the area to the types and intensity of uses provided a means of visually assessing the current state of the estuary. This physical representation is a benchmark needed to develop and support any estuary planning objectives.

The ecology of the area was further analyzed based on the surveyed human uses. This analysis took place in a technical meeting with area biologists at the GTMNERR offices. The purpose of this meeting was to gather expert opinion about the suitability of
certain estuarine habitats for particular coastal activities (these opinions are somewhat removed from hard data). The information gathered at the meeting was processed into a habitat suitability model. The habitats were evaluated based on the analytic hierarchy process (AHP). This process derives ratio scale measures through pairwise comparisons, and priorities are derived from a set of verbal judgments (Forman 1983). Forman and Selly (2000:45) noted “... by using the AHP pairwise comparison process, weights or priorities are derived from a set of judgments. While it is difficult to justify weights that are arbitrarily assigned, it is relatively easy to justify judgments and the basis (hard data, knowledge, experience) for the judgments.” The opinions of experts is not preferred over hard data, however, geographical data indicating the suitability of estuarine habitats to support estuarine human uses does not currently exist. Therefore, it was necessary to derive the estuarine habitat suitabilities from verbal judgments given by estuarine scientists at the technical meeting.

The biologists were asked to judge the suitability of nine estuarine habitats, open water/water column, sand beaches, emergent aquatic vegetation, tidal flats, salt marsh, mangrove swamp, freshwater marsh, maritime forest, and hard bottom. These habitats were chosen based on existing estuarine and coastal habitat programs1 and data availability. The AHP directed participants through goal statements for each suitability exercise. For example, goal one was to determine the suitability of each estuarine habitat for motorized coastal human use.

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1 See the North Carolina Habitat Protection Program, available at  www.ncfisheries.net
Biologists compared one habitat with another based on the suitability of that habitat to support the four use categories. The habitat evaluations used a pairwise comparison scale (Table 3-1) and the pairwise comparisons were recorded on a series of worksheets.

Table 3-1. Pairwise comparison scale used to evaluate the suitability of estuarine habitat for human use

<table>
<thead>
<tr>
<th>Numerical Value</th>
<th>Verbal Scale</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Equal importance of both elements</td>
<td>Two elements contribute equally</td>
</tr>
<tr>
<td>2.0</td>
<td>Intermediate values</td>
<td>Used to compromise between two judgments</td>
</tr>
<tr>
<td>3.0</td>
<td>Moderate importance of one element over another</td>
<td>Experience and judgment favor one element over another</td>
</tr>
<tr>
<td>4.0</td>
<td>Intermediate values</td>
<td>Used to compromise between two judgments</td>
</tr>
<tr>
<td>5.0</td>
<td>Strong importance of one element over another</td>
<td>An element is strongly favored</td>
</tr>
<tr>
<td>6.0</td>
<td>Intermediate values</td>
<td>Used to compromise between two judgments</td>
</tr>
<tr>
<td>7.0</td>
<td>Very strong importance of one element over another</td>
<td>An element is very strongly dominant</td>
</tr>
<tr>
<td>8.0</td>
<td>Intermediate values</td>
<td>Used to compromise between two judgments</td>
</tr>
<tr>
<td>9.0</td>
<td>Extreme importance of one element over another</td>
<td>An element is favored by at least an order of magnitude</td>
</tr>
</tbody>
</table>

The habitat rankings were applied to the nine estuarine habitats in each use category (Table 3-2). These habitat rankings reflected how the biologists of the area prioritized the use of the estuarine habitats. The ranked habitat grids for each use category were then subtracted from the human use grids for each use category. The subtraction produced conflict grids for each of the use categories, which were used in the final analysis of the estuary use plan.

**Inventorying Coastal Human Use**

Human use and ecological inventories provide the physical context in which to plan for estuarine resources. Development of these inventories started with an examination of

2 Adapted from Decisions by Objectives by E. H. Forman and M.A. Selly (2000), World Scientific available at [http://mdm.gwu.edu/Forman/DBO.pdf](http://mdm.gwu.edu/Forman/DBO.pdf)
current coastal activities taking place within the GTMNERR. A coastal human use survey was administered to generate coastal activity data (Figure 3-2).

Figure 3-2. The organization of the coastal human use inventory.

The views of coastal and estuarine users who live around and visit the GTMNERR are an important component of the human use inventory. These views are incorporated into the estuary planning process through the identification of the most popular uses and travel routes in the area. The coastal human use survey quantified the types and intensity of coastal human uses in the GTMNERR.

**Survey Goals**

The goals of the coastal use survey were as follows.

1. Describe use patterns within the GTMNERR and surrounding areas.
2. Identify density of uses.

3. Identify high intensity use areas based on percentage of use normalized by the total uses.

**Survey Analyses**

The survey goals were satisfied through the following descriptive and geographical analyses.

1. Determine if there are specific areas or routes most frequently used in the GTMNERR.

2. Determine if density of use increases based on activity or location.

3. Determine if the percentage of use by geographical area is greater for any given use.

4. Delineate high use zones within the estuary.

**Survey Instrument and Data Collection**

The coastal use inventory survey asked users of the GTMNERR to identify coastal activities in which they participated. The survey also contained a user profile, which asked users to identify areas they deemed enjoyable or congested, as well as areas they avoided. Lastly, the survey presented two maps, the northern and southern sections of the GTMNERR, and asked users to indicate on the maps, what activities they engaged in, where they initiated their activities, and their travel routes within the reserve and surrounding areas.

**Survey Implementation**

The surveys were administered at various locations within the GTMNERR and surrounding areas in the summers of 2002 and 2003. The survey population was coastal users of the GTMNERR and surrounding areas. The survey was conducted through two methods: (1) two public meetings were held, one in the northern section and one in the southern section, where the attendees were asked to complete the survey, and (2) walk-
up, intercept surveys were conducted at various boat ramps and state parks throughout the
GTMNERR.

GIS Methods with Survey Data

The travel route information on the survey maps was processed into a geodatabase
by scanning the paper maps into image files that could be brought into Arcview©.
Arcview Image Analyst© was used to rectify the map-images to known coordinates.
Next, the travel route and activity point data were digitized and shapefiles of the travel
routes and activity points were created. The digitized lines and points were then
summarized to 250-meter grids. The software generated center points for the line files,
which placed a point in the center of each cell where a line was present. The analysis
calculated the density for each cell by summing the value found in the population field
for each point in the search radius, and dividing by the area of the circle in area units.
The population field determined the measured quantity to distribute through the output
grid theme. The search radius determined the distance to search for points from each cell
in the output grid theme (in this case, one square mile) and the output density values were
the occurrences of measured quantity per square mile. The resulting 250-meter grids
were resampled to 30 meters, in order to be comparable to existing data sets and gain
finer data resolution. The 30-meter use grids were normalized by the total uses, resulting
in percent of intensity of use.

GIS was used to analyze and display geographic concentrations or hot spots of
costal human uses within the GTMNERR. The analysis used the technique of kernel
estimation, or kernel smoothing, a spatial statistics method that generates a map of
density values from the point event data. Arcview Spatial Analyst© was used to generate
a density grid across an area where the value of each cell was the result of a units-per-
specified-area calculation. Density calculations provide a measure of the quantity of an input feature data set (line or point) distributed throughout the landscape (ESRI 2001). Density surfaces are useful for illustrating areas where point or line features are concentrated.

Because resource preservation is a goal for estuary planning, it was important to make judgments about certain groups of uses and the associated impacts on estuarine areas. Once the total use density for each use was determined, the uses were grouped into use categories. These categories were based on human use categories used in Florida Blueways research (Murphy 1999, Murphy and Brooks 2000), which found that management is aided by grouping activities based on their impacts to the coastal or marine area (Table 3-2).

<table>
<thead>
<tr>
<th>Use Category</th>
<th>Included Uses</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorized</td>
<td>Waterskiing, Scuba Diving, Parasailing, Overnight Anchorage, Jet Skiing, Fishing from Boat (recreational), Fishing from Boat (commercial) Beach Driving</td>
<td>Activities that require a motorized vehicle</td>
</tr>
<tr>
<td>Nonmotorized</td>
<td>Hiking, Fishing (bridge), Biking, Crabbing (recreational), Camping, Canoeing, Socializing, Sight-seeing, Visiting Historic Sites, Bird Watching, Hunting, Photography, Other (jogging), Nature Study, Swimming, Sunbathing, Sailing, Surfing</td>
<td>Activities that do not require a motorized vehicle</td>
</tr>
<tr>
<td>Extractive</td>
<td>Fishing, Crabbing, Hunting, Fishing from Boat (recreational), Fishing from Boat (commercial)</td>
<td>Activities that remove resources from the estuary complex</td>
</tr>
<tr>
<td>Passive</td>
<td>Hiking, Biking, Canoeing, Socializing, Sight-seeing, Visiting Historic Sites, Bird Watching, Photography, Other (jogging), Nature Study, Wind Surfing, Swimming, Sunbathing, Surfing</td>
<td>Activities that do not require a motorized vehicle and do not remove resources from the estuary complex</td>
</tr>
</tbody>
</table>

**Estuary Planning: Synthesizing Legal, Human Use and Ecological Research**

The final component of the methods used in my study focused on the estuary use plan (EUP) for the GTMNERR. The creation of the GTMNERR EUP took into account legal, human use, and ecological research and data. Methods for developing the final
EUP were based upon two coastal and marine planning initiatives: the development of management alternatives for the Florida Keys National Marine Sanctuary (FKNMS) and the Water Area Use Classification System (Clark 1989, Nagy and Siderelis 1990). Because the scope of this project is much smaller than the FKNMS, the methods used to develop the GTMNERR EUP are smaller in scope. For example, workshops were held to determine management issues for the FKNMS, while management issues for the GTMNERR were gleaned from interviewing resource managers of the area, questioning user groups, and existing literature about the area. Workshops were held to determine the preferred planning alternative for the FKNMS, and the preferred alternative for the GTMNERR EUP was determined through the results of my study.

The methods used for developing the final EUP included: 1) identification of management issues (NOAA 1996), 2) research into the legal feasibility of the estuary planning initiative, 3) inventory of estuarine human uses, 4) inventory of digital data describing the estuarine area, 5) identification of determinant and nondeterminant data (Nagy and Siderelis 1990), 6) analysis of estuarine conflicts, both human and resource based, 7) assessment and assignment of estuarine water factors and factor values to the GTMNERR (Nagy and Siderelis 1990), and 8) classification or zoning of the estuarine waters. The results section of my study contains the findings from the legal research, the output of the GIS research, and the analysis and synthesis of the EUP alternatives. The section concludes by discussing the elements that comprise the final EUP for the GTMNERR and surrounding areas.
Figure 3-3. Ecological data used to describe the GTMNERR and surrounding areas, these data include estuarine habitats, bird rookeries, and artificial reefs.
Figure 3-4. Political boundaries used to describe the GTMNERR and surrounding areas, these data include, city limit boundaries, Florida state parks, St. Johns River Water Management District lands, wildlife management areas, state conservation lands, and the GTMNERR boundary.

Object 5. Larger image of Figure 3-4.
Figure 3-5. Physical data used to describe the GTMNERR and surrounding areas, these data include major roads, bathymetry, waterways, boat ramps, and marinas.

Object 6. Larger image of Figure 3-5.
CHAPTER 4
RESULTS

The results of my study are divided into four components and follow the organization of the methods described in Chapter 3 (Figure 3-1). The first component comprises results of the research on the legal basis of estuary planning. The second component describes the ecological inventories and the habitat valuation and suitability analyses. The third component reports the results of the human use research conducted in the GTMNERR including the human use surveys, the human use density analyses, and the analyses of conflicts between uses and resources. The fourth component of the results is the estuary use and zoning plan, which includes the procedural and operational goals, objectives, and actions of the plan.

Federal Legislation, Regulations, and Authorities

Various federal legislation, regulations, and executive authorities exist which provide support for estuarine\(^1\) zoning. Consideration of current laws and regulations that affect the resources and uses of estuarine areas is important because the final EUP must be consistent with federal, state, and local requirements. The federal actions that support estuarine planning and zoning\(^2\) include the Antiquities Act\(^3\), the Magnuson-Stevens Act\(^4\),

\(^1\) For the purpose of my study, all references to estuary planning and zoning include areas of the estuarine zone that extends into upland areas, as well as the marine zone, which extends from the shore into the open ocean. Although the study area, the GTMNERR, is defined as an “estuarine reserve,” both estuarine and marine resources are included in the analysis.

\(^2\) An exhaustive discussion of possible federal powers is beyond the scope of my study.

\(^3\) 16 USC 431-433


**The Antiquities Act**

The American Antiquities Act of 1906 authorizes the presidential declaration of “. . . historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest.” The Act is one of the most potentially powerful pieces of legislation used in environmental preservation. The Antiquities Act is simple, yet has broad language that delegates substantial power to the executive branch (Brax 2002). Using the Antiquities Act to designate certain estuarine areas as national monuments would close these areas to all extractive uses.

The power of the Antiquities Act is far reaching; designation of a monument does not require public notice or participation, nor does it require congressional oversight; designation is not subject to the NEPA process or judicial review (Sanjay 2001, Brax 2002). Sanjay (2001) noted that there has never been a successful legal challenge to any use of the Antiquities Act, and the judiciary has interpreted the Act broadly. According to legal scholars all four published federal cases addressing national monument designation upheld the designation at stake (Sanjay 2001, Brax 2002).8

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6 Executive Order No. 13,158, 65 Fed. Reg. 34,909 (May 26, 2000)

7 16 USC 431-433

8 Cameron v. United States, 252 U.S. 450, 455 (1920), upholding the designation of the Grand Canyon as "an object of unusual scientific interest"; Wyoming v. Franke, 58 F. Supp. 890, 896 (D. Wyo. 1945), upholding the designation of Jackson Hole National Monument, and concluding that "this seems to be a controversy between the legislative and executive branches of the government in which, under the evidence presented here, the court cannot interfere"; Alaska v. Carter, 462 F. Supp. 1155, 1160 (D. Alaska 1978), finding that the argument that the President's involvement of the Secretary of the Interior in advising and recommending a designation triggered the NEPA requirement "approaches the absurd"; Anaconda Copper Co. v. Andrus, 14 Env't Rep. Cas. (BNA) 1853, 1853 (D. Alaska 1980), upholding a
The Antiquities Act applies not just to terrestrial resources, but also to submerged federal lands such as the Channel Islands National Monument in California, the Santa Rosa National Monument in Florida, and Buck Island Reef National Monument in the Virgin Islands. Although the precedent for applying this act to submerged resources has been set, the designations are not permanent and do not carry the full weight of the law (Rasband 2001, Brax 2002).

Using the Antiquities Act as a foundation for estuary planning and zoning by setting aside areas or zones proven to have scientific or historical interest is plausible and logical. As Brax (2002) stated, “the Antiquities Act and the National Marine Sanctuary Act, used in concert, may serve as the foundation of a set of new, groundbreaking underwater wilderness areas in the United States.”

**The Magnuson Act**

Originally passed and signed into law in 1976, the Magnuson-Stevens Fisheries Conservation and Management Act (The Magnuson Act) established the 200 nautical mile limit of the U.S. Exclusive Economic Zone or EEZ. In addition, the Act sets forth national fishery conservation standards and gives the federal government authority to regulate fisheries in the U.S. EEZ through regional councils. It authorizes regional councils to close areas and limit permits in order to protect long-term stocks.

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9 Brax (2002) page 19

10 The term "exclusive economic zone" means the zone established by Proclamation Number 5030, dated March 10, 1983, and the inner boundary of that zone is a line coterminous with the seaward boundary of each of the coastal States.

11 The Magnuson Act established eight regional councils with some members appointed by the Secretary of Commerce to represent fishing and fishing-related communities, while other members are designated...
The Magnuson Act states “one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine and other aquatic habitats.”13 Thus, the Act acknowledges the importance of habitat to the preservation of certain marine species, and the identification of essential fish habitat14 (EFH) is an important facet of the Act. There is currently an EFH program set up by the National Marine Fisheries Service (NMFS) within NOAA. In order to protect EFH, they must first be identified, and NMFS funds internal and external projects that add to the existing, but somewhat sketchy, knowledge base. NMFS also works with Federal agencies that authorize, fund, or conduct activities that may adversely affect EFH, to develop measures that minimize the damage. The NMFS does not have veto authority over federal projects adversely affecting EFH, and the focus of the Magnuson Act is on fisheries management; its purpose is extraction of resources, not the conservation and management of estuarine species (Chapman 2002).

The identification of EFH could be an important step in building an estuary plan. Certainly, estuary-zoning restrictions could reflect EFH designations and habitat areas of concern. The South Atlantic Fishery Management Council has described EFH for panaeid shrimp and rock shrimp, red drum, snapper-grouper species, golden crab, spiny

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12 See 16 U.S.C. 1853(a)-(d). The Act also, of course, provides the Secretary with enforcement power through civil penalties, the revocation of permits and other methods. See generally 16 U.S.C. 1857-1858 (particularly 16 U.S.C. 1858(a), (g)).

13 16 U.S.C. 1801 104-297 (9)

14 The term "essential fish habitat" means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. 16 U.S.C.1802 (10)
lobster, coral, coral reefs, and hard bottom habitats.\textsuperscript{15} These descriptions provide the blueprint for some estuarine zones due to their mapable parameters for specific estuary characteristics.

**The National Marine Sanctuaries Act**

The National Marine Sanctuaries Act (NMSA) and the system of National Marine Sanctuaries began as eleven separate bills in the House of Representatives in 1968. Blumm and Blumstein (1978) noted that the bills were a response to public outrage stemming from a series of incidents that resulted in the degradation of popular coastal areas, most notably the dumping of nerve gas and oil wastes off the coast of Florida and the infamous 1968 Santa Barbara oil spill. From 1968 to 1972, Congressional application of the NMSA changed focus from the protection of marine areas against oil and gas drilling to protection of significant marine areas against all anthropogenic threats (Brax 2002).

The NMSA is now the strongest, most accessible marine counterpart to the legislation used to create terrestrial reserves. Brax (2002) stated that the NMSA provides the best means of comprehensively managing marine activities by designating and assuring the protection of ecologically valuable marine areas. The NMSA allows the Secretary of Commerce or Congress to designate a sanctuary if the area is of special national significance due to its resources or human-use values.\textsuperscript{16}

\textsuperscript{15} http://www.nmfs.noaa.gov/habitat/habitatprotection/images/SAFMC.pdf

\textsuperscript{16} 16 U.S.C. 1433(a) (2) (A) (1994). Unfortunately, for environmentalist, the Act's legislative history also demonstrates an emphasis on maximizing human benefit and use. Congressional representative Hastings Keith stated, for example, “that the Act provides for multiple uses of the designated areas, a balanced even-handed means of prohibiting the resolution of one problem at the expense of the other, it guards against ecology for the sake of ecology.” 117 Cong. Rec. 30,858 (1971).
Significant sections of the NMSA that apply to estuarine planning and zoning include 301, 303, 304, and 305. Section 301 sets forth the findings, purpose, and polices of the Act establishing a clear intent to create a program capable of unifying national marine protected areas (MPAs) and managing them in a comprehensive manner. It is noteworthy that the U.S. Congress found that, prior to the passage of the NMSA; resource-specific legislation had failed to provide a “coordinated and comprehensive approach to the conservation and management of special areas of the marine environment.”

Sections 303 and 304 of the NMSA control the sanctuary designation process. These sections specifically sanction the examination of economic impacts and open dozens of loopholes whereby user groups can seek to block proposed designations (Brax 2002). Pluralistic consensus building and a gauntlet of regulatory review are some of the phrases used to describe this process. Section 305 establishes the enforcement options available to the Secretary of Commerce. The Secretary can issue regulations to manage activities within the sanctuary, officers of the Secretary are granted enforcement authority, and the Secretary retains some power over other federal agencies if a federal action seems likely to destroy or injure a sanctuary resource.

The NMSA gives authority to designate areas of marine significance, and to some extent, regulate what goes on in those areas, but the Act does not provide the legislative authority to exclude users from certain areas for the good of the resources. Congressional representatives, furthermore, have retained a substantial amount of power to block or delay an undesirable sanctuary within their state boundaries (Brax 2002). At present,

several states and dozens of statutes manage more than three hundred MPAs in the U.S. While the Act includes specific statutory language regarding the designation and management of sanctuaries, it also addresses the issue of transferring MPAs from other administrative regimes to the sanctuary program (Brax 2002). Despite the Act’s shortcomings, it offers an existing vehicle for comprehensive marine protection, if the necessary funding and attention are provided by the current administration.

**Executive Order 13158**

On May 26, 2000, President Clinton announced Executive Order (EO) 13158, Marine Protected Areas (MPAs). The order officially established and defined MPAs, and directed federal agencies to strengthen the management and protection of existing MPAs, to develop a scientifically based, comprehensive national system of MPAs, and to avoid causing harm to MPAs through federal activities. The language of this executive order indicates that a comprehensive catalogue of all national MPAs will eventually be developed, as well as a plan for bringing those marine areas under one governing statute and regulating authority (Brax 2002).

Throughout history U.S. presidents have relied on their executive authority to make unilateral policy without interference from either Congress or the courts (Mayer 2002). Mayer (2002) defined executive orders as presidential directives that require or authorize some action within the executive branch . . . they are presidential edicts, legal instruments

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20 MPAs are defined as any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. This definition is broad enough to include national marine sanctuaries, fisheries management zones, national seashores, national parks, national monuments, critical habitats, national wildlife refuges, national estuarine research reserves, state conservation areas, state reserves, and many others.
that create or modify laws, procedures, and policy by fiat. In his last years in office, President Clinton sought to establish a legacy of environmental conservation, using the Antiquities Act of 1906 to make over 3 million acres of federal land off-limits to development by declaring them national monuments. These areas included Utah's Grand Staircase-Escalante, Arizona's Grand-Canyon-Parashant and California's Pinnacles. With these actions, Clinton set aside more acreage under the Act than Theodore Roosevelt, the first president to take advantage of the Act, and the one most credited with establishing the U.S. system of federal land protection.  

Scholars believe that President Clinton issued EO 13158 to preserve commercial fishing interests and continued managerial responsibility for Regional Fishery Management Councils (Chapman 2002). The EO did not technically change the legal status of designated MPAs, but rather, directed traditional management agencies to develop policies that preserve the ecological character of the area (Chapman 2002). The resultant actions from the EO were aimed at coordinating federal management of the marine environment. The EO also established an MPA advisory group whose duties include providing advice and recommendations to the Secretaries of Commerce and the Interior on implementation of aspects of the MPA Executive Order.

The Administration of President Bush adopted EO 13158\textsuperscript{22} and began selecting the national MPA Advisory Committee in the summer of 2001.\textsuperscript{23} The president finalized the

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\textsuperscript{22} Press Release, Donald L. Evans, Secretary of Commerce, Supplement to Executive Order 13,158 (June 4, 2001), available at \url{http://80-mpa.gov.lp.hscl.ufl.edu/frontmatter/sup1_eo.html}
selections for the Advisory Committee in January 2003. NOAA currently maintains the national MPA website, which disseminates information about national and international marine protected areas.

**The Oceans Act**

Congress addressed ocean policy issues in the summer of 2000 by passing the Oceans Act. This act focused on a new and comprehensive policy for protecting and managing ocean resources. The Oceans Act grants the administration power to influence and perhaps create that new policy (Craig 2002). The Act established the Commission on Ocean Policy, whose purpose is to review national policies concerning the marine environment. In February 2003, the Commission determined that it would not meet the June 20, 2003, reporting date for transmitting its final report to the President and Congress, due to the depth and complexity of the issues. However, milestones from the Commission’s work to date include the unanimous adoption in November 2001 of a resolution supporting the United Nations *Law of the Sea Convention*; the drafting of an elements document in early 2002, *Developing a National Policy for our Ocean Future*; the development of an options document in July 2002, *Toward a National Ocean Policy*; and the release of a mid-term report, *Developing a National Ocean Policy*, in September

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24 [http://mpa.gov/mpabusiness/mpa_fac_pr_jan3_03.pdf](http://mpa.gov/mpabusiness/mpa_fac_pr_jan3_03.pdf), there are four representatives (out of thirty) from the state of Florida (Bob Bendick of the Nature Conservancy, Dr. John Ogdon of the Florida Institute of Oceanography, Dr. Dan Suman of the University of Miami, and Bob Zales owner of a private charter out of Panama City Beach)


In April of 2004 the Commission released its *Preliminary Report of the U.S. Commission on Ocean Policy—Governors’ Draft*. This report represents the Commission’s most recent findings to date and includes 31 chapters that report on a range of issues from ocean policy to marine commerce to ocean stewardship.

Both the MPA Executive Order and the Oceans Act are particularly important to planning and management of the GTMNERR, because for the first time, the federal government has called for the establishment of a system of marine protected areas, and suggested that the administration of existing marine protected areas be located under one governing statute and regulating authority. Thus, the federal government has formally acknowledged the need for integrated and comprehensive marine area planning and protection. Craig (2002) states that if used in combination with the MPA Executive Order, the Oceans Act could reinvent American ocean policy, replace the current paradigm of use with one of preservation, defragment current regulatory programs, unify them under a comprehensive system, and legitimize an ecosystem approach to the ocean issues. If the establishment of a national system of marine protected area comes to fruition, then there would be both precedent and a federal model for such a system in the State of Florida.

Clearly, the U.S. federal government has established statutory authority to aid in the management of America’s coasts and adjacent marine areas. This country continues to pass laws intent on saving or preserving natural resources nearly 100 years after the passage of the Antiquities Act. The Antiquities Act, the Magnuson-Stevens Act, National Marine Sanctuaries Act, Executive Order 13158, and the Oceans Act of 2000 all

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demonstrate a strong desire of the American people, reflected in their congressional representatives’ actions, to preserve, restore, and comprehensively manage America’s coastal and marine resources, including ocean habitats and species.

State Level Legislation and Estuary Planning Programs

This section of the Results explores legislation and authority granted at the state level that is applicable to estuary planning and zoning and examines established state ocean zoning and planning programs, including those found in Oregon, Maine, and North Carolina. The section concludes with a look at Florida’s legislative authority applicable to this concept and examines the potential for comprehensive estuarine and ocean planning development within the state.

The State of Oregon’s Estuary Planning Program

In 1987, Oregon instituted an ocean resources management program within its state government. The program is a facet of the statewide land-use planning program and coastal management program developed in the 1970s (Bailey 1997). Oregon developed a comprehensive ocean resources management program as part of the Oregon Coastal Management Program making the protection of aquatic resources a priority; four of the nineteen statewide planning goals are specific to coastal resource protection.

28 Florida Coastal Management Program, personal communication 02/27/03

It is interesting to note that DEPs strategic plan has changed in focus and scope from 1997 to 2001, specifically in terms of estuarine and marine resources. While the 1997 plan made direct mention of these areas, including a strategic goal, indicators and objectives, the most recent strategic plan (FY 2000-2001) does not even mention estuarine or marine resources, but does address Everglade restoration.

30 Goal 16 – Estuarine Resources; Goal 17 – Beaches and Dunes; Goal 18 – Coastal Shorelands; and Goal 19 – Ocean Resources; OAR 660-015 see Oregon Department of Land Conservation 19 statewide planning goals and guidelines at: http://www.lcd.state.or.us/goalhtml/goals.html, updated 11/01/02
In addition to integrating the coastal management program and the land-use planning department, Oregon passed the Oregon Ocean Resources Management Act of 1987, which included overall ocean management policies and established an Ocean Resources Management Task Force (Bailey 1997). The task force developed a plan for managing open ocean resources in Oregon’s 200-mile U.S. Exclusive Economic Zone (EEZ). This legislation established the importance of the broad marine environmental policy by expressing the state’s intention to plan for ocean resources within both federal and state waters (Bailey 1997).

The Oregon Ocean Resources Management Act also incorporated the responsibilities of local governments in the management of ocean resources. County boundaries extend seaward from the shore to the limit of state waters; however, to date no local government has adopted policies or regulations for ocean resources. This is largely because the original act made it clear that planning for and management of ocean resources would be conducted at the state level.

In addition to passing innovative legislation, Oregon also created several plans instituted at the state level that address coastal and ocean issues at the state level. The Oregon Ocean Resources Management Plan, published in 1990, articulates the state’s interest over the entire continental shelf (Bailey 1997). The Territorial Sea Plan contains enforceable standards for state and federal programs conducted within Oregon’s territorial seas (Bailey 1997). The Oregon Estuary Plan Book, published in 1987 by the Oregon Department of Land Conservation and Development, classifies and maps estuaries along the Oregon coast using Geographic Information Systems (GIS). This

31 Oregon Revised Statutes Chapter 196.405-515
book remains the principle reference for estuary and coastal planning in Oregon, and for coastal communities looking to protect and sustain their saltwater resources. In addition, to the on-line estuary-planning book, the website provides interactive mapping for planners and coastal decision makers in Oregon.32

Bailey (1997) identifies lessons learned from Oregon’s ocean management program. First, ocean planning and management requires a program not just a plan. Second, ocean planning and management takes time, technical resources, money, and expertise. Third, all affected governmental agencies must participate in ocean planning and management. Fourth, ocean management programs must be sensitive to local governments and local users applying abstract policy to real world issues. Finally, the political climate must be favorable for championing environmental issues; otherwise, an ocean management program will not be supported by the state.

**Ocean Planning in the Gulf of Maine**

Ocean planning in the Gulf of Maine is one of the few regional approaches to marine and ocean management. In 1989, the governors and premiers of the five jurisdictions bordering the Gulf of Maine (Nova Scotia, New Brunswick, Maine, New Hampshire, and Massachusetts) signed an agreement creating the Gulf of Maine Council as a regional entity to "protect the Gulf's ecological integrity and the many uses that depend upon its continued good health." Since then, the Council has focused its efforts on protecting and restoring coastal habitats, promoting sustainable development of marine and coastal resources, raising public awareness about the Gulf of Maine, and

32 Using ArcIMS software at: [http://www.inforain.org/interactivemapping/or_estuary.htm](http://www.inforain.org/interactivemapping/or_estuary.htm)
cultivating support for stewardship at the local level. The Council’s approach to management of marine resources reflects the tenets of ecosystem management.

A central goal established by the Council focuses on marine sustainability. In December 2002, the Gulf of Maine Council for the Maine Environment sponsored a forum on ocean zoning in the Gulf of Maine. The Council wanted to investigate the extent to which ocean zoning can establish marine sustainability goals. As discussed in the Literature Review section of my study, the GOMC’s initial approach includes determining current jurisdictional and management conditions, identifying resources that need to be protected, initiating small-scale pilot projects to test different zoning scenarios, and developing public support. The Gulf of Maine program takes an ecosystem approach to the management of marine resources, ignoring political boundaries and attempting to manage resources on an ecological basis. In addition, the program is not averse to using innovative techniques to manage marine resources, such as zoning.

**The Albemarle-Pamlico Estuary Study, North Carolina**

In November 1990, the University of North Carolina’s Sea Grant Program published a report entitled, “North Carolina’s Estuaries: A Pilot Study for Managing Multiple Use in the State’s Public Trust Waters.” The study area was the Albemarle-Pamlico estuary in Carteret County, North Carolina. The report acknowledged conflicting uses occurring within the estuary, including anglers versus developers, boaters, and shoreline residents versus personal watercraft users, and people who support privatization of estuarine areas versus those that do not. The report developed a management option for governing uses of the public trust waters of North Carolina’s estuaries.
The management model proposed in the North Carolina Estuaries report is essentially an extension of the comprehensive planning process used on land, which has several benefits (Clark 1990). First, expanding land-use planning to cover aquatic areas results in a more comprehensive view of the region. Second, establishing a plan for aquatic areas imparts a sense of predictability for the area. For example, a plan informs an environmentalist that the area is protected for the long-term, and tells a developer what development is possible before they invest in a project. Third, a comprehensive plan can provide resolution of overlapping jurisdictions, policies, and legislation. Finally, a plan for aquatic areas can act as a collecting point for scientific research, merging new and archived information.

The North Carolina Estuaries report advocates a system of classification based on the characteristics of aquatic areas to aid implementation of policies adopted by Carteret County. Clarke (1990) pointed out that, water classes delineated on a map allow local governments and its citizens to specify areas where certain policies apply. The designation of water classes allows local governments to illustrate policies, such as where and at what intensity water-based activities occur, and to indicate areas of resource conservation.

The idea of applying land-use regulation techniques to estuarine waters has been slow to catch on in North Carolina, this is due in large part to a shift of political priorities to issues such as the economy and homeland security. Although a water use plan is not explicitly incorporated in the guidelines, the Coastal Resources Commission used water use planning language into their regulations. For example, the regulations pertaining to

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33 Walter Clark, personal communication April 10, 2003 via e-mail
freestanding moorings require a water use plan before allowing new moorings.\textsuperscript{34} Despite the lack of a specific water use plan, the report does proved a published template that extends the comprehensive planning process to aquatic areas. The research described in my study seeks to build on that template, and suggests extending comprehensive planning to estuaries. The result is a geographical footprint of ecological resources and human use activities, and ultimately a water use plan based on these geographic delineations.

**Legislative Authority in Florida**

Florida has many statutes aimed at managing and protecting the environment, and these authorities have resulted in a number of environmental programs. The following paragraphs discuss Florida state laws and programs that relate specifically to estuarine and marine planning, including the Florida Aquatic Preserve Act of 1975\textsuperscript{35}, the Florida Administrative Code provisions on Outstanding Florida Waters\textsuperscript{36}, the Beach and Shore Preservation Act\textsuperscript{37}, and the Coastal Zone Protection Act of 1985.\textsuperscript{38} Laws and programs with less obvious links to coastal and marine planning will also be discussed, such as the Florida Local Government Comprehensive Planning and Land Development Regulation Act, known as the Growth Management Act (GMA) and the Areas of Critical State Concern program (ACSC).

The legislative intent of the Florida Aquatic Preserve Act is “that state-owned submerged lands in areas which have exceptional biological, aesthetic, and scientific

\textsuperscript{34} 15 NCAC 07H .0208(b)(10).

\textsuperscript{35} Fla. Stat.258.35-258.394 and 258.40-258.46

\textsuperscript{36} 62-302.700, F.A.C

\textsuperscript{37} Fla. Stat.161 011-161.242 and 161.25-161.45

\textsuperscript{38} Id at 161.52-161.58
The Aquatic Preserve Act defines three types of aquatic preserves: 1) biological—an area set aside to promote certain forms of animal or plant life or their supporting habitat, 2) aesthetic—an area set aside to maintain certain scenic qualities or amenities, and 3) scientific—an area set aside to maintain certain qualities or features which have scientific value or significance. The Board of Trustees of the Internal Improvement Trust Fund maintains the 30 aquatic preserves found throughout the state.

The Aquatic Preserve Act is probably the piece of Florida legislation that comes closest to current federal initiatives on marine protected areas. However, the Act itself does not have much in the way of teeth. In fact, the Act states that neither the establishment nor the management of the aquatic preserves can infringe upon the traditional riparian rights of upland property owners adjacent to or within the preserves.

All of Florida’s waters fall into one of five surface water classifications, with specific criteria applicable to each class of water. The state arranges water quality classifications in order of the degree of protection required, with Class I water having generally the most stringent water quality criteria and Class V the least (Table 4-1). However, Class I, II, and III surface waters share water quality criteria established to protect both recreation and the propagation and maintenance of healthy, well-balanced populations of fish and wildlife.

39 Fla. Stat. 258.36.
40 Id at 258.37 (2) (3) (4)
41 Id at 258.44
42 62-302.400 F.A.C.
Table 4-1. Description of water classifications in Florida (62-302.400, F.A.C.(1))

<table>
<thead>
<tr>
<th>Class Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Potable water supplies</td>
</tr>
<tr>
<td>Class II</td>
<td>Shellfish propagation or harvesting</td>
</tr>
<tr>
<td>Class III</td>
<td>Recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife</td>
</tr>
<tr>
<td>Class IV</td>
<td>Agricultural water supplies</td>
</tr>
<tr>
<td>Class V</td>
<td>Navigation, utility and industrial use</td>
</tr>
<tr>
<td>Outstanding Florida Water</td>
<td>Ecological protection</td>
</tr>
</tbody>
</table>

In addition to its surface water classification, a water body may be designated as an Outstanding Florida Water.\(^43\) Section 403.061 (27), Florida Statutes, grants the Florida Department of Environmental Protection (DEP) power to establish rules that provide for a special category of water bodies within the state, to be referred as "Outstanding Florida Waters," (OFW), which are worthy of special protection because of their natural attributes. Within the boundaries of the GTMNERR, there are several bodies of water designated OFW including: Guana River Marsh Aquatic Preserve, Guana River State Park, Pellicer Creek Aquatic Preserve, Faver-Dykes State Park, and Washington Oaks State Gardens.\(^44\)

The regulatory significance of the OFW statute is in the DEP’s power to withhold permits for pollutant discharges into designated OFWs. In general, the DEP cannot issue permits for direct pollutant discharges to OFWs, which would lower ambient water quality and significantly degrade the Outstanding Florida Water. Permits for new dredging and filling must be clearly in the public interest.\(^45\)

\(^43\) 62-302.700 F.A.C

\(^44\) Janet, Klemm personal communication 04/14/03

\(^45\) Factors determining the public interest: whether the activity will adversely affect the public health, safety, or welfare or property of others; whether the activity will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats, whether the activity will adversely affect navigation or the flow of water or cause harmful erosion or shoaling, whether the activity will adversely affect the fishing or recreational values or marine productivity in the vicinity of
The Beach and Shore Preservation Act sets forth guidelines for coastal construction and reconstruction, beach nourishment and beach armoring. Part Two of the Act establishes beach and shore preservation districts, assigning control of the districts to the respective coastal county commissions. The Act confers broad powers to the county commissions, including the power “to acquire and hold lands and property by any lawful means; to exercise the power of eminent domain; to enter upon private property for purposes of making surveys, soundings, drillings, and examinations; to construct, acquire, operate, and maintain works and facilities; and to make rules and regulations.”

The intent of the Act is to preserve Florida’s beaches and shores through coastal construction controls and beach nourishment and armoring.

The legislative findings of Florida’s Coastal Zone Protection Act of 1985 recognized the role coastal areas play in protecting coastal ecology and the public health, safety, and welfare of the citizens of the state. The Act also recognized that Florida’s coastal areas have been subjected to increasing growth pressures “and that unless these pressures are controlled, the very features which make coastal areas economically, aesthetically, and ecologically rich will be destroyed.”

Despite the broad findings of the Coastal Zone Protection Act, the legislative intent was quite narrow: the management of sensitive coastal areas through “the imposition of strict construction standards in order to minimize damage to the natural environment,

46 Fla. Stat. 161.36 (1-8)
47 Fla. Stat. 161.53(1)
private property, and life.” The Act addresses vehicular traffic on beaches by conferring regulatory authority to coastal counties. Similar to the Beach and Shore Preservation Act, the Coastal Zone Management Act focuses on regulating construction in Florida’s coastal zone.

The Growth Management Act (GMA) requires local governments to adopt comprehensive plans and land development regulations to guide future growth and development. The state reviews local comprehensive plans and if state criteria are not satisfied, amendments may be necessary. In addition, if local governments cannot complete all elements required for the comprehensive plan, one of the eleven regional planning councils must assist them in preparation. Tucker (2001) stated that the GMA has the potential to conserve ecological resources because it provides a clear mandate requiring local governments to protect natural resources, including forests, wildlife, wetlands, coastal areas, fisheries, and rivers.

Using the GMA as a natural resource planning tool has both benefits and drawbacks. On the positive side, the GMA provides broad authority for resource protection. However, the GMA does not provide specific guidelines for such protection, and many local governments do not have the money, tools, or labor to protect natural resources. Much of the resource protection, furthermore, focuses on listed species and

48 Id at (5)
49 Fla. Stat. 161.58
50 Fla. Stat. 163.3167
51 Id. at (3), (4)
52 Local government conservation elements must provide for conservation, use and protection of rivers and related natural resources, including water, water recharge areas, wetlands, estuarine marshes, soils, shores, flood plains, forests, fisheries and wildlife. 163.3177 (6)(d)
wetland areas; in addition, the state does not require local governments to protect natural resources. The Department of Community Affairs (DCA), which oversees the local government comprehensive planning process, routinely approves plans that do not adequately protect resources\textsuperscript{53} (Tucker 2001).

Another important aspect of planning that the GMA addresses is intergovernmental coordination. Intergovernmental coordination is necessary for the protection of interconnected ecosystems based on ecological boundaries and not political ones. Unfortunately, the GMA fails to require local governments to coordinate adequately when developing comprehensive plans (Tucker 2001). The GMA should require intergovernmental coordination to address regulatory conflicts before a project is proposed.

The GMA could facilitate statewide estuary planning and management because it already provides sufficient statutory authority to the DCA to implement ecosystem management objectives though agency rulemaking (Tucker 2001). The comprehensive planning process is a continuous and ongoing process,\textsuperscript{54} dynamic, easily changed and updated. Such flexibility is useful in creating plans for coastal and marine areas. By having a fluid planning process, policy makers can meet the needs of both stakeholders and resources.

Beginning in the 1990s, Florida began to examine the management of its environmental resources. The intent of legislation evolved a strict focus on construction

\textsuperscript{53} For example, local governments with jurisdictions over the Green Swamp (an ACSC) adopted densities higher than those recommended by scientists and a task force composed of interest groups; DCA approved the plan. See DCA v. Lake County, No. 91-5960GM 48, 1994.

\textsuperscript{54} Fla. Stat. 163.3191(1)
control to achieve environmental preservation. In 1993, Florida became the first state to adopt ecosystem management as an official state policy, thereby reflecting this evolution (Tucker 2001). The state established an Office of Ecosystem Management within DEP. Unfortunately, ten years later, the ecosystem management program has all but disappeared, although the DEP maintains that ecosystem management is inherent in all of its programs. Typing ecosystem management into the search engine on the DEP website returns outdated websites that apply only to northeast Florida. In fact, the original ecosystem management website no longer functions. The DEP confirmed that the ecosystem management program had been eliminated, but that the concept of ecosystem management had been applied to all existing programs within the DEP.

Despite the fleeting focus on ecosystem-level protection in Florida, the Areas of Critical State Concern (ACSC) program (that pre-dates ecosystem management) identifies and regulates ecological areas of statewide importance. Established under the Florida Environmental Land and Water Management Act, the program requires the state to adopt principles for guiding development to control land-use at each of the five ACSC

55 Grumbine (1994) defines ecosystem management as “integrating scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term.”

56 The Florida Legislature directed the state's environmental protection and land management agency to “protect the functions of entire ecological systems through enhanced coordination of public acquisition, regulatory, and planning programs.” See The Florida Environmental Reorganization Act of 1993, 1993 Fla. Laws ch. 213 § 2(2)(c) (codified at FLA. STAT. ch. 20.255 (1997)). The agency has adopted ecosystem management as the guiding principle for achieving this objective. FLA. DEPT OF ENVTL. PROT., Beginning Ecosystem Management, in 4 ENVTL. EXCH. POINT 2, 5-6 1994.

57 http://www.dep.state.fl.us/northeast/admweb/ecosysmgmt/emupdate.htm, last updated 10/01

58 http://www.dep.state.fl.us/emsp/emis.html/

Local governments must implement these principles though their comprehensive plans and land development regulations. The majority of ACSC actions focus on conserving water resources and listed species. The intent of the program is to temporarily list areas of concern, and then de-designate once the local government’s resource protection plans satisfies the state-adopted principles for that area. To date, no area has been de-listed, and since the program’s inception, the Legislature has not designated any new ACSC sites.

Tucker (2001) noted that the ACSC program holds little promise for statewide conservation. This is largely due to the substantial local government and citizen opposition to the program, and to the state’s less-than-diligent method of implementing and enforcing its provisions. In addition, Tucker (2001) pointed out that current political priorities of homeland security and economic stimulus take precedent over the ACSC program. Ironically, in 1992, the state Environmental Land Management Study Commission recommended that the Legislature use the ACSC program to protect additional areas of ecological significance in Florida.

The Areas of Critical State Concern program is the only authorized state program that supports a regional approach to managing ecological resources in the state of Florida. Reinventing and repackaging the program to manage regional coastal areas, including estuaries and open ocean areas, is a potential remedy to the current decentralized system.

60 The legislature has designated the Florida Keys, the City of Key West, Big Cypress Swamp, Green Swamp and Apalachicola Bay as ACSC sites.

61 Fla. Stat. 380.05(6)

62 Id. at 380.05(12)

63 Id. The state may not de-designate unless the local governments have been successfully implementing the ACSC requirements for at least one year.
of coastal protection. However, due to current public opposition, such a remedy may not be feasible.

The state of Florida has no comprehensive goals and objectives for management of coastal and marine areas\textsuperscript{64}. In addition, the State has no plans to create any kind of oversight or comprehensive planning for these important areas. The nation is well on its way to sorting out ocean policy and making marine planning a priority. If Florida chooses to develop and implement a plan for state coastal resources before federal action, the state program could be used as a template to aid in the creation of the national system. Proactive ocean and coastal policy in Florida could set a standard for the rest of the country’s coastal states. Now is the time for the state of Florida, a state with the largest coastal area next to Alaska, to make coastal and ocean planning a priority.

Local Authority Over Coastal, Estuarine, and Marine Areas

Some scholars describe the role of local government as that of an incidental participant in a federal system of environmental law (Nolon 2002). However, local governments have begun to take control of their environmental policy, no longer waiting for the federal or state governments to hand down their version of ecological do’s and don’ts. As the environmental movement gained momentum in the 1970s, early signs of local environmental law became apparent. Nolon (2002) noted that one source of local control came from the National Flood Insurance Program, which requires local governments to adopt and enforce floodplain management programs as a prerequisite to

\textsuperscript{64} In 1997, the idea of marine ecosystem management areas (MEMAs) was briefly discussed and documented in the last few pages of Christie et al. Looking Seaward: Development of a State Ocean Policy for Florida
local eligibility for national flood disaster payments.\textsuperscript{65} Nolon (2002) also pointed out that catastrophes shifted the movement towards increased regulation at the local level, especially in coastal states. This led to local stormwater management standards and setback requirements along the coasts of barrier islands.\textsuperscript{66}

Currently, local governments formulate their own versions of environmental legislation and these local environmental laws take a number of forms. They include local comprehensive plans expressing environmental values, zoning districts created to protect watershed areas, environmental standards contained in subdivision and site plan regulations, and stand-alone environmental laws adopted to protect particular natural resources (Nolon 2002).

**Comprehensive Planning**

If a community wishes to adopt local laws that regulate the environment, it may create a legal basis for those regulations in its comprehensive plan. Since many states require local land-use regulations to conform to the comprehensive plan, such provisions help sustain environmental regulations when challenged (Rathkopf 1975). Typically, a comprehensive plan has three main characteristics: 1) statement of goals, societal needs, and far-reaching, if not ultimate, objectives; 2) detailed planning with plans backed by studies and information; and 3) plan implementation (Platt 1996). In Florida, the Growth Management Act requires all of Florida's 67 counties and 476 municipalities to adopt Local Government Comprehensive Plans that guide future growth and development. Comprehensive plans contain elements that address future land-use, housing,

\textsuperscript{65} 44 C.F.R. § 60 (2000); see also 42 U.S.C. §§ 4011, 4013 (1994).

transportation, infrastructure, coastal management, conservation, recreation and open space, intergovernmental coordination, and capital improvements.

The coastal elements of comprehensive plans must contain “the plans and principles used to control development and redevelopment to eliminate or mitigate the adverse impacts on coastal wetlands; living marine resources; barrier islands, including beach and dune systems; unique wildlife habitat; historical and archaeological sites; and other fragile coastal resources.” The coastal element should also include “regulatory and management techniques that the local government plans to adopt or have adopted in order to…control proposed development and redevelopment in order to protect the coastal environment and give consideration to cumulative impacts.” The GMA statute also directs local governments to establish a process for identifying and prioritizing coastal properties that are pristine in nature or significant in terms of environmental sensitivity, as well as other policies for effective coastal management. In addition to the coastal element, the conservation elements of comprehensive plans must provide for the conservation, use, and protection of natural resources in the community, including "wetlands, . . . estuarine marshes, soils, beaches, shores, flood plains, rivers, bays, lakes, forests, fisheries and wildlife, [and] marine habitat.” The coastal element coupled with the conservation element of the comprehensive planning process provides local governments with the authority to plan for local ecological resources.

67 Fla. Stat. 163.3178(2) (b)
68 Id. at (j)
69 Id. at (8)
70 Fla. Stat.163.3177(6)(d)
The teeth of the comprehensive planning process exist in the policies outlined under the objectives and contained in the goals of each element. The coastal element of the St. Johns County comprehensive plan has an objective of coastal protection. Part of this objective states: “waters that flow into either the ocean or estuary shall be protected through established conservation techniques. . . .71” A policy directly associated with this language requires limitation of impacts on natural resources by activities associated with development.72 In addition, the policy directs the County to “prepare a Coastal Area Plan that will analyze and evaluate the carrying capacity of the study area and the balance between land-use densities and intensities and the coastal environmental constraints.”73 The policy also states that land-uses determined to adversely impact the quality and quantity of water should be restricted.

Carrying Capacity Studies in Comprehensive Planning

Some scholars have suggested that local governments use cumulative impact or carrying capacity analysis as a tool to assess the impact of plans, policies, and regulations upon built and natural resources (Schneider et. al 1978, Witten 2001). A carrying capacity analysis assesses the ability of a built resource, such as roadways, wastewater treatment plants, municipal swimming pools, or a natural resource, such as aquifers, surface water bodies, or coastal estuaries, to absorb population growth and related physical development without permanently impairing the productivity of that resource (Schneider et. al 1978). Witten (2001) noted that, without such an analysis, a system

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71 Objective E.1.5 St. Johns County coastal GOPs
72 Id. at Policy E.1.5.5
73 Id. at Policy E.1.5.8
could fail to perform as designed⁷⁴, or in the case of a natural resource, diminish in health or productivity.⁷⁵

Unfortunately, determining the carrying capacity of a built or natural resource is not easy. Carrying capacity analyses are time and labor intensive. Witten (2001) stated that municipalities and local government agencies might avoid this analysis, because they believe it requires scientific investigations beyond their financial or technical abilities. However, by completing a carrying capacity analysis, the government, and local governments in particular, gain a powerful and legally defensible tool with which to make decisions (Plater et al. 1998). Furthermore, this analysis may also help local governments to resolve conflicts between competing development and preservation goals (Plater et al. 1998).

The U.S. Army Corps of Engineers is currently engaged in the Florida Keys Carrying Capacity Study (FKCCS). Legal challenges to the Monroe County Year 2010 Comprehensive Plan initiated a carrying capacity approach to growth management that was adopted during final revisions. The goal of the FKCCS is to “determine the ability of the Florida Keys ecosystem, and the various segments thereof, to withstand all impacts of additional land development activities.”⁷⁶

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⁷⁴ Built resources such as bridges, roads, water distribution systems and wastewater treatment facilities, for example, have design carrying capacities (Witten 2001).

⁷⁵ Some advocates presume that all natural resources have a carrying capacity, although the carrying capacity for many natural resources has not been quantified. For example, underlying many federal laws designed to protect wildlife is the assumption that wildlife habitat must be protected to ensure the protection of the species. See, e.g., Northern Spotted Owl v. Lujan, 758 F. Supp. 621, 629 (W.D. Wash. 1991) holding that the Endangered Species Act required listing of Northern Spotted Owl occur in conjunction with designation of the species’ critical habitat.

⁷⁶ The Florida Keys Carrying Capacity Study is focused on all of Monroe County, which extends from Key Largo to the Dry Tortugas.

⁷⁷ FAC Rule 28-20.100
The FKCCS produced a spatial model that predicts the final effects of land-use scenarios on the natural and social systems of the Florida Keys. Through the Graphical User Interface (GUI), the user defines changes in land-use as alternative land-use scenarios to modify land-use patterns and specify stormwater and wastewater treatment types (URS Corp 2003). Unfortunately, reviews for this model have not been positive. Due to precision problems of intensive quantitative analysis, the model “as it exists . . . cannot fulfill the original vision of a tool to assess carrying capacity of the region and the ability of the Florida Keys to withstand all impacts of land development activities” (Peer Review of FKCCS 2002). The Peer Review of the FKCCS (2002) noted that the model seems to be capable of evaluating some useful, although imprecise, surrogate measures of the impacts of development on the terrestrial habitats in the Florida Keys. Many critics, however, call for significant improvements in the model before local governments and planning entities use its predictive capabilities.

**Zoning and Overlay Districts**

The Standard Zoning Enabling Act (SZEA), which was promulgated in 1926 by the Federal Advisory Committee on Zoning, directed that zoning be in accordance with a comprehensive plan (Callies et al. 1999). A model act, its language was adopted and changed to suit the planning strategy of each state. While environmental zoning continues to evolve, one zoning technique used to protect critical or sensitive environmental areas is the adoption of zoning districts with boundaries that are contiguous with natural boundaries. The Ohio Supreme Court upheld an Open Space Conservation Zoning District as a legitimate exercise of police power in Reed v.
Rootstown Township Board of Zoning Appeals. The court determined that a five-acre minimum lot size was reasonable, since the district essentially consisted of a swamp.

Overlay districts are additional planning tools used to protect environmental resources. Local governments use overlay districts to establish alternative land development requirements within specific areas of a community; it is typically superimposed over conventional zoning districts, but may also be used as a stand-alone regulation to manage land use development. Two sets of zoning regulations control a parcel within the overlay zone: the underlying zoning district provisions and the overlay zoning requirements (Nolon 2002). For example, a natural resource overlay district would seek to protect environmentally significant lands from intense development by restricting densities and providing incentives for preserving open space that contains floodplains, wetlands, groundwater recharge areas, endangered habitat areas, and watersheds.

While St. Johns County has no conservation zoning districts within its boundaries, four overlay districts exist, each with different objectives. The main objective of the Ponte Vedra/Palm Valley coastal corridor overlay district is to enhance property development by regulating signage along highway A1A, and establish minimum setbacks within the district. The purpose and intent of the South Anastasia Island Coastal Corridor District is “to protect and preserve the 'Old Florida' style, rural beach community in the South Anastasia Island Coastal Overlay District.”

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78 458 N.E.2d 840 (Ohio 1984)

79 Id. at 842

80St. Johns County Land Development Code, Sec. 3.06.01, revised October 2002

81 Id. at 3.07.01
Anastasia Island Coastal Corridor Overlay District establishes additional requirements that regulate development in order to protect natural resources, as well as maintain and enhance the diverse and unique character of the area. The purpose and intent of the North Coastal Corridor Overlay District is “to encourage a respect for the history of the area, by establishing standards and guidelines that reflect this history, while sustaining and supporting a sense of place.”

In addition to overlay districts, St. Johns County provides protection for natural resources in the Land Development Code (LDC). Article IV of the LDC establishes standards and procedures by which natural resource impacts are determined, as well as the basis for approval or disapproval of development in light of these environmental impacts. An objective highlighted in the LDC is to “protect environmentally sensitive areas from activities which would alter their ecological integrity, balance, or character.” The LDC sets forth minimum vegetative buffers of fifty feet between development and the St. Johns, Matanzas, Guana and Tolomato River, as well as their tributaries and streams. The LDC identifies “Significant Natural Communities Habitat,” imperiled coastal habitats within the county, including beach dune, coastal grassland, coastal strand, and maritime hammock. In development projects greater than 10 acres, the LDC

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82 Id. at 3.08.01
83 Id. at 3.09.01
84 Id. at 4.00.00, revised June 2001
85 Id. at 4.01.01 B(4)
86 Id. at 4.01.06 A(2)
87 Id at 4.01.07 G(1-4)
requires the developers to preserve 10% of these habitats occurring within the developed area.

Local governments probably have the most control over their coastal areas, especially in Florida. The idea of estuary planning is analogous to comprehensive planning at the local level. If local planning agencies adopt estuary planning as a management tool, then those agencies will be taking a preventative approach, as opposed to a prescriptive approach, towards the protection of regional coastal and estuarine resources.

**Development of an Estuary Use Plan for the GTMNERR**

An estuary use plan (EUP) for the GTMNERR was developed by identifying the legal authorities for estuary planning, describing the estuarine environment, inventorying coastal human uses, and synthesizing these components into an estuary plan (Figure 3-1). The EUP takes into account many of the goals, objectives and policies set forth by the coastal management elements of St. Johns and Flagler counties. Since humans remain obligatorily dependent on the productivity of the environment (Rees 1990), the overarching goal of the EUP seeks to manage, through estuary zoning, this productivity while providing for human use of coastal resources. Both operational and procedural objectives (executed by actions) support this goal. Operational objectives reflect the ideal vision for the estuary based on the planning actions. Procedural objectives support the reality of estuary use planning, and reflect the systematic process used to achieve the overarching goal of the EUP.

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88 Similar to Goal E.1. from the St. Johns County conservation and coastal goals, objectives and policies, adopted May 10, 2000.
Operational Objectives and Actions for the Estuary Use Plan for the GTMNERR

Operational Objective 1: Protect existing and future estuarine resources.

O. Action 1.1: Protect areas of ecological significance through zoning and enforcement of policies and regulations.

O. Action 1.2: Discourage use of ecologically significant areas with the placement of educational signage, and possible legal restrictions.

O. Action 1.3: Attempt to establish an “estuary ethic” by fostering a sense of stewardship for the GTMNERR and surrounding estuarine areas.

Operational Objective 2: Provide for enhanced recreational opportunities.

O. Action 2.1: Accommodate existing estuary uses and minimize conflict among estuary users. In sensitive areas where unsuitable uses are identified, seek to redirect these uses out of the sensitive areas so that important estuarine resources remain intact and unfragmented.

O. Action 2.2: Identify established estuary use patterns so that less traveled areas can be targeted for preservation.

O. Action 2.3: Plan for future use and encourage existing use in areas identified as suitable for motorized, nonmotorized, extractive or passive use with the appropriate placement or withholding of coastal infrastructure (e.g. boat ramps and public access) and education signage (see O. Action 1.2).

Operational Objective 3: Support additional water use planning efforts by applying the process of estuary use planning to other estuaries and marine areas.

O. Action 3.1: Using the GTMNERR EUP process, establish an EUP strategy in other aquatic systems.
O. **Action 3.2**: Establish zoning as an accepted form of controlling aquatic-based uses.

**O. Action 3.3.** Establish a legal basis for the use of EUPs (or marine use plans) in conjunction with established land use plans for coastal areas.

**Procedural Objectives and Actions for the Estuary Use Plan for the GTMNERR**

**Procedural Objective 1**: Identify areas of high ecological value based on existing data and expert opinion.

**P. Action 1.1**: Inventory existing geographical data depicting the ecology of the GTMNERR.

**P. Action 1.2**: Identify gaps in existing data stores, gather additional data as necessary.

**Procedural Objective 2**: Determine the type of coastal human use occurring in the GTMNERR, the geospatial footprint of each activity and the intensity at which the use exists.

**P. Action 2.1**: Inventory existing estuary uses through intercept and mail-back surveys.

**P. Action 2.2**: Ask estuary users to record travel routes and points of origin.

**P. Action 2.3**: Using GIS, map the intensity of various estuary use categories.

**Procedural Objective 3**: Create estuary use planning zones for the GTMNERR.

**P. Action 3.1**: Gather scientific opinions about the suitability of estuarine habitats, using those results and GIS analyses, create habitat suitability surfaces for the various use categories.
P. Action 3.2: Assign zoning categories based on the comparisons of geographical analysis data layers as well as the determinant and nondeterminant factors identified for the GTMNERR.

P. Action 3.3: Create a zoning map of the GTMNERR that supports the EUP developed for that area.

Results from the Estuarine Habitat Inventory and Analysis

Nine estuarine habitats: open water/water column, sand beaches, emergent aquatic vegetation, tidal flats, salt marsh, mangrove swamp, freshwater marsh, maritime forest, and hard bottom, were identified that represent the majority of estuarine habitats within the GTMNERR (Table 4-2). These habitats were selected from existing estuarine and coastal habitat programs and geographical data availability.

Table 4-2. Acreage of identified estuarine habitats in the GTMNERR and surrounding areas

<table>
<thead>
<tr>
<th>Estuarine Habitats</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand beaches</td>
<td>4.7925</td>
</tr>
<tr>
<td>Mangrove swamp</td>
<td>1.0357</td>
</tr>
<tr>
<td>Emergent aquatic vegetation</td>
<td>0.0465</td>
</tr>
<tr>
<td>Maritime forest</td>
<td>0.3452</td>
</tr>
<tr>
<td>Hard bottom</td>
<td>28.583</td>
</tr>
<tr>
<td>Open water</td>
<td>85.359</td>
</tr>
<tr>
<td>Tidal flats</td>
<td>1.312</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>22.702</td>
</tr>
<tr>
<td>Freshwater marsh</td>
<td>2.5538</td>
</tr>
</tbody>
</table>

Results from the estuarine habitat valuation workshop established priority rankings for each habitat with respect to use group (habitat use rankings). A transformation was performed, resulting in the conversion of the raw rankings, with ranges between 0.0 to

89 Shell bottom, also known as oyster bars, and submerged aquatic vegetation, or seagrasses, have been used in other habitat protection programs, but no geographical data currently exists for these habitats in the GTMNERR.

90 See the North Carolina Habitat Protection Program, available at www.ncfisheries.net

91 Rescaled Value = (((mapValue – 1) * ((9-1)/(maxValue − 1)))) + 1
1.0, to the final ranks, with ranges between 0.0 and 9.0, thereby making the converted ranks comparable to the values in the human use density surfaces (Table 4-3 through 4-6).

Table 4-3. Raw and final rankings for the suitability of motorized use in estuarine habitats

<table>
<thead>
<tr>
<th>Estuarine habitats</th>
<th>Biologist’s raw rankings</th>
<th>Final ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand beaches</td>
<td>0.182</td>
<td>4.56</td>
</tr>
<tr>
<td>Mangrove swamp</td>
<td>0.047</td>
<td>1.13</td>
</tr>
<tr>
<td>Emergent aquatic vegetation</td>
<td>0.042</td>
<td>1.00</td>
</tr>
<tr>
<td>Maritime forest</td>
<td>0.114</td>
<td>2.82</td>
</tr>
<tr>
<td>Hard bottom</td>
<td>0.152</td>
<td>3.94</td>
</tr>
<tr>
<td>Open water</td>
<td>0.341</td>
<td>9.00</td>
</tr>
<tr>
<td>Tidal flats</td>
<td>0.045</td>
<td>1.08</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>0.044</td>
<td>1.05</td>
</tr>
<tr>
<td>Freshwater marsh</td>
<td>0.046</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Table 4-4. Raw and final rankings for the suitability of nonmotorized use in estuarine habitats

<table>
<thead>
<tr>
<th>Estuarine habitats</th>
<th>Biologist’s raw rankings</th>
<th>Final ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand beaches</td>
<td>0.169</td>
<td>7.11</td>
</tr>
<tr>
<td>Mangrove swamp</td>
<td>0.089</td>
<td>2.54</td>
</tr>
<tr>
<td>Emergent aquatic vegetation</td>
<td>0.062</td>
<td>1.00</td>
</tr>
<tr>
<td>Maritime forest</td>
<td>0.115</td>
<td>4.03</td>
</tr>
<tr>
<td>Hard bottom</td>
<td>0.110</td>
<td>3.74</td>
</tr>
<tr>
<td>Open water</td>
<td>0.202</td>
<td>9.00</td>
</tr>
<tr>
<td>Tidal flats</td>
<td>0.086</td>
<td>2.37</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>0.084</td>
<td>2.26</td>
</tr>
<tr>
<td>Freshwater marsh</td>
<td>0.083</td>
<td>2.20</td>
</tr>
</tbody>
</table>

Table 4-5. Raw and final rankings for the suitability of extractive use in estuarine habitats

<table>
<thead>
<tr>
<th>Estuarine habitats</th>
<th>Biologist’s raw rankings</th>
<th>Final ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand beaches</td>
<td>0.125</td>
<td>3.74</td>
</tr>
<tr>
<td>Mangrove swamp</td>
<td>0.096</td>
<td>1.53</td>
</tr>
<tr>
<td>Emergent aquatic vegetation</td>
<td>0.089</td>
<td>1.00</td>
</tr>
<tr>
<td>Maritime forest</td>
<td>0.115</td>
<td>2.98</td>
</tr>
<tr>
<td>Hard bottom</td>
<td>0.106</td>
<td>2.30</td>
</tr>
<tr>
<td>Open water</td>
<td>0.194</td>
<td>9.00</td>
</tr>
<tr>
<td>Tidal flats</td>
<td>0.094</td>
<td>1.38</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>0.092</td>
<td>1.23</td>
</tr>
<tr>
<td>Freshwater marsh</td>
<td>0.089</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 4-6. Raw and final rankings for the suitability of passive use in estuarine habitats

<table>
<thead>
<tr>
<th>Estuarine habitats</th>
<th>Biologist’s raw rankings</th>
<th>Final ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand beaches</td>
<td>0.139</td>
<td>5.37</td>
</tr>
<tr>
<td>Mangrove swamp</td>
<td>0.098</td>
<td>1.56</td>
</tr>
<tr>
<td>Emergent aquatic vegetation</td>
<td>0.092</td>
<td>1.00</td>
</tr>
<tr>
<td>Maritime forest</td>
<td>0.103</td>
<td>2.02</td>
</tr>
<tr>
<td>Hard bottom</td>
<td>0.103</td>
<td>2.02</td>
</tr>
</tbody>
</table>
Table 4-6. Continued

<table>
<thead>
<tr>
<th>Estuarine habitats</th>
<th>Biologist’s raw rankings</th>
<th>Final ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open water</td>
<td>0.178</td>
<td>9.00</td>
</tr>
<tr>
<td>Tidal flats</td>
<td>0.096</td>
<td>1.37</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>0.096</td>
<td>1.37</td>
</tr>
<tr>
<td>Freshwater marsh</td>
<td>0.094</td>
<td>1.19</td>
</tr>
</tbody>
</table>

For all use categories, experts found open water and sand beaches to be the most suitable for human use. Experts ranked swamps, marshes, and tidal flats as least suitable for estuarine human use. The final rankings of estuarine habitats resulted in four maps reflecting the ideal estuarine use maps based on scientific opinion (Figures 4-1 through 4-4). These habitat suitability surfaces were used with the results from the human use surveys to analyze potential areas of conflict between human use and estuarine resources.

**Results from the Human Use Surveys in the GTMNERR**

This section includes results from the human use surveys, including the human use inventories and the GIS use density analysis. The GIS analysis is a snapshot of activities occurring in the GTMNERR and surrounding areas. This analysis is not intended to predict future behavior, but rather, to aid in planning initiatives for this estuarine area.

**Human Use Inventories**

The human use surveys were conducted during the spring and summer, 2003. The human use inventory results reflect the uses recorded for each survey (n=60). The most common uses of the GTMNERR were fishing from a boat (recreational) and power boating (Table 4-7). Not all estuarine uses were captured in the survey results; however, these uses do sometimes occur in the GTMNERR. Horseback riding and commercial shrimping, for example, have been personally observed within the boundaries of the GTMNERR.
The geographical data collected by the surveys were analyzed using GIS and recorded 127 travel routes, 175 activity points, and 63 origin points (Figure 4-5 and 4-6). Travel routes are the travel paths captured by the human use survey maps, including both aquatic travel routes and terrestrial travel routes. Activity points are places where respondents marked they engaged in one or more of the listed activities on the survey. Origin points represent places in the GTMNERR where people noted the beginning of their recreation, a starting point for whatever activity they engaged in. These data showed a large spatial distribution throughout the study area, but many of the travel routes followed established recreational corridors (e.g. the intercoastal waterway and the beaches along the Atlantic Ocean).

<table>
<thead>
<tr>
<th>Use Category</th>
<th>Water Based Activities</th>
<th>Surveyed Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorized and extractive</td>
<td>Fishing from boat (recreational)</td>
<td>45</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Fishing from boat (commercial)</td>
<td>1</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Crabbing (recreational)</td>
<td>1</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Crabbing (commercial)</td>
<td>0</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Clamming (recreational)</td>
<td>0</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Clamming (commercial)</td>
<td>0</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Shrimping (recreational)</td>
<td>0</td>
</tr>
<tr>
<td>Motorized and extractive</td>
<td>Shrimping (commercial)</td>
<td>0</td>
</tr>
<tr>
<td>Motorized</td>
<td>Overnight anchorage</td>
<td>1</td>
</tr>
<tr>
<td>Motorized</td>
<td>Water skiing</td>
<td>5</td>
</tr>
<tr>
<td>Motorized</td>
<td>Parasailing</td>
<td>1</td>
</tr>
<tr>
<td>Motorized</td>
<td>Personal watercraft use</td>
<td>6</td>
</tr>
<tr>
<td>Motorized</td>
<td>Scuba diving</td>
<td>1</td>
</tr>
<tr>
<td>Motorized</td>
<td>Power boating</td>
<td>41</td>
</tr>
<tr>
<td>Nonmotorized and extractive</td>
<td>Oyster harvest (recreational)</td>
<td>2</td>
</tr>
<tr>
<td>Nonmotorized and extractive</td>
<td>Oyster harvest (commercial)</td>
<td>0</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Canoeing or kayaking</td>
<td>18</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Sailing</td>
<td>7</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Swimming</td>
<td>12</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Sail boarding</td>
<td>0</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Surfing</td>
<td>1</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Wind surfing</td>
<td>1</td>
</tr>
<tr>
<td>Use Category</td>
<td>Land Based Activities</td>
<td>Surveyed Response</td>
</tr>
<tr>
<td>Motorized</td>
<td>Beach driving</td>
<td>2</td>
</tr>
<tr>
<td>Motorized</td>
<td>Off-road vehicles</td>
<td>2</td>
</tr>
<tr>
<td>Motorized or Nonmotorized</td>
<td>Camping</td>
<td>2</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Sunbathing</td>
<td>8</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Hiking</td>
<td>20</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Biking</td>
<td>8</td>
</tr>
<tr>
<td>Use Category</td>
<td>Land Based Activities</td>
<td>Surveyed Response</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Picnicking</td>
<td>7</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Bird watching</td>
<td>11</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Horseback riding</td>
<td>0</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Hang-gliding/Ultralites</td>
<td>0</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Jogging</td>
<td>4</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Photography</td>
<td>10</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Nature study</td>
<td>8</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Visiting historic sites</td>
<td>5</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Socializing</td>
<td>6</td>
</tr>
<tr>
<td>Nonmotorized and passive</td>
<td>Sight seeing</td>
<td>5</td>
</tr>
<tr>
<td>Extractive</td>
<td>Hunting</td>
<td>3</td>
</tr>
<tr>
<td>Extractive</td>
<td>Fishing from bridge, pier, dock or shore</td>
<td>14</td>
</tr>
</tbody>
</table>

**Human Use Density Analysis**

The density surfaces created using GIS represent intensity of uses based on geographic location. These density surfaces indicate areas of high, moderate, and low within the GTMNERR (Figure 4-7). As discussed in Chapter 3, the uses were grouped into categories (motorized use, nonmotorized use, extractive use and passive use) that reflect their impact on the environment (Table 3-1). Research has shown that grouping individual uses into functional categories, aids in data processing, and allows for easier explanation to the general population (Murphy and Brooks 2000). When the surveyed and mapped uses were broken down into the four categories, geographic variations in uses were evident (Figure 4-8 through 4-11). For example, areas of high motorized use (Figure 4-8) appeared in and around the St. Augustine inlet, the only inlet in St. Johns County leading to the Atlantic Ocean that is accessible by larger boats. Nonmotorized use densities reflected areas of public access to beaches, state parks, water management district lands, and state gardens (Figure 4-9).

**Estuarine Habitat and Use Conflict Analysis**

The habitat use rankings were used in conjunction with the use density surfaces to analyze potential conflicts between users and resources throughout the GTMNERR and
surrounding areas. The combination of the habitat suitability surfaces with the human use density surfaces resulted in four maps highlighting the over-utilized and under-utilized areas in the GTMNERR (Figures 4-12 through 4-15). This analysis represents an estuarine user versus estuarine resources analysis and not a user versus user analysis.

The maps reflect a range of numbers (-8 to +7) that are the result of subtracting the biologists’ ideal use surfaces from the estuary use density surfaces. Each map shows the resulting conflict surface based on the four use categories (motorized, nonmotorized, extractive and passive). The negative numbers represent the areas where biologists indicated suitable habitats for estuarine use, but estuary users are not currently using these areas at high densities. These numbers can be broken down further, where -8 to -5 is considered a nonconflicting use pattern and -4 to -1 is considered a low conflicting use pattern. The positive numbers represent areas where the biologists indicated habitat was unsuitable for estuarine human use, but estuarine use occurs. A range of +1 to +4 is a moderately conflicting use pattern and +5 to +7 is a high conflicting use pattern. A score of 0 on the conflict map indicates a balanced use pattern, where estuary users are using the GTMNERR at a level biologists find sustainable. This analysis was used along with other data to determine estuary use zones for the GTMNERR.

**Establishing Determinant and Nondeterminant Factors for Estuary Use Zones**

Since the human use surveys and the GIS analysis produced a snapshot of activities occurring in the GTMNERR and surrounding areas, it was important that the estuary use zones for the GTMNERR not be based solely on static data. Therefore, estuary use zones were identified based on the synthesis of determinant factors, nondeterminant factors (Nagy and Siderelis 1990), and the previously described geographical data analyses (Table 4-8). Determinant factors represent areas designated by legislative mandate
(Figure 4-16) and may already have established human use restrictions (Table 1-3). By evaluating estuarine use zones based on determinant factors, a more feasible zoning plan can be created based on existing policies or regulations that correspond with each designated area. Nondeterminant factors influence estuarine areas, but are not yet and may never be designated by law (Figures 4-17). These factors do not have human use restrictions that have been codified, however, they influence where estuary use zones should be placed within the GTMNERR. For example, an active recreation zone would encompass existing boat ramps and public access points, or a preservation zone would include bird rookeries and rare or sensitive estuarine habitats. By using the determinant and nondeterminant factors to derive estuarine use zone placement, an estuary use plan is developed that considers existing public policy and management feasibility.

<table>
<thead>
<tr>
<th>Determinant Factor Data Layers</th>
<th>Nondeterminant Factor Data Layers</th>
<th>Geographical Analysis Data Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outstanding Florida Waters (OFW)</td>
<td>Estuarine habitats</td>
<td>Estuarine use density surfaces</td>
</tr>
<tr>
<td>Waterways</td>
<td>Bird rookeries</td>
<td>Conflict surfaces</td>
</tr>
<tr>
<td>SJRWMD lands</td>
<td>Bathymetry</td>
<td>Ideal biological use surfaces</td>
</tr>
<tr>
<td>State parks</td>
<td>Boat ramps and marinas</td>
<td></td>
</tr>
<tr>
<td>Local parks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National monument</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State gardens</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Estuary Use Zones for the GTMNERR**

Four zoning categories for the GTMNERR EUP were created: preservation zones (Figures 4-18 and 4-19), conservation zones (Figures 4-20 and 4-21), active recreation zones (Figures 4-22 and 4-23), and conflict zones (Figures 4-24 and 4-25). Because

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92 All geographical data analysis was performed using the following use categories: motorized, nonmotorized, extractive and passive

93 This factor examines the developments of regional impact (DRIs) planned adjacent to the GTMNERR.
preservation of existing and future resources\textsuperscript{94} is the main goal of estuary planning, zones were created that correspond to the ideal estuary usage based on the opinions of the biologists surveyed (Table 4-9) to the degree possible given existing use patterns. These surfaces were created from the AHP technical meeting results (Figures 4-1 through 4-4).

Three of the EUP zones (Figures 4-26 and 4-27) were based on the existing use patterns within the estuary, and the determinant and nondeterminant factors. Each use density surface was divided into three numerical categories reflecting low, moderate, and active use. Low use was defined as 10 to 30 percent of the total uses, moderate use was 40 to 60 percent of uses, and active use was 70 to 100 percent of uses that occurred in a particular area of the GTMNERR.

<table>
<thead>
<tr>
<th>Table 4-9. The ideal zones for preservation of estuarine resources based on the surveyed responses of biologists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservation Zone</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>Conservation Zone</td>
</tr>
<tr>
<td>Active Recreation Zone</td>
</tr>
</tbody>
</table>

The fourth zone, the conflict zone (Figures 4-24, 4-25, and 4-28), occurs when the biologists’ ideal surfaces and the human use density surfaces overlap, thus creating a theoretical conflict of interest and activity, and/or when determinant or indeterminate factors indicate an existing or potential conflict. The conflict zone is the most dynamic of the four zones, acting as an overlay district, it suggests the need to add provisions or restrictions to the estuary use zone beneath it.

\textsuperscript{94} The potential for finding future resources and then preserving those resources is also part of this goal.
Policy Implications of the Estuary Use Zones for the GTMNERR

The four types of zones—preservation, conservation, active recreation, and conflict—have potential implications for local government polices and regional coastal management. Similar to the estuary management units used for Oregon’s estuaries, all estuary use zones, with the exception of conflict zones, have nested regulatory implications.

Preservation zones contain regions of ecologically significant habitats. These zones also have significantly lowered levels of coastal activity, and therefore have low conflict potential. Policies related to preservation zones would be designation of idle-speed/no wake areas, or no take areas, temporal closure of certain areas during wildlife nesting or spawning seasons, and prohibition of anchoring in sensitive areas.

Conservation zones are areas where moderate passive, nonmotorized uses occur, and motorized and extractive uses occur less frequently. Policies related to conservation areas would be restriction of boat ramp and marina sitings, recommendation that dredging not occur, prohibition of vessel discharge, and where appropriate, limitation of outdoor lighting that may affect sea turtle nesting areas. Activities that disturb or destroy estuarine habitats should also be prohibited in preservation and conservation areas.

Active recreation zones, the least restrictive of the all zones, provide sites for all reasonable estuary uses. Active recreation zones should be designated in areas where coastal infrastructure such as boat ramps, public access points, public beaches, and recreation areas exist, or will be constructed and where minimal ecological degradation will occur.

Conflict zones, identified as over-utilized areas or areas adjacent to developments of regional impact are similar to overlay districts in land-use zoning. Conflict zones are
not permanent and may change location as use patterns change. Monitoring conflict areas for both use and ecological impacts is important. Examination of specific conflicts is necessary to determine management policy for conflict zones. Specific user groups that are in conflict, or specific estuarine habitats that are being overutilized, for example, have important management implications. By examining the context of the conflict, a specific and targeted action plan can be developed. Conflict areas should have high priority for data collection and analyses.

My study identified the area around Pine Island (in the northern section of the GTMNERR) as a conflict zone (Figure 4-28). Bordered on the western side by Nocatee, a development of regional impact, this area is a popular fishing and boating spot. It is a high use area with ecologically significant habitats and urban development pressures in the form of increased urban runoff and additional users making it particularly susceptible to ecological degradation. This area should be identified as a priority for data collection, and a small-scale planning effort focused on preserving current use patterns and existing resources, should be initiated.

On the other hand, St. Augustine Inlet (which is outside the boundaries of the GTMNERR) is another area of conflict, not because it was identified as an area with high ecological value, but because of high use densities. This area should be targeted for a

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95 Nocatee has been a controversial development since its proposal in 1999. The mixed-use development comprises approximately 15,000 acres (2,200 acres in Duval County and 12,800 acres in St. Johns County) of upland and wetland communities. Over 25 years, the development plans to include about 35,000 residents, residential villages, a nature preserve, schools, and a town center with offices and retail stores. The development will include about 14,000 houses and apartments. The Sierra Club and St. Johns County resident Ellen Whitmer challenged approved amendments the county’s comprehensive plan, arguing that the new development would create urban sprawl. One such amendment was a land use designation, new town, which would apply to Nocatee. The new town designation allows an area to function as its own town, with houses, offices, schools, churches, stores, and parks (Sundin 2002, Woods 2002).
small-scale planning effort focused on sorting out the conflicting use patterns. It is important that an EUP identify conflict areas, either based on ecology or human use, so that managers of the area can monitor environmental quality and quantity of human use for specific planning endeavors. Advising local governments of conflict areas within their borders, gives them the option to propose regulatory solutions, such as restricting access to over utilized areas, or partner with coastal managers to begin small area plans like the ones proposed for Pine Island and the St. Augustine Inlet.
Figure 4-1. Final rankings of suitability of estuarine habitats for motorized use based on scientific opinion (using the Analytic Hierarchy Process).

Object 7. Larger image of Figure 4-1.
Figure 4-2. Final rankings of suitability of estuarine habitats for nonmotorized use based on scientific opinion (using the Analytic Hierarchy Process).

Object 8. Larger image of Figure 4-2.
Figure 4-3. Final rankings of suitability of estuarine habitats for extractive use based on scientific opinion (using the Analytic Hierarchy Process).

Object 9. Larger image of Figure 4-3.
Figure 4-4. Final rankings of suitability of estuarine habitats for passive use based on scientific opinion (using the Analytic Hierarchy Process).

Object 10. Larger image of Figure 4-4.
Figure 4-5. Surveyed travel routes (n= 127) for the GTMNERR and surrounding areas.

Object 11. Larger image of Figure 4-5.
Figure 4-6. Surveyed point data (n=238) for the GTMNERR and surrounding areas, these data include origin points, activity points and combination activity/origin points.

Object 12. Larger image of Figure 4-6.
Figure 4-7. Total use density for the GTMNERR and surrounding areas, broken down by percentage.

Object 13. Larger image of Figure 4-7.
Figure 4-8. Motorized use density for the GTMNERR and surrounding areas, broken down by percentage.

Object 14. Larger image of Figure 4-8.
Figure 4-9. Nonmotorized use density for the GTMNERR and surrounding areas, broken down by percentage

Object 15. Larger image of Figure 4-9.
Figure 4-10. Extractive use density for the GTMNERR and surrounding areas, broken down by percentage.
Figure 4-11. Passive use density for the GTMNERR and surrounding areas, broken down by percentage.

Object 17. Larger image of Figure 4-11.
Figure 4-12. Motorized use conflict surface for the GTMNERR and surrounding areas.

Object 18. Larger image of Figure 4-12.
Figure 4-13. Nonmotorized use conflict surface for the GTMNERR and surrounding areas.

Object 19. Larger image of Figure 4-13.
Figure 4-14. Extractive use conflict surface for the GTMNERR and surrounding areas.
Figure 4-15. Passive use conflict surface for the GTMNERR and surrounding areas.

Object 21. Larger image of Figure 4-15.
Figure 4-16. Determinant factors for the GTMNERR and surrounding areas, these data include, Outstanding Florida Waters, waterways, St. Johns River Water Management District lands, state parks, local parks, national monuments, and state gardens.
Figure 4-17. Nondeterminant factors for the GTMNERR and surrounding areas, these data include, estuarine habitats, bird rookeries, bathymetry, boat ramps, marinas, and land-use.

Object 23. Larger image of Figure 4-17.
Figure 4-18. Preservation zones for the northern section of the GTMNERR (note that the points included within the zones represent bird rookery point data incorporated into the zoning methodology).

Object 24. Larger image of Figure 4-18.
Figure 4-19. Preservation zones for the southern section of the GTMNERR (note that the points included within the zones represent bird rookery point data incorporated into the zoning methodology).

Object 25. Larger image of Figure 4-19.
Figure 4-20. Conservation zones for the northern section of the GTMNERR.

Object 26. Larger image of Figure 4-20.
Figure 4-21. Conservation zones for the southern section of the GTMNERR.

Object 27. Larger image of Figure 4-21.
Figure 4-22. Active recreation zones for the northern section of the GTMNERR.

Object 28. Larger image of Figure 4-22.
Figure 4-23. Active recreation zones for the southern section of the GTMNERR Object 29. Larger image of Figure 4-23.
Figure 4-24. Conflict zones for the northern section of the GTMNERR Object 30. Larger image of Figure 4-24.
Figure 4-25. Conflict zones for the southern section of the GTMNERR.

Object 31. Larger image of Figure 4-25.
Figure 4-26. All EUP zones for the northern section of the GTMNERR.

Object 32. Larger image of Figure 4-26.
Figure 4-27. All EUP zones for the southern section of the GTMNERR.

Object 33. Larger image of Figure 4-27.
Figure 4-28. Conflict zone present around Pine Island in the northern section of the GTMNERR.

Object 34. Larger image of Figure 4-28.
CHAPTER 5
DISCUSSION

This discussion section focuses on three major points. First, estuary planning and the Estuarine Use Plan (EUP) proposed for the GTMNERR are evaluated by determining whether 1) the importance of estuary use planning has been demonstrated, 2) the proposed plan has the potential to solve problems facing Florida’s coasts, and 3) such a process is achievable at the local level and/or state level. Second, the results are examined with respect to their contribution to the current body of knowledge of coastal, estuarine, and marine research. Finally, some additional and future research that furthers the concept of estuary planning is discussed.

The Importance of Estuary Use Planning

Eclipsed by issues such as homeland security, education and the job market, environmental issues are not currently on Florida’s political forefront. As Florida’s population continues to grow, however, pressure on coastal, estuarine, and marine resources will increase. The effects of population increase are broadly felt. For example, traveling Interstate 95 from Jacksonville to Orlando, one observes too many people in too many cars and an increase in the likelihood of slowed traffic and traffic accidents. The same is true for Florida’s waterways. As more people use estuarine areas for recreation, the more crowded and affected these areas become. Estuary use planning is an important tool to manage crowded waterways, to identify areas used by conflicting user groups, and to describe estuarine habitats considered ecologically unsuitable for human uses. Through this type of planning, estuarine areas that are ecologically rich, over-utilized by
humans and adjacent to burgeoning development can be identified, managed and protected.

**The GTMNERR Estuary Use Plan Analysis**

The results presented in my study indicate that estuary use planning is a unique and valuable method for not only identifying estuarine resources for protection, but also enhancing recreational opportunities. Because humankind is dependent on the natural environment, estuarine use planning applies a central tenant from Grumbine’s (1994) definition of ecosystem management: accommodating human use and occupancy into the planning process. My research has shown that by understanding the ecology of an estuary and determining the geographical footprint of human uses, a simple and effective water-use plan can be created.

The EUP proposed for the GTMNERR reflects the comprehensive planning process used in local government planning, and was created through inventory, analysis, and synthesis of existing and collected data. The final EUP for the GTMNERR proposes four zoning categories — preservation, conservation, active recreation and conflict zones — simple in definition, but based on solid science and public input. The preservation zone can be used to protect sensitive and significant estuarine resources in areas that are not frequently used. The conservation zone can be used to manage significant estuarine resources in areas that are used moderately. Active recreation zones delineate areas of moderate to high use in areas of low to moderate ecological significance. The presence of a conflict zone informs estuarine managers and local governments that there is significant potential for conflicts in the area, either user versus user, or user versus resource. Once described, government authorities responsible for the GTMNERR can
implement policies appropriate to these zones, and management entities can prescribe ways to educate users and enforce zones regulations.

**Local Level Estuary Use Planning**

If estuary protection is a priority, then estuary use planning is feasible. Local and state governments are enabled by the SZEA to zone lands for the public good. The SZEA is a “model law” and its language can be changed to reflect an inclusion of state and local waters. Some would argue that coastal elements of comprehensive plans are sufficient for planning for estuarine areas, but they are not. Many coastal elements are merely extensions of conservation elements, and do not address the issues specific to estuarine areas such as carrying capacity, significant coastal and estuarine resources and submerged areas in conflict with exiting and future land-use patterns. Estuary planning goes beyond both the coastal and conservation elements of most local governments’ comprehensive plans by addressing these issues.

Similar to what was suggested in Carteret County, North Carolina (Clark 1990) the comprehensive planning process should extend to the waterways and submerged resources of each county. Local governments could choose to include estuary use planning into the comprehensive planning process, or estuary use planning could stand alone; however, a stand-alone estuary use plan would be difficult to implement at the local level. Difficulties arise in funding an additional layer of government. Included as part of the comprehensive planning process, however, estuary use planning would not add that additional layer and could extend from the future land-use element thereby creating a vision for the estuary
State Level Estuary Use Planning

A stand-alone estuary use plan at the state level would be easier to implement than one at the local level. Taking a cue from the federal government, the state could create an Office of Ocean Policy and make estuary use planning part of the Office’s mission. Implementing estuary use planning at the state level, as it is in Oregon, would give Florida a blueprint for coastline planning.

Part of the state level planning initiative would be to create an overlay district for the entire coastline. This district would contain the proposed EUP zoning categories and would add a range of allowed and restricted uses within Florida’s state waters, but would not supersede the authority and function of existing designations. Existing designations such as Florida Keys National Marine Sanctuary, state aquatic preserves, the various National Estuary Programs and the three National Estuarine Research Reserves would keep any existing management provided it does not interfere with established goals of the state plan.

A state level planning initiative would also allow for under funded county governments to plan for their estuaries. Money is provided to local governments for schools, public transportation, and other planning initiatives, all in the public interest. An estuary planning program is also in the public’s interest. Florida could borrow the idea of an environmental management charge from Australia’s Great Barrier Reef Marine Park Authority. This charge has been in effect since 1993 and targets companies that make their living off the Great Barrier Reef. Most commercial operations in the park are subject to the charge, including tourist operations, mariculture, commonwealth-island
resorts, and land-based marine sewage outfalls.¹ The Great Barrier Reef Marine Park Authority uses all funds raised by the environmental management charge for research, education, and park management.

In Florida, an environmental management charge could be incorporated into the price of fishing licenses, which all anglers must buy in order to fish in Florida. The fee could be collected at boat ramps using boxes similar to those used in State Parks. According to Florida’s fishing license statistics collected in 2001, there are 3,104,000 registered anglers in the state of Florida.² If an environmental management charge of $4.50 (the amount used in Australia) were added to the license price, the state would gross almost $14 million dollars. The environmental management charge would also apply to tourism operators, such as dolphin and manatee watch boats and other day cruise operations. The money collected through the environmental management charge could go towards funding the Office of Ocean Policy, and many of its programs, including estuary planning for both large and small estuaries. Other programs funded through this state agency could be coastal, estuarine, and marine environmental education for all ages, enforcement (e.g. signage and coastal patrol officers), and research.

Adding to the Current Body of Knowledge in Coastal Research

Current coastal and marine research is starting to explore the concept of zoning surface waters. The research presented in my study is a first attempt at zoning and planning for estuarine waters that fall under many jurisdictions. The results apply zones similar to land-use zones to estuarine waters, and create a template for estuary use plans.

¹See generally the GBRMPA Environmental Management Charge website <http://www.gbrmpa.gov.au/corp_site/permits/emc.html>

²See the Florida Fish and Wildlife Conservation Commissions website on fishing statistics <http://fishingcapital.com/research.htm>
My study, furthermore, defines a methodology for estuary planning which can be applied to other coastal and estuarine areas. With the exceptions of the Great Barrier Reef Marine Park Authority and the Florida Keys National Marine Sanctuary, there is limited application of zoning to marine waters, and no existing application to inland or estuarine waters.

The most significant contribution of my research is the estuary use planning methodology. This methodology is important because it gathers current data about estuarine human use and analyzes it based on the ecology of the area. In addition, the EUP methodology incorporates scientific opinion using the Analytic Hierarchy Process, and suitability surfaces using GIS into the final estuary zoning analysis, resulting in estuary use zones based on factors such as land use, coastal infrastructure, and sensitive estuarine resources.

The significance of estuary use planning lies in not only the methodology, but also the transferability of that methodology to other estuarine and marine areas. Estuary use planning would support NOAA’s efforts to implement Executive Order 13158, requiring the federal government to "significantly strengthen and expand a national system of MPAs." Applying estuary use planning methods to marine areas, can establish a standard process for MPA planning. In addition, the model zoning categories defined in my study could be applied to MPAs thus simplifying the dissemination of information to the public, lawmakers, and natural resource managers. Creating a standard on which all estuarine and marine plans are based allows research efforts and funds to be focused on other aspects of the marine environment. Estuary use planning could be a component of
MPA management and would support coastal and marine planning endeavors at all levels of government.

**Continued Research**

There is great potential for continued research in estuary use planning. The research presented in my study could be extended to create a detailed estuary plan for smaller areas in the GTMNERR, such as Pine Island, or the Saint Augustine Inlet. Small area plans would allow specific place-based questions to be answered. Pine Island, for example, is a popular fishing and boating area, and it is adjacent to the Nocatee development. A small area EUP for Pine Island could examine the impact of anglers by collecting catch and human use data. Extensive inventories for this area could be included in the Pine Island EUP, including detailed habitat descriptions, and direct and indirect impacts of the Nocatee development. The EUP could also include a strategy for monitoring and quantifying impacts.

Another potential for future research is the drafting of policies and regulatory language that could be used by local governments in estuary use planning. Local governments that intend to adopt an estuary use planning strategy would benefit from access to examples of language used for establishing and enforcing specific estuary use zones. The policy and regulatory examples could then be tailored to meet the needs and concerns of each particular local government or community.

Additional research is needed on the habitat analysis methods and analytical hierarchy process. In the research for my study, nine estuarine habitats in the GTMNERR were evaluated as part of the habitat analysis. If the ecological ideal continues to be used as the base map for zoning classes, all habitats that occur within the study area should be evaluated. Thus, a large swath of unanalyzed area in the northern
section of the GTMNERR, which was not included in the original analysis because it was not considered estuarine habitat, should be included in the habitat suitability analysis.

This area, classified as hardwood hammock, mixed hardwood pine, and pineland habitats, occur within the GTMNERR and could be considered as a significant ecological resource. Expanding the number of experts evaluating habitat suitability is also important to improving the habitat suitability analysis. Fifteen estuarine biologists and ecologists were invited to the workshop held at the GTMNERR; however, only six attended the meeting. In order to gain more insight into this area, additional scientific opinion is necessary.

Another avenue for research exists in examining human use conflicts occurring in coastal, estuarine, and marine areas. Such conflicts are becoming an issue in Florida. For example, an environmental assessment of personal watercraft (PWC) use published in March 2004, by the Gulf Islands National Seashore located in Florida’s panhandle provides one example. The study was prompted by pressure from the PWC industry after PWCs were banned from the park The assessment documented the effects of PWC use on the park’s natural areas, and conflicts between PWC use and more passive uses of the park (NPS and GUIS 2004). The resolution proposed by the assessment was to create zones of PWC use, and the document is currently in the public comment stage. The PWC issue in the Gulf Islands National Seashore is an appropriate scenario for estuary planning since Perdido Bay, Pensacola Bay, Escambia Bay and East Bay all comprise the study area.

Conclusion

The results of my study have shown that estuary use planning is necessary and feasible for Florida’s estuaries and adjacent coastal areas. The methods used in my study
result in a planning approach that creates a vision for coastal waters and submerged resources. Conducting my study in the GTMNERR, an area with many jurisdictional boundaries, demonstrates the feasibility of creating an estuary use plan. As people continue to seek out coastal areas for new housing developments, and recreational and commercial pursuits, these areas will degrade. It is important and necessary that local and state governments and authorities rise to meet this challenge by developing management plans for coastal, estuarine, and marine resources.

In 1926, the Department of Commerce published a standard State Zoning Enabling Act which allowed municipalities to adopt zoning regulations. Land-use zoning is carried out under the police power and is well within the powers granted to the legislature by the Florida constitution. It is time to change the definition of zoning, almost eighty years after the Act’s codification, to include estuaries and their surrounding coastal and marine areas. The research in my study begins the debate to facilitate this change, demonstrating that estuary use planning is necessary for the health of the nation’s coastal areas.
Thank you for taking the time to complete this survey, only a sample of the users of the Reserve will be surveyed so your input is very important. The purpose of this survey is to inventory and record existing uses of the estuary, and plan for future uses. Your responses are completely anonymous, confidential and the findings will never discuss individual responses. Your responses are very important for helping the GTMNERR meet future management needs.

Use Inventory

Please indicate which of these activities you or your group participate in, here in the GTMNERR and surrounding areas.

<table>
<thead>
<tr>
<th>Water-Based Activities</th>
<th>Land-Based Activities</th>
<th>Other Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Power boating (PB)</td>
<td>☐ Sunbathing (SU)</td>
<td>☐ Photography (PH)</td>
</tr>
<tr>
<td>☐ Fishing from boat—recreational (FBR)</td>
<td>☐ Shore/Bridge fishing (FI)</td>
<td>☐ Nature study (NS)</td>
</tr>
<tr>
<td>☐ Fishing from boat—commercial (FBC)</td>
<td>☐ Camping (CA)</td>
<td>☐ Sightseeing (SS)</td>
</tr>
<tr>
<td>☐ Overnight anchorage (OA)</td>
<td>☐ Hiking/Walking (HI)</td>
<td>☐ Hunting (HT)</td>
</tr>
<tr>
<td>☐ Waterskiing (WK)</td>
<td>☐ Biking (BI)</td>
<td>☐ Visiting historic (VH)</td>
</tr>
<tr>
<td>☐ Parasailing (PS)</td>
<td>☐ Picnicking (PI)</td>
<td>☐ Socializing (SO)</td>
</tr>
<tr>
<td>☐ Canoeing/Kayaking (CK)</td>
<td>☐ Bird watching (BW)</td>
<td></td>
</tr>
<tr>
<td>☐ Sailing (SA)</td>
<td>☐ Off-road vehicles (OR)</td>
<td></td>
</tr>
<tr>
<td>☐ Jet skiing (JS)</td>
<td>☐ Beach driving (BD)</td>
<td></td>
</tr>
<tr>
<td>☐ Board sailing (SB)</td>
<td>☐ Hang-gliding/Ultralites (HA)</td>
<td></td>
</tr>
<tr>
<td>☐ Surfing (SU)</td>
<td>☐ Other (OT)</td>
<td></td>
</tr>
<tr>
<td>☐ SCUBA or snorkeling (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Windsurfing (WS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Crabbing—recreational (CBR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Crabbing—commercial (CBC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Clamming—recreational (CLR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Clamming—commercial (CLC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Shrimping—recreational (SR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Shrimping—commercial (SC)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
User Profile

Which of these activities is your primary activity?

Which of these activities is your secondary activity?

In which season do you participate in these activities?  (Please circle all that apply)

Winter (December – February)    Spring (March – May)
Summer (June – August)          Fall (September – November)

How often do you visit the GTMNERR?

Use Mapping

Please indicate with an X (on the maps provided) your point of entry or origin in the GTMNERR. Using the initials of the activity list, please indicate where in the GTMNERR you engage in these activities. For activities that include travel (i.e. boating, hiking, biking), please indicate (as accurately as you can) the travel route on the map, and where you started and finished.
LIST OF REFERENCES


Cox, J. (1994) *Closing the gaps in Florida's wildlife habitat conservation system: recommendations to meet minimum conservation goals for declining wildlife species and rare plant and animal communities*. Office of Environmental Services, Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.


BIOGRAPHICAL SKETCH

Ashley Murphy Johnson graduated from the University of Florida in 1997 with a Bachelor of Science degree in forest resource conservation, with a concentration in natural resource management. In the fall of that year, she was accepted into the Master of Arts program in the Urban and Regional Planning Department. After completing an internship with the Florida Marine Research Institute in the summer of 1998, Ashley began researching the concept of marine planning and zoning. In 1999, she successfully defended her master’s thesis on Florida Blueways, an integrated marine-management concept.

Wanting to further the concept of marine planning, Ashley applied for and won a Graduate Research Fellowship through the National Oceanic and Atmospheric Administration’s National Estuarine Research Reserve program. Ashley entered the doctoral program in the School of Natural Resources and the Environment at the University of Florida, in the fall of 1999, as a NOAA graduate research fellow. The 3-year fellowship allowed her to apply her background in environmental science and planning policy to the Guana Tolomato Matanzas National Estuarine Research Reserve. Ashley lives with her husband, son, and puppy, in Jacksonville, Florida.