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FLORIDA LOCAL GOVERNMENT CONSERVATION PLANNING:
VARIABILITY, DRIVERS, AND POLICY IMPLICATIONS

by

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ABSTRACT

This study examined the quality of Florida county government conservation planning. To assess conservation planning quality, a theoretical model of conservation planning as prescribed by the conservation science literature was first developed. A plan evaluation coding protocol was applied to local comprehensive plan Conservation Elements to determine the extent to which county-level conservation planning met the theoretical model. A high degree of variability in conservation planning quality was found. Highest quality conservation planning occurred in the Gulf coast counties of southwest Florida. Lowest conservation planning quality occurred in the Florida Panhandle counties. The quality of conservation planning of coastal counties was significantly higher than that of inland counties. Significant regional differences were also found, where conservation planning quality in South Florida counties was significantly higher than conservation planning quality in Panhandle counties. Geographic differences in conservation planning quality were likely attributable to significant differences in socioeconomic variables among counties, including differences in education, wealth, and urbanization. Multiple regression analysis using an information theoretic approach was employed to develop a predictive model of conservation planning quality of Florida local governments. The two most plausible predictors in the model were education level of the public and total resources. Local and global spatial autocorrelation analysis were next applied to county conservation planning scores to investigate spatial patterns of conservation planning quality, which were found to be related to the policy process of diffusion. Lastly, current local government conservation planning policy was analyzed for effectiveness and policy recommendations were made. Improving the

effectiveness of local conservation planning will require changes in statutory provisions of the state Florida Forever and Growth Management statutes. It will also require a greater commitment on the part of the state of Florida to protect the state's biological resources over the long term.

ACKNOWLEDGMENTS

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<u>Introduction</u>

The traditional strategy for protecting biodiversity is to designate undeveloped land or

waters as nature preserves or conservation lands (Margules & Pressey 2000; Ervin 2003a;

Hockings 2003; Svancara et al. 2005; Mora & Sale 2011).The process of selecting and

designing those areas, as well as managing them, is conservation planning (Margules & Pressey

2000). The goals of conservation planning are to preserve all living things, the ecological and

evolutionary processes that generate biodiversity, and also contain threats to long-term

biodiversity persistence (Noss 1994; Margules & Pressey 2000; Gutzwiller 2002; Lambeck &

Hobbs 2002; Klein et al. 2009).Critical for the protection of species, natural systems, and

ecological heterogeneity, conservation lands today also provide refuge for wild populations

increasingly subject to human disturbances (Hockings 2003; Rodrigues et al. 2004; Joppa et al.

2009; Stokes et al. 2010; Mora & Sale 2011).

Despite conservation planning efforts, biodiversity continues to decline, in both terrestrial

and aquatic environments across the Earth, largely because of global land transformation (Noss

& Murphy 1995; Vitousek et al. 1997). In the United States, the main driver of land

transformation is urbanization, particularly housing developments (Theobald et al. 2000;

McKinney 2002; Brown & Laband 2006; Milder 2007; Radeloff et al. 2010; Stokes et al. 2010;

Ramalho & Hobbs 2012). From 1992-1997, urban lands in the United States increased nationally

by 34%, and in the next 25 years, the amount of developed land in the United States is projected to increase in area by 79%, an area of 18 million hectares (Miller et al. 2009).

Urban development in the United States is governed by local governments (Theobald et al. 2000; Miller & Hobbs 2002; Brody et al. 2004; Miller et al. 2009; Tang et al. 2009; Radeloff et al. 2010; Stokes et al. 2010). In the United States, there is no national land-use or conservation policy (Bengston et al. 2004; Baldwin & Trombulak 2007). Though some federal lands are held and managed for preservation of natural resources, most are managed for commodity production, such as mining, grazing, and silviculture (Meretsky et al. 2006; Lerner et al. 2007). The federal government does, however, provide incentives for biodiversity protection through federal grants for state and local conservation lands acquisition (Mullins et al. 2008). The federal government plays almost no role in growth management and open space protection, though (Bengston et al. 2004). State governments may play a role in regulating local government land use policies, though states vary considerably in their growth management regulatory frameworks. Roughly only a quarter of U.S. states (12 of 50 or 24%) have growth management laws that require local governments and regions to manage development and protect biodiversity through local land-use planning (Cort 1996; Bengston et al. 2004; Miller et al. 2009). The majority of states have no such laws. Most land-use decisions affecting development and biodiversity protection are local in scale (Stokes et al. 2010).

Regulation of growth and development is normally relegated to the level of local government because of the long tradition in the United States of local land-use decision-making and private property rights (Bengston et al. 2004). Local governments create land-use regulations that govern privately-owned lands, which are home to most of the nation's biodiversity (Cort

1996; Doremus 2003). Because of this, county commissioners, city councils, town boards, and local planning staff make decisions that have significant collective implications for native species and communities (Brody 2003b).

There is often an uncomfortable spatial mismatch, however, between the local scale of land-use planning and the scale of natural systems (Carruthers 2002; Berke 2007; Moilanen & Arponen 2011). In many cases, local decision-makers do not consider biodiversity conservation relevant to local land use decision-making (Miller & Hobbs 2002; Miller et al. 2009; Stokes et al. 2010). Accordingly, local land-use planners do not routinely incorporate biodiversity data and conservation goals into local land-use plans (Cort 1996; Miller et al. 2009; Stokes et al. 2010). This lack of attention to biodiversity conservation, combined with pressure on local decision-makers to increase property tax revenues and accommodate growth, results in on-going urban and suburban development and the concordant habitat loss, habitat fragmentation, and urban runoff that causes biodiversity decline (Doremus 2003). Local land use decisions on small scales can then result in a collection of activities that have substantial adverse impacts on the long-term persistence of biodiversity across the larger landscape (Theobald et al. 2000; Brody et al. 2003; Berke 2007; Kartez & Casto 2008; Miller et al. 2009; Moilanen & Arponen 2011). And often times planning to protect biodiversity occurs as a reactionary measure only after biodiversity has been degraded or lost entirely (Cort 1996; Brody 2003a; Kline 2006; Berke 2007).

The spatial discord of local land-use decision-making and conservation planning is often exacerbated by inadequate biodiversity conservation legislation and a problematic disconnect between policy makers and conservation scientists (Lambeck & Hobbs 2002; Hockings 2003; Svancara et al. 2005; Knight et al. 2008; Holt et al. 2011). Conservation planning goals are often

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policy-driven instead of scientifically based, resulting in conservation targets that are much

lower than those required to maintain biotic integrity or are otherwise inappropriate (Hockings

2003; Svancara et al. 2005; Tear et al. 2005; Kartez & Casto 2008; Cook et al. 2011; Noss et al.

2012). Policy-based conservation targets are also often disconnected from the inherent

complexity and details of conservation planning and management. They often fail to address

conservation of the various levels of biodiversity (genes, species, communities, ecosystems), the

varying levels and types of management required to protect different biodiversity features, or the

issue of how to protect evolutionary and ecological processes that sustain biodiversity (Svancara

et al. 2005).

A Case Study: Conservation Planning in the State of Florida

The state of Florida has been a leader among the United States in conservation planning

since the 1970s[1]. Driven by population growth pressures, the state of Florida has allocated more

resources toward the acquisition of conservation lands in the last 40 years than any other state

and even the United States government (Lerner et al. 2007). Today, Florida state-owned lands

amount to approximately 5.4 million acres, 15.6% of the state's land area[2] (Farr & Brock 2006;

Florida Natural Areas Inventory (FNAI) 2011). Conservation planning in Florida has occurred

via two mechanisms: protected areas legislation and growth management legislation. Protected

areas legislation enabled the state of Florida to purchase and manage conservation lands, as well

as provide matching grants for local governments to acquire conservation lands (Farr & Brock

---

[1] Major changes occurred in 2010 and 2011 to reverse this trend through state legislative initiatives to promote real
estate development and reduce state-owned conservation lands holdings.
[2] The total area of state owned land in fee simple is 4,865,877 acres. An additional 560,792 acres is less than fee
simple ownership.

2006). Growth-management legislation required local governments to develop plans to manage future development so that natural resources of the state, including biodiversity, would be conserved.

<div align="center">Florida Protected Areas Legislation</div>

The earliest meaningful biodiversity protection laws in Florida were enacted in the 1970s. The Florida Environmental Land and Water Act of 1972 established protection for Areas of Critical State Concern, such as wildlife refuges and critical habitat for listed species, as well as regulatory requirements for large developments affecting more than one county, called Developments of Regional Impact (DRIs) (Schaefer et al. 2008). A second piece of protected areas legislation, the Land Conservation Act of 1972, was enacted to preserve Florida's natural resources, including native plant and animal habitat:

Land Conservation Act of 1972--

259.032, F.S.

(1) It is the policy of the state that the citizens of this state shall be assured public ownership of natural areas for purposes of maintaining the state's unique natural resources…

(3)(a) To conserve and protect environmentally unique and irreplaceable lands that contain native, relatively unaltered flora and fauna representing a natural area unique to, or scarce within, a region of the state or larger geographic area;

(c) To conserve and protect native species habitat or endangered or threatened species… and especially those areas that are special locations for breeding and reproduction;

(d) To conserve, protect, manage, or restore important ecosystems, landscapes, and forests, if the protection and conservation of such lands is necessary to enhance or protect significant…fish or wildlife resources…;[3]

Furthermore, special priority was to be given to the acquisition of lands where biodiversity was most threatened by human population growth:

259.032 Conservation and Recreation Lands Trust Fund; purpose.-

(1) … It is the further intent of the Legislature, with regard to the lands described in paragraph (3)(c), that a high priority be given to the acquisition, restoration, and management of such lands in or near counties exhibiting the greatest concentration of population and, with regard to the lands described in subsection (3), that a high priority be given to acquiring lands or rights or interests in lands that advance the goals and objectives of the Fish and Wildlife Conservation Commission's approved species or habitat recovery plans,…[4]

Since 1972, state land acquisition has been funded by the sale of bonds, mineral extraction taxes, and documentary stamp taxes on real estate transactions (Farr & Brock 2006). In 1990, to increase the state's ability to protect land due to increasing development pressure through the 1980s, funding for land acquisition was increased to $300 million[5] each year for ten years by the Preservation 2000 Act, and extended through 2010 by the Florida Forever Act of 1999, which also permitted funding to be used for land management (Tear et al. 2005). During the twenty years from 1990-2010, over two-thirds of the funds were distributed to different state agencies for conservation lands acquisition. The remaining 22% of the funds were distributed as

---

[3] Section 259.032 F.S.
[4] Section 259.032 F.S. This is the language in the 2013 version of the statute.
[5] In some years, total funding for land acquisition in Florida was around $500 million, including federal and county programs (R. Noss, personal communication).

grants to local governments and nonprofit groups to acquire land for conservation planning (Farr & Brock 2006).

Florida Growth Management Legislation

The second mechanism through which conservation lands have been designated in Florida is growth management legislation. The Florida State Comprehensive Planning Act was enacted in1972, which declared the state of Florida's interest in state and local planning, and required the development of a state comprehensive plan that would set forth the state's vision for future development so that growth would be managed in the public interest (Carruthers 2002; Carriker 2006). Three years later, the Local Government Comprehensive Planning Act of 1975 required local governments to adopt comprehensive growth management plans to manage development as well. Local comprehensive plans were required to set forth the county's long-term goals and policies that would govern future land use in the county (Theobald et al. 2000).

These earlier legislative growth management efforts were revised and strengthened by the State and Regional Planning Act of 1984 and the Local Government Comprehensive Planning and Land Development Act of 1985 (Florida's "Growth Management Act") (Carriker 2006). These laws required development of a new state comprehensive plan, as well as state agency, regional planning council, and local government comprehensive plans consistent with the state plan. The goal of these 1984 and 1985 pieces of legislation was to integrate growth management at all levels of government to increase the effectiveness of land-use planning and environmental management (Carriker 2006). The Florida Department of Community Affairs (DCA) was created to coordinate this integration of state, regional, and local growth planning after the 1984 and 1985 laws were enacted. Under the 1985 Growth Management Act, Florida local government

comprehensive plans were required to develop guidelines to manage existing and future development, promote public welfare, and protect environmental resources. Eight specific development-related elements were required to be included in each local plan, setting forth goals and implementation strategies for each element (Carriker 2006). Specified to address the conservation of natural resources, the Conservation Element must include local government biodiversity conservation goals:

> Local Government Comprehensive Planning and Land Development Act of 1985--
>
> *163.3177 Required and optional elements of comprehensive plan; studies and surveys.—*
>
> *(6) 2. The [conservation] element must contain principles, guidelines, and standards for conservation that provide long-term goals and which:*
>
> *b. Conserves, appropriately uses, and protects the quality and quantity of current and projected water sources and waters that flow into estuarine waters or oceanic waters and protect from activities and land uses known to affect adversely the quality and quantity of identified water sources*
>
> *d. Conserves…and protects…..native vegetative communities, including forests, from destruction by development activities.*
>
> *e. Conserves…and protects fisheries, wildlife, wildlife habitat, and marine habitat and restricts activities known to adversely affect the survival of endangered and threatened wildlife.*
>
> *g. Maintains cooperation with adjacent local governments to conserve…or protect unique vegetative communities located within more than one local jurisdiction.*
>
> *h. Designates environmentally sensitive lands for protection based on locally determined criteria which further the goals and objectives of the conservation element.*
>
> *j. Protects and conserves wetlands and the natural functions of wetlands[6]*

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[6] Section 163, F.S.

In 1986, DCA created Rule 9J in the Florida Administrative Code, which set forth procedural requirements by which local governments would submit their plans for state review, as well as substantive requirements for the content of local plans (Brody 2003a). To meet the requirements of the Conservation Element, and gain state approval under Rule 9J, local governments had to comply with a checklist of requirements from DCA for procedure, plan content, and for amending local plans. Local governments were required to designate environmentally sensitive areas, which the county would strive to protect in future land use plans. The county would also develop land use regulations, such as local ordinances, zoning regulations, and development orders, to minimize the effects of urbanization (Lubell et al. 2005).

Conservation Planning by Florida Local Governments

Both protected areas legislation and growth management legislation guide the conservation planning activities of Florida local governments. Many counties acquired conservation lands to capitalize on state matching funds under the Preservation 2000 and Florida Forever laws. Since 1972, local land acquisition programs have been developed in 29 of Florida's 67 counties and in nine municipalities--primarily in those bordering coastal areas (Trust for Public Land 2002; Farr & Brock 2006). These county land conservation efforts have been largely funded by voter-approved sales and/or property tax increases. The total lands owned by local governments in 2011 was 468,992 acres, 1.5% of the state of Florida[7] (Florida Natural Areas Inventory 2011b). Matching funds were awarded to local governments from the state of

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[7] The total number of acres of local-government-owned land in fee simple is 461,668 acres. An additional 7,324 acres is less than fee ownership.

Florida to purchase these lands based on the quality of the natural resources on the sites, and how well the acquisition contributed to the implementation of the local comprehensive plan provisions (Farr & Brock 2006). Further, as required by the local comprehensive plan Conservation Element, counties have developed land use regulations and future land-use plans to protect native plants and wildlife and their habitats. County-level conservation planning also involves coordination with other jurisdictions and restricting human activities that adversely affect nature, such as outdoor recreation, pollution, and hunting and fishing.[8]

Florida local government conservation planning is an important component of biodiversity conservation efforts. However, no studies have examined the effectiveness or quality of local government conservation planning for biodiversity. Studies have evaluated other aspects of local government environmental planning, however, and found considerable variation exists among local governments in the content and quality of environmental protection plans as well as in plan implementation. For example, Berke and Manta Conroy (2000) examined local comprehensive plans from ten states to determine how well the plans incorporated principles of sustainable development. The content of the local plans was found to vary considerably, as did the ways in which sustainable development principles were implemented (Berke & Manta Conroy 2000). Similarly, Brody (2003) examined the extent to which Florida local comprehensive plans embodied principles of ecosystem management. This study also found that local plans varied across jurisdictions, and that overall, ecosystem management principles were not well-incorporated into local plans. Moreover, many plans failed to be implemented after adoption. Likewise, Brody et al. (2004) determined there was variation among Florida local

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[8] Section 163, F.S.

jurisdictions in local comprehensive plan provisions for watershed management. Highest quality plans for watershed management were those in counties with a high degree of already-existing environmental degradation, as well as large, wealthy and highly educated populations. In another study, Brody and Highfield (2005) examined how well wetlands development policies set forth in local comprehensive plans were implemented. The study found that in many cases wetlands development regulations were implemented differently among local jurisdictions, marked differences occurring between jurisdictions in the northern and southern regions of Florida. The same phenomenon of significant differences in local plan quality, tied to sociopolitical factors, were found by other researchers when they examined the incorporation of environmental impact assessments into California local land use plan decision-making (Tang 2009), the quality of environmental impact reports produced under California local land use plans (Tang et al. 2009), and the quality of local climate change action plans from jurisdictions across the United States (Tang et al. 2010).

Several studies have found that the quality of local comprehensive plans is related to socioeconomic and political factors. For example, in a study examining California local comprehensive plans, Tang et al. (2009) found that plan quality was related to planning resources and urbanization pressure in the local jurisdictions (Tang et al. 2009). Similarly, Brody et al. (2006) found that Florida local comprehensive plan quality for urban-sprawl reduction policies was related to the wealth and education level of the public, and local planning department capacity (Brody et al. 2006). In another study, the effectiveness of urban planning for biodiversity in Swedish cities was related to the degree to which planners were educated in

conservation biology, institutional resources, and the existence of legislative mandates (Sandstrom et al. 2006).

These studies suggest that substantial variation in local government environmental protection planning is common, and that local and regional sociopolitical factors play a key role in the extent to which environmental protection occurs at local levels. Given the results from these studies, it is highly likely that there is also variation among local governments in conservation planning for biodiversity. Moreover, despite state-mandated growth management requirements, local government conservation planning enjoys a high degree of autonomy in Florida, and what top-down regulation did exist is becoming more limited[9](Knaap & Song 2005). Local governments are only required to meet the minimum statutory requirements for conservation planning. Once plan provisions are set forth, local governments may implement their Conservation Element provisions to different degrees. Because the decisions of local governments have significant impacts on biodiversity conservation, it is necessary to understand the nature of variations in local government conservation planning quality and their cause. It is also necessary to understand the impacts of this variation on larger collective biodiversity conservation efforts (Farr & Brock 2006; Oetting et al. 2006; Miller et al. 2009).

<u>Research Problem</u>

Among the studies that have evaluated local government environmental planning, none has evaluated the quality of local government conservation planning for the long-term

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[9] In 1993, amendments to the Growth Management Act of 1985 reduced the authority of the regional planning councils to advisory roles and providers of technical assistance to local governments. As such, local government development decisions cannot be appealed by regional planning councils (Knaap & Song 2005). Moreover, in 2011, the oversight powers of the state over local land comprehensive plans were greatly reduced by the Community Planning Act.

preservation of biodiversity specifically (Brody et al. 2004; Brody & Highfield 2005; Tang et al. 2009). The goal of this study is to evaluate the variation in conservation planning quality of Florida county governments for biodiversity preservation, and understand the drivers of that variation. Florida and its 67 county governments are an appropriate system for this research as a case study because of Florida's role as a former leader among the United States in conservation planning through its growth management and conservation lands acquisitions legislation. The research questions for this study are: 1) To what extent are conservation planning methods being used to conserve biodiversity in Florida counties? 2) To what degree is there variation in county conservation planning quality for biodiversity preservation? 3) What are the causes of variation in conservation planning quality of Florida county governments? 4) What is the role of current state conservation policy in producing this variation?

<div align="center">Organization of the Dissertation</div>

Chapter 1 discusses urbanization as a leading threat to biodiversity persistence in the United States today, and the role of local governments in controlling local development. Chapter 1 provides a history of the efforts of the state of Florida to preserve its biodiversity through two legislative frameworks, conservation lands acquisitions and growth management. Chapter 1 then presents the research issue, which concerns the potential for variability in conservation planning at the local government level. Chapter 2 sets forth the protocol used to measure the quality of each county's Conservation Element, and provides the results of that analysis for each of the 67 counties in Florida. For each county, a conservation planning quality score was obtained. Those

scores were then analyzed to determine if significant differences in conservation planning quality exist between inland and coastal counties and between regions.

Chapter 2 details the collection and analysis of socioeconomic data acquired to serve as independent variables in multiple regression analysis. One source of that data was a Likert-style survey questionnaire sent to the planning departments of each Florida county. Survey data and other socioeconomic data were then regressed against the conservation planning quality scores for each county to identify the most plausible predictor variables of conservation planning quality, and produce a predictive model. Chapter 3 examines public policy theory regarding policy adoption, and uses global and spatial autocorrelation analysis to determine if variability in conservation planning quality scores is in part a function of the policy process of diffusion among neighboring Florida counties. Chapter 4 discusses the overall findings, and discusses the conservation implications of the changes made to Florida's growth management policies by the Community Planning Act of 2011 as well as the post 2008 changes to Florida's conservation lands acquisitions policies. Chapter 4 concludes with a discussion of the limitations of this study and future research needs.

CHAPTER TWO: ASSESSING FLORIDA COUNTY GOVERNMENT CONSERVATION PLANNING QUALITY, IDENTIFICATION OF SOCIOECONOMIC DRIVERS OF VARIABILITY, AND DEVELOPMENT OF A PREDICTIVE MODEL OF FLORIDA COUNTY CONSERVATON PLANNING QUALITY

Introduction

Mandated under Florida's 1985 Growth Management Act,[10] the Conservation Element of the local comprehensive plan must set forth strategies and guidelines for the local jurisdiction to conserve natural resources, including biodiversity, in the face of future development. This element can include a mixture of regulatory, incentive-based and public ownership approaches to conservation, so long as the local government goals and policies are consistent with state goals and policies for natural resource conservation. The goals and policies that must be included in county Conservation Elements are set forth in the statute:[11]

> *2. The element must contain principles, guidelines, and standards for conservation that provide long-term goals and which:*
>
> *b. Conserves, appropriately uses, and protects the quality and quantity of current and projected water sources…*
>
> *d. Conserves…and protects…..native vegetative communities, including forests, from destruction by development activities.*
>
> *e. Conserves…and protects fisheries, wildlife, wildlife habitat, and marine habitat and restricts activities known to adversely affect the survival of endangered and threatened wildlife.*
>
> *g. Maintains cooperation with adjacent local governments to conserve…unique vegetative communities located within more than one local jurisdiction.*

---

[10] Section 163.3177 F.S., renamed the Community Planning Act in 2011.
[11] Section 163.3177(6)(d) F.S.

h. Designates environmentally sensitive lands for protection based on locally determined criteria which further the goals and objectives of the conservation element.

j. Protects and conserves wetlands and the natural functions of wetlands

To gain state approval of the Conservation Element, the language of the local Conservation Element must meet these criteria as well as satisfy additional substantive and procedural requirements set forth in the statute[12] (Brody et al. 2003; Brody et al. 2004). Once the Conservation Element (as a part of the larger Local Comprehensive Plan) has been approved by the state and adopted, the Conservation Element is legally binding in the local jurisdiction, and all detailed land development and use regulations must be consistent with its provisions[13] (Knaap & Song 2005; HCBCC 2008). The Conservation Element can thus be considered a planning document as well as a legally enforceable public policy instrument (Peters 2010).

Because of the uniform procedural and substantive criteria required of local government comprehensive plans and their elements, they are standardized to a significant degree. At the same time, however, the statute specifically provides that local government comprehensive plans should preserve the autonomy of local governments to make land use and development decisions:[14]

163.3161(2) It is the purpose of this act to utilize and strengthen the existing role, processes, and powers of local governments in the establishment and implementation of comprehensive planning programs to guide and manage future development consistent with the proper role of local government.

---

[12] See Section 163.3177(1) to (7), F.S.
[13] Section 163.3177(1), F.S. Although the Community Planning Act of 2011 decreased the state's role in reviewing Comprehensive Plans and modified the plan approval procedural requirements, the requirements for each element within the plans remain intact, and the content of the plans was not affected by the new law.
[14] Section 163.3161 F.S.

(4) It is the intent of this act that local governments have the ability to preserve and enhance present advantages; encourage the most appropriate use of land, water, and resources,…and protect natural resources within their jurisdictions.

(9) It is the intent of the Legislature that…this part…not be interpreted to limit or restrict the powers of municipal or county officials, but be interpreted as a recognition of their broad statutory and constitutional powers to plan for and regulate the use of land…

The standardized nature of local comprehensive plans allows for empirical methodologies to be developed to assess their effectiveness. At the same time, though, because each local comprehensive plan reflects local community values and goals, such empirical methods can also be used to compare the quality of different local plans.

Plan evaluation is a critical component of a rational planning process (Hill 1968). The planning literature offers several techniques for evaluating the effectiveness of public sector plans. One set of approaches involves examining whether a plan has achieved predetermined goals (Hill 1968). Many studies in the planning literature have employed this goals-achievement approach to empirically evaluate local comprehensive plans (Brody 2003c, a; Brody et al. 2003; Brody et al. 2004; Tang 2009; Tang et al. 2009; Tang et al. 2010). In those studies, a conceptual model of a high quality plan is first developed. To create the conceptual model, the basic theoretical component parts of the plan are first established, for example 1) facts that support plan provisions, 2) goals, 3) approaches and methodologies, 4) coordination, and 5) implementation (Brody 2003b; Tang et al. 2009). Indicators are developed for each plan component, which are words, pieces of information, strategies, or policies that comprise the component in theory. A coding protocol is then developed to score the extent to which the indicators are included in the plan. Plan provisions are then evaluated against that conceptual

model to determine how well the plan meets the theoretical criteria. These studies assume that the greater the number of indicators found in the plan, the higher the quality of the plan (Brody 2003b). This method has been used to evaluate the effectiveness of local comprehensive plans for sustainable development principles (Berke & Manta Conroy 2000), climate change mitigation and adaptation provisions (Tang et al. 2010), environmental assessment criteria (Tang 2009), ecosystem management (Brody et al. 2004), and plan implementation (Brody & Highfield 2005).

In the case of conservation planning, the conservation science literature offers several frameworks to guide conservation planning, which include the following basic elements: 1) factual information about the biodiversity of the planning region, 2) quantitative targets for preserving species and environmental features, 3) coordination with other jurisdictions, 4) prioritization of lands to acquire as protected areas, 5) acquisition and design of conservation areas, and 6) management of conservation lands based on explicit objectives, monitoring, and adaptive management (Noss & Cooperrider 1994; Noss et al. 1997; Margules & Pressey 2000; Lambeck & Hobbs 2002; Opdam 2002; Pressey et al. 2007). A high-quality plan for biodiversity conservation theoretically includes each of these components. As such, Florida county government Conservation Elements can be evaluated against these theoretical components to assess the quality of Florida local government conservation planning. While other studies have evaluated the quality of local comprehensive plans for other criteria, no studies have evaluated local comprehensive plans specifically for their quality in conserving biodiversity.

<u>Methods</u>

Following a review of the conservation science literature, I developed a conceptual model of the components of conservation planning for biodiversity preservation based on the plan evaluation methodology of Brody et al. (2003) (Figure 1).
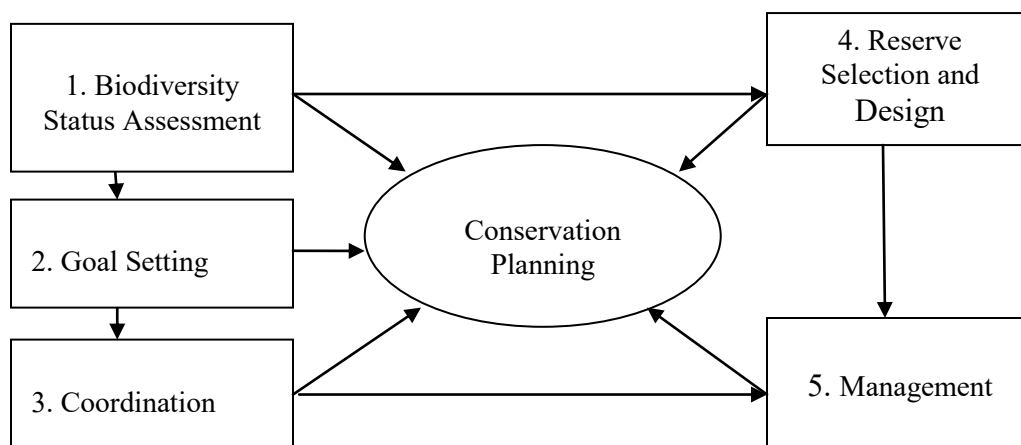
Figure 1. Conceptual model of conservation planning and its components.

The model includes five elements: 1. Biodiversity Status Assessment, 2. Goal Setting, 3. Coordination, 4. Reserve Selection and Design, and 5. Management. While all five elements inform conservation planning, they also exercise influence on one another in non-linear ways. For example, the baseline biological information of the planning region determines which goals are set, which in turn determine the parameters of coordination. Biodiversity status, goals, and coordination determine the criteria for reserve selection and design, all of which impact management. In this way, the components can influence conservation planning and one another to different degrees.

For each of these components, I developed a list of indicators based on the conservation science literature. The indicators include potential activities, pieces of information, or criteria important in that step of conservation planning which could be applied to Florida county governments. For example, for the Biodiversity Status Assessment component, indicators included species lists and habitat delineations obtainable from the Florida Natural Areas Inventory and Florida Fish and Wildlife Conservation Commission, as well as population models, remote sensing vegetation analyses, and predictive models for climate change and sea level rise (Carroll et al. 1999; Margules & Pressey 2000; Pressey 2004).

The Goal-Setting component indicators included the species or categories of species that would be the focus of conservation efforts, the breadth of conservation outcomes envisioned over temporal and spatial scales, and goals to protect not only pattern but also ecological processes and minimize dynamic threats (such as climate change and sea level rise) through increasing ecosystem resilience and genetic diversity (Noss et al. 1997; Margules & Pressey 2000; Tear et al. 2005; Nicholson et al. 2006; Beier & Brost 2010; Grantham et al. 2010; Lewandowski et al. 2010). Indicators for the Coordination component involved the different stakeholders and collaborative strategies that would be used in conservation planning, such as collaboration among governments at different jurisdictional levels, collaboration over regional and landscape scales, prioritizing ecological over political boundaries, and collaboration with private landowners and with planning and zoning departments (Noss 1983; Kiester et al. 1996; Margules & Pressey 2000). For the Reserve Selection and Design component, indicators involved the methods used to select lands for acquisition and delineate protected areas, and other considerations about reserve size, connectivity, corridors, habitat heterogeneity, buffer and core

areas (Noss 1983; Noss & Harris 1986). Lastly, indicators for the Management component involved the methods used to manage protected areas for long-term biodiversity persistence, such as management of populations and biodiversity processes, protection of nesting and migrating populations, human use restrictions in protected areas, routine monitoring, and adaptive management (Christensen et al. 1996; Theobald et al. 2000; Brody 2003b; Opdam & Wascher 2004; Pressey et al. 2007).

The list of indicators developed for this study, (eighty-three indicators total), is set forth in Table 1.

Table 1. Conservation planning components and indicators.

_____

Component	Indicators
Biodiversity Status Assessment	Utilize surveys
	Utilize Florida Fish and Wildlife Conservation Commission (FFWCC) data
	Utilize Florida Natural Areas Inventory (FNAI) data
	Employ spatially-explicit population models
	Employ population viability analysis
	Utilize gap analysis
	Utilize sensitivity analysis
	Utilize remote sensing data and/or vegetation analysis
	Employ Geographic Information System (GIS) data
	Utilize climate change predictive models
	Utilize sea level rise models
Goal-Setting	Represent all ecosystem or community types
	Conserve listed and imperiled species (endangered, threatened, species of special concern)
	Ensure long-term persistence
	Maintain viable populations of species
	Sustain ecological processes or function
	Sustain evolutionary processes
	Protect sensitive species, communities, or habitats
	Protect rare species
	Protect endemic or unique species or communities

Component	Indicators
	Identify and utilize focal species
	Create networks adaptable to changing environment
	Identify and quantify targets
	Select surrogates
	Protect critical areas
	Use a fine filter, coarse filter approach
	Consider multiple levels of biodiversity and species' life history requirements
	Consider different spatial scales
	Consider different temporal scales
	Prevent dynamic threats
	Increase ecosystem resilience
	Increase the acreage of protected areas and reserves
	Increase linkages
	Conserve and/or increase genetic diversity
	Assist colonizations in response to sea level rise
	Minimize threat of development and urbanization
Coordination	Engage in interjurisdictional coordination
	Engage in regional coordination
	Coordinate with private landowners
	Coordinate with planning and zoning and land use regulations
	Coordinate considering ecological instead of political boundaries
	Engage in landscape-scale coordination
Reserve Selection and Design	Utilize reserve selection algorithms
	Utilize decision support software
	Minimize fragmentation
	Consider protecting reserve of large size
	Create continuous areas of protected land
	Protect hydrology
	Protect natural disturbance regimes
	Protect edge habitats
	Protect core areas
	Create buffer areas
	Increase connectivity between protected areas
	Protect habitat that has no roads or has minimal roads
	Protect ecosystem, community and habitat heterogeneity
	Create corridors
Management	Maintain targets for individual protected areas, communities or species
	Impose human use restrictions
	Manage for evolutionary processes
	Manage for dynamic threats
	Manage for ecological processes
	Consider patch dynamics
	Consider metapopulation dynamics
	Protect dispersal, nesting and breeding
	Protect migration species and habitats used for migration

Component	Indicators
	Protect and facilitate gene flow
	Restore degraded habitats and systems
	Restrict hunting, poaching, and fishing
	Employ management techniques to mimic natural disturbances
	Manage for habitat and/or species heterogeneity
	Manage for climate change
	Manage for sea level rise
	Prevent and/or control erosion
	Translocate biota when necessary
	Increase genetic diversity
	Assisted colonizations and dispersal
	Control invasive exotics
	Conserve peripheral and disjointed populations
	Give special attention to species confined to a small portion of their range
	Employ an ecosystem management approach
	Employ adaptive management, evaluate indicators, set and evaluate performance measures to evaluate plan effectiveness
	Monitor populations, habitats, systems, and human activities
	Use natural areas for scientific research or as controls for ecosystem management

Evaluation of Florida County Conservation Elements

The list of indicators was then used to evaluate the local comprehensive plan Conservation Element of each of the 67 Florida counties. I obtained the Conservation Element of each county's local comprehensive plan from county web sites. I then reviewed each Conservation Element for the presence of each indicator. The extent to which each indicator was incorporated into the Conservation Element was scored based on the plan evaluation coding protocol employed by Brody et al. (2004). Under this protocol, indicators were scored on a 0-2 scale: 0 = the indicator is not mentioned, 1 = the indicator is mentioned but not discussed thoroughly, and 2 = the indicator is fully considered. To receive a score of 1, the indictor was mentioned less than four times. To receive a score of 2, the indicator was mentioned more than

four times. Where an indicator was mentioned exactly four times, I re-reviewed the context in which the indicator was discussed in the document and then made the determination based on context whether the indicator should be scored 1 (mentioned but not discussed thoroughly or 2 (fully considered). All indicators were weighted equally. The indicator scores for each plan component (1. Biodiversity Assessment, 2. Goal Setting, 3. Coordination, 4. Reserve Selection and Design, and 5. Management) were summed, and then divided by the total possible score for each plan component and multiplied by 10, to standardize the scores so that the total possible score for each component was 10. Next, the plan Component Scores were added to derive the Total Plan Sore for each county, where the maximum possible planning quality score was 50 (5 components x total possible score of 10 for each component). Component Plan Scores and Total Plan Scores were calculated using the following equations:

$$PCj = 10 * [(\textstyle\sum_{i=1}^{mj} Ii)/2mj)] \qquad\qquad (1.1)$$

$$PQ = \textstyle\sum_{j=1}^{5} PCj \qquad\qquad (1.2)$$

where PC*j* is the quality of the *j*th plan component (Component Plan Score), (ranging from 0-10), *mj* is the number of indicators within the *j*th plan component, and I*i* is the *i*th indicator's score (ranging from 0-2). PQ is the quality of the total conservation planning activity of the county (Total Plan Score), resulting from the summation of all of the plan component scores.

Total Plan Scores were used as a measure of conservation planning quality following the methods established in the planning literature for evaluating planning documents (Berke & Manta Conroy 2000; Brody 2003b; Brody et al. 2004; Tang 2009; Tang et al. 2009; Tang et al.

2010). Under this methodology, it is assumed that higher indicator scores equate with higher plan quality. Data were examined for outliers using boxplots and rechecked for accuracy. Total Plan Scores were used to create a map of county conservation planning quality using ArcGIS 10.0. Component Plan Scores and Total Plan Scores were then analyzed using descriptive statistics to quantify the variability in conservation planning quality among Florida counties. Summary statistics were tabulated in SPSS (version 21.0, IBM Corp. 2012). Charts were produced in SPSS and in Microsoft Excel 2010.

Total Plan Score data was also analyzed for global spatial autocorrelation in ArcGIS 10.0. A spatial weights matrix was created to model the spatial relationships among counties for the global spatial autocorrelation statistics calculations. The spatial weights applied to neighboring counties were based on an inverse distance conceptualization of spatial relationships, where the impact of one county's values on another county decreased with distance (a distance-decay model). I specified that a minimum of ten neighbors would be considered for each county's calculations, and that no threshold distance or distance band would be imposed (Lee & Wong 2001). With no threshold distance, all counties would be considered in the calculations of target counties, though more distant counties would have a lesser impact than more proximate counties.

Next, I tested the hypothesis that differences exist in the quality of conservation planning between Florida coastal and inland counties and between Florida counties grouped into regions. Comparisons were performed using the nonparametric independent samples t-test and Kruskall-Wallis test. I grouped Florida counties into four regions delineated by Enterprise Florida, Inc., a public-private entity that promotes statewide economic development in Florida

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(www.eflorida.com). The four regions are 1) Panhandle, 2) North, 3) Central, and 4) South, shown in Figure 2.
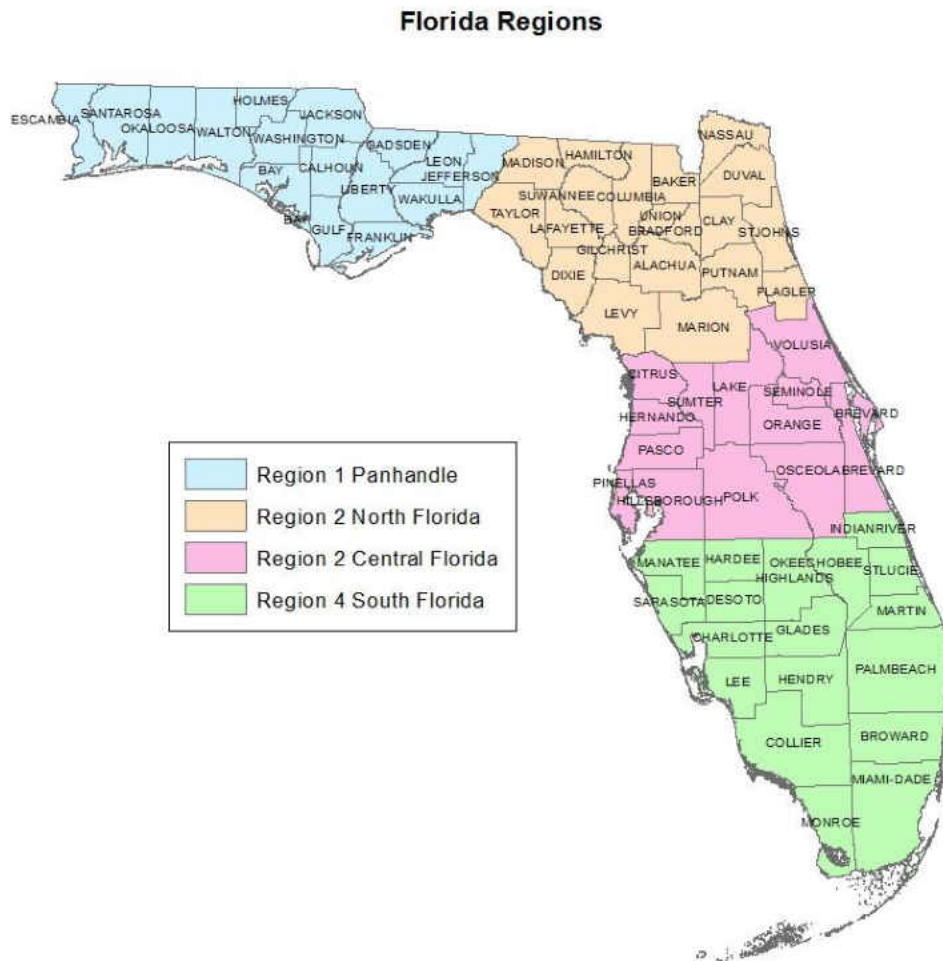
Florida Regions

Figure 2. Florida Regions based on Enterprise Florida, Inc. boundaries.

Next, to examine the extent to which counties are planning for climate change and sea level rise, indicator data involving climate change and sea level rise were extracted and summed for each county. Those data were aggregated for Component Plan Score data and for Total Plan Score data and compared among coastal and inland counties and among regions.

Importantly, this study did not measure or analyze the extent to which the goals and strategies set forth in local government Conservation Elements are actually implemented. Nonetheless, this study still provides important insights about the degree to which counties are envisioning biodiversity conservation and incorporating said measures into the local comprehensive plan. Moreover, given the legally-enforceable nature of local comprehensive plans, there is a high likelihood that once provisions are set forth in local plans, local governments will take steps to create the necessary land use regulations to enact those provisions (Brody 2003b; Brody et al. 2004).

Identification of Variables Influencing Florida County Conservation Planning

To understand how socioeconomic and political factors influence conservation planning by Florida county governments, I developed a list of variables that have been found to influence conservation and environmental protection planning in other studies. These factors fell into four general categories: 1) Demographics, 2) Resource Availability, 3) Collaboration on Biodiversity Issues, and 4) Recognition of Legislative Mandates. I then researched U.S. Census and state data sources for current data on Florida's counties for each of these variables. Variables from each of these categories for which county data were available were selected as indicators. Each category, the variables selected as indicators for that category, their measurement, and the data sources for

those indicators, are listed in Table 2 and are described below. Data for each variable was

collected for each of Florida's 67 counties.

Table 2. Variables selected as potentially influencing Florida county conservation planning.

Variable	Measurement	Scale	Data source
Demographics			
Wealth	Median household income 2011	Continuous	2011 American Community Survey (U.S. Census Bureau)
	Total county revenues	Continuous	FL EDR
Education	Percentage of persons age 25 or older with a bachelors degree or higher 2010	Continuous	FL EDR
Population density	Persons per square mile 2012	Continuous	FL EDR
Political affiliation	Percent registered voters Republican Percent registered voters Democrat	Continuous	FL DE
Value of nature	Total value of nature conservation	Continuous	Survey
Urbanization	Percent change number of housing units 2000-2011	Continuous	FL EDR
	Percent population growth 1980-2012	Continuous	FL EDR
Resource Availability			
Conservation lands	Percent of county land area as conservation lands in 2011	Continuous	FNAI
	Percent of county conservation lands owned or managed by county in 2011	Continuous	FNAI
	Percent of county land area is state and/or federally owned or managed conservation lands in 2011	Continuous	FNAI
Total resource availability	Total county conservation planning resources	Continuous	Survey
Collaboration on Biodiversity Issues			
With all groups	Total collaboration	Continuous	Survey
Existence of Mandates			
Recognition of conservation mandate	Total county recognition of state mandates for conservation planning	Continuous	Survey

Demographics. Variables selected as indicators of demographics in this study are wealth, education, population density, political affiliation, community ecological values, and degree of urbanization (Stokes et al. 2010). Measures of wealth included median household income for each county, using U.S. Census Bureau data, and total county revenues from the Florida Office of Economic and Demographic Research (FLEDR). FLEDR also provided data on education level and population density. Education level was measured by the percent of persons in each county age 25 or older with a bachelor's degree or higher. Population density was measured by the number of persons per square mile in each county. Political affiliation was measured by the percent of people in each county registered by party (Democrat, Republican, or Independent) from Florida Division of Elections data. The extent to which the community values nature conservation was ascertained through a survey sent to the planning departments of each county with questions about how planners, decision-makers, and the pubic value nature conservation in the county (discussed below). Urbanization was measured by the percent change in the number of housing units in each county from 2000 to 2011, and by percent population growth in the county from 1980-2012, using data from FLEDR. While religion has been found to affect environmentalism (Raudsepp 2001), indictors of religion were not included in this study due to lack of available data on religion for Florida counties.

Resource availability. Variables selected as indicators of resource availability include the nature of land acquisition funding and management, planning staff size, frequency of continuing education in conservation planning for staff, use of biodiversity data in land use planning, whether a trained conservation specialist is on staff, and the degree of institutional support for conservation planning such as a program or department dedicated to conservation lands

acquisition and management (Cort 1996; Theobald et al. 2000; Sandstrom et al. 2006; IPCC 2007; Kartez & Casto 2008; Stokes et al. 2010). These data were acquired through a survey sent to the planning departments of each county. Additional indicators of resource availability were the percentage of land in each county designated as conservation land, the percentage of conservation land owned by the county, and the percentage of conservation land owned by the state and the federal government, which data came from the Florida Natural Areas Inventory (FNAI).

Collaboration on biodiversity issues. Variables selected as indicators of collaboration were the frequency of collaboration in land use planning for nature conservation among local government departments, among local jurisdictions, with environmental groups, with regional planning councils, between planners and citizens, and with state conservation agencies. These data were acquired through a survey sent to the planning departments of each county.

Legislative mandates. In Florida, the Growth Management Act of 1985 requires local governments plan for biodiversity conservation, and also to collaborate with adjacent jurisdictions.[15] However, it is unclear to what degree local planning departments recognize those mandates in conservation planning. The variable selected as an indicator of legislative mandates was the recognition of existing mandates for biodiversity conservation and for collaboration in biodiversity conservation by planning personnel. These data were acquired through a survey sent to the planning departments of each county.

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[15] Section 163.3177, F.S.

Analysis of Socioeconomic Variables

Next, the socioeconomic variables acquired from U.S. Census and Florida state records (listed in Table 2) were also analyzed for descriptive statistics and for significant differences between coastal and inland counties and between regions after verifying assumptions for the independent samples t-test and one-way ANOVA tests.

Survey Methodology

Data that were not available from U.S. Census or state data sources were acquired through a survey questionnaire sent to the planning departments of all 67 Florida counties. The survey, titled the Florida Counties Conservation Planning Survey, was conducted in October 2012 through the Science and Planning in Conservation Ecology (SPICE) Lab at the University of Central Florida. The survey questionnaire was divided into four categories of questions: 1) General Position on the Value of Conservation of Nature (Values), 2) Resource Availability, 3) Collaboration, and 4) Mandates. The questions in the Values category were designed to measure the degree to which nature conservation is valued by planners, decision-makers, and the public in each county. Resource Availability questions were designed to identify and measure the types and quality of resources available to and employed by planners for conservation planning. Collaboration category questions were designed to measure the degree of collaboration between county planning departments and other parties in developing land-use plans to conserve native species and habitats. Finally, the questions in the Mandates category were developed to measure how federal and state laws are perceived and understood by planners at local government levels,

and to understand the impact of the Florida Community Planning Act of 2011 legislative changes on local government conservation planning.

Surveys were designed following the tailored design method (Dillman et al. 2009). I used a Likert-scale design, with responses ranging from two to seven levels (Fink 2009; de Winter & Dodou 2010). The Human Research Protocol & Instructions (submitted to the IRB) and Explanation of Research can be found in Appendix A. The survey methodology and all documents used in the study were approved by University of Central Florida Institutional Review Board (IRB) (Appendix B). The survey invitation, survey instrument, and thank-you follow-up letter are in Appendix C.

Survey questionnaires were mailed to the planning directors of each of the 67 counties in Florida in October 2012, following the methods of Miller et al. (2009). The questionnaires were coded with random numbers so that responses were anonymous. I anticipated a response rate of approximately 70% based on the response rate of similar surveys of local government planning departments (Cort 1996; Kartez & Casto 2008; Miller et al. 2009; Ramirez de la Cruz 2009; Vance-Borland & Holley 2011). Of the 67 questionnaires sent, 61 responses were received, a response rate of 91%, which was enough to meet statistical requirements (Fig. 3).
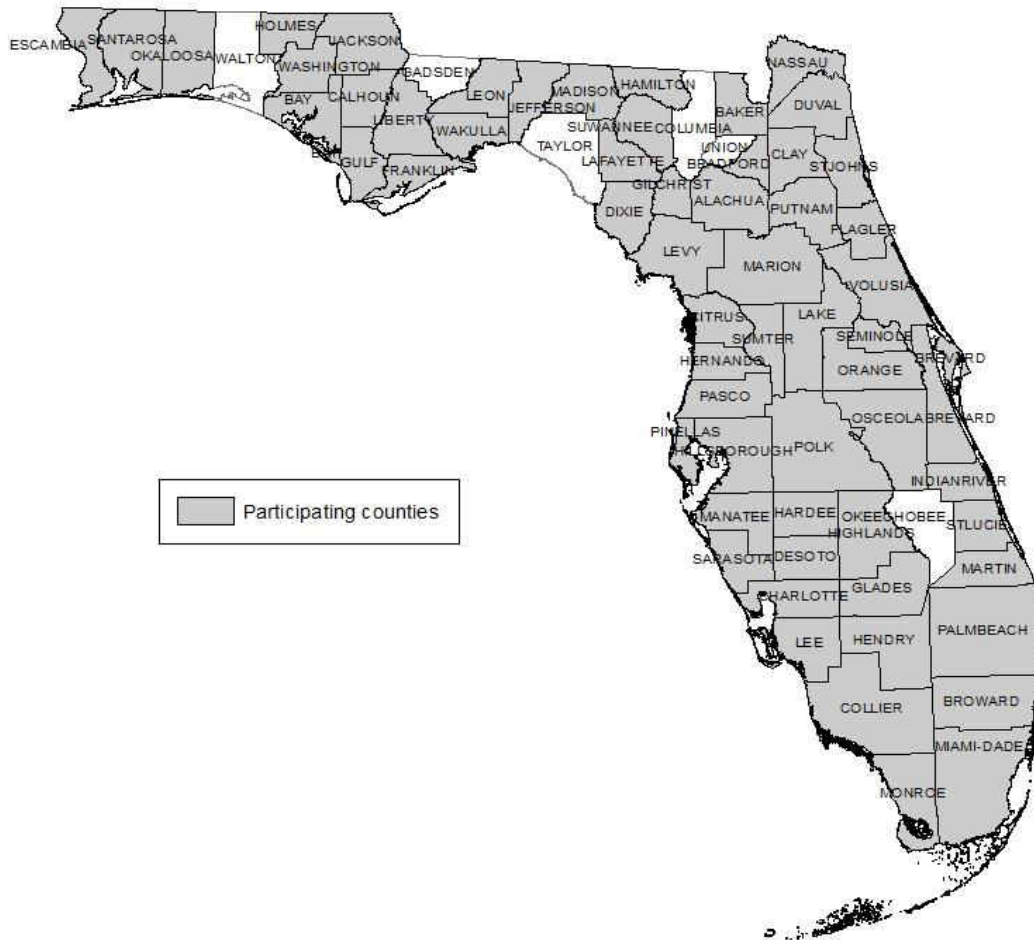
Figure 3. Florida counties participating in the Florida Counties Conservation Planning Survey which was conducted via mailed survey questionnaires in October 2012.

Each question response was converted from the Likert scale into an ordinal numeric score. Item nonresponses, including "not applicable" and "don't know" responses, were excluded from analysis. As a result, for some questions there were fewer than 61 responses.

Analysis of Survey Data

For each question response, I calculated descriptive statistics and frequency distributions. Where ordered comparisons of the data were of interest, means were computed and differences among mean ranks were tested for significance using the Kruskall-Wallis test. The Mann-Whitney-Wilcoxon test was used to analyze specific sample pairs for significant differences. For each question, responses were also analyzed for significant differences between inland and coastal counties and between regions using the nonparametric Mann-Whitney-Wilcoxon two sample rank sum and Kruskall-Wallis tests. Summary statistics were tabulated in SPSS (version 21.0, IBM Corp. 2012). Charts were produced in Microsoft Excel 2010. All of the responses to the questions in each survey category (Values, Resource Availability, Collaboration, and Mandates) were then summed to produce total category scores for each county (Total Values Score, Total Resources Score, Total Collaboration Score, Total Mandates Score) (Table 3).

Table 3. Survey questions the responses to which were summed for each category to produce a total category score for each county.

_____

Values category questions
1. How would you rank "Preserve native species and habitats" in terms of its importance in land-use planning in your county?
2. How would you best characterize land-use planning for conservation of nature (native species and habitats), as a part of land-use planning overall in your county?
3. How important is it for planners in your county to have education and training in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats) to perform their job?
4. How would you best describe the conservation values of the public in your county?
5. When land-use planning decisions designed to avoid loss of native species and habitats are made in your county, how would you best characterize those decisions?
6. Where proactive land-use plans for the conservation of nature (native species and habitats) have been developed in your county, how often have those plans been implemented?

Resource Availability category questions
1. What is the size of the planning staff in your county, including planners and support staff?
2. Does your county provide training, funding, or other active opportunities for planners to learn about conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?
3. To the best of your knowledge, how well are most planners in your county trained in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?
4. Are there currently one or more people employed by the county who are conservation specialists or biologists with specific knowledge of conservation science, and who are employed to utilize this knowledge in conservation planning?
5. Does your county have a department, agency, or program responsible for acquiring conservation lands?
6. Does your county have a department or agency responsible for managing conservation lands?
7. Which of the following best characterizes the nature of funding for conservation lands purchases in your county since the 1980s?
8. Which of the following best characterizes the nature of funding for conservation lands management in your county since the 1980s?
9. How aware are planners of the availability of the following types of biological information, and how often are they used by planners and/or others assisting planners in developing land-use plans?
10. How aware are planners of the availability of the following sources of biological information, and how often are these information sources consulted by planners in developing land-use plans?
11. How aware are planners of the availability of the following resources for incorporating biological information into land-use plans, and how often are they used

Collaboration category questions
1. To the best of your knowledge, how often do the parties listed below collaborate on developing land-use plans to conserve native species and habitats?

Mandates category questions
1.To the best of your knowledge, do federal and/or state laws currently require local governments to develop land-use plans to conserve and protect native species and habitats within the local government's jurisdiction?
2. To the best of your knowledge, do federal and/or state laws currently require local governments to work together to plan for development in such a way that will conserve and protect native species and habitats within the two or more local governments' jurisdictions?

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Where missing data occurred due to item nonresponse, those cases were removed, resulting in different numbers of responses (n) for each category. Total category score data was grouped by county location and analyzed for significant differences between coastal and inland counties and between regions. Independent sample t-tests were conducted to assess differences in total category scores between inland and coastal counties after verifying that the data met the assumptions for t-test of 1) normally distributed variables, 2) independence, and 3) homogenous variances between groups (Gotelli & Ellison 2004). Where these assumptions were not met, I used the nonparametric Mann-Whitney U test to compare median ranks. Total category scores were next analyzed for differences in regions via one-way ANOVA after checking to ensure the assumptions of ANOVA have been met: 1) normal distribution of residuals, 2) independence, and 3) homogenous variances. Regions were those depicted in Figure 2 above (Region 1 = Panhandle, Region 2 = North Florida, Region 3 = Central Florida, Region 4 = South Florida). Where data did not meet the assumptions for a one-way ANOVA, the Kruskall-Wallis non-parametric test was used to determine if variables differed among regions, which only requires homogenous variances among groups.

Climate Change and Sea Level Rise

Responses from survey questions relating to climate change and sea level rise planning (Table 4) were also pooled, (after removal of missing values), resulting in a total Climate Change/Sea Level Rise total score for each county.

Table 4. Survey questions addressing climate change and sea level rise the responses to which were aggregated to produce a Climate Change/Sea Level Rise total score for each county.

Values category questions
1. How important is the issue of climate change in land-use planning to conserve native species and habitats in your county currently?
2. How important is the issue of sea level rise in land-use planning to conserve native species and habitats in your county currently?
Resource Availability category questions
3. How aware are planners of the availability of threat modeling software for incorporating biological information into land-use plans, and how often are they used?
4. How aware are planners of the availability of sea level rise projections and vulnerability assessments for incorporating biological information into land-use plans, and how often are they used?
5. How aware are planners of the availability of climate change models and projections for incorporating biological information into land-use plans, and how often are they used?
6. Is your county designating, or does your county plan to designate, Adaptation Action Areas to address sea-level rise as a part of their local comprehensive plans?

The data were divided into inland and coastal county responses, and by regions, and were found to be non-normally distributed. The nonparametric Mann-Whitney U and Kruskall-Wallis tests were used to compare inland and coastal counties and regions.

Multiple Regression Analysis: Development of a Predictive Model of Florida County Conservation Planning Quality

I next developed a theoretical conceptual model of the factors influencing Florida county government conservation planning quality, where the four categories of socioeconomic factors identified above were independent variables and county government conservation planning quality (Total Plan Score) was the dependent variable (Tang et al. 2009) (Fig. 4).

Category 1 Independent variable: Demographics			Category 3 Independent variable: Collaboration
	Dependent variable: County government conservation planning quality score (Total Plan Score)		
Category 2 Independent variable: Resource Availability			Category 4 Independent variable: Legislative Mandates
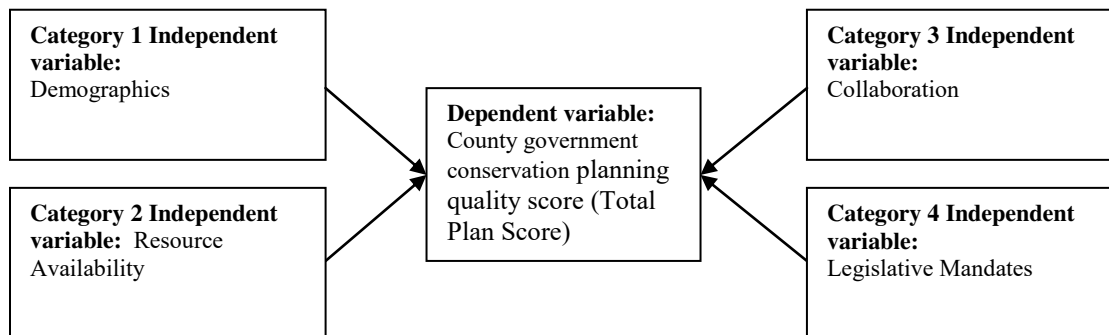
Figure 4. Conceptual model of dependent and independent variables.

Several hypotheses were developed based on this model: 1) effect of demographic category variables only, 2) effect of resource availability category variables only, 3) effect of collaboration category variables only, 4) effect of mandates category variables only, 5) effect of all category variables, 6) effect of interactions of variables, and 7) the null hypothesis. The null hypothesis was that there is no relationship between the independent variables and the dependent variable. I then employed ordinary least squares multiple regression analysis to evaluate the hypotheses and develop a predictive model of Florida county conservation planning quality.

To prepare survey data to be incorporated with other independent variables in multiple regression analysis, missing values for item non-response due to "don't know," "not applicable" and blank responses were imputed into five multiple imputation datasets in SPSS. Results from the five imputation datasets were averaged for each survey category (Values, Resource Availability, Collaboration, and Mandates) resulting in a total score containing imputed values for each category (Total Values, Total Resource Availability, Total Collaboration, Total Mandates).

After confirming that the outcome variable and independent variables data met the assumptions for multiple regression analysis, a hierarchical blockwise method was used to enter predictor variables into the model (Field 2000). For example, variables from the Demographics category were entered into the model first, followed by variables from the Resource Availability, Collaboration, and Mandates categories, in that order. Stepwise forward and backward methods were employed to compare results based on the order of variable input for the best model.

Next, I used model selection based on maximum likelihood and information theory to evaluate a group of candidate models (Abad-Franch et al. 2012). Eight alternative models were fit with parameters using Akaike's information criterion corrected for small sample size (AICc) (Burnham & Anderson 2002; Wagenmakers & Farrell 2004). The eight candidate models were compared based on the variation in AICc of each model (ΔAICc) relative to the lowest AICc model. Models with ΔAICc < 10 were selected as the most plausible (Burnham et al. 2011). I then computed normalized relative likelihoods for each model, or Akaike weights, to evaluate the weight of evidence in favor of each model (Wagenmakers & Farrell 2004; Burnham et al. 2011). A confidence set of three models was selected, (which included the model with the highest AICc weight and two models that had Akaike weights within 10% of the highest weight model), and compared using model evidence ratios (Burnham & Anderson 2004). I then calculated importance weights for individual parameters in the confidence set of models using Akaike weights to estimate the relative importance of each covariate.

Next, I used AIC model-averaging to weight the parameter estimates and variances and combine them in a composite model. Finally, model-averaged standard errors and confidence intervals were calculated and reported with the composite model parameters and coefficients

(Burnham & Anderson 2002; Burnham & Anderson 2004). SPSS version 21.0 and JMP version

10.0 (SAS Institute) were used for statistical analysis and to produce tables and charts.

Results

County Conservation Element Evaluation Results

Component Plan Scores and Total Plan Scores for each county are set forth in Table 5.

Table 5.Component Plan Scores and Total Plan Scores for each Florida county.

County	Biodiversity Status Assessment	Goal Setting	Coordination	Reserve Selection and Design	Management	Total Plan Score
Alachua	2.73	5.00	8.33	5.00	3.70	24.76
Baker	1.36	1.40	2.50	1.43	0.56	7.25
Bay	1.36	3.40	5.83	2.14	1.11	13.85
Bradford	1.82	2.40	3.33	1.07	1.30	9.92
Brevard	1.36	2.40	5.00	2.14	1.85	12.76
Broward	1.36	2.20	5.00	1.43	1.48	11.47
Calhoun	0.91	2.20	3.33	1.43	0.56	8.43
Charlotte	1.36	3.60	5.83	3.93	1.30	16.02
Citrus	1.82	2.40	5.83	1.43	1.48	12.96
Clay	1.36	1.20	4.17	1.79	1.30	9.81
Collier	3.18	2.80	6.67	6.07	2.78	21.50
Columbia	1.36	2.00	3.33	1.07	0.74	8.51
DeSoto	1.82	2.00	6.67	1.79	1.67	13.94
Dixie	1.36	2.20	5.00	1.07	1.30	10.93
Duval	2.27	3.60	7.50	2.86	2.59	18.82
Escambia	1.82	1.80	4.17	0.71	1.48	9.98
Flagler	1.82	2.40	3.33	1.79	0.93	10.26
Franklin	0.45	1.00	5.00	0.36	1.11	7.92
Gadsden	0.91	2.00	4.17	2.14	1.30	10.51
Gilchrist	1.36	2.00	4.17	1.43	1.11	10.07
Glades	0.91	1.60	5.00	1.07	0.37	8.95
Gulf	0.45	1.20	5.00	0.00	0.19	6.84
Hamilton	1.36	1.80	2.50	1.07	0.74	7.48
Hardee	0.45	1.80	3.33	0.71	0.00	6.30

County	Biodiversity Status Assessment	Goal Setting	Coordination	Reserve Selection and Design	Management	Total Plan Score
Hendry	0.91	1.20	4.17	1.07	0.56	7.90
Hernando	1.36	2.80	5.83	3.21	1.67	14.88
Highlands	1.36	2.00	6.67	2.50	1.67	14.20
Hillsborough	1.36	2.60	5.83	4.64	2.41	16.85
Holmes	0.91	1.40	2.50	0.36	0.56	5.72
Indian River	1.82	3.40	4.17	2.50	2.59	14.48
Jackson	1.36	2.00	4.17	2.86	0.74	11.13
Jefferson	0.00	1.00	3.33	1.43	0.56	6.32
Lafayette	1.36	2.00	3.33	1.07	0.93	8.69
Lake	3.64	4.40	5.83	4.29	3.33	21.49
Lee	0.91	3.80	6.67	3.93	2.59	17.90
Leon	0.91	2.20	6.67	2.14	1.48	13.40
Levy	0.91	1.80	5.83	1.79	1.67	11.99
Liberty	1.82	1.20	4.17	2.86	0.74	10.78
Madison	1.82	2.60	4.17	2.14	1.30	12.02
Manatee	0.91	1.60	8.33	2.50	1.48	14.82
Marion	0.91	2.40	2.50	1.43	1.30	8.53
Martin	2.27	3.60	7.50	3.21	2.59	19.18
Miami-Dade	0.45	2.60	5.00	1.07	1.85	10.98
Monroe	3.18	2.40	5.83	3.21	4.07	18.70
Nassau	0.00	1.40	4.17	2.50	0.37	8.44
Okaloosa	1.36	1.80	6.67	1.07	1.30	12.20
Okeechobee	0.91	1.00	4.17	0.71	0.19	6.98
Orange	1.36	2.60	5.83	3.21	1.67	14.68
Osceola	1.82	2.60	6.67	3.21	2.41	16.71
Palm Beach	1.36	2.60	5.83	2.86	2.04	14.69
Pasco	0.45	2.40	5.83	3.57	1.85	14.11
Pinellas	1.36	2.60	7.50	2.86	2.59	16.91
Polk	0.91	1.40	3.33	0.71	0.56	6.91
Putnam	0.91	1.80	5.00	1.79	1.30	10.79
Santa Rosa	0.45	1.20	4.17	1.07	0.37	7.26
Sarasota	0.45	4.00	9.17	4.64	3.70	21.97
Seminole	0.91	2.00	4.17	1.79	1.11	9.97
St Johns	1.36	3.20	5.83	3.21	1.85	15.46
St Lucie	4.09	3.20	5.83	2.86	2.04	18.02
Sumter	0.00	1.80	5.00	2.14	0.93	9.87
Suwannee	1.36	2.00	4.17	1.79	1.30	10.61
Taylor	1.36	2.00	5.00	1.07	0.93	10.36

County	Biodiversity Status Assessment	Goal Setting	Coordination	Reserve Selection and Design	Management	Total Plan Score
Union	1.82	2.40	2.50	1.07	0.93	8.72
Volusia	1.36	2.80	4.17	2.50	1.67	12.50
Wakulla	1.82	1.60	5.00	1.43	0.56	10.40
Walton	2.27	1.60	6.67	1.43	1.48	13.45
Washington	0.91	3.00	5.83	2.50	1.48	13.72

Descriptive statistics for Component Plan Scores and Total Plan Scores are listed in Table 6.

Table 6. Descriptive Statistics for Component Plan Scores and Total Plan Scores for Florida counties.

	Biodiversity Status Assessment	Goal-Setting	Coordination	Reserve Selection and Design	Management	Total Plan Score
Mean	1.37	2.27	5.07	2.12	1.45	12.30
Standard Deviation	0.78	0.84	1.57	1.22	0.88	4.29
Median	1.36	2.20	5.00	1.79	1.30	11.13
Mode	1.36	2.00	4.17	1.07	1.30	N/A[16]
Normality						
W	0.89	0.94	0.96	0.94	0.93	0.95
df	67	67	67	67	67	67
p	0.00	0.00	0.03	0.00	0.00	0.00

Component Plan Score Data

Of the five components, highest scores occurred for the Coordination component (mean=5.07, SD=1.22) followed by the Goal-Setting component (mean=2.27, SD=0.84). Lowest scores occurred for the Biodiversity Status Assessment component (mean=1.37, SD=0.78) and Management component (mean=1.45, SD=0.88). Each component had a total possible score of 10. Results from the detailed analysis of Component Plan Score data is presented in Appendix F.

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[16] There was no mode for this dataset as no value occurred more than once.

Total Plan Score Data

Total Plan Score had a mean of 12.30 (SD= 4.29) and ranged from the lowest score of 5.72 (Holmes County) to the highest score of 24.76 (Alachua County) out of a possible score of 50. Counties were divided into four groups representing quality of conservation planning based on natural breaks in the Total Plan Score data: Very High quality (scores 16.92-24.76, n=9), High quality (scores 12.51-16.91, n=19), Medium quality (scores 8.96-12.50, n=21), and Low quality (scores 5.72-8.95, n=18) (Fig. 5). The majority of Very High quality scores (77.7%) and High quality scores (68.4%) occurred in coastal counties. The majority of Low quality scores occurred in inland counties (72.2%).

Florida Counties
Conservation Element
Total Plan Score
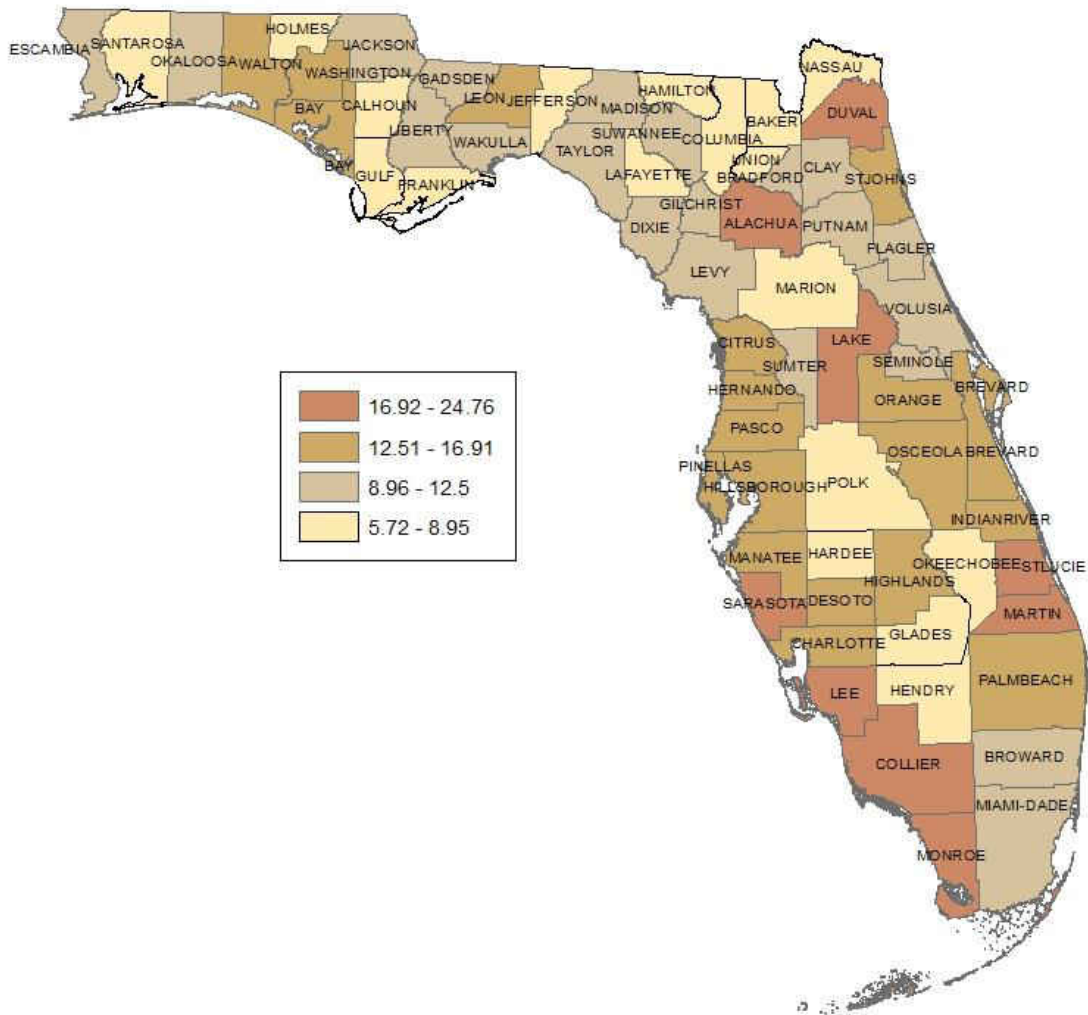
Figure 5. Total Plan Scores for 67 counties in Florida showing four different levels of conservation planning quality out of a possible 50 points based on natural data breaks.

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Total Plan Score data were non-normally distributed under the Shapiro-Wilk test (W=0.95, df 67, p=0.008. The data were log-transformed to fit a normal distribution (W=0.99, df 67, p=0.700).

Following analysis for global spatial autocorrelation, the overall spatial relationship of all of the counties for Total Plan Score was statistically clustered and the data were non-independent of one another (Moran's I=0.045, p=0.010), indicating the Total Plan Score data were globally spatially autocorrelated.

Differences in Total Plan Score Among Coastal and Inland Counties

Total Plan Score data from coastal counties were normally distributed (W=0.98, df 35, p=0.810, n=35). Total Plan Score data for inland counties, however, were right-skewed and non-normally distributed (W=0.84, df 32, p <0.001, n=32). Inland County Total Plan Score data were then log-transformed, resulting in a normal distribution (W=0.96, df 32, p=0.288). However, under Levene's test coastal county Total Plan Score Data and log-transformed inland county Total Plan Score had unequal variances (F=53.88, p <0.001) requiring use of the unequal variance t-test to compare Total Plan Scores among inland and coastal counties (Ruxton 2006). Differences in Total Plan Score between coastal (mean=13.58, SD=4.06) and log-transformed inland counties (mean=2.33, SD 0.33) were significant (t(-16.35)=34.50, p<0.001).

Differences in Total Plan Score Among Regions

Total Plan Score data for the four regions did not meet the assumptions for a One-Way ANOVA because Region 2 data were non-normally distributed, the residuals of Regions 1, 3 and

4 data were non-normally distributed, and sample sizes for the four regions were unequal (Appendix F). Therefore, the Kruskall-Wallis non-parametric test was used to determine if Total Plan Scores differ among regions, which only requires homogenous variances among groups. The results of the Kruskall-Wallis test indicated there were significant differences in Total Plan Score median ranks among regions (H=12.37, 2 df, p<0.001). Pairwise comparisons of regional Total Plan Score data were computed via Mann-Whitney U tests with a Bonferroni correction of 0.008 (0.05/6 possible comparisons = 0.008) to maintain the overall probability of a Type I error at 0.05. Significant differences in Total Plan Score were detected between Region 1 (Panhandle) and Region 4 (South Florida) (U=61; p=0.004)

Climate Change and Sea Level Rise Planning

The Conservation Elements of seven out of 67 counties (10.4%) included indicators for climate change and sea level rise. All seven counties were coastal counties. No indicators for climate change and sea level rise occurred in inland county Conservation Elements. Scores for climate change and sea level rise indicators for each of these counties are listed in Table 7.

Table 7. Scores for climate change and sea level rise indicators for Florida counties addressing climate change and sea level rise in their Conservation Element.

County	Biodiversity Site Assessment	Goal-Setting	Management	Total Climate Change/Sea Level Rise score
Collier	1	0	0	1
Flagler	0	1	0	1
Indian River	1	0	0	1
Monroe	0	0	1	1
Pinellas	2	0	1	3
Sarasota	0	0	1	1
St Lucie	2	0	0	2

Socioeconomic Variable Analysis Results

Results from the analysis of socioeconomic variables are presented in Appendix E.

Survey Data Results

Results from the survey are presented in Appendix D.

Multiple Regression Analysis Results

For the non-survey independent variables, data from the six counties that did not participate in the survey (Columbia, Gadsden, Okeechobee, Taylor, Union, and Walton) were omitted from analysis to avoid missing data issues in multiple regression analysis. The resulting sample size for the multiple regression analysis was 61 counties. Data were then analyzed for normality. Non-normal dependent and independent variable data were log- and square root-transformed (Appendix G). The final list of independent variables used in multiple regression analysis after transformation is set forth in Table 8.

Table 8. Independent variables used in multiple regression analysis transformed in some cases to meet the requirement of normality.

Category	Symbol	Transformed?	Variable used in analysis
Demographics			
Wealth	d_1	No	Median household income 2011
	d_2	Yes	Log(Total county revenues)
Education	d_3	No	Percentage of persons age 25 or older with a bachelor's degree or higher 2010
Population	d_4	Yes	Log(Persons per square mile 2012)

Category	Symbol	Transformed?	Variable used in analysis
Political affiliation	d_5	No	Percent voters registered as Republican
	d_6	Yes	Log(Percent voters registered as Democrat)
Value of nature	d_7	No	Total value of nature conservation
Urbanization	d_8	Yes	Log(Percent change in the number of housing units 2000-2011)
	d_9	Yes	Log(Percent population growth 1980-2012)
Resource Availability			
Conservation land	r_1	Yes	Log(Percent of county land area as conservation lands in 2011)
	r_2	Yes	Log(Percent of county conservation lands owned or managed by county in 2011)
	r_3	Yes	Sqrt(Percent of county land area is state and/or federally owned or managed conservation lands in 2011)
Total resource availability	r_4	No	Total county conservation planning resources
Collaboration on Biodiversity Issues			
With all groups	c_1	No	Total collaboration

Predictive models were developed to test each of the hypotheses as set forth above. The Total Mandates explanatory variable was not included in models due to its lack of significance in survey results and in analysis of differences between coastal and inland counties and regions. Specific variables included for each hypothesis tested and corresponding models are listed in Table 9.

Table 9. Hypotheses and models tested in multiple regression analysis.

Hypothesis	Hypothesis description	Model
H_{A1}	Conservation planning quality is high where populations are large, wealthy, educated, majority Democrat, urban, and the public is supportive of conservation efforts and values biodiversity	$\beta_0 + \beta_1 d_1 + \beta_2 d_2 + \beta_3 d_3 + \beta_4 d_4 + \beta_5 d_5 + \beta_6 d_6 + \beta_7 d_7 + \beta_8 d_8 + \beta_9 d_9$
H_{A2}	Conservation planning quality is high where there is a high percentage of county land that is conservation land, a high percentage of county conservation land is county-owned, and is low where a high percentage of county conservation land is state and federally owned, and local governments have high resource availability for conservation	$\beta_0 + \beta_1 r_1 + \beta_2 r_2 + \beta_3 r_3 + \beta_4 r_4$
H_{A3}	Conservation planning quality is high where there is strong collaboration among jurisdictions and stakeholders	$\beta_0 + \beta_1 c_1$
H_{A4}	Conservation planning quality is influenced by all demographic, resource availability, and collaboration variables	$\beta_0 + \beta_1 d_1 + \beta_2 d_2 + \beta_3 d_3 + \beta_4 d_4 + \beta_5 d_5 + \beta_6 d_6 + \beta_7 d_7 + \beta_8 d_8 + \beta_9 d_9 + \beta_1 r_1 + \beta_2 r_2 + \beta_3 r_3 + \beta_4 r_4 + \beta_1 c_1$
H_{A5}	Conservation planning quality is influenced by the interactions of demographic, resource availability, and collaboration variables	$\beta_0 + \beta_1 d_1 \text{ x } \beta_2 d_2 \text{ x } \beta_3 d_3 \text{ x } \beta_4 d_4 \text{ x } \beta_5 d_5 \text{ x } \beta_6 d_6 \text{ x } \beta_7 d_7 \text{ x } \beta_8 d_8 \text{ x } \beta_9 d_9 \text{ x } \beta_1 r_1 \text{ x } \beta_2 r_2 \text{ x } \beta_3 r_3 \text{ x } \beta_4 r_4 \text{ x } \beta_1 c_1$
H_0	Conservation planning quality has no relationship to demographic, resource availability, and collaboration variables	β_0

Multiple ordinary least squares regression produced estimates of parameters for each model tested. Parameters that were significant were tested for statistically significant interaction effects on the outcome variable. A significant effect of interaction occurred for the Total Resources and Log-total county revenues interaction term (p=0.002), though only for Region 4 (South Florida) and not for the other regions or between coastal and inland counties. In that model, the Total Resources variable was significant (p<0.001) though the Log-total county revenues variable was not (p=0.423). No other statistically significant interaction effects were

found. As such, models including interaction terms were not included in the candidate set of models.

Model selection. The eight candidate models were next evaluated using the Akaike information criterion and multimodal inference (Table 10) (Burnham & Anderson 2002) .

Table 10. Candidate models for Log_Total Plan Score. Model selection was based on second-order Akaike's Information Criterion differences (Δ AICc) among models.

Model	Model description	Number of parameters in model K	$AICc_i$	$\Delta_i AICc$	$w_i AICc$
1	**Pct bachelors degree + Log total county revenue + Total resources : $d_3 + d_2 + r_4$**	**3**	**14.57**	**0**	**0.3731**
2	Pct bachelors degree + Total resources: $d_3 + r_4$	2	15.3350	0.765	0.2545
3	Pct bachelors degree + Total resources + Log pct conservation lands county-owned + Total collaboration: $d_3 + r_1 + r_2 + c_1$	4	15.3355	0.766	0.2544
4	Pct bachelor's degree + Log total county revenues + Total resources + Log pct conservation lands county-owned + Total collaboration: $d_3 + d_2 + r_4 + r_2 + c_1$	5	16.88	2.31	0.1175
5	All resource availability variables: $r_1 + r_2 + r_3 + r_4$	4	25.70	11.13	0.0022
6	All demographic variables: $d_1 + d_2 + d_3 + d_4 + d_5 + d_6 + d_7 + d_8 + d_9$	9	31.40	16.83	0.0001
7	All parameters: $d_1 + d_2 + d_3 + d_4 + d_5 + d_6 + d_7 + d_8 + d_9 + r_1 + r_2 + r_3 + r_4 + c_1$	14	38.71	24.14	0.0000
8	All collaboration variables: c_1	1	46.11	24.14	0.0000

The model with the smallest AICc value was Model 1. Models 2 and 3 had a Akaike differences $(\Delta_i AICc) < 2$, also indicating there is substantial support for those models. With an AICc difference $(\Delta_i AICc)$ of 2.31, there is somewhat less support for Model 4. All of the other models had $\Delta_i AICc$ above 10, indicating they are not plausible explanations for the outcome variable (Burnham and Anderson 2004). Furthermore, considering Akaike weights, the probability of

Model l is 37%, while the probabilities of Models 2 and 3 are each 25%. Under repeated sampling, then, we would expect Model l to come out as the best model 37% of the time, though 25% of the time Model 2 would be ranked best and 25% of the time Model 3 would be ranked best. The evidence in favor of the other models is much weaker. For example, the probability of Model 4 is only 11.2%, and the probability of Models 5 through 8 is less than .2%.

Examination of evidence ratios also reveals the strongest support for Models 1, 2, and 3. The evidence ratio for Model 1 compared to Model 2 is 0.37/0.25 = 1.48, which means that Model 1 is 1.48 times more likely than Model 2. Because the Akaike weights are nearly identical for Models 2 and 3, Model 1 is also approximately 1.48 times as strong as Model 3. The evidence ratio for Model 1 versus Model 4 though is 0.37/0.12 = 3.08, indicating Model 1 is 3.08 times stronger than Model 4. The evidence ratio for Model 1 versus Model 5 is much higher at 168.18, which means there is strong evidence that Model 1 represents the "truth" 168 times better than Model 5. Models 6, 7 and 8 which have even lower Akaike weight values will have even higher evidence ratios compared to Model 1. Because model relative likelihoods, probabilities, and evidence ratios provide the strongest evidence for Models 1, 2 and 3, these models were retained as the confidence set of models (Burnham & Anderson 2004).

Assumptions. Model 1 was next analyzed to determine if it met the assumptions for multiple regression analysis, which analysis is set forth in the Appendix G.

Multimodal Inference. The relative importance of the individual parameters was next examined by calculating importance weights for each parameter (Appendix H). Importance weights indicate that Total Resources and percent bachelor's degree are the most plausible explanations for the response variable. Both of these are (0.882/0.3731 = 2.36) 2.36 times more

likely explanations for the outcome than the log-transformed total county revenue predictor, and $(0.882/0.2544 = 3.47)$ and 3.47 times more plausible than Total Collaboration and log-transformed percent conservation lands county-owned variable. However, the parameter estimates differ in the three confidence set models. To determine the reliability of the parameter estimates for each confidence set model, I examined the standard errors of the parameter estimates (Appendix H). None of the parameter estimates had standard errors that were large (greater than 2X the parameter estimate), therefore, all of the parameter estimates were reliable for predicting the outcome.

Because the confidence set of models were all plausible explanations for the outcome, and because the parameter estimates were all found to be reliable predictors, I calculated model-averaged parameter estimates for the three confidence set models to obtain a composite model (Appendix H). Incorporating the model-averaged parameter estimates, the composite model for log-transformed Total Plan Score has the following parameters:

Log Total Plan Score = 1.499+ 0.003(Total Resources$_i$) + 0.015(Percent Bachelors Degree$_i$) + 0.054(Log Total County Revenues$_i$) – 0.007(Total Collaboration$_i$) + 0.027(Log Percent Conservation Land County-Owned$_i$) + error

To determine the reliability of the model-averaged parameter estimates, I calculated the model selection variance (MSV) (Appendix H). Model selection variances were then used to calculate unconditional standard errors for the model-averaged parameters in the composite model. The unconditional standard errors (SE) are reported with 95% confidence intervals for each model-averaged parameter below (Table 11).

Table 11. Composite model estimates, standard errors, and 95% confidence interval.

Parameter	Estimate	SE	95% CI Upper	Lower
Intercept	1.499	0.6838	2.1328	0.7651
Total Resources	0.003	0.0007	0.0037	0.0022
Percent Bachelor's Degree	0.015	0.0101	0.0251	0.0048
Log Total County Revenue	0.054	0.0604	0.1144	-0.0064
Total Collaboration	-0.007	0.0078	0.0008	-0.0148
Log Percent Conservation Land County-Owned	0.027	0.0351	0.0621	-0.0081

Discussion

County Conservation Element Evaluation

Applicability of the Conservation Planning Theoretical Model to Florida County Government Conservation Planning

The results of the analysis of county Conservation Elements indicate that the components of conservation planning set forth in the theoretical model in Figure 1 have varying importance in Florida county conservation planning. Therefore, the conceptual model should be modified to reflect the varying strength of the component inputs for Florida county conservation planning. The higher Coordination Component Plan Score mean, median and mode reflect the greater attention being allotted to collaboration strategies in the Conservation Element than to the other components. This is likely because coordination among jurisdictions is emphasized as an important part of the local comprehensive plan as a whole in several different places in the

Growth Management Act of 1985 statute[17], one required element itself being an

Intergovernmental Coordination Element.[18] It may be that Conservation Element collaboration

provisions are restating the collaborative strategies that have been worked out for the

Intergovernmental Coordination Element and in other plan elements,[19] and perhaps county

governments have given more consideration to collaborative strategies than to other components

of conservation planning because collaboration is emphasized so much in the statute.

The low scores for the Biodiversity Status Assessment component indicate counties are

not using the full range of biological information available to quantify and understand the

baseline biological conditions in the county. This finding is in line with the results of other

studies that have examined the use of biological information in conservation planning. For

example, Cort (1996) surveyed state natural heritage programs nationwide to determine the

usage of biodiversity data in local land use planning. That study found that, across states,

biodiversity data are used only modestly by local governments, even when there are state-

mandates to do so and the data are in facilitative formats such as GIS data. In a similar study,

Kartez and Casto (2008) found that in Maine, the use of biological data in local land use

planning was limited and depended on the wealth of the county, the degree of urbanization

pressures facing the county, and the extent to which stakeholders were familiar with biological

data. In another study, Stokes et al. (2010) surveyed planning directors from municipal

governments in the Seattle area about land-use planning to conserve biodiversity. Respondents

indicated that planners lacked knowledge as to what the term biodiversity means, why preserving

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[17] For example, see sections 163.3161(5) and 163.3177(3)(a), F.S. in which coordination of planning and development activities of local governments among municipalities and counties is a fundamental goal of the statute.
[18] Section 163.3177(6)(h), F.S.
[19] The other required elements under the statute are future land use, transportation, public services, recreation and open space, and housing.

biodiversity is important, and about the performance measures that can be used to assess biodiversity protection efforts. In another study surveying planning directors from three regions across the United States, respondents indicated that planning for biodiversity conservation was a low priority, one cause of which was the lack of access of planners to biological data (Miller et al. 2009).

Close examination of the Biodiversity Status Component indicators present in Florida county Conservation Elements in this study reveals that counties are primarily employing survey data, FFWCC data and FNAI data. Most biodiversity data used by counties concern past or present biodiversity pattern, such as species lists and habitat or vegetation delineations, though some Conservation Elements had little or no language about collecting biodiversity data at all. Lacking in use in county Conservation Elements are population models and predictive models. GIS data were also infrequent in the documents, though this may not accurately reflect the use of GIS data by counties, because the GIS data indicator was scored only if the language specifically referred to GIS, but not if the language generally referred to maps.

The most common Goal-Setting component indicators were "minimize threat of development," "conserve listed species," "protect critical sites," and "enlarge protected areas," which reflect broad goals that more-or-less reproduce the state-mandated criteria for the Conservation Element.[20] The indicator "sustain ecological processes" was almost always associated with wetlands, which mirrors the statutory language of section 163.3177(d)(2)(j): "*Protects and conserves wetlands and the natural functions of wetlands*." However, when this

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[20] E.g. see Section 163.3177(d), F.S.

indicator was present in non-wetlands contexts, few Conservation Elements provided details as to which "ecological processes" were intended to be sustained.

The overall focus of county goals reflects foremost a habitat-protection approach to conservation, with a minor focus on protecting species or groups of species. Endangered and threatened species were indicators in every county's Conservation Element, which is again a required part of the element, though counties may also be compelled to recognize them because of the state and federal protections afforded to those species. Indicators for rare and unique or endemic species made up roughly only 8% of the indicators in the Goal-Setting component. Indicators reflecting ecologically material goals for long-term protection of all biodiversity in the planning region, such as "consider multiple levels of biodiversity," "maintain viable populations of all native species in the region," and "represent all ecosystem types" were seldom present. There was also a lack of indicators for quantitative methodological approaches (such as identifying targets, surrogates, and focal species), for protecting biodiversity processes, and for protecting biodiversity from dynamic threats, such as climate change and urbanization.

For the Reserve Selection and Design component, the most frequently occurring indicator was "protect hydrology" in the context of wetlands, riparian areas, river corridors, and estuaries, likely because of the high priority placed on water management in Florida, as well as the attention afforded to water conservation and protection of wetlands in the statute.[21] The indicator "buffer" was also frequently employed, especially in the context of urban, silviculture, and mining land use. A high percentage of indicators occurred that addressed continuity of protected areas, such as "create continuous areas of protected land," "increase connectivity between

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[21] E.g. see Section 163.3177(d)1(a), (d)1(b), 2(j), 2(k), 3, F.S.

protected areas," and "create corridors." Markedly fewer indicators occurred that addressed the design of reserves, however, such as "protect core areas," "protect edge habitats," and "consider protecting reserves of large size." Resources to aid in decision-making about the acquisition and prioritization of protected areas, such as decision support software and reserve selection algorithms indicators, were not found in any documents.

Lastly, indicators in the Management component that appeared most frequently involved restrictions on human use of protected areas, such as building setbacks and pollution restrictions. In some cases restrictions called for passive recreational uses of protected areas. Indicators for prohibitions on hunting and fishing limits were rarely specifically discussed. "Prevent and/or control erosion" was a frequent indicator and fully discussed in terms of specific implementation requirements, in accordance with language regarding soil conservation measures in the statute.[22] Conversely, "restore degraded habitats and systems" was a frequently-mentioned indicator but was not often discussed in detail. The indicators "control invasive species" and "monitor populations, habitats, systems, and human activities" occurred with the next highest frequency. Conservation Elements lacked specific indicators for managing populations and for managing for ecological processes or dynamic threats. The overall low scores for the Management component in this study should be interpreted with caution, however, as they could be attributable to more site-specific management guidelines being set forth in management manuals designed for specific protected areas which were not included in the scope of this study.

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[22] Section 163.3177(d)1(d), F.S.

Variability in Conservation Planning Quality Among Florida Counties

Conservation planning quality was found to be highly variable among Florida counties. A review of the map of Total Plan Scores reflects the highest scores in the Gulf coast counties of southwest Florida (Fig. 5). Alachua and Lake Counties stand out as the only two inland counties with Total Plan Scores in the Very High quality conservation planning tier, with Alachua county having the highest score statewide. High quality tier scores occur primarily in coastal counties on both sides of the peninsula. Low quality tier scores occur in inland peninsular Florida, north Florida and throughout the Florida Panhandle. Total Plan Scores were significantly higher for coastal counties than inland counties, and the South Florida region had significantly higher Total Plan Scores than the Florida Panhandle region.

That variability is likely attributable to socioeconomic and political differences among counties in different areas of the state. Analysis of socioeconomic variables found significant differences in several demographic indicators among Florida coastal and inlands counties and among regions, including education, population density, wealth, political affiliation, and environmental values (Appendix E). Education levels were significantly higher for coastal counties (median percent bachelor's degree 25%) than for inland counties (median percent bachelor's degree 12.4%). Similarly, Florida's central and southern regions have significantly higher median education levels (percent bachelor's degree Region 3 (Central Florida) = 20%; percent bachelor's degree Region 4 (South Florida) = 26%) than Region 2 (North Florida) (percent bachelor's degree = 12%), (though interestingly not Region 1 (Florida's Panhandle) which has a median percent bachelors degree of 17.5%). In other studies, high quality environmental protection and planning has been associated with high education level of the

public (Brody et al. 2004; Kline 2006). Highly-educated populations tend to be more knowledgeable about environmental issues than less well-educated populations (Robelia & Murphy 2012). Highly educated populations have a corresponding high likelihood of supporting actions that protect biodiversity and the environment (Bjorkland & Pringle 2001; Tang et al. 2009; Stokes et al. 2010; Robelia & Murphy 2012).

Population density was also significantly different across the state. Coastal counties have significantly higher population densities than inland counties. The median population density for coastal counties is 277.30 persons per square mile (mean=508.15), compared to inland counties whose median is only 58.95 persons per square mile (mean=207.36). Central Florida also has significantly higher populations densities than northern and Panhandle Florida counties. Mean population density in Central Florida is 451.50 persons per square mile, versus 46.75 for Region 1, 92.70 for Region 2, and 270.90 for Region 4. The Florida Panhandle region has the lowest population density and least urbanization pressure. Median Panhandle population growth was 62.5% from 1980-2012, compared to 99% for Region 2, 148% for Region 3, and 122% for Region 4. Where high levels of population density and urbanization occur, more attention is directed to the protection of open space (which includes parks and protected areas) and development of higher-quality environmental and conservation plans, which reflects the negative impact of urbanization on quality of life and biodiversity persistence (Brody et al. 2004; Kline 2006).

Variables measuring wealth were also significantly different for Florida counties. With larger populations, coastal counties have significantly higher overall total county revenues (coastal total county revenues median (in $thousands)=$341,055) than inland counties (inland

total county median (in $thousands)=$58,052). Similarly, Regions 3 and 4 have significantly

higher total county revenues (Region 3 total county revenues median (in $thousands)=$635,200;

Region 4 coastal total county revenues median (in $thousands)=$359,313) than Region 1

(Region 1 coastal total county revenues median (in $thousands)=$40,305) and Region 2 (Region

2 coastal total county revenues median (in $thousands)=$56,578). Total county revenues are

highly variable among Florida counties, however. Mean total county revenues for coastal

counties range from $28,750 (Dixie County) to $9,080,000 (Miami-Dade County). For inland

counties, total county revenues range from a low of $15,242 (Lafayette County) to a high of

$2,213,055 (Orange County). Coastal counties also had significantly higher median household

incomes (coastal county median $48,225) than inland counties (inland county median $41,288),

though there were no significant differences in median household income among regions.

Wealthy jurisdictions have been associated with high levels of environmental protection, likely

because they have the financial resources required to support large and well-equipped planning

departments (Brody et al. 2004).

Florida coastal counties have significantly higher percentages of Republican registered

voters (39.8% than inland counties (34.1%), though political party affiliation differences were

not significant among regions. Based on the results of the survey, coastal counties also had

significantly higher Total Values Scores than inland counties, (coast county mean=34.41, inland

county mean=30.56), which indicates that biodiversity conservation may be more important for

coastal counties. There were also significant difference in Total Values Scores between Region 1

and Region 4, where Panhandle counties had significantly lower scores than South Florida,

indicating biodiversity conservation may be a lower priority (Appendix D).

Resource-related indicators were also significantly different across the state. Coastal counties have significantly higher percentages of conservation lands that are county-owned (median=2.58%) than inland counties (median=0.37%), which likely reflects higher county budgets that have money to spend on acquiring and managing conservation lands. Not surprisingly, Region 1 (which has the lowest total county revenues) has a significantly lower amount of county-owned conservation lands (median=0.06%) than Region 3 (median=6.85), as well as the lowest median total county revenues of the three regions. Total Resources Scores were also significantly higher for coastal counties (coastal mean=148.06) than for inland counties (inland mean=104.21), which means that coastal counties have more financial resources as well as educational, human, institutional, and informational resources than inland counties. Total Resources Scores also differed significantly between Regions 1 and 4, where the Panhandle counties had significantly lower scores (Region 1 mean=117.7) than South Florida counties (Region 4 mean=150) (Appendix D).

Variability among Florida counties is also likely attributable to collaboration, as significant differences were found in Total Collaboration Scores between coastal and inland counties, though not between Florida regions (Appendix D). The degree to which a county collaborates with other jurisdictions for conservation planning is likely related to resource availability, though other factors may also come into play, such as county government institutional structure, political commitment and will, and existing communication channels between counties.

It is important to note that some of the higher scores for coastal counties could also be attributable to indicators in the Conservation Element that integrated some provisions from the

Coastal Element, which is required for coastal counties but not for inland counties, which indicators were difficult to disentangle in some cases (such as Collier county). Counties other than Collier had separate sections for coastal and conservation provisions within the Conservation Element, or separate Conservation and Coastal Elements altogether. The higher scores for coastal counties could also be in part attributable to more regulatory requirements (federal, state, county) for coastal management.

Higher coastal county conservation planning quality scores may also be related to more numerous Conservation Element indicators for protection of wetlands (though coastal wetlands specifically would be addressed in the Coastal Element) and river corridors in estuarine areas. Hydrology was the most frequently scored indicator under the Reserve Selection and Design component, and as such, counties with large bodies of water like rivers and estuaries in their boundaries included more measures for their conservation.

Finally, this study found that the variability in conservation planning quality among Florida counties also has a spatial component, in that Total Plan Scores were spatially autocorrelated. Under Walter Tobler's First Law of Geography, "everything is related to everything else, but near things are more related than distant things" (Longley et al. 2005). Interestingly, mean regional Total Plan Scores increased progressively from the northern to the southern part of the state (Panhandle Region 1 mean=10.12; North Florida Region 2 mean=11.17; Central Florida Region 3 mean=13.89; South Florida Regions 4 mean=14.33). Significant differences in Total Plan Score were found between Regions 1 and 4, which are the furthest apart. A well-recognized tenet of policy theory, deemed policy transfer or diffusion, is that actors in neighboring jurisdictions often borrow policies from one another (King & Mori

2007). Neighboring jurisdictions have been found to have more similar public policies than jurisdictions that are more distant in several studies (Canon & Baum 1981; Jensen 2003; King & Mori 2007; Sugiyama 2008; Baybeck et al. 2011). In this study, the differences between Region 1 and Region 4 in conservation planning quality therefore may be a result of policy diffusion processes impacting the selection and adoption of information, methodologies and activities set forth in the Conservation Element. This hypothesis is investigated in Chapter Three.

Climate Change and Sea Level Rise

Analysis of the frequency of indicators having to do with climate change and sea level rise in this study revealed that those issues have been only weakly institutionalized into county conservation planning and Conservation Elements in a small percent of coastal counties. The variability in use of predictive models, in considering goals for protecting biodiversity from these threats, and in devising management strategies shows that, at this time, there is a great deal of heterogeneity in either the embracement of climate change and sea level rise predictions, or in the determinations about what responsive measures should be taken.

Another explanation for the dearth of climate change and sea level rise indicators in the Conservation Element is that counties may have separate documents specifying their response plans for climate change and sea level rise changes, and thus this study did not capture those elements.

Multiple Regression Analysis: A Predictive Model of Conservation Planning Quality

Multiple regression analysis produced a best model with three predictors: total resources, percent bachelor's degree, and log-transformed total county revenues.

Log Total Plan Score = $1.171 + 0.003$(Total Resources$_i$) + 0.011(Percent Bachelors Degree$_i$) + 0.054(Log Total County Revenue$_i$) + error   Model1

These results indicate that the null hypothesis should be rejected, as there is no support for alternative hypotheses that conservation planning quality is influenced by demographic, resource availability, or collaboration variables alone. The confidence set of models provide strong evidence that education, county revenues, resource availability, collaboration, and the amount of conservation land that is county-owned are the key drivers of conservation planning quality for Florida county governments.

Resource availability and education as the most important predictors of conservation planning quality, however. These two explanatory variables were present in all three confidence set models, and also had the highest importance weights of 88% each. Both of these variables are 2-4 times more likely to explain conservation planning quality in repeated samples. Looking at the 95% confidence intervals for the composite model, the slope for total resources is somewhere between 0.0037 and 0.0022, and the slope for percent bachelor's degree so somewhere between 0.0251 and 0.0048. Both of these predictors have tight confidence intervals, which indicates that the model is reflecting accurate relationships between these predictors and the outcome variable. Because the confidence interval for total resources is narrower, however, this parameter is more significant in the composite model than percent bachelor's degree.

The lesser predictive strength of the other model parameters is evident from examination of the standard errors and 95% confidence intervals. The 95% confidence intervals for the other three parameters cross zero, indicating that in some samples the predictors have negative relationships to the outcome, and in other samples the predictors have positive relationships. Of the three, log-transformed total county revenue has the widest confidence interval, indicating it is the least representative parameter in the model. It also has the highest standard error of all of the parameters, 0.06. In the model, log-total county revenues has a positive relationship with the outcome (coefficient=0.054), but in some cases high total plan score is predicted by a negative value, or low total resources. This indicates that while total county revenue contributes to the overall total resources a county devotes to conservation, a county's financial capability is not necessarily the best predictor of conservation planning quality.

In the composite model the confidence intervals for the other two predictors, total collaboration and log-transformed percent county conservation lands county-owned, also cross zero. The percent conservation lands that are county-owned variable has a positive relationship to the outcome (coefficient=0.027), which would be expected since higher conservation planning quality necessarily involves more conservation land holdings. The significance of this parameter in the model supports the findings that coastal counties had more conservation lands that were county-owned than inland counties, and that Region 3 had significantly more county-owned conservation lands than Region 1. However, the model suggests that in some cases higher conservation planning quality is related to fewer county-owned conservation lands. In those cases, it may be that counties with fewer county-owned conservation lands put more effort and resources into the other components of conservation planning quality for the fewer county-

owned conservation lands they do own, such as higher quality biodiversity status assessments, higher conservation goals, more considerations for reserve selection and design, higher levels of collaboration, and more considerations and activities in management.

The third parameter, Total Collaboration, has a surprising negative relationships to the outcome (coefficient=−0.007), but the 95% confidence interval also crosses zero, which means that in some cases conservation planning quality is related to low collaboration, and sometimes high overall collaboration. The significance of this parameter in the composite model reflects the finding of significant differences between inland and coastal counties in total collaboration, though there were no significant differences between regions. It is expected that higher quality conservation planning would be positively related to high levels of collaboration. Low levels of collaboration and high levels of conservation planning may occur either where other components of conservation planning are higher, as with the percent conservation land county-owned predictor.

CHAPTER THREE: ARE POLICY PROCESSES INFLUENCING THE SPATIAL PATTERN OF CONSERVATION PLANNING QUALITY AMONG FLORIDA COUNTY GOVERNMENTS?

The policy sciences literature offers several models of the policy-making process that attempt to explain the reasons governments adopt policies. Some models see policy adoption as heavily influenced by the political, economic, and social factors within a political jurisdiction (Berry & Berry 2007; Ingle et al. 2007a). These *internal determinants models* focus on the role of actors in the policy-making process, such as interest groups and politicians, while others focus on the role of institutions, and some models find explanations for policy adoption in combinations of the two (Ostrom 1990; Lubell et al. 2005; Ramirez de la Cruz 2009; Knox 2010). Other internal determinants models focus on intrajurisdictional influences such as the economic, political and social environment as the main determinants of whether and if policies are adopted (Ingle et al. 2007b).

In contrast to internal determinant models, *diffusion models* posit that policy adoption is fundamentally a function of formal and informal communication channels between governments, geography, and practical considerations of efficiency and cost (Walker 1969; Rose 1991; King & Mori 2007; McCann & Ward 2013; Obinger et al. 2013). Policy diffusion refers to the general process by which "knowledge about policies, administrative arrangements, institutions and ideas in one political system …is used in the development of policies…and ideas in another political system" (Dolowitz & Marsh 1996, 2000; King & Mori 2007; Marsh & Sharman 2009). Policy diffusion in some cases is viewed as the spread of innovation, where one government develops a novel policy, which is then communicated to other governments and subsequently adopted by them (Canon & Baum 1981). In other cases, policy diffusion is characterized more as the

borrowing of (not necessarily new) policies from one jurisdiction for use in another, which is called policy transfer (King & Mori 2007). Governments commonly borrow policies or adapt the policies of other jurisdictions to their own circumstances, making policy diffusion or transfer an important driver of the policy-making process (King & Mori 2007; Baybeck et al. 2011; Benson & Jordan 2011).

Policy diffusion or transfer occurs through several different mechanisms, which may themselves be intertwined (Braun & Gilardi 2006; Shipan & Volden 2008; Marsh & Sharman 2009). Learning or lesson-drawing models argue that diffusion occurs as a result of efforts to simplify complex problems and take "decision-making shortcuts" (Rose 1991; Dolowitz & Marsh 2000; Berry & Berry 2007). Where one government adopts a policy that turns out to be successful, the policy is subsequently adopted in other jurisdictions as well in an effort to replicate positive policy outcomes with the minimum investment of resources (Rose 1991; Berry & Berry 2007; Marsh & Sharman 2009). Policy diffusion may also occur because of competition among governments, such as where jurisdictions compete with neighboring jurisdictions, such as for students, revenues, and jobs (Berry & Berry 2007; Ingle et al. 2007b; Marsh & Sharman 2009). A third cause of diffusion may be coercive pressure. Mandates from higher levels of government may require governments to adopt certain policies (Dolowitz & Marsh 2000; Shipan & Volden 2008; Marsh & Sharman 2009). Jurisdictions may also respond to pressures to embrace "shared norms" of professional conduct, communicated through professional organizations and publications, which leads to the adoption of policies from other jurisdictions (Rose 1991; Jensen 2003; Berry & Berry 2007). The fourth mechanism of policy diffusion is mimicry, where policies are adopted simply out of the desire to mimic another jurisdiction that is

seen as a "social leader." Mimicry has little to do with the policy itself and more to do with

following social norms (Marsh & Sharman 2009; Obinger et al. 2013).

It is well-established in the literature that policy diffusion or transfer occurs most readily

among neighbors, those political jurisdictions that share a border (Berry & Berry 2007; Ingle et

al. 2007b; Cho & Nicley 2008; Baybeck et al. 2011; Obinger et al. 2013). The greatest influence

on policy adoption comes from bordering jurisdictions because jurisdictions that are

geographically proximate are likely to share communicative channels (Berry & Berry 2007; Cho

& Nicley 2008). The communicative channels occur as formal or informal networks in the form

of professional associations, at the state, regional, and national level (Ingle et al. 2007b). These

neighbor models apply primarily to cases involving learning or competition mechanisms of

diffusion, and have been used to explain variability in policies adopted by neighboring

jurisdictions under those circumstances (Berry & Berry 2007, Sabatier 2007). Under coercive

mechanisms of diffusion, however, neighbor models become less applicable and there is more

homogeneity in policy adoption among geographically proximate jurisdictions. Where policies

are adopted because of mandates, whatever heterogeneity exists occurs where lower jurisdictions

have some discretion and autonomy in developing policies given the overall mandate (Berry &

Berry 2007).

<u>What Is The Spatial Pattern Of Conservation Planning Quality Among Florida Counties?</u>

In the case of conservation planning by Florida county governments, the quality of

conservation planning was found to be highly variable ranging from a low quality of 5.72 to a

high quality of 24.76, out of a total possible score of 50 points. It was determined that

conservation planning quality differs significantly in various respects between Florida regions (Panhandle and South Florida) and between inland and coastal counties, indicating that conservation planning quality is influenced by geography. The multiple regression analysis indicated that conservation planning quality is primarily a function of the education level of the citizenry and of the total resources allocated to conservation planning. However, the best regression model based on AICc values has a likelihood of 37%, which means that other factors are also contributing to the variability. The question I explore here is, can some of the variability in conservation planning quality among Florida counties be explained by the diffusion or transfer process of policy-making?

Conservation planning quality is, in part, a function of the language and provisions set forth in the Conservation Element of the local comprehensive plan. Mandated by state law, each county's Conservation Element is a *policy instrument*, defined as "the method or mechanism used by government, political parties, business or individuals to achieve a desired effect, through legal or economic means" (King & Mori 2007; Peters 2010). The Florida Growth Management Act of 1985 mandates that counties develop Conservation Elements to guide conservation planning in an attempt to unify and standardize counties to achieve state goals, yet the Act allows counties autonomy in developing their own conservation planning policy provisions. The variation in conservation planning among Florida counties reflects that autonomy in decision making. Despite the state-mandated and standardized checklist of requirements designed to standardize Conservation Elements, coastal and inland counties and some regions differ significantly in certain aspects of the quality of their conservation plans. The diffusion or transfer among neighboring counties of values, goals, ideas, knowledge about sources of biological

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information, reserve design methodologies and management techniques, and the conservation element policy instrument itself may be a cause of some of this variability.

Spatial analysis can be used to characterize spatial patterns of phenomena and determine if those patterns are non-random. Significant non-random patterns indicate, in turn, that values from nearby locations are not independent and that spatial processes are responsible for the spatial pattern across the study area (Lee & Wong 2001; Chaikaew et al. 2009). Understanding the spatial pattern can lead to an understanding of the spatial processes causing that pattern (Wong & Lee 2005).

Spatial patterns can be clustered, dispersed, or random. A clustered spatial pattern suggests there is a positive spatial relationship among neighboring units due to some shared similarity among them, while a dispersed pattern implies a negative or repulsive spatial relationship among neighbors due to differences among them. A random pattern suggests there is no particular structure or system controlling the pattern (Lee & Wong 2001; Wong & Lee 2005). Spatial pattern analysis involves two scales of measurement: global and local. Global spatial analysis describes the overall spatial relationship of all of the features in the study area. In global analysis, the similarity and dissimilarity of units across the entire distribution is measured to determine if broad-scale spatial clustering exists. A finding of significant global spatial autocorrelation means that correlations among values are due to a broad geographic pattern (Lee & Wong 2001). Spatial autocorrelation is also measured for its strength, such that strong positive or negative spatial autocorrelation implies a significant spatial relationship among features and weak spatial autocorrelation suggests a close-to random pattern and no real spatial relationship (Lee & Wong 2001; Wong & Lee 2005).

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Global spatial autocorrelation statistics do not account for heterogeneity across the study area at smaller scales, however. To capture the heterogeneity within the overall global distribution, local spatial autocorrelation analysis is used (Lee & Wong 2001; Lloyd 2010). Local spatial autocorrelation identifies statistically significant clusters of features where high values are grouped together, or hot spots, and locations where low values are clustered together, or cold spots (Wong & Lee 2005). Local spatial analysis can also be used to identify spatial outliers, where high values are surrounded by low values, and vice versa. Local spatial statistics can thus identify significant patterns of similarities and differences which result from spatial processes at local scales.

Spatial pattern analysis using geographic information systems (GIS) has been used in many aspects of social science research to inform policy (Cho & Gimpel 2012). For example, spatial analysis has been employed to characterize the spatial pattern of disease, (Chaikaew et al. 2009), to understand the socio-economic factors underlying human population spatial distribution, (Lloyd 2010), to explore the spatial pattern of human poverty and how it relates to socio-economic drivers (Khamis & El-Refae 2012), to analyze the effect of ballot-box distance on voter turn-out (Gimpel & Schuknecht 2003), and to understand the spatial relationship between alcohol-related violence and land use (Pridemore & Grubesic 2012).

Spatial analysis has also been applied in the policy sciences field to evaluate diffusion theory. Baybeck et al. (2011) examined the adoption of lotteries among American states and found that lottery policy diffused across geographically proximate states as a result of competition for revenues. A similar study used spatial analysis to examine the diffusion of state lotteries and welfare benefits, finding that diffusion due to competition applied to the adoption of

lottery policies but not welfare benefits policies (Berry & Baybeck 2005). Cho and Nicely (2008) used spatial analysis to examine the role of state borders in policy-making, finding that similar political behavior and policies cluster together in geographically proximate areas, notably among nearby counties, but that state borders create barriers between types of voting behavior (Cho & Nicely 2008). In a study examining the spatial pattern of campaign donation behavior, spatial analysis showed that ethnic networks drive the diffusion of spatial pattern of campaign contributions (Cho 2003). Brody et al. (2003) used spatial pattern analysis to characterize the spatial pattern of Florida local government watershed management plans. That study found that high quality plans clustered around other high quality plans, or hot spots, suggesting an underlying process of information-sharing, communication, and collaboration (diffusion) among some local governments.

Here, I employed spatial analysis to describe the spatial pattern of conservation planning quality and determine if variability in conservation planning can be explained in part by diffusion theory (Cho & Gimpel 2012). First, I tested the hypothesis that there is a non-random pattern of conservation planning quality among Florida counties across the entire study area using global spatial autocorrelation analysis. A result of significant spatial clustering at the global level implies that county conservation planning quality is not independent and is influenced by geography (Khamis & El-Refae 2012). Second, I tested the hypothesis that there is non-random spatial clustering of conservation planning quality among neighboring counties at a local scale using local spatial autocorrelation analysis. A result of non-random spatial clustering at the local level indicates which neighboring counties are adopting similar or dissimilar policies and implies that positive or negative diffusion is influencing county conservation planning quality.

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Global Spatial Analysis

Component Plan Score data (Biodiversity Status Assessment, Goal-Setting, Reserve Design and Selection, and Management components) and Total Plan Score data from the analysis of Florida county Conservation Elements (see Chapter Two above) were analyzed for global spatial autocorrelation using ArcGIS 10.0. I used the Moran's I test statistic, which evaluates whether the overall pattern of conservation planning quality scores in the study area is clustered, dispersed, or random. The Moran's I is an exploratory statistic and does not provide information about autocorrelation between specific neighbors, but does evidence the general tendency of values to be related across the study areas (Cho & Nicley 2008; Baumont 2009; Khamis & El-Refae 2012). The null hypothesis was no spatial clustering of the values associated with the geographic features in the study area (Lentz 2009).

A spatial weights matrix was created to model the spatial relationships among counties for the global spatial autocorrelation statistics calculations. The spatial weights applied to neighboring counties were based on an inverse distance conceptualization of spatial relationships, where the impact of one county's values on another county decreases with distance (a distance-decay model). I specified that a minimum of ten neighbors would be considered for each county's calculations, and that no threshold distance or distance band would be imposed (Lee & Wong 2001; ESRI 2012). With no threshold distance, all counties are considered in the calculations of target counties, though more distant counties have a lesser impact than more proximate counties (Lee & Wong 2001; Obinger et al. 2013). Maps were created in ArcGIS 10.0.

The Natural Breaks (Jenks) method was used to divide data into low, middle, and high value categories.

Local Spatial Analysis

Next, I used local spatial autocorrelation analysis in ArcGIS 10.0 to explore the spatial pattern of conservation planning quality among neighboring counties for Component Plan Score and Total Plan Score data. I used two methods of local spatial pattern analysis, or *local indicators of spatial association (LISAs):* Hot Spot Analysis and Cluster & Outlier Analysis. Because the focus of this study is to understand if a neighbors model of diffusion can explain some of the variation in conservation planning quality, I used a first-order polygon continuity "edges-corners" conceptualization of spatial relationships for both statistical methods. Under this model, neighbors are defined as any counties sharing a boundary or a node with a target county (Cho & Nicley 2008; ESRI 2012). The model employs no threshold distance and uses no minimum number of neighbors. Therefore, the local spatial autocorrelation statistics are calculated based on only neighbors sharing a boundary or node with a target county.

Hot Spot Analysis uses the Getis-Ord Gi* statistic to measure the degree to which high or low values in a study area are concentrated (Chaikaew et al. 2009). The null hypothesis was that there was no local spatial clustering of values. If the null hypothesis is rejected due to a small p-value, a positive Z-score indicates that high values cluster together in the study area and a negative Z-score indicates that low values cluster together. The higher or lower the Z-score, the stronger the intensity of the clustering (Lentz 2009).

Cluster & Outlier Analysis employs Anselin's Local Moran's I statistic to identify

clusters of features that share values similar in magnitude, and identifies outliers--features with

values very different from surrounding feature values. The local Moran's I provides more

information and more refined analysis about how individual counties are related to their

neighbors, and provides an indication of which type of spatial autocorrelation exists and where

(Cho & Nicley 2008). A positive Moran's I statistic indicates the county is surrounded by other

counties with similar scores and thus part of a cluster, which may be a cluster of low scores

(negative Z-score) or high scores (positive Z-score). If the cluster is statistically significant at the

p=0.05 level, it is labeled HH (high value surrounded by high values), or LL (low values

surrounded by low values). A negative Moran's I statistic indicates the feature is an outlier.

Statistically significant outliers are labeled LH (low value surrounded by high values) or HL

(high value surrounded by low values) (Lentz 2009). Significant clusters imply that spatial

processes are influencing conservation planning among neighboring counties, which may include

diffusion.

<u>Results</u>

Global Spatial Autocorrelation

For the Components of conservation planning quality, the Biodiversity Status Assessment

and Goal-Setting Component Score data each exhibited spatial patterns that were not

significantly different from random (Biodiversity Status Assessment Component Score: Moran's

I=-0.195, p=0.814; Goal-Setting Component Score: Moran's I=0.019, p=0.068). However,

Coordination, Reserve Selection and Design, and Management Component Score data all

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occurred in a statistically significant clustered pattern with a less than 1% likelihood that the

patterns could be the result of random chance (Coordination Component Score: Moran's

I=0.059, p<0.001; Reserve Selection and Design Component Score: Moran's I=0.053, p<0.001;

Management Component Score: Moran's I=0.053, p<0.001).

Coordination Component Score data had low-score clusters (2.50 - 4.16) in north Florida,

medium score clusters in central and southeast Florida (4.17 – 5.83), and high scores in

southwest Florida (5.84 – 9.17) (Fig.6).
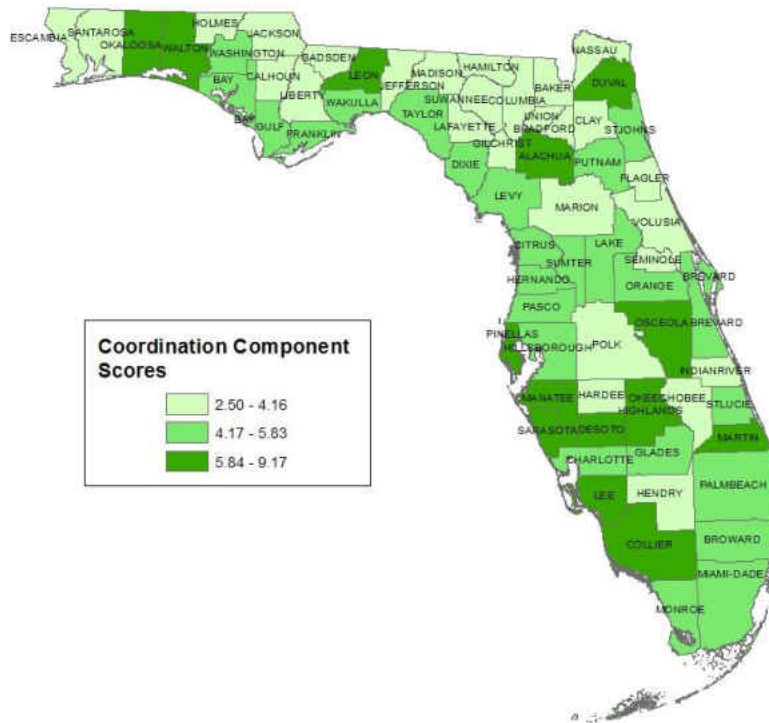
Figure 6.Coordination Component Score data grouped into three tiers showing nonrandom clustering, where lowest scores cluster in northern Florida, middle scores cluster in central and southeast Florida, and highest scores cluster in southwest Florida.

For the Reserve Selection and Design component, low-score clusters occur in the Panhandle, in north Florida, middle inland Florid and in southeast Florida (0 – 1.78), medium scores cluster in the Panhandle and eastern Florida (1.79 – 3.57), and a high-score cluster occurs in southwest Florida (3.58 – 6.07) (Fig.7).
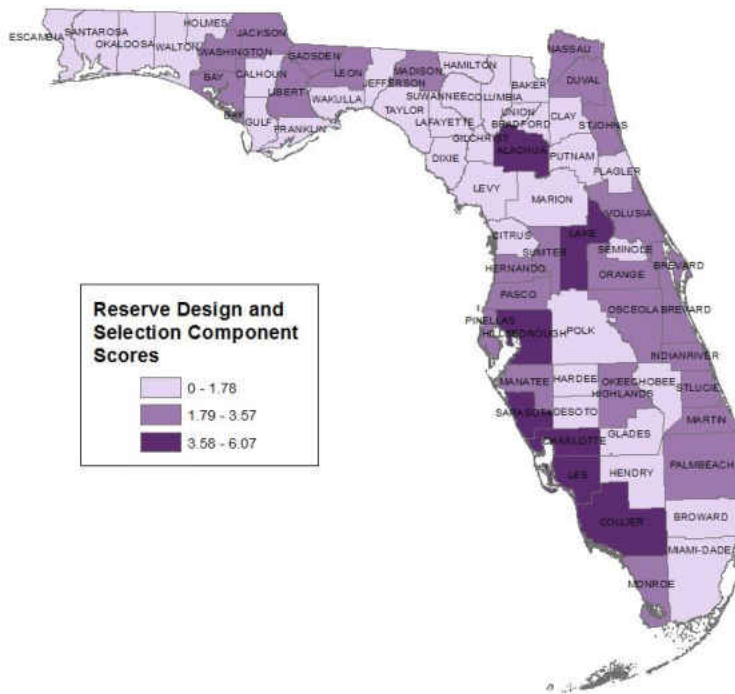
Figure 7. Reserve Selection and Design Component Score data grouped into three tiers showing nonrandom clustering, where lowest scores are clustered in the Panhandle, northern, middle-inland and southeast Florida, middle scores are clustered in the Panhandle and eastern Florida, and highest scores are clustered in southwest Florida.

For the Management component, low-score clusters occur in northern and inland Florida (0 – 0.92), medium score clusters in the Panhandle and central and southeast Florida (0.93 – 2.03), and high scores cluster in southwest Florida and in a stepping-stone pattern from central-eastern Florida northward to Alachua and Duval Counties (2.04 – 4.07) (Fig.8).
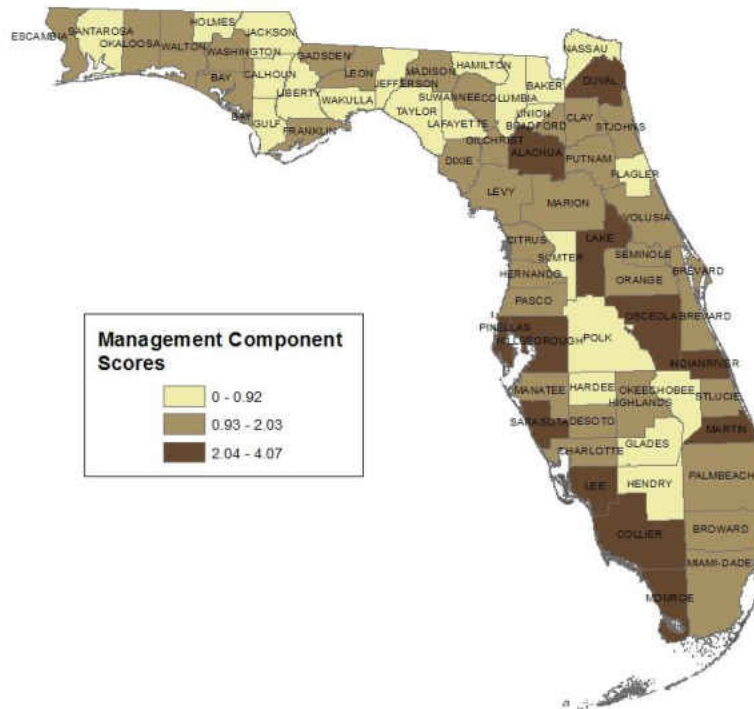
Figure 8. Management Component Score data grouped into three tiers showing nonrandom clustering, where lowest scores are clustered in northern and middle-inland Florida, middle scores are clustered in the Panhandle, central and southeastern Florida, and highest scores are clustered in southwest Florida and central eastern Florida.

Total Plan Score data were globally spatially autocorrelated (Moran's I= 0.045, p=0.001) With Total Plan Score data divided into three groups and mapped, low score counties (5.72-11.13) cluster in the Panhandle/North Florida and inland Florida areas southward through the peninsula, middle score counties (11.14-16.02) cluster along the coasts, and high scoring counties (16.03-24.76) cluster in western/southwestern Florida with a stepping-stone structure from eastern Florida through the inland counties of Osceola, Lake, Alachua, up to northeastern Duval County (Fig. 9).
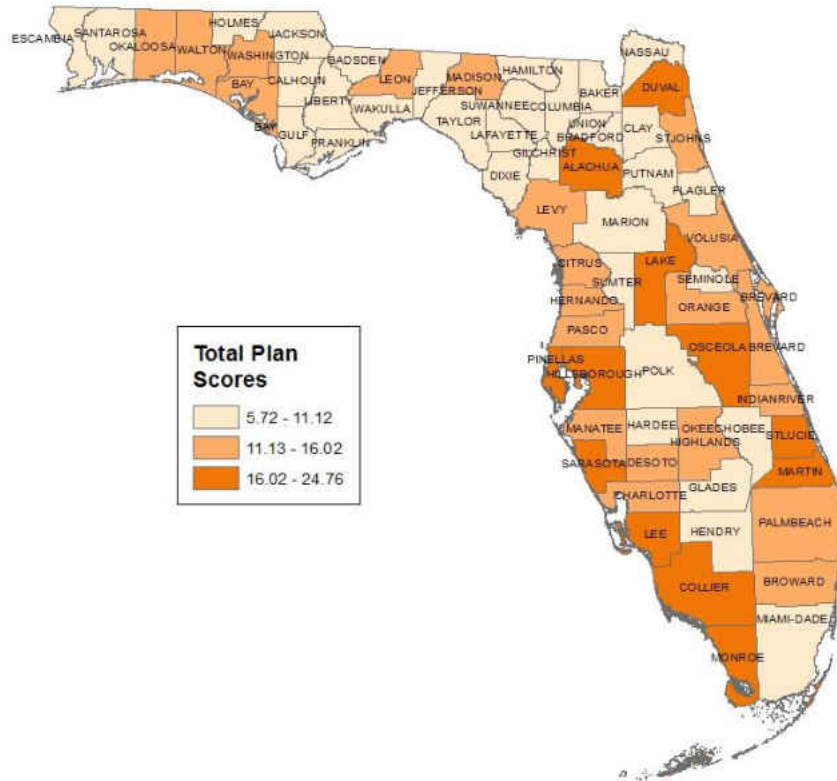
Figure 9. Total Plan Scores grouped into three tiers showing nonrandom clustering, where lowest score clustered in northern and inland Florida, middle scores cluster in coastal Florida, and highest scores clustered in western/southwestern Florida, eastern and central Florida.

Local Spatial Autocorrelation

For the Biodiversity Status Assessment Component data, Hot Spots Analysis revealed the most intense clustering of high scores at the p=0.05 level around St. Lucie county (Z=2.38, p=0.017, score=4.09), and around Monroe County (Z=2.04, p=0.040, score=3.18). Less intense

clusters of high Biodiversity Status Assessment Component Scores at the p=0.10 level occurred around Indian River (Z=1.87, p=0.061, score=1.81) and Miami-Dade (Z=1.78, p=0.070, score=0.45) Counties (Fig. 10a) However, Clusters & Outliers Analysis revealed that Miami-Dade County is an outlier (LH) with a low score of 0.45, surrounded by high-scoring counties (I=-1.808, Z=-3.25, p=0.001) (Fig. 10b). Lake County is also an outlier (HL) with a high score of 3.63 by low scores (I=-1.23, Z=-3.47. p<0.001).
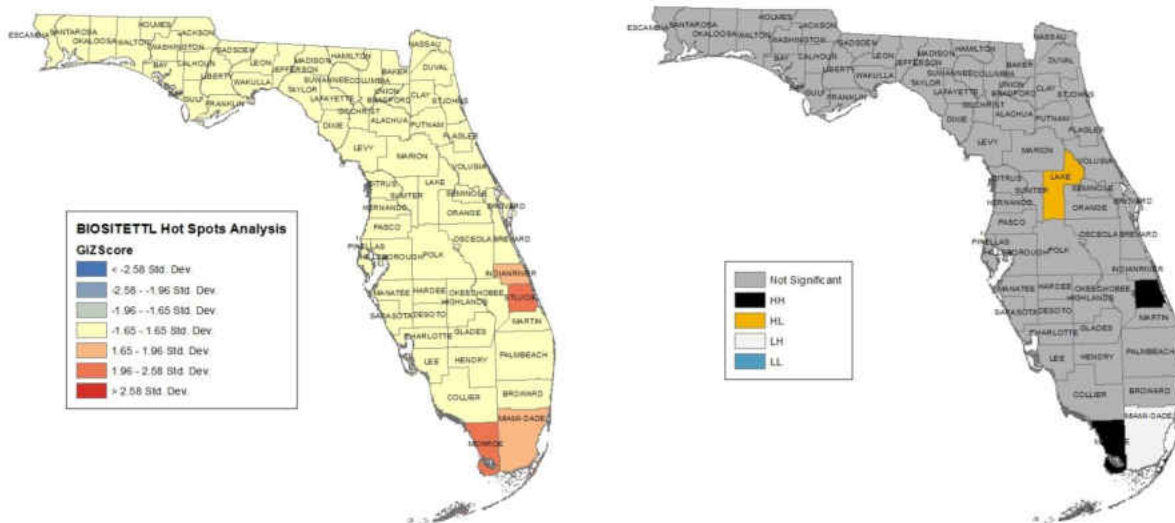
Figure 10. LISAs for Biodiversity Status Assessment Component Score data. (a) Hot Spots Analysis reveals high clusters at the p = 0.05 level around Monroe and St. Lucie Counties and high clusters at the p = 0.10 level around Miami-Dade and Indian River counties; (b) Clusters & Outliers Analysis results show two significant clusters of high Biodiversity Site Assessment Component Score data surrounded by high scores around Monroe and St. Lucie Counties. Miami-Dade County is a low-score outlier surrounded by high scores, while Lake County is an outlier with high score surrounded by low-scoring counties.

For the Goal-Setting component data, a cluster of low-scoring counties (cold spot) significant at the p=0.05 level exists in the Panhandle area around Franklin (Z=-2.507, p=0.012, score=1), Wakulla (Z=-2.412, p=0.015, score=1.6), and Liberty (Z=-2.144, p=0.031, score=1.2), Counties. In central Florida, a cluster of high-scoring counties significant at the p = 0.10 level occurs surrounding Marion County (Z=1.879, p=0.060, score=2.4) (Fig. 11a). Cluster & Outliers

analysis shows a cluster of low scoring counties surrounded by other low scoring counties significant at the p=0.05 level around Franklin (I=1.68, z=3.060, p=0.002) and Liberty (I=0.80, Z=2.319, p 0.020) Counties (Fig. 11b).
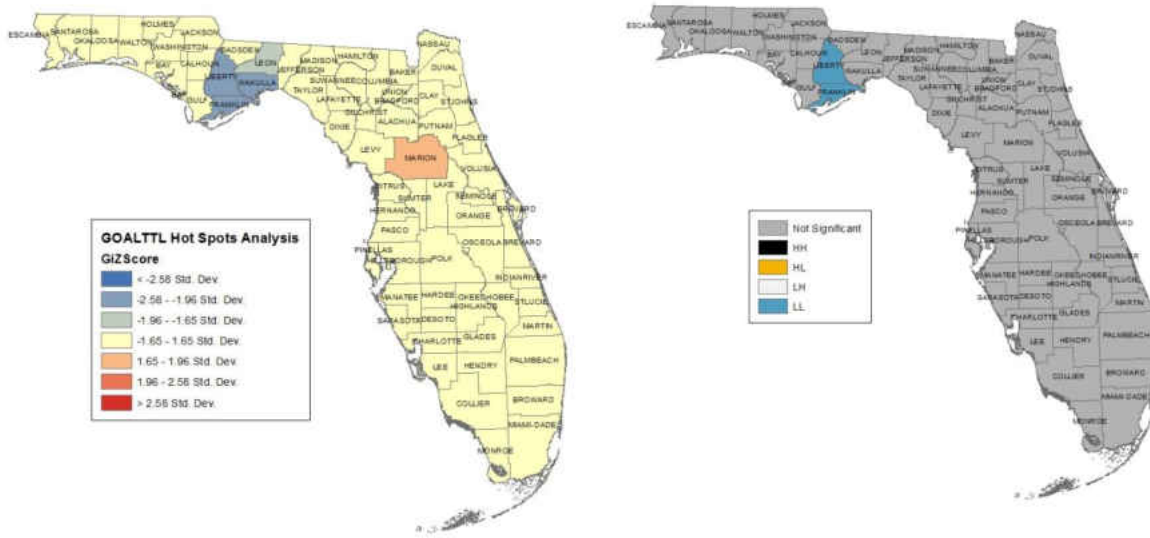
a)   b)

Figure 11. LISAs for Goal-Setting Component Score data. (a) Hot Spots Analysis shows a low-score cluster at the p = 0.05 level in the Panhandle around Franklin, Wakulla and Liberty Counties; (b) Clusters & Outliers Analysis results confirms the cold spot for Goal-Setting Component Scores (low score cluster) in the Panhandle.

For Coordination Component Score data, one hot spot significant at the p=0.05 level occurs in central/southwest Florida. The most intense high-score clustering occurs around Sarasota County, (Z=3.277, p=0.001. score=9.16). One cold spot occurs in northern Florida and the cold spot counties share similar levels of cluster intensity: Suwanee County (Z=-2.46,

p=0.013, score=4.16), Columbia County (Z=-2.099, p=0.035, score=3.33), Baker County (Z=-2.099, p=0.035, score=2.50), Hamilton County (Z=-2.071, p=0.038, score=2.50), Madison County (Z=-2.227, p=0.025, score=4.16) (Fig. 12a). Clusters & Outliers analysis confirmed the high and low clusters around Sarasota (HH) and Columbia (LL) Counties. Alachua County (I=-1.769, Z=-4.929, p<0.001) is an outlier with a high score of 8.33 surrounded by low-scoring counties (HL) for the Coordination Component (Fig. 12b).
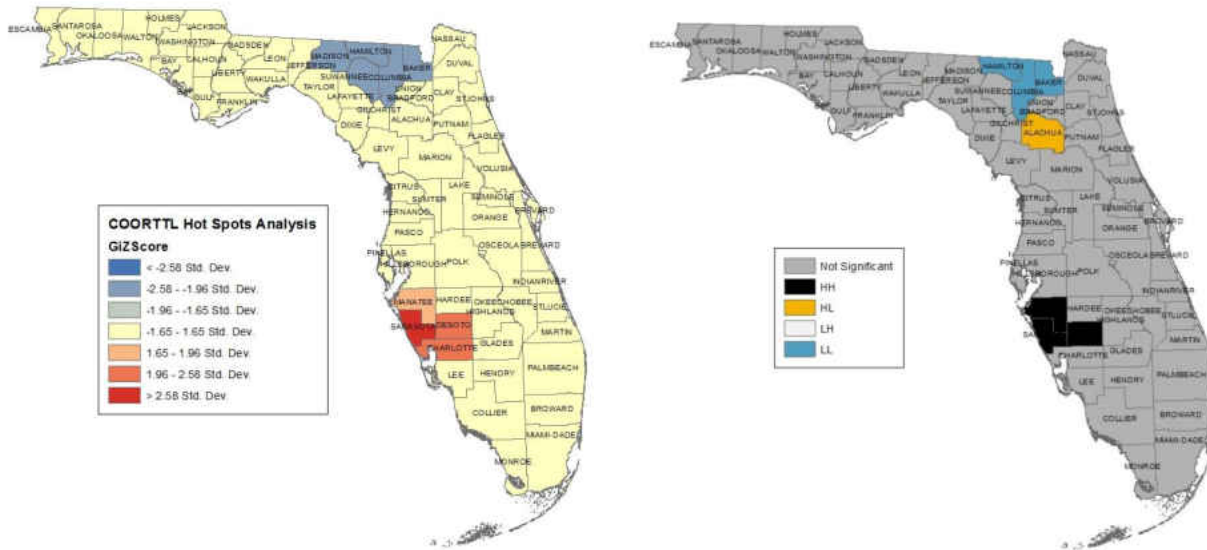
Figure 12. LISAs for Coordination Component Score data. (a) Hot Spots Analysis shows a cold spot low-score cluster at the p = 0.05 level in northern Florida and a hot spot high score cluster in central coastal Florida; (b) Clusters & Outliers Analysis results confirms the significant low score cluster (LL) in northern Florida and high score cluster (HH) in central/southwest Florida, and also indicates Alachua County is an outlier with a high score for the Coordination Component surrounded by low-scoring counties.

For Reserve Selection and Design Component Score data, two hot spots occur at the p=0.05 significance level, one surrounding Lee County (Z=2.082, p=0.037, score=3.92), and one surrounding Pinellas County (Z=2.279, p=0.022, score=2.85), both of which are located on Florida's west coast. Less-intense clustering of high scores at the p=0.10 for Reserve Selection and Design Component Score data also occurs on the west coast around Sarasota (Z=1.847, p=0.064, score=4.64) and Monroe (Z=1.933, p=0.053, score=3.21) counties (Fig 13a). Clusters-

Outliers Analysis also showed a high cluster of scores (HH) around Lee County (I=1.110, Z=2.349, p=0.018) in southwest coastal Florida, and two outliers: Alachua County is a high-scoring outlier (HL) with a score of 5.0 surrounded by low-scoring counties (I=-1.439, Z=-4.027, p=0.000), and Polk County, a low-scoring outlier (LH) with a score of 0.714 surrounded by high-scoring counties (I=-0.594, Z=-2.007, p=0.044) (Fig. 13b).

a)   b)
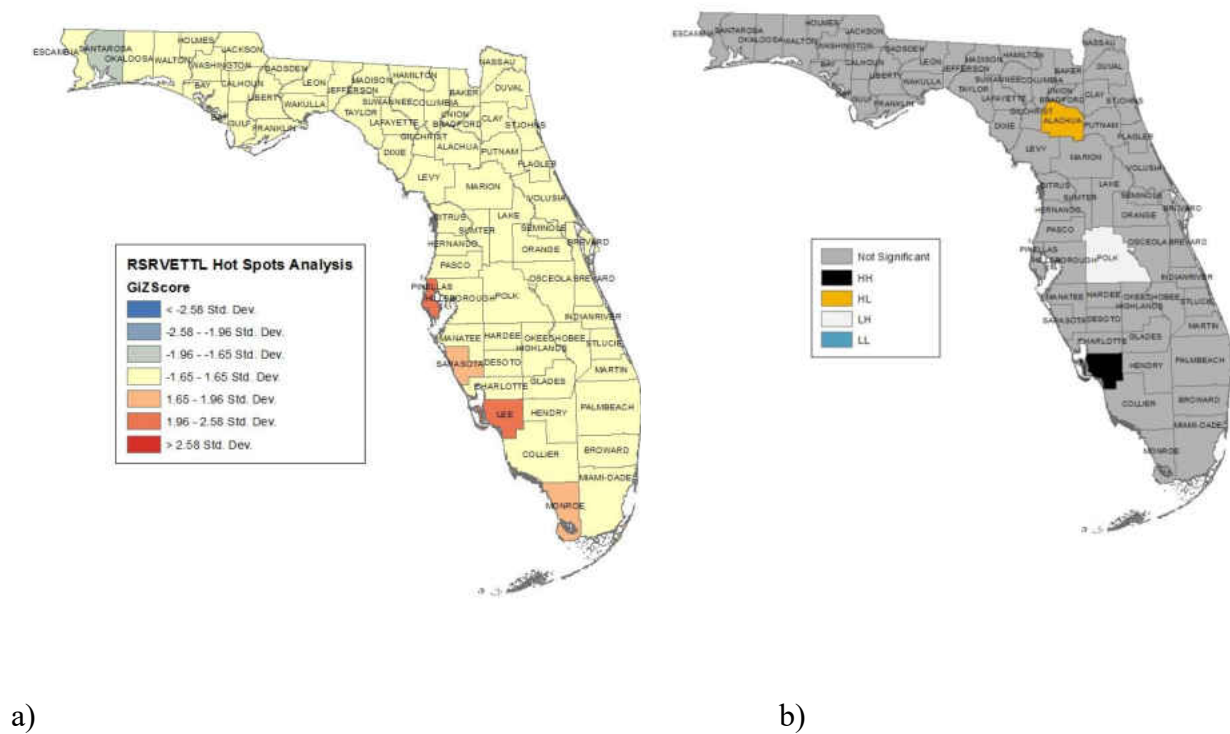
Figure 13. LISAs for Reserve Selection and Design Component Score data. (a) Hot Spots Analysis reveals two hot spots at the p = 0.05 level in western and southwestern coastal Florida; (b) Clusters & Outliers Analysis results confirm the significant high score cluster (HH) in southwest Florida and reveals two outliers: Alachua County is an outlier with a high score for the Reserve Design and Selection Component surrounded by low-scoring counties (HL), and Polk County is an outlier with a low score surrounded by high-scoring counties (LH).

For Management Component Score data, a high-intensity hot spot at the $p=0.01$ level was revealed in south/southwest Florida surrounding Monroe County ($Z=2.917$, $p=0.003$, score=4.07) with high score clustering of less intensity at the $p=0.05$ level surrounding Collier ($Z=2.239$, $p=0.025$, score=2.77) and Miami-Dade Counties ($Z=2.561$, $p=0.010$, score=1.85). A high-intensity cold spot at the $p=0.05$ level occurred around Calhoun ($Z=-2.004$, $p=0.045$, score= 0.555) and Liberty ($Z=-2.140$, $p=0.032$, score=0.740) Counties in the Florida Panhandle (Fig. 14a). Clusters & Outliers Analysis showed a high-score cluster (HH) in southwest Florida surrounding Monroe ($I=2.917$, $Z=4.266$, $p<0.001$) and Collier ($I=1.123$, $Z=2.678$, $p=0.007$) Counties and a low-score cluster (LL) in the Panhandle surrounding Gulf county ($I=0.952$, $Z=2.021$, $p=0.043$, score=0.185). Alachua County is a high-score outlier surrounded by low-score counties for the Management Component Score data ($I=-0.776$, $Z=-2.154$, $p=0.031$, score=3.703) (Fig. 14b).
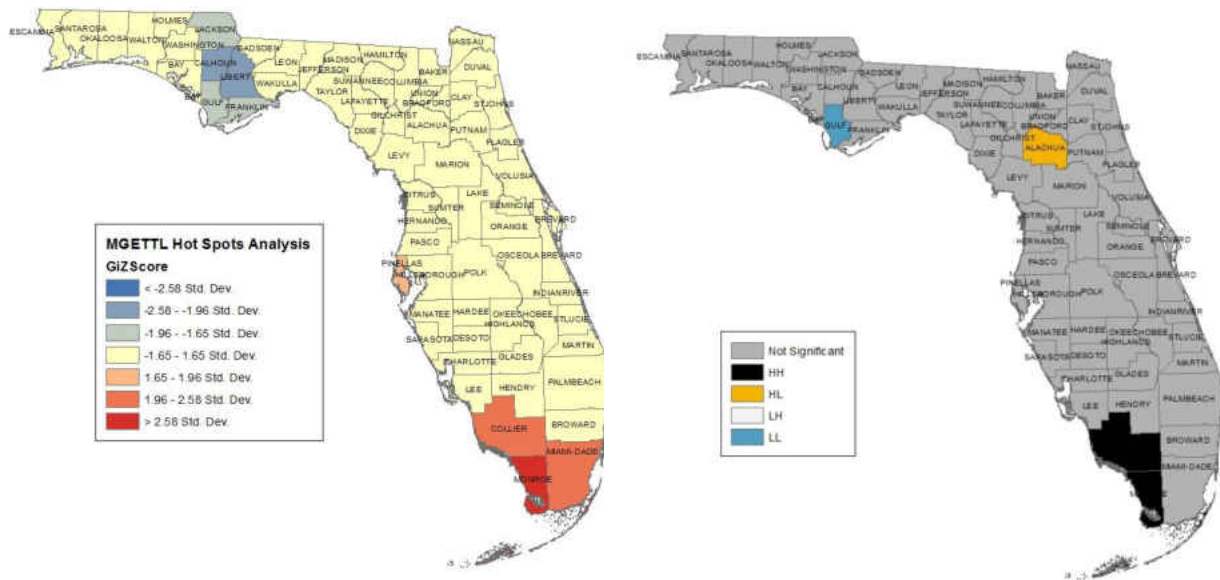
a)

b)

Figure 14. LISAs for Management Component Score data. (a) Hot Spots Analysis indicates a hot spot of high intensity clustering at the p = 0.05 level occurs in southern coastal Florida; and a high-intensity cold spot of low scores occurs in the Panhandle (b) Clusters & Outliers Analysis results confirm both the significant high score cluster (HH) in southern coastal Florida and the significant low score cluster in the Panhandle (LL). Alachua County is an outlier with a high score for the Management Component Score data surrounded by low-scoring counties (HL).

For Total Plan Score data, Hot Spot Analysis revealed significant (p=0.05) clustering of high scores around Sarasota (Z=2.109, p=0.034, score=21.96) and Monroe (Z=1.96, p=0.049, score=18.70) Counties in southwest and central western coastal Florida. Low scores at the p=0.10 level of significance clustered around the Panhandle/northern Florida area around Madison (Z=-1.82, p=0.068, score=12.02) and Liberty (Z=-1.66, p=0.096, score=10.78)

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Counties (Fig. 15a). Clusters & Outliers Analysis also found two clusters of significantly high scores (HH), one around Sarasota County (I=1.37, Z=2.49, p=0.012) and one around Monroe County (I=1.36, Z=2.00, p=0.045). Alachua County is a significant outlier (I=-1.69, Z=-4.73, p<0.001) with high Total Plan Score of 24.76 surrounded by low scoring counties (HL) (Fig. 15b).

a)   b)
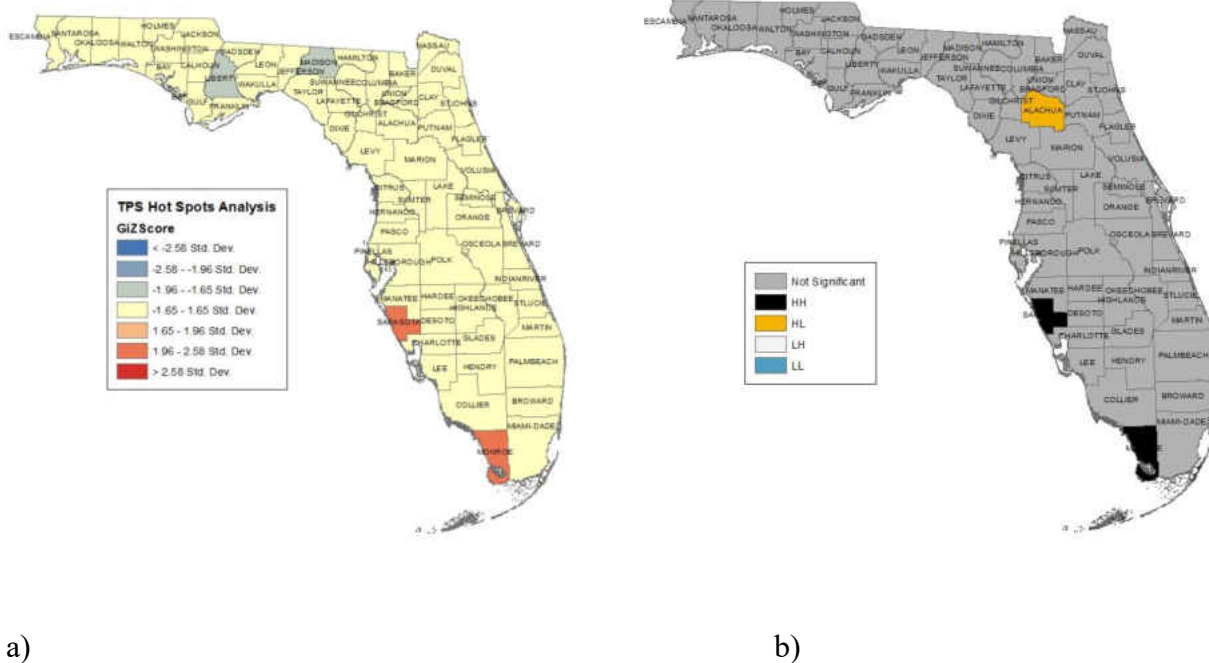
Figure 15. LISAs for Total Plan Score data. (a) Hot Spots Analysis reveals high Total Plan Score clusters at the p = 0.05 level in southwestern and central western coastal Florida and low Total Plan Score clusters at the p = 0.10 level in the Panhandle/North Florida area; (b) Clusters & Outliers Analysis results show two significant clusters of high Total Plan Scores surrounded by high scores in southwest and central western coastal Florida and Alachua County as an outlier with high Total Plan Score surrounded by low-scoring counties.

<center>Discussion</center>

Global and local spatial autocorrelation results indicate that the spatial patterns of conservation planning quality and its components are non-random. The significant high and low-score clusters of counties here suggest that in some cases, neighboring counties are using the ideas, knowledge and language of other neighboring counties in their Conservation Elements. Conversely, the existence of outliers implies either a lack of knowledge of the Conservation Element provisions of neighboring counties, or decision-making against adopting the policies of neighboring counties, referred to as negative diffusion.

The likely forum for this transfer of information is the Regional Planning Councils. Eleven Regional Planning Councils (RPCs) were created in Florida by the State and Regional Planning Act of 1984.[23] These regional bodies were created at the behest of two studies that found regional planning to be necessary for furthering the state's vision for Florida's future development[24] (Fig. 16).

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[23] Sections 186.504 and 186.505, F.S.

[24] The 1979 Resource Management Task force under Governor Bob Graham recommended integration of state, regional and local planning to manage future growth. A second study in 1982, the Environmental Land Management Study, reviewed the effectiveness of environmental and land use legislation and also recommended the need for integrated state, regional and local planning to manage growth (Carriker 2006).
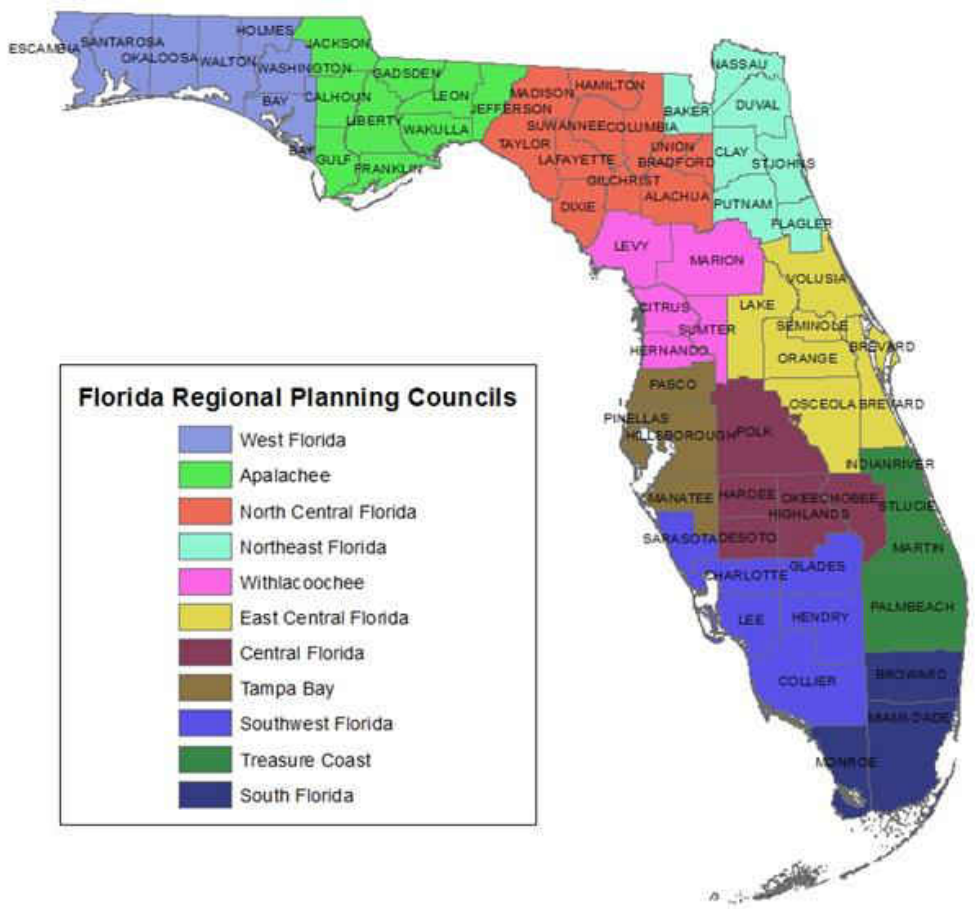
Figure 16. Florida Regional Planning Councils.

The State and Regional Planning Act of 1984 required the State of Florida to create a State Comprehensive Plan to guide Florida's future development, and the Regional Planning Councils were each required to create similar Comprehensive Strategic Regional Policy Plans. RPCs were tasked with the responsibility of reviewing local government plans for consistency with the regional plan and coordinating development decisions that impacted more than one local government. RPCs were also responsible for providing technical assistance to local governments on planning issues (Carriker 2006). Under the Act, all county land development regulations were required to be consistent with their Regional Strategic Policy Plan, as well as with the state plan. Therefore, the RPC is situated to play a critical role in the dissemination of information to local governments and provide a forum for networking. Moreover, all eleven Regional Planning Councils are parties to the Florida Regional Councils Association (FRCA), which coordinates regional and state growth management efforts, and represents Florida RPCs in national associations. One of the missions of the Florida Regional Councils Association is to "*[f]oster relationships and partnerships and coordinate with state, regional, and national associations and organizations, non-profit entities, public-private partnerships, the Governor's office, state agencies and others, on issues of mutual interest and concern and with whom FRCA shares mutual goals and programs*" (Florida Regional Councils Association 2013). Florida's eleven Regional Planning Councils likely play a critical role in diffusion because their very mission is to create communication channels for counties about growth management planning.

Nonetheless, there is a great deal of variability among the local spatial patterns. Although significant non-random clusters were found for all components and for Total Plan Score data, the majority of counties in all six analyses were not members of clusters, which means that in most

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cases county conservation planning quality was not influenced by diffusion. Furthermore, there was a high degree of variability in the location of clusters and in the counties that comprised clusters for the different aspects of conservation planning quality examined. Given the specific provisions that are required to be included in the Conservation Element by state law, we would expect to see homogeneity (as a result of the coercive pressure mechanism of diffusion) in the spatial pattern of county conservation planning quality and its components. Instead, the local spatial patterns are heterogeneous, indicating common ideas, knowledge, goals, and language have been utilized only by some neighboring counties in the development of only some aspects of Conservation Elements.

Whether or not diffusion occurs may depend on context. Governments with social, political, and economic similarities often develop a certain "like-mindedness" (Berry & Baybeck 2005; Cho & Nicley 2008). Like-minded counties may have a greater propensity to adopt the policy provisions of neighboring counties (diffusion) because of their shared context, if similar policy outcomes in one jurisdiction are likely to occur in the other jurisdiction as well (Berry & Berry 2007; Cho & Nicley 2008). In a study of state adoption of merit-based scholarship programs, it was found that both diffusion through learning and competition, and internal determinants, in the form of the economic and political environments, were factors determining policy adoption (Ingle et al. 2007b).

Closer examination of the local spatial patterns of both Component Scores and Total Plan Scores suggests that both diffusion and internal determinants are influencing local spatial patterns. For example, two high-score clusters occur for the Biodiversity Status Assessment Component data, one surrounding Monroe County in southwest Florida, and one surrounding St.

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Lucie County on the south-central east coast. Both of these clusters of counties are gathering baseline biological information about the planning areas from more sources and in a greater variety of forms than other counties. Interestingly though, Miami-Dade County sits between both clusters, and is an outlier having a low score for Biodiversity Status Assessment compared to the surrounding South Florida counties. The low scores for this Component for Miami-Dade County may reflect the high degree of urbanization that differentiates Miami-Dade from the surrounding South Florida counties. Miami-Dade is Florida's most populous county, with an estimated 2012 population of 2,551,290, or 1,344.4 person per square mile (13.4% of Florida's population) (Florida Legislature Office of Economic and Demographic Research 2012b). Furthermore, although 67% of the land area of Miami-Dade County is conservation lands, 98.8% of those conservation lands are owned and managed by the federal and state government in the western part of the county in the Florida Everglades. Only 1.2% of the county's conservation lands (0.8% of total county land area) are owned and managed by local government (Florida Natural Areas Inventory 2011a). The vast areas of state and federally-owned conservation lands may lead to the perception that conservation at the county level is unnecessary. The heavy urbanization, large population and small area of county-managed conservation lands in Miami-Dade County may mean the county area outside of the Everglades is already biologically-impoverished, making biological status assessments a low priority.

Conversely, the surrounding South Florida counties have less urbanization, more conservation lands, and more county-owned conservation lands. In Monroe County, 96% of the county is conservation lands, though only 0.05% of conservation lands are county-owned. For St Lucie County, 9% of the county is conservation lands, but 29.8% of those lands are owned by the

county (Florida Natural Areas Inventory 2011a). The other counties in the high-score cluster areas share similar context in terms of conservation lands: 25% of Martin County is conservation lands, and the county owns 3% of those lands. Palm Beach County is 36% conservation lands, 10.1% of which are county-owned, Indian River County is 26% of county conservation lands, 5.5% of which county owned. Because of the similarity among these counties in the amount of conservation lands in the county, and the urbanization pressures encroaching northward from South Florida, their shared context may be cause of the high-cluster scoring. (Broward County is anomalous, however, with 62% conservation lands, though 98.9% of those lands are state-owned and managed as Water Conservation Areas, leaving 1.1% to be county-owned). The fact that these high-clusters occur only in the South Florida area, and not in other areas of the state, though, where other counties have significant holdings of conservation lands in the face of heavy development pressure (e.g. Duval, Pinellas, Hillsborough, Orange Counties), cannot be explained. It is possible then that these high-score clusters are in part the result of similar context but also the result of diffusion of biological information facilitated through the South Florida, Southwest Florida, and Treasure Coast Planning Councils.

The other outlier for the Biodiversity Status Assessment Component data was Lake County in mid-central Florida, which has high scores for gathering baseline biological information compared to surrounding low-score counties. Urbanization pressure may account for Lake County's position as an outlier as well. Lake County is currently under heavy development pressure as suburban expansion from Orlando moves west into Lake County. Lake County's population increased 45% in the ten years between 1980 and 1990, 38.4% between 1990 and 2000, and 41.1% from 2000 and 2010. The change in the number of housing units permitted was

also increasing rapidly prior to the recession of 2005: 2001-2002 18.7%, 2002-2003 17%, 2003-2004 20.3%, 2004-2005 8.9% (Florida Legislature Office of Economic and Demographic Research 2012a). Despite this rapid growth, 33% of the land area of Lake County is conservation lands. Lake County's high Biodiversity Status Assessment scores may reflect its effort to catalog, document and protect as much of the county's biodiversity as possible in the face of rapid urbanization pressure.

The spatial pattern of the Goal-Setting component data was markedly different from the Biodiversity Status Assessment data in that there was only one significant cluster, of low-scores, in the Panhandle. Franklin, Wakulla, and Liberty Counties in this cluster had much lower scores than other counties due to a lack of stated conservation goals and strategies in their Conservation Elements. This could be due to the lack of county-wide conservation lands acquisition programs in these counties. These counties have large percentages of conservation lands: Franklin County: 81% of total county land areas, Liberty County: 63%, Wakulla County: 63%. However, those conservation lands are almost entirely owned and managed by the state and federal government (Franklin County: 99.5%, Liberty County 97.6%, Wakulla County 99.6%) (Florida Natural Areas Inventory 2011a). As a result of the large state and federal land holdings, county conservation land acquisition programs are scarce in these and other Panhandle and northern Florida counties (Fig. 17).
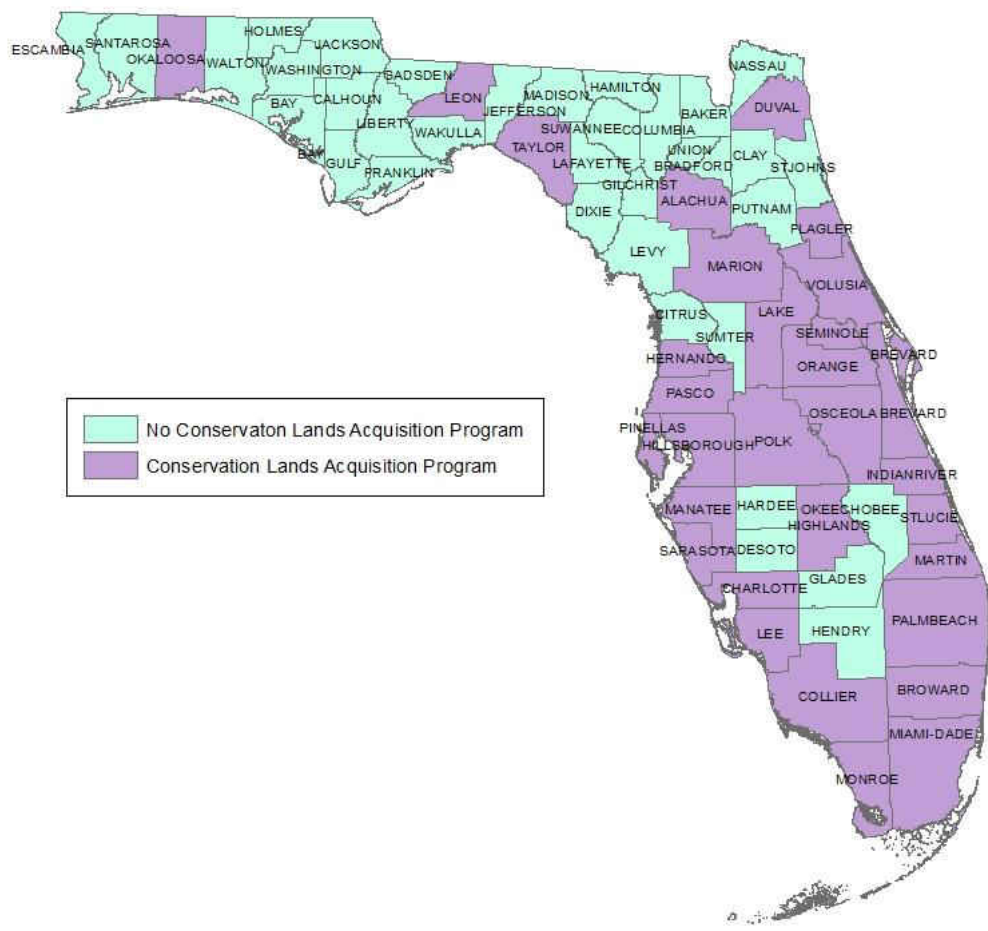
Figure 17. Florida counties with and without county-level conservation lands acquisition programs according to a 2002 survey of Florida counties by The Trust for Public Land.

One would expect that counties with little or no conservation lands would have few conservation goals and strategies, especially where large amounts of land in the county are held by other levels of government that would have their own established conservation goals and strategies. Still, clustering is significant only in one area of the Panhandle and not across the entire Panhandle/north Florida regions where most counties have no local conservation lands programs. This implies that the counties in the low-scoring cluster are choosing to include similar specific goals and language for biodiversity conservation that are less comprehensive than other Florida counties, which suggests the influence of communication channels among neighboring counties. Franklin, Wakulla, and Liberty Counties are all part of the Apalachee Regional Planning Council.

There appears to be a combination of diffusion and external factors affecting the spatial pattern of the other component data as well. Coordination component data involved the county's collaborative strategies for conservation planning and the variety of stakeholders that would be included in conservation planning efforts. Here, the high-score cluster occurs surrounding Sarasota county on Florida's west coast, but extends east into Desoto County, which has no conservation lands acquisition program. The high score for Desoto County may reflect the diffusion of ideas and language from neighboring Sarasota County, which has the highest score of all counties for this component, 9.16. The low-score cluster occurs in northern Florida, amongst counties all having no conservation lands acquisitions program (Hamilton, Suwanee, Madison, Columbia, and Baker Counties). This lack of county-owned conservation lands means that counties will have less need to coordinate with stakeholders, including private landowners, the planning and zoning department, and neighboring counties where conservation lands extend

into both jurisdictions. However, other counties with no county-level conservation lands programs, such as the Panhandle and south central inland counties, were not found to form significant clusters, so the similarity in low scores must be due to other factors. The Conservation Elements of all of the counties in the cluster included no indicators for coordination with private landowners, or for landscape scale coordination. This similarity is likely the result of the borrowing of policy language from other counties. All of the counties in the low-scoring cluster are part of the North Central Florida Regional Planning Council, which may be the source of language used in Conservation Element drafting. Interestingly, though, Alachua County is an outlier for the Coordination component, with one of the highest scores for this component of all of the counties of 8.33, and it is also part of the North Central Florida Regional Planning Council.

If diffusion is the mechanism responsible for the low-scoring cluster, then *negative* diffusion must be responsible for Alachua County's position an outlier. Although diffusion can lead to the adoption of policies in some neighboring political jurisdictions, other jurisdictions can fail to adopt policies of others (termed "hold-outs") either due to the lack of communication channels between them, or due to internal determinants influences (Ingle et al. 2007b). Since these counties are part of the same RPC, the lack of communication between them is unlikely. A more likely cause of this difference is the presence of the University of Florida and its unique position in conservation-related issues. The University of Florida is the state's public land grant research university and houses the College of Agriculture and Life Sciences, the School of Forest Resources and Conservation, the Department of Wildlife Ecology and Conservation, and the School of Natural Resources and Environment. These entities are in turn affiliated with the

Institute of Food and Agricultural Sciences (IFAS), which is a federal-state and county partnership engaging in agriculture and life sciences research, and provides extension in each of Florida's counties to bring research findings to other areas of the state. The mission of IFAS is stated as follows: "*IFAS is a federal-state-county partnership dedicated to developing knowledge in agriculture, human and natural resources, and the life sciences, and enhancing and sustaining the quality of human life by making that information accessible*" (University of Florida College of Agriculture and Life Sciences 2013). IFAS in turn collaborates with the Florida Fish and Wildlife Cooperative Unit, which employs research faculty and some courtesy faculty who are full-time biological scientists with federal or state agencies. The collaborative nature of these entities combined with the outreach mission of extension is likely the source of high scores for the Collaboration component for Alachua County. The difference in policy outputs between the low-scoring cluster of counties and Alachua County must be attributable to negative diffusion based on the dissimilarities between Alachua County because of the presence of the University of Florida and its neighbors.

Similarly, Reserve Selection and Design component data had two significant high-score clusters, which both occurred in Florida's west coast, one surrounding Lee county in southwest Florida and one surrounding Pinellas county in central western Florida. High-scoring clusters for this component included more provisions than other counties for the design of reserves and criteria used to select lands for conservation. Lee and Pinellas Counties and surrounding counties all have conservation lands acquisition programs, though the mere existence of conservation lands acquisition programs in these clusters cannot explain the significant high-score clustering as the majority of counties in the coastal peninsula have conservation lands programs. Lee and

Pinellas Counties are members of two different RPCs, the Southwest Florida RPC and the

Tampa Bay RPC. While diffusion would be a more likely explanation if these counties were part

of the same RPC, it may be that there is a high level of coordination, information-sharing and

networking between the two Regional Planning Councils, resulting in the two high-score clusters

for this component. Two outliers were presented for this component: Alachua County, a high-

score outlier with surrounded by low-score counties, and Polk County, a low-score county

surrounded by high-scoring counties. Alachua County's position as an outlier may be explained

by that fact that Alachua County has a conservation lands acquisition program, but is surrounded

by counties without conservation lands acquisition programs to the east, north and west. Alachua

County owns and manages 14.1% of the conservation lands in the county, or 2.6% of the total

county land area (Florida Natural Areas Inventory 2011a).

Surrounding counties with no conservation lands programs would have little reason to

make provisions in their Conservation Elements for protected area acquisition and design

criteria. Polk County, on the other hand, has a conservation lands acquisition program, which

makes its position as an outlier surprising, though its score for this component is low at 0.714.

Polk county is surrounded to the east, north, and west by counties with higher component scores:

Osceola: 3.21; Orange: 3.21; Lake: 4.28; Sumter: 5.0; Pasco: 3.5; Hillsborough: 4.64; and

Manatee: 2.5. However, Polk County is a member of the Central Florida Regional Planning

Council, along with Hardee, DeSoto, Okeechobee and Highlands Counties which surround Polk

County to the south, Highlands County being the only other county in this RPC to have a

conservation lands acquisition program. Interestingly, Polk County's component score is in-line

with the component scores of the other counties in the Central Florida RPC, except for Highlands

County: Hardee: 0.714; DeSoto: 1.785; Okeechobee: 0.714; Highlands: 2.5. Polk County's outlier status may be the result of similar provisions used in its Conservation Element as its fellow Central Florida RPC members, which suggests the influence of diffusion.

Likewise for the Management component, both diffusion and internal determinants appear to be affecting local spatial patterns. The indicators for the Management component relate to the methods used to manage conservation lands for long-term biodiversity persistence. For this component, there was one significant hot spot cluster in southwest and southern Florida around Monroe, Miami-Dade and Collier Counties, which are members of the Southwest Florida (Collier County) and South Florida (Monroe and Miami-Dade Counties) RPCs. There was also one significant cold-spot cluster in the Florida Panhandle around Gulf, Calhoun and Liberty Counties, all of which are members of the Apalachee RPC. The significant high and low clusters are likely related to the amount of conservation lands in those areas, the management of which requires policies. The hot spot occurs around large amounts of federally-owned and managed land in Everglades National Park and Big Cypress Preserve, and the state-owned Water Conservation Areas. Even though the majority of conservation lands in these areas is state and federally owned, it is likely that there is a diffusion of ideas, knowledge and language about management through communicative networks between state and federal government land management agencies and local governments.

However, the Florida Panhandle also contains large conservation land areas that are also primarily held by the federal and state governments, so this alone cannot explain the differences in high and low scores for the management component. A major difference between South Florida and Florida's Panhandle, however, is the degree of urbanization and population growth.

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Interestingly, the Panhandle cluster includes Florida's least populous county, Liberty County, and the South Florida cluster includes Florida's most populous county, Miami-Dade. Average population density for Miami-Dade, Monroe, and Collier Counties is 582.9 persons per square mile, with an average of 413,165 housing units. In contrast, average population density for Gulf, Calhoun and Liberty counties is 21.4 persons per square mile, and an average of 6,155 housing units. There are thus stark differences in population among these areas of Florida, and the lack of management indicators in the Panhandle counties may be due to the perception that biodiversity conservation is not a pressing issue because of the lack of urbanization pressure. The traditional approach to ecosystem management and conservation land acquisition by local government is reactionary—occurring after significant development occurs (Brody et al. 2003).

Lastly, Total Plan Score high and low-score clusters reflect the component data aggregated together. The high-score cluster for Total Plan Score data around Sarasota and Monroe Counties are consistent with high-scoring clusters in the component data; i.e. Sarasota and Monroe Counties for Biodiversity Status Assessment, Sarasota county for Coordination, Sarasota and Monroe counties for Reserve Selection and Design, and Monroe county for Management. The low-score clusters around Liberty and Madison counties in Panhandle and northern Florida are also consistent with the component data results: Liberty County for Goal-Setting, Madison County for Coordination, and Liberty County for Management. The emergence of Alachua County as an outlier in Total Plan Score data is also consistent with the same finding in local spatial analysis of the Coordination, Reserve Selection and Design, and Management components.

Brody et al. (2003) also found evidence for diffusion in environmental planning. Significant global and local spatial clustering of Florida local governments was found for ecosystem management planning quality. In that study, hot spots of local governments with high quality ecosystem management plans occurred because of borrowing of environmental data, program descriptions and the wording of specific policies from local comprehensive plans (diffusion) from Pinellas and Martin Counties. Significant spatial clustering of high quality plans in the Tampa Bay Watershed Ecosystem Management Area (EMA) was attributed to a collaborative project among local governments in the EMA that contributed to the diffusion of plan content. However, local governments in the nearby Southwest Florida EMAs were not part of the significant hot spot clusters and had lower ecosystem management scores. The study thus found that diffusion was not consistent, which led a lack of homogeneity in ecosystem management planning and policy gaps.

The findings here suggest that both diffusion and internal determinants play a role in the variability in Florida county conservation planning quality. Where diffusion occurs, Regional Planning Councils are likely playing a major role in facilitating communication channels and networks. Whether diffusion occurs likely depends on demographic, economic, political, or social factors. Here, the major internal determinants affecting conservation planning quality appear to be population size and urbanization, the size of the conservation lands holdings within the county or area, the ownership of those lands, and the presence of the uniquely-situated University of Florida. However, this study does not rule out other internal determinants that may also drive policy adoption decisions or create the context that in turn influences diffusion, such as special interests (Knox 2010), and local political structure (Ramirez de la Cruz 2009).

CHAPTER FOUR: CONCLUSIONS AND POLICY IMPLICATIONS

This study sought to determine the extent to which Florida county governments are employing systematic conservation planning methods as prescribed in the conservation science literature. The analysis of county Conservation Elements in Chapter Two supports a modified conceptual model of conservation planning for Florida county governments, reflecting the greater attention placed on coordination and goal-setting than on gathering baseline biodiversity information, developing guidelines for reserve selection and design, and managing county lands (Fig. 18).
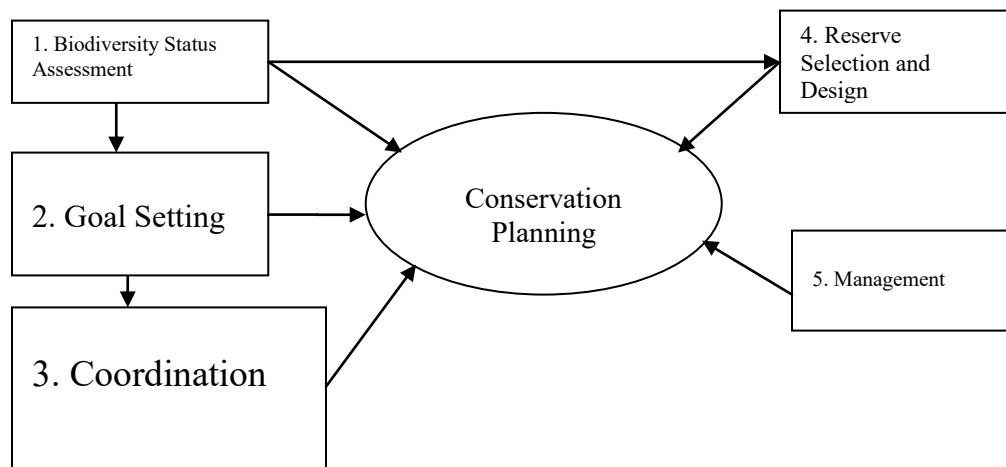
Figure 18. Modified conceptual model of conservation planning and its components for Florida county governments.

Florida county Conservation Elements probably emphasize coordination and goal-setting over the other components of conservation planning because they follow the Growth Management Act statutory language, which also emphasizes interjursidictional coordination and goal-setting. However, when analyzed in the context of the conservation science literature, this translates into only minimum to moderate levels of conservation planning quality. Other studies

also found that while local government conservation planning meets the minimum standards required by the state, those efforts fall below the level of conservation planning required to ensure the persistence of biodiversity over the long term (Miller et al. 2009; Stokes et al. 2010). This is particularly the case for local governments that are lacking in resources for conservation efforts (Miller et al. 2009; Stokes et al. 2010).

This study also found a high degree of variability among Florida county governments in conservation planning quality, the most influential predictors of which were education level of the public and resource availability. Resource availability included not only financial resources but also informational, educational, and human resources. The paramount importance of financial resources, though, was reflected in the other predictor variables in the composite model, which were total county revenues and the percent of county land area that is county-owned conservation lands. The fifth predictor, total collaboration, may also be a function of financial resources yet involves as well the ability and willingness of jurisdictions to work together. Some of the variability in conservation planning quality is also attributed to policy diffusion, which may in large part be driven by Regional Planning Councils.

What Is The Effectiveness Of Current Florida Local Government Conservation Planning Policy For Biodiversity Preservation?

Public policies are often evaluated based on the extent to which the goals of the statute or program have been achieved (Peters 2010). In the case of Florida local government conservation planning policy, the goals are statewide goals reflecting Florida's interest in protecting biodiversity as a natural resource. The goals for Florida local government conservation planning are set forth in the Florida Forever and Growth Management statutes:

259.105 The Florida Forever Act. [25] —

(4) It is the intent of the Legislature that projects or acquisitions…contribute to the achievement of the following goals:

(b) Increase the protection of Florida's biodiversity at the species, natural community, and landscape levels, as measured by:
1. The number of acres acquired of significant strategic habitat conservation areas;
2. The number of acres acquired of highest priority conservation areas for Florida's rarest species;
3. The number of acres acquired of significant landscapes, landscape linkages, and conservation corridors, giving priority to completing linkages;
4. The number of acres acquired of underrepresented native ecosystems;
5. The number of landscape-sized protection areas of at least 50,000 acres that exhibit a mosaic of predominantly intact or restorable natural communities…
6. The percentage increase in the number of occurrences of imperiled species….

(c) Protect, restore, and maintain the quality and natural functions of land, water, and wetland systems of the state, as measured by:
1.…the number of acres which represent actual or potential imperiled species habitat…
5. The number of acres acquired that protect surface waters of the state;
7. The number of acres acquired that protect fragile coastal resources;
8. The number of acres of functional wetland systems protected;
10. The percentage of public lakes and rivers in which invasive, nonnative aquatic plants are under maintenance control; or
11. The number of acres of public conservation lands in which upland invasive, exotic plants are under maintenance control.

State Comprehensive Plan Act[26]:

187.201 State Comprehensive Plan adopted.—The Legislature hereby adopts as the State Comprehensive Plan the following specific goals and policies:

(7) WATER RESOURCES.—
(a) Goal.—Florida shall assure the availability of an adequate supply of water for all competing uses…and shall maintain the functions of natural systems...

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[25] Florida Forever Act, section 259.105, F.S.
[26] State and Regional Planning Act of 1984, Chapter 187, F.S.

(9) NATURAL SYSTEMS AND RECREATIONAL LANDS.—
(a) Goal.—Florida shall protect and acquire unique natural habitats and ecological systems, such as wetlands, tropical hardwood hammocks, palm hammocks, and virgin longleaf pine forests, and restore degraded natural systems to a functional condition.
(b) Policies.—
1. Conserve forests, wetlands, fish, marine life, and wildlife to maintain their environmental…values.
3. Prohibit the destruction of endangered species and protect their habitats.
4. Establish an integrated regulatory program to assure the survival of endangered and threatened species within the state.
5. Promote the use of agricultural practices which are compatible with the protection of wildlife and natural systems.
7. Protect and restore the ecological functions of wetlands systems to ensure their long-term environmental…value.
9. Develop and implement a comprehensive planning, management, and acquisition program to ensure the integrity of Florida's river systems.
10. Emphasize the acquisition and maintenance of ecologically intact systems in all land and water planning, management, and regulation.

Local Comprehensive Plan Act[27]:

163.3177 Required and optional elements of comprehensive plan; studies and surveys.—

(6) In addition to the requirements of subsections (1)-(5), the comprehensive plan shall include the following elements:

(d) A conservation element for the conservation, use, and protection of natural resources in the area, including…wetlands,…rivers, bays, lakes, harbors, forests, fisheries and wildlife, marine habitat,...

2. The element must contain principles, guidelines, and standards for conservation that provide long-term goals and which:

(1) Conserve[s],…and protect[s]…..native vegetative communities, including forests, from destruction by development activities.
(2) Conserve[s]…and protect[s] fisheries, wildlife, wildlife habitat, and marine habitat, and restrict[s] activities known to adversely affect the survival of endangered and threatened wildlife.

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[27] Local Government Comprehensive Planning and Land Development Act of 1985, Chapter 163, F.S, (currently the Community Planning Act of 2011)

(3) Maintain[s] cooperation with adjacent local governments to conserve…or protect unique vegetative communities located within more than one local jurisdiction.
(4) Designate[s] environmentally sensitive lands for protection based on locally determined criteria which further the goals and objectives of the conservation element.[28]

Are State Goals To Conserve Biodiversity Being Met?

In all three statutes, the goals as they pertain to biodiversity conservation are broadly stated, and in the Local Comprehensive Planning Act, only broad "principles, guidelines, and standards" are set forth in the statute, with specific goals to be developed by the local governments at their discretion. The Florida Forever Act goals include the protection of multiple levels of biodiversity, "[i]ncrease the protection of Florida's biodiversity at the species, natural community, and landscape levels," though the performance measures all focus on measuring acres of land, with the exception of one, which involves organismal data, "[t]he percentage increase in the number of occurrences of imperiled species." The second goal addresses the protection of natural (purportedly ecological) functions "[p]rotect, restore, and maintain the quality and natural functions of land, water, and wetland systems of the state," though the performance measures all involve acres of land or numbers of lakes, and none involve ecological metrics of populations or communities.

The State Comprehensive Planning statute includes several goals for maintaining "natural function" or "ecological integrity," though the words "natural function" and "ecological integrity" are not defined and no specific reference is made to species, communities, or populations. The statute does include as a goal the conservation of "forests, wetlands, fish,

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[28] Section 163, F.S.

marine life, and wildlife to maintain their environmental…values," though the term "environmental values" is also not defined, and the statute does not say anything about preserving populations or communities at sufficient levels to ensure long-term persistence. It also does not include as goals the protection of multiple levels of biodiversity, viable populations of native species, trophic levels, or the ecological and evolutionary processes that sustain biodiversity. The statute does, however, include more pointed goals for the protection of endangered species to "[p]rohibit the destruction of endangered species and protect their habitats" and "[e]stablish an integrated regulatory program to assure the survival of endangered and threatened species within the state."

The Local Comprehensive Planning statutory language is similarly vague. The statute requires that local Conservation Element goals must be consistent with state guidelines to "conserve[s],…and protect[s]…..native vegetative communities, including forests, from destruction by development activities" and "conserve[s]…and protect[s] fisheries, wildlife, wildlife habitat, and marine habitat, and restrict[s] activities known to adversely affect the survival of endangered and threatened wildlife." However, because of this discretion, local government comprehensive planning has resulted in different degrees of conservation planning, as evidenced by the high degrees of variability in conservation planning quality found in this study.

As written, then, the state statutory goals for biodiversity conservation are vague and do not provide the level of detail necessary to cause local governments to use biologically-based approaches to conservation. In fact, the Local Comprehensive Planning statute acknowledges

that it mandates only minimum requirements of local governments to achieve the intent of the

Act:

> *163.3161 Short title; intent and purpose.—*
>
> *(1) This part shall be known and may be cited as the "Community Planning Act."*
>
> *(8) The provisions of this act in their interpretation and application are declared to be the minimum requirements necessary to accomplish the stated intent, purposes, and objectives of this act; to protect human, environmental, social, and economic resources; and to maintain, through orderly growth and development, the character and stability of present and future land use and development in this state.*

Therefore, if current Florida local government conservation planning policy is evaluated in terms of relevance to state goals, current policy appears to be effective. The state, through the statutory language in the Florida Forever and Growth Management Acts, has not made the long-term persistence of biodiversity an actual goal. The state goal is merely to conserve biodiversity at some undefined level through protection of habitat. Local governments therefore are meeting the minimum requirements of the statute to conserve biodiversity, though some counties are doing more (e.g. Alachua county and those along the southwest Gulf coast of Florida).

How Can The Effectiveness Of Local Government Conservation Planning For Long-term Biodiversity Persistence Be Improved? Policy Recommendations

If current policy is evaluated in terms of its effectiveness for long-term preservation of all levels of biodiversity and the processes that sustain it, however, then current policy cannot be seen to be effective. Local governments play critical roles in efforts to conserve biodiversity today because of their authority to govern how land is used at the local level. Through local land

use planning, local governments uniquely have the ability to establish limits on urban and suburban development and minimize fragmentation, which are widely considered the greatest threats to biodiversity in the United States today (Bengston et al. 2004; Miller et al. 2009; Stokes et al. 2010).

Recognizing the importance of local governments in conservation, several opportunities exist to improve the effectiveness of local government conservation planning in Florida. First, goal statements for biodiversity conservation in the state Florida Forever and Growth Management statutes must be made more ecologically meaningful. Specific goals for the preservation of viable populations of native species, for representation of all types of ecosystems, for conservation of all types and levels of biodiversity, as well as for long-term persistence of biodiversity must be set forth in the statute. A shift of focus in statutory and plan language is also needed from goals centered on protecting biodiversity pattern alone, to goals that also include protection of ecological and evolutionary processes. Furthermore, references to "natural function" or "ecological function" need to be defined as they relate to biodiversity, for example, functioning trophic levels, succession, dispersal, gene flow, metapopulation dynamics, and natural disturbance regimes, so that protection of those functions can be addressed.

Second, the state of Florida must make a greater financial commitment to preserving the state's biological resources. A stable, permanent source of funding for biodiversity conservation is of utmost importance.[29] Currently, there is no stable source of funding for Florida Forever program land acquisition and management. Under the Florida Forever statute, funds for

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[29] In 2013 a citizen's initiative is campaigning to add an amendment to the Florida constitution in 2014, which would mandate the allocation of 33% of existing documentary stamp tax revenues to conservation purposes. If passed, these revenues would comprise less than 1% of Florida's budget (The Public Trust Environmental Legal Institute of Florida 2013).

conservation lands acquisitions and management were funded by the sales of bonds, (the debt for

which was repaid by documentary stamp taxes and other revenue sources), as appropriated by

the Florida legislature through 2010. Though the statute was reauthorized for another ten years in

2009, funding for the program though bonds and other general revenue appropriations is at the

discretion of the legislature and can be vetoed by the Governor (Florida Department of

Environmental Protection 2012). From 1990 through 2007, state conservation lands acquisition

programs had been funded at approximately $300 million annually (Rockwell 2011). Those

budgets were significantly cut after 2008. In 2010, the program was appropriated only $15

million from the Florida legislature, and in 2011, no monies were appropriated to the program,

though in a stark reversal of past decades of state efforts to conserve land, the Department of

Environmental Protection was directed to develop a list of existing state conservation lands to be

sold as "surplus lands" to fund the acquisition of other conservation lands[30,31] (Rockwell 2011;

The Public Trust Environmental Legal Institute of Florida 2013). Between 2009 and 2013, state

funding for land and water conservation programs were cut by 97.5% (The Public Trust

Environmental Legal Institute of Florida 2013).

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[30] The 2013 list of proposed surplus lands totals 5,341 acres of state conservation lands from state parks, wildlife management areas, and other conservation areas (Florida Department of Environmental Protection 2013; Spear 2013)

[31] Such other conservation lands are defined as "lands that have a greater need for conservation—for instance, land that is protective of springs, water quality, water quantity and land that can be used as a military buffer zone" (Florida Department of Environmental Protection 2013), reflecting the shift in conservation values that occurred with the political changes in Florida that occurred in 2008 and 2009.

The Growth Management statutes also do not provide reliable funding for the implementation of local comprehensive plans, and local governments are required to implement their Conservation Elements only to the extent economically feasible.[32]

> *Chapter 187 F.S. State Comprehensive Plan*
>
> *187.101 Description of plan; legislative intent; construction and application of plan.—*
>
> *(1) The State Comprehensive Plan shall provide long-range policy guidance for the orderly social, economic, and physical growth of the state…*
>
> *(2) The State Comprehensive Plan is intended to be a direction-setting document. Its policies may be implemented only to the extent that financial resources are provided pursuant to legislative appropriation or grants or appropriations of any other public or private entities…*
>
> *(3) The goals and policies contained in the State Comprehensive Plan shall be reasonably applied where they are economically and environmentally feasible…*

Increased and reliable financial resources are needed for local government planning departments, especially for smaller planning departments in less wealthy jurisdictions (Stein 2007; Miller et al. 2009; Stokes et al. 2010). Stable funding is needed not only for conservation land acquisition and management, but also for the acquisition of biological information through surveys and monitoring, for human resources, continuing education and training of planners in conservation science, and for informational resources and tools, such as GIS technologies and conservation planning software. There must also be funding available to advance collaborative

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[32] In 2013, two bills were proposed to the Florida legislature, (HB901 and SB584), to prohibit state and local agencies from purchasing additional conservation lands unless other state or local lands were sold. Though both of these bills died in committee, the fact that they were proposed highlights the vulnerability of biodiversity conservation efforts to political whims.

efforts, such as applied science research and collaborative projects between conservation scientists and governments.

Third, there is a need for regular evaluation of conservation planning effectiveness. This study found that most Conservation Elements contained little or no provisions for evaluation. Without regular evaluation, there is no way for county governments to gauge the extent to which conservation planning efforts are actually resulting in biodiversity persistence, or if conservation planning efforts are selectively benefitting some species or ecosystems but not others. Effective conservation planning will require inclusion of scientific protocols or criteria, such as quantitative targets and performance measures, as well as monitoring, evaluation, and adaptive management. To effectively accomplish this necessitates the expertise of biologists either on staff with counties or though consultation, which expertise is currently lacking for the majority of county governments. Once conservation planning efforts can be evaluated, the resources necessary for effective management, such as prescribed burns, removal of invasive exotics, restorations, assisted dispersal, and translocations must be also be available.

A fourth recommendation is for continued emphasis on regional planning. Regional and landscape-level conservation planning is critical to biodiversity preservation efforts because populations, communities and ecosystems operate outside of local political boundaries (Noss 1983; Brussard et al. 1992; Noss & Cooperrider 1994; Dixon et al. 2006). In this study, it was found that Regional Planning Councils (RPCs) likely play a key role in the dissemination of ideas, strategies, and plan language among neighboring counties. Regional Planning Councils were created to facilitate regional-scale planning under the State and Regional Planning Act of 1984. However, the Community Planning Act of 2011 reduced the role of Regional Planning

Councils to only comment on local plan amendments that would adversely impact regional state resources or that are inconsistent with the local comprehensive plans of other local governments within the region.[33] As such, RPCs now have only a minor role in influencing local plan amendments, (on a voluntary basis), and then only if they involve large developments of regional scale (1000 Friends of Florida 2012). The role of Regional Planning Councils as key drivers of conservation planning must be reinstated to ensure a regionally-focused approach to biodiversity protection rather than a county-based incremental approach.

Fifth, the state mandate for biodiversity conservation by local governments should be strengthened.[34] Although respondents in the survey in this study did not indicate that state mandates play a significant role in conservation planning quality, other studies have found that strong state mandates are critical for effective biodiversity conservation in local planning (Carruthers 2002; Miller et al. 2009; Stokes et al. 2010; Tang et al. 2010). State mandates that take a minimalist approach have been found to achieve only weak incorporation of state goals into local government planning documents (Brody 2003b; Tang et al. 2009). In fact, this study found that only 10.6% of all coastal Florida counties (5 of 47) have designated Adaptation Action Areas, which is optional under the Community Planning Act of 2011, reflecting the state of Florida's lack of a unified mandate for climate change and sea level rise planning. The high degree of variability in conservation planning quality among Florida local governments is also indicative of the weak mandate and lack of state vision for long-term biodiversity preservation in Florida.

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[33] Section 186.504, F.S.

[34] The Community Planning Act of 2011 revised Florida's growth management laws to facilitate development and thus encourage economic growth. The Act weakened the state mandate for local government biodiversity conservation by eliminating the Department of Community Affairs and the state's oversight over local comprehensive plan development and implementation to a significant degree.

Moreover, in addition to strong state mandates, state policy must employ a wide range of policy instruments, including incentives and education in addition to public ownership of land and regulation (Bengston et al. 2004). The state of Florida can employ incentives to encourage local governments to employ land use planning methods to protect biodiversity though urban renewal and smart growth initiatives, and can also promote biodiversity conservation through tax incentives, and by increasing the availability of relevant biological information to local governments and regional planning councils (Doremus 2003; Berke 2007). Greater education of the public is clearly also needed. Given the importance of education in this study as a predictor of conservation planning quality, the state can make great strides to increase the effectiveness of local government conservation planning by increasing the ecological education of public and government officials and planners through required environmental education in school curricula and training programs (Berke 2007; Miller et al. 2009).

Finally, better integration of conservation policy and conservation science is needed. Planners must be more informed about the existence of scientific data and resources on species, populations, and communities that are available for use in planning, about where to find those data, and how to employ conservation science resources in planning efforts. This can be accomplished through increasing communicative channels between planners and conservation scientists, additional training for planners, and more outreach to planners by conservation scientists and government wildlife agencies (Berke 2007; Stein 2007; Kartez & Casto 2008; Miller et al. 2009).

Limitations Of The Study

This study did not look at existing climate change action plans for counties or groups of counties (like a conservation compact), and also did not consider management plans for county-owned conservation lands, or separate documents for land acquisition strategies and criteria. Therefore, had these documents been included, the conservation planning quality scores for some counties may have been higher than they were determined to be in this study. Also, this study evaluated conservation planning and did not evaluate or consider the extent to which plans are implemented. It is possible that in some counties, conservation actions are not implemented to the extent they are set forth in local comprehensive plans. Conversely, it is also possible that some counties are engaging in biodiversity conservation measures that exceed comprehensive plan provisions, especially if they are collaborating with other entities, for example, private landowners and nongovernmental organizations. Finally, additional variables may influence conservation planning quality that were not examined in this study, including the influence of different stakeholders involved in the planning process, the degree of influence of special interest groups on local land use policy, local government structure, and perhaps other demographic variables such as religion.

Future Research Needs

Beyond this study, research is needed to evaluate existing conservation planning efforts. Given that the majority of local comprehensive plans lack specific quantitative targets and performance measures, it is unknown if current plan provisions are protecting biodiversity over the long term. Such evaluative studies are necessary to develop adaptive management responses

and guide planning goals. Research is also needed to determine how variability in county conservation planning impacts populations and communities. Studies using real species data are needed to determine if variability in local conservation planning affects different types of species in different ways; for example, wide-ranging animals such as Florida panthers or black bears might be affected differently from species that function as metapopulations on a smaller spatial scale and require connectivity among local populations, such as gopher tortoises or sensitive species such as Florida scrub-jays, which require large areas of core habitat with highly specific structure. Ecological studies taking life history characteristics into account for plant and animals species, and considering dispersal, migrations, patch dynamics, and ecological and evolutionary processes are needed to truly understand how variability in conservation planning among county governments will affect biodiversity persistence in the long term. Third, studies are also need to evaluate plan implementation. Such studies would need to involve a detailed examination and comparison of county land-use regulations, conservation lands management plans, and climate change and sea level rise plans (if they exist) to understand the extent to which plans for biodiversity conservation are translating into conservation actions that will ensure long-term persistence.

APPENDIX A: UNIVERSITY OF CENTRAL FLORIDA INSTTUTIONAL REVIEW BOARD
HUMAN RESEARCH REQUIRED DOCUMENTS

Human Research Protocol and Instructions

1) **Protocol Title**
   - Florida Counties Conservation Planning Survey

2) **Principal Investigator**
   - Pamela L. Pannozzo, M.S., J.D., PhD. Candidate, UCF Department of Biology

3) **Objectives**
   - The objective of this study is to document and analyze the variability of Florida county government policies that affect conservation

   - Research questions: 1). Are systematic conservation planning methods being used for acquiring and managing conservation lands in Florida counties? 2). What are the causes of differences in conservation planning activities of Florida county governments, if they exist?

   - Hypotheses: Conservation planning quality is high where the public is supportive of conservation efforts and values biodiversity, where local governments have sufficient resources for biodiversity conservation, where legislative mandates for biodiversity conservation are recognized, and where there is strong collaboration among jurisdictions and stakeholders.

   - The conservation planning activities of each of the 67 Florida counties will be evaluated and rated via a protocol used to score a set of indicators in county documents: land acquisition and management manuals, local comprehensive plan conservation elements, and climate change plan documents. A conservation planning score will be tabulated for each county. County conservation scores will be regressed against the four independent variables set forth in the hypothesis, (community values, resource availability, state mandates, collaboration), to determine the existence and nature of causal relationships.

4) **Background**
   The use of human research to elicit information about planning and conservation policy-making is established in the literature. Miller et al. (2009) surveyed planning directors from local jurisdictions across the United States to determine the extent to which local planning included conservation objectives. A web-based invitation and survey were sent to 116 planners, following the tailored design methodology. The study found that biodiversity conservation was either not considered or was a minor consideration, and that provisions for the conservation of native plants and animals

were rare in planning documents (Miller et al. 2009). Cort (1996) surveyed 53 directors of state natural heritage programs nationwide to determine the usage of biodiversity data in local land use planning. A two-page questionnaire was mailed to the director of the Natural Heritage Program in each state. That study found that, across states, biodiversity data are used only modestly by local governments, even when there are state-mandates to do so and the data are in facilitative formats such as GIS data (Cort 1996). Kartez and Casto (2008) surveyed 134 local officials and natural resources professionals across the state of Maine to determine the extent to which biological information was used in environmental planning. A survey questionnaire was mailed to local government contacts. That study found that local governments' use of biological data in land use planning depends on 1) the wealth of the county, 2) urbanization pressures, and 3) the extent to which various stakeholders routinely use biological data (Kartez & Casto 2008). Stokes et al. (2010) interviewed 17 planning directors from municipal governments across three counties near Seattle, Washington about the extent to which biodiversity conservation activities were incorporated into land use planning in their jurisdictions. Interviews were conducted in person and participants were asked open-ended multiple choice questions. Responses included planners' views about the factors that facilitate and impede biodiversity conservation in local land use planning (Stokes et al. 2010). Vance-Broland and Holley (2011) surveyed natural resources professionals to determine patterns in relationships among them in a social network analysis study. The goal of the study was to determine how social networks affect conservation action. The study used paper survey questionnaires, web-based surveys, and telephone and in-person interviews to survey 111 people. The data was used in network analysis and mapping to show relationships affecting conservation actions across different ecosystems (Vance-Borland & Holley 2011). Ramirez de la Cruz (2009) used data from two previous web-based, telephone, and written surveys of Florida municipal governments regarding land use practices and of the degree of activism of special interest groups. The aim of the study was to determine the characteristics of local governments that cause them to use smart-growth land-use regulations. That study found that the use of smart-growth regulations by local governments is related to the activism of special interest groups and how those groups interact with local political institutions (Ramirez de la Cruz 2009). Ervin (2003) summarizes the use of survey questionnaires developed by the World Wildlife Fund to assess the management effectiveness of protected areas. These written surveys are administered to stakeholders and managers during workshops, and pose questions about contextual issues and management effectiveness, including planning, protected areas policies, and processes (Ervin 2003b).

- Several studies have evaluated aspects of local government environmental protection planning. However, no studies have examined the quality of local government land use planning for biodiversity conservation specifically. The previous studies indicate variation occurs in many aspects of environmental protection plans of local governments. Given the results from these studies, it

is likely that there is also variation among local governments in planning for biodiversity conservation. If this is the case, and because the decisions of local governments have pivotal effects on biodiversity, it is necessary to understand the nature of these variations, determine their collective effect on long-term biodiversity persistence, and their cause. Through our survey of planning directors, we are attempting to understand the relative importance of different drivers in each county's conservation planning: community values, availability of resources, state mandates, and collaboration.

- The human research in this study is necessary to determine which independent variables impact local government conservation planning and the relative importance of those independent variables for different counties in Florida. This information will be used to better integrate conservation science and land use planning in the future.

5) Setting of the Human Research

- The research will be conducted via mailed survey questionnaires to the planning directors of each of the 67 Florida counties at county Planning Department offices. The surveys will be returned to the home address of the Principal Investigator. There are no site-specific regulations or customs affecting this research.

6) Resources available to conduct the Human Research

- I will obtain the list of 67 Planning Directors and their addresses and contact information from the Florida Department of Economic Opportunity Division of Community Affairs.

- The human research study will be conducted over a period of 8 weeks. Respondents will receive a prenotice letter followed by the questionnaire mailing 3 to 5 days later, which will include the Survey Invitation, Explanation of Research HRP 302c Form, Survey Questionnaire, and a $2 bill as a token financial incentive. A thank you/reminder postcard will be sent one week following the mailing of the questionnaire. A replacement questionnaire will be sent to nonrespondents 2 to 4 weeks after the previous questionnaire mailing. A final phone call will be made 2 to 4 weeks after the previous mailing encouraging nonrespondents to complete the survey.

- Staff for this study includes only the Principal Investigator. The Principal Investigator has piloted the survey questions and studied local government culture through interviews with local government planners and land managers. The PI will be the only person carrying out the study protocol, collecting and analyzing data.

- The human research will be conducted via survey questionnaires mailed to respondents at county planning department offices. Survey questionnaires will

be returned to the home address of the Principal Investigator. All data analysis will be conducted in the home office of the Principal Investigator.

7) Study Design

a) Recruitment Methods

- Recruitment methods follow the tailored design method for mail survey implementation of Dillman et al. (2009). Survey questionnaires will be sent via mail to the director of the planning department of each county. We expect a response rate above 70% based on response rates of prior similar surveys: 77% (Cort 1996); 61% (Kartez & Casto 2008)72.4% (Miller et al. 2009); 69% (Stokes et al. 2010); 42% (Vance-Borland & Holley 2011). We will include a token financial incentive of one $2 bill with each survey questionnaire, which incentive has been shown to increase response rates (Dillman et al. 2009). Survey mailings will be personally addressed to each respondent. The survey will be printed on card stock with the SPICE Lab and UCF logos on the envelopes, invitation, consent form and questionnaire. These methods have been shown to increase response rates (Dillman et al. 2009).

b) Inclusion and Exclusion Criteria

- N/A/, we are only surveying planning directors.

c) Study Endpoints N/A

d) Procedures involved in the Human Research.

- The survey questionnaire involves reading questions and answering those questions by checking a box using pen or pencil. We are not using any misleading statements or deception in the study design. Once the surveys are mailed, we will collect response questionnaires within 2 weeks. After another 14 days, we will mail another copy of the survey to nonrespondents again asking for their participation in the survey. If survey responses have not been returned after 2 weeks, we will follow up with a phone call to nonrespondents asking for their response. After 14 days, the response window will close. All survey questionnaires will be coded to make them identifiable by county. Respondents' identities will not be associated with survey questionnaire responses. Respondents' identities will be used only in addressing mailings to personalize the survey, which method has been effective in increasing response rate (Dillman et al. 2009).

e) Data and specimen management

- The data collected consist of responses to survey questions. These data will be coded with numbers (for example, 1-5 if there are 5 response options) for statistical analysis. All survey responses will be collected, coded, and inputted

by the Principal Investigator. Data will be managed in Microsoft Excel and analyzed in SPSS and JMP.

- Multiple regression will be used to determine which factors significantly influence county conservation plan quality (Brody 2003c; Gotelli & Ellison 2004; Tang et al. 2009; Tang et al. 2010). Variables will first be analyzed by category to determine which variables in each category are statistically significant. We will then develop a model using the statistically significant predictors from each category (Tang et al. 2010). We will conduct tests to ensure regression model assumptions are not violated, and that the ordinary least squares will yield best, linear, and unbiased estimates, including tests for model specification, multicollinearity and heteroskedasticity. We will also perform diagnostic test for outliers and influential data points (Brody 2003c; Gotelli & Ellison 2004; Tang et al. 2009; Tang et al. 2010).

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- Power analysis for sample size estimation indicates a required sample size of 25 to 38 for power between .8 and .9, with a large estimated model effect size ($f^2 = 0.35$) (Fig. 19). We expect a large model effect size because the independent variables tested in our study have been identified in other studies as being factors that affect different aspects of environmental planning by local governments. In the event, however, the model effect size is smaller ($f^2 = 0.15$), a sample size of 55 to 70 is identified for adequate precision (Fig. 20).
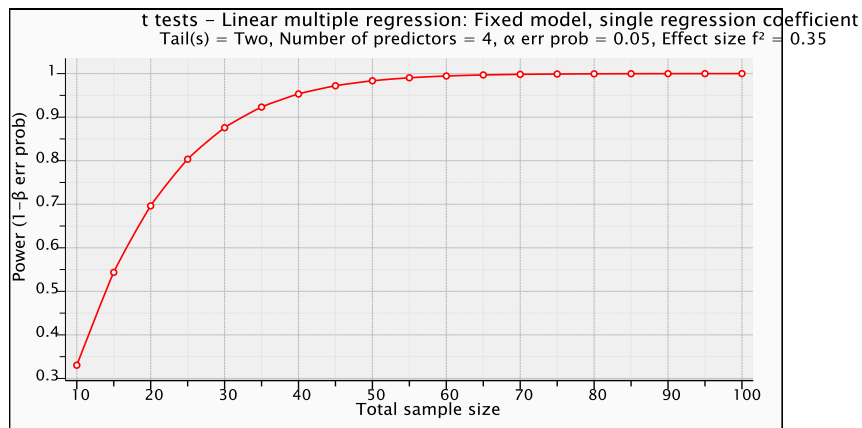
Figure 19. Power analysis results for a large model effect ($f^2 = 0.35$).
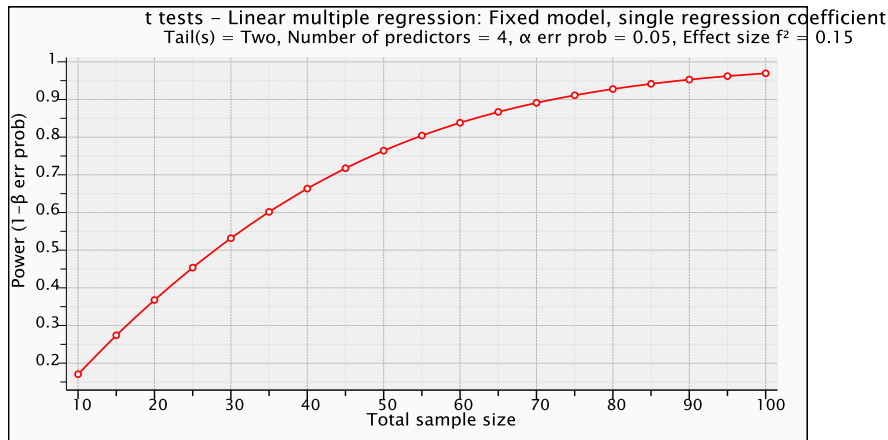
Figure 20. Power analysis results for a medium model effect ($f^2 = 0.15$).

f) Provisions to monitor the data for the safety of participants

- N/A

g) Withdrawal of participants

- There are no anticipated circumstances under which participants could be withdrawn from the research without their consent, nor are there procedures from orderly termination. In the event respondents do not return survey questionnaires, or withdraw from the study after returning survey questionnaires, data for that county will not be used in statistical analysis.

8) Risks to participants

- This human research study involves no discomforts, or hazards, and only minor inconveniences and risks to the participants. The survey questionnaire includes 26 questions and will take approximately 20 to 30 minutes to complete, which may be an inconvenience of time. Respondents are asked questions about how the county (including citizens, planners, and decision-makers) values biodiversity conservation, and about the availability of resources for conservation planning, extent of collaboration with other jurisdictions, and knowledge of state and federal laws. Respondents may engage in a social risk in answering these questions which could be perceived as being critical of others, or of county policies. However, this risk is minor in that responses will be coded and will not be associated with individual

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respondents. Further, responses will be aggregated with other data for statistical analysis and will not be traceable to any particular person.

9) Potential direct benefits to participants

- Respondents will likely receive no direct benefit from the study. Indirect benefits may be in learning about some of the issues involved in linking conservation science and planning, and in leaning about the resources available that can be used for conservation planning.

10) Provisions to protect the privacy interests of participants

- The survey questionnaire will be addressed to the planning directors personally at their offices. Respondents may complete the survey in the privacy of their offices. No other persons will be contacted about the survey.

- Responses will be anonymous. Survey questionnaires will be coded for county but will not be otherwise associated with an individual.

11) Provisions to maintain the confidentiality of data

- Survey questionnaires will be assigned a numerical code linked to county. The numerical code will be generated using random numbers in Microsoft Excel. The numerical code will appear on the survey questionnaire. Survey questionnaires will not include any information where they could be identified with an individual. Data from survey questionnaires will be entered for each county into a Microsoft Excel spreadsheet after responses have been coded. The names and contact information of respondents for each county will be stored in a separate Microsoft Excel spreadsheet.

- Data will be stored on the home office computer of the Principal Investigator, who is the only person that will have access to the data. Survey questionnaire data will be stored for five years following completion of the study. Respondent contact information and linkages to counties will be destroyed upon completion of the survey.

12) Medical care and compensation for injury

- N/A

13) Cost to participants

- N/A

14) Consent process consent in writing

- This process should qualify for Exempt Review and thus should not require the long consent form but only the Explanation of Research Form HRP 302c to satisfy the requirement for a Consent Process.

- Respondents will consent to the survey by returning the survey questionnaire after receiving the Survey Invitation and the Explanation of Research HRP 302c Form.

15) Process to document consent in writing

- This research involves minimal risk and should qualify for a waiver of written documentation of consent under HRP-417(2), in that it meets the following requirements:
  - o All written information to be provided includes all required and appropriate additional elements of consent disclosure in Section 7: Elements of Consent Disclosure in the Checklist: Criteria for Approval and Additional Considerations.
  - o The research presents no more than minimal risk of harm to the participants, as set forth in Section 8 above.
  - o The research involves no procedures for which written consent is normally required outside of the research context. The study involves only asking participants to complete a written survey and return the survey via the mail.

16) Vulnerable populations N/A

17) Drugs or Devices N/A

18) Multi-site Human Research N/A

19) Sharing of results with participants

- We have no plans for providing aggregate data and sharing the results of the study with participants.

Explanation of Research

Title of Project: Florida Counties Conservation Planning Survey, October 2012
Principal Investigator: Pamela L. Pannozzo, M.S., J.D., PhD. Candidate
Faculty Supervisor: Reed Noss, PhD.

You are being invited to take part in a research study. Whether you take part is up to you.

As a part of the Science and Planning in Conservation Ecology (SPICE) Lab at the University of Central Florida, we are conducting a state-wide survey to assess the current state of county-level land-use planning for the conservation of nature in Florida. We are contacting the Directors of the Planning Departments of all Florida counties to request your participation in the survey. The survey includes questions about land-use planning for the conservation of native species and habitats. Increasingly, local land-use and development decisions are having greater impacts on native species and habitats across the larger landscape. Today, urbanization and sprawl are the leading cause of species declines in the United States. We need your help to document and analyze the variability among Florida county government policies that affects conservation. Your answers to this survey will be used to determine ways to better integrate conservation science, land–use planning, and growth management in the future. This study involves no discomforts, or hazards, and only the minor inconvenience of time spent in completing the survey.

Enclosed is a survey questionnaire and a $2.00 cash token incentive of our appreciation for your time. Please read the survey and check the appropriate box with a pen or pencil. Please answer the following questions candidly and thoughtfully. Once completed, please return the survey in the enclosed return envelope. The survey is anonymous and responses will be aggregated for statistical analysis. Individual responses will not be released or used for any other purpose. The survey includes 26 questions and should take 20 minutes or less to complete.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints please contact: Pam Pannozzo, PhD. Candidate, SPICE Lab, Biology Department, University of Central Florida, (561) 512-5659, pannozzop@knights.ucf.edu, or Dr. Reed F. Noss, Faculty Supervisor, SPICE Lab, Biology Department, University of Central Florida, (407) 823-0975, reed.noss@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

APPENDIX B: UNIVERSITY OF CENTRAL FLORIDA INSTITUTIONAL REVIEW
BOARD HUMAN SUBJECTS PERMISSION LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Pamela L. Pannozzo**

Date: **September 18, 2012**

Dear Researcher:

On 9/18/2012, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Florida Counties Conservation Planning Survey
Investigator:	Pamela L. Pannozzo
IRB Number:	SBE-12-08690
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 09/18/2012 04:56:54 PM EDT

IRB Coordinator

Page 1 of 1

APPENDIX C: SURVEY INVITATION, SURVEY QUESTIONNAIRE, AND FOLLOW-UP LETTER

Florida Counties
Conservation Planning Survey

October 2012

Dear Planning Director:

As a part of the Science and Planning in Conservation Ecology (SPICE) Lab at the University of Central Florida, we are conducting a state-wide survey to assess the current state of county-level land-use planning for the conservation of nature in Florida. We are contacting the Directors of the planning departments of all Florida counties to request your participation in the survey.

Increasingly, local land-use and development decisions are having greater impacts on native species and habitats across the larger landscape. Today, urbanization and sprawl are the leading cause of species declines in the United States.

We need your help to document and analyze the variability among Florida county government policies that affect conservation. Your answers to this survey will be used to determine ways to better integrate conservation science and land–use planning in the future.

You will receive the survey instrument via mail within the next week. Enclosed with the survey questionnaire will be a stamped return envelope and a $2 bill as a token of our appreciation for your time. The survey is anonymous and should take no more than 20 minutes to complete. We ask that you complete the survey questionnaire and return it at your earliest convenience within a week.

Your input is incredibly valuable and we really appreciate you taking the time to share your views.

For information about the SPICE Lab, please visit http://noss.cos.ucf.edu/.

If you have questions about this survey, please contact us. Thank you for participating in this survey.

Pam Pannozzo, PhD. Candidate
Science and Planning in Conservation Ecology Lab
Department of Biology
University of Central Florida
Orlando, FL
pannozzop@knights.ucf.edu
(561) 512-5659

Thank you!

A note on privacy
This survey is anonymous.
The record kept of your survey responses does not contain any identifying information about you.

**Florida Counties
Conservation Planning Survey**

October 2012

Dear Planning Director:

Thank you for agreeing to take part in this survey. The survey is anonymous and responses will be aggregated for statistical analysis. Individual responses will not be released or used for any other purpose. The survey includes 26 questions and should take 20 minutes or less to complete.
The survey includes questions about land-use planning for the conservation of native species and habitats. We are trying to understand how conservation of wildlife and biodiversity fits into land-use planning at the county level in Florida.
Please answer the following questions candidly and thoughtfully. The data from this survey will be used to inform conservation planning across the state of Florida and help to bridge the gap between conservation science, land use planning, and growth management. Thank you for your participation in this important survey.

Category 1: General County Position on the Value of Conservation

The following questions will help us understand how conservation is valued in your county by planners, decision-makers, and the public.

How would you rank the following objectives and considerations in terms of their importance in land-use planning in your county?

	1st	2nd	3rd	4th	5th
Preserve native species and habitats					
Preserve open space and quality of life					
Creation of neighborhoods and communities					
Commute time, traffic patterns and flow					
Cost of extending urban services					

How would you best characterize land-use planning for conservation of nature (native species and habitats), as a part of land-use planning overall in your county?

○ Conservation of nature is always actively and routinely considered in land-use planning
○ Conservation of nature is frequently considered in land-use planning
○ Conservation of nature is occasionally considered in land-use planning
○ Conservation of nature is rarely considered in land-use planning

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○ Conservation of nature is never considered in land-use planning

○ Don't know

How important is the issue of <u>climate change</u> in land-use planning to conserve native species and habitats in your county currently?

○ Very important
○ Important
○ Moderately Important
○ Of Little Importance
○ Unimportant

○ Don't know

How important is the issue of <u>sea level rise</u> in land-use planning to conserve native species and habitats in your county currently?

○ Very important
○ Important
○ Moderately Important
○ Of Little Importance
○ Unimportant

○ Don't know

How important is it for planners in your county to have education and training in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats) <u>to perform their job</u>?

○ Very important
○ Important
○ Moderately Important
○ Of Little Importance
○ Unimportant

○ Don't know

How would you best describe the conservation values <u>of the public</u> in your county?

○ Very important—there is a consistent, reliable, recurring interest in conserving native species and habitats
○ Important—there is a fairly reliable and recurring interest in conserving native species and habitats
○ Moderately Important—there is a recurring interest in conserving native species and habitats
○ Of Little Importance—there is occasional interest in conserving native species and habitats

○ Unimportant-- there is no interest in conserving native species and habitats

○ Don't know

When land-use planning decisions designed to avoid loss of native species and habitats are made in your county, how would you best characterize those decisions? *("Proactive" decisions are defined as those made prior to impairment of ecological systems to avoid loss of species and habitats. "Reactionary" decisions are defined as those made after impairment of ecological systems to avoid further loss of species and habitats).*

○ Land-use planning decisions designed to avoid loss of native species and habitats are routine and proactive
○ Land-use planning decisions designed to avoid loss of native species and habitats are frequent and proactive
○ Land-use planning decisions designed to avoid loss of native species and habitats are occasional and proactive
○ Land-use planning decisions designed to avoid loss of native species and habitats are routine and reactionary
○ Land-use planning decisions designed to avoid loss of native species and habitats are frequent and reactionary
○ Land-use planning decisions designed to avoid loss of native species and habitats are occasional and reactionary
○ No land-use planning decisions designed to avoid loss of native species and habitats have been made in this county

○ Don't know

How would you best characterize the <u>level of commitment</u> for proactive planning for the conservation of native species and habitats currently by decision-makers in your county, (for example, county manager or Board of County Commissioners)?

○ High
○ Much
○ Some
○ Little
○ None

○ Not applicable--proactive land use plans for the conservation of nature have not been developed in this county
○ Don't know

Where proactive land-use plans for the conservation of nature (native species and habitats) have been developed in your county, how often have those plans been <u>implemented</u>?

○ Always

○ Frequently
○ Occasionally
○ Rarely
○ Never

○ Not applicable-proactive land use plans for the conservation of nature have not been developed in this county
○ Don't know

Category 2: Resource Availability

The following questions will help us understand the types and quality of resources available to planners for conservation planning.

What is the size of the planning staff in your county, including planners and support staff?

○ Over 20 people
○ 11-20 people
○ 6-10 people
○ 2-5 people
○ 1 person

○ Not applicable—there is no planning staff in this county
○ Don't know

Does your county provide training, funding, or other active opportunities for planners to learn about conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?

○ Yes, routinely
○ Yes, often
○ Yes, on occasion
○ Yes, though rarely
○ No

○ Not applicable—there is no planning staff in this county
○ Don't know

To the best of your knowledge, how well are most planners in your county trained in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?

○ Most planners have extensive training in conservation planning
○ Most planners have a great deal of training in conservation planning
○ Most planners have basic training in conservation planning

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○ Most planners have limited training in conservation planning
○ Most planners have no training in conservation planning

○ Not applicable—there is no planning staff in this county
○ Don't know

Are there currently one or more people employed by the county who are <u>conservation specialists or biologists with specific knowledge of conservation science,</u> and who are employed to utilize this knowledge in <u>conservation planning</u> (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats), either directly or as a liaison or advisor?

○ Yes
○ No

○ Don't know

Does your county have a department, agency, or program responsible for <u>acquiring</u> conservation lands (lands acquired to protect native species and habitats)?

○ Yes
○ No

○ Don't know

Does your county have a department or agency responsible for <u>managing</u> conservation lands (lands acquired to protect native species and habitats)?

○ Yes
○ No

○ Don't know

Which of the following best characterizes the nature of funding for conservation lands <u>purchases</u> (lands acquired to protect native species and habitats) in your county since the 1980s?

○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of a consistent amount each year
○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of varying amounts each year, though there has always been some funding
○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of varying amounts each year, though some years there has been no funding

○ There has been an occasional source of funding (such as through grants or general revenue appropriations) in varying amounts each year, though some years there has been no funding
○ There has been no funding for conservation lands purchases

○ Don't know

Which of the following best characterizes the nature of funding for conservation lands <u>management,</u> such as prescribed burning, other vegetation or hydrologic management, and control of non-native species, in your county since the 1980s?

○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of a consistent amount each year
○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of varying amounts each year, though there has always been some funding
○ There has been a dedicated source of funding (such as a bond referendum, sales tax, special assessment, or other general revenue appropriation) of varying amounts each year, though some years there has been no funding
○ There has been an occasional source of funding (such as through grants or general revenue appropriations) in varying amounts each year, though some years there has been no funding
○ There has been no funding for conservation lands management.

○ Don't know

The Florida Forever Act provides state match funding for Florida local governments to acquire land for the conservation of nature (native species and habitats). If Florida Forever funding is decreased or eliminated, what impact would this have on your county's ability <u>to conserve native species and habitats in the long term?</u>

○ Large impact
○ Some impact
○ Little impact
○ No impact

○ Don't know

How aware are planners of the availability of the following <u>types</u> of biological information, and how often are they used by planners and/or others assisting planners <u>in developing land-use plans</u>?

	Very aware- always used	Very aware- sometimes used	Very aware, never used	Somewhat aware- sometimes used	Somewhat aware- rarely used	Somewhat aware- never used	Not aware- never used	Not applicable —there is no planning staff	Don't know
Vegetation surveys or natural community mapping									
Species presence/absence data									
Imperiled or endangered and threatened species occurrence data (for example, from the Florida Natural Areas Inventory)									
Habitat distribution or niche models for imperiled species									
Species richness data									
Population or metapopulation models or data									
Population or molecular genetics data									
FFWCC (Florida Fish and Wildlife Conservation Commission) Strategic Habitat Conservation Areas digital maps and/or data									
The Nature Conservancy Ecoregional Plans									

How aware are planners of the availability of the following <u>sources</u> of biological information, and how often are these information sources consulted by planners <u>in developing land-use plans</u>?

	Very aware- always used	Very aware- sometimes used	Very aware- never used	Somewhat aware- sometimes used	Somewhat aware- rarely used	Somewhat aware- never used	Not aware- never used	Not applicable —there is no planning staff	Don't know
Biologists in another county department									
Consulting firms									
Academic scientists and other scientists from outside the county									
University of Florida/IFAS County Extension Service scientists									
Florida Natural Areas Inventory (FNAI) digital maps or other data									
City government agencies within the county									
Regional Planning Councils									
FFWCC (Florida Fish and Wildlife Conservation Commission) biodiversity data									
State government agencies other than FFWCC									
Federal government agencies (e.g., U.S. Fish and Wildlife Service, NOAA, National Park Service)									
Nongovernmental organizations (e.g. The Nature Conservancy, Audubon of Florida, Florida Wildlife Federation, Sierra Club)									

How aware are planners of the availability of the following resources for incorporating biological information into land-use plans, and how often are they used?

	Very aware-always used	Very aware-sometimes used	Very aware-never used	Somewhat aware-sometimes used	Somewhat aware-rarely used	Somewhat aware-never used	Not aware-never used	Not applicable—there is no planning staff	Don't know
Geographic information systems (GIS)									
Decision support software (e.g. NatureServe VISTA, CommunityViz)									
Reserve (site) selection algorithms (e.g., MARXAN, Zonation)									
Land use change simulation models									
Other conservation planning software (e.g., Fragstats, Link , FunConn)									
Threat modeling software									
Future human population growth or urbanization models and data									
Sea level rise projections and vulnerability assessments									
Climate change models and projections									

Category 3: Collaboration

To the best of your knowledge, how often do the parties listed below collaborate on developing land-use plans to conserve native species and habitats?

	Always	Very frequently	Occasionally	Rarely	Very rarely	Never	Don't know
Departments or agencies within your county							
Departments and agencies of your county and conservation or environmental groups							
Your county's land-use planners and its citizens							
Your county's land-use planners and conservation scientists in universities or elsewhere							
Your county and private landowners							
Your county and city governments within the county							
Your county and other city and county governments							
Your county and its regional planning council							
Your county and Florida state land and wildlife conservation agencies, such as water management districts, DEP, FFWCC, Florida Forest Service							
Your county and federal agencies							

Category 4: Federal and State Laws

The following questions will help us understand how federal and state laws are perceived and understood by planners at local government levels.

To the best of your knowledge, do federal and/or state laws currently require local governments to develop land-use plans to conserve and protect native species and habitats within the local government's jurisdiction?

○ Yes
○ No

○ Don't know

To the best of your knowledge, do federal and/or state laws currently require local governments to work together to plan for development in such a way that will conserve and protect native species and habitats within the two or more local governments' jurisdictions?

○ Yes

○ No

○ Don't know

The Florida 2011 Community Planning Act amended the Growth Management Act of 1985, which requires local governments to prepare local comprehensive land-use plans. Under the Community Planning Act, the state has reduced oversight of, and involvement in, local government comprehensive planning. What impact does this change have on your local government's ability <u>to conserve native species and habitats</u> in the long term?

○ Large impact
○ Some impact
○ Little impact
○ No impact

○ Don't know

The Florida 2011 Community Planning Act amended the Growth Management Act of 1985, which requires local governments to prepare local comprehensive land-use plans. Under the Community Planning Act, counties can designate Adaptation Action Areas to address sea-level rise as a part of their local comprehensive plans. Is your county designating, or does you county plan to designate, such Adaptation Action Areas?

○ Yes
○ No

○ Don't know

**Florida Counties
Conservation Planning Survey**

October 2012

Dear Mr. _____:

Thank you again for your participation in the Florida Counties Conservation Planning Survey. During the next few months, the data will be statistically analyzed to assess the current state of local conservation planning in Florida. Once that work is completed, we will send you a summary of our results.

If you haven't returned the survey questionnaire form yet, if you would please do so **no later than October 31, 2012** it would be greatly appreciated. If you have questions or need another copy of the survey questionnaire, please contact me at pannozzop@knights.ucf.edu or (561) 512-5659.

Best wishes!   Pam Pannozzo, Ph.D. Candidate

APPENDIX D: SURVEY RESULTS

Individual Survey Questions and Statistical Analysis of Responses

Individual question response data were determined to be skewed and non-normally distributed, necessitating the use of nonparametric statistical methods.

General County Position on the Value of Conservation of Nature Category

1) Survey question: How would you rank the following objectives and considerations in terms of their importance in land-use planning in your county?

28.3% of respondents ranked "Preserve native species and habitats" as the most important objective in land use planning, while 20% ranked this as the least important objective in land-use planning. When the mean for each objective was calculated and objectives were ordered from highest to lowest based on means, "Preserve open space and quality of life" ranked as the most important objective in county-level land-use planning, followed by "Creation of neighborhoods and communities," and "Cost of extending urban services." "Preserve native species and habitats" ranked fourth in importance (Table 12). The difference between the rankings of objectives was significantly different among... (H = 13.30, 4 df, p < 0.001). Pairwise comparisons were significant between the highest ranked objective "Preserve open space and quality of life" and the third, fourth and fifth-ranked objectives "Cost of extending urban services" (U = 1351, p = 0.020), "Preserve native species and habitats" (U = 1352, p = 0.020), "Commute time, traffic patterns, and flow" (U = 1136, p < 0.001).

Table 12. Rank of importance of objectives in land-use planning from highest to lowest.

Rank	Objective	Mean*	Median	Mode
1	Preserve open space and quality of life	3.67	4	5
2	Creation of neighborhoods and communities	3.28	3	3
3	Cost of extending urban services	3.05	3	2
4	Preserve native species and habitats	2.98	3	1, 4**
5	Commute time, traffic patterns, and flow	2.73	3	1

5 = most important, 1 = least important
*** multiple modes exist*

2) Survey question: How would you best characterize land-use planning for the conservation of nature (native species and habitats), as a part of land-use planning overall in your county?

Conservation of nature is a common consideration in land-use planning for a majority of counties (median = 4, "frequently" considered; mode = 5, "always and routinely" considered). 46.7% of respondents indicated that conservation of nature is "always and routinely" considered in land-use planning, and 36.7% indicated conservation of nature is "frequently" considered in land-use planning. Coastal counties consider nature conservation in land-use planning more regularly (median = 5, "always and routinely") than Inland counties (median = 4, "frequently") (Fig. 21). However, the difference between Inland and Coastal counties in the importance of nature conservation as a part of land-use planning was not significant (U = 330.5, n_I = 27, n_C = 33, p = 0.061), nor was the difference among Regions (H=7.15, df 3. p=0.067).
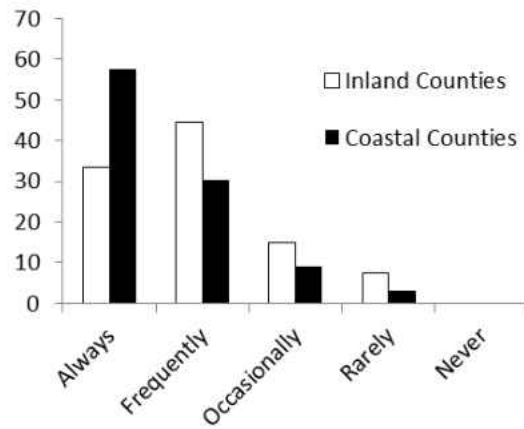
Figure 21. Percentage of responses characterizing the consideration of land-use planning for the conservation of nature (native species and habitats) as a part of land-use planning overall for Inland (n=27) and Coastal (n=33) counties in Florida.

3) Survey question: How important are the issues of climate change and sea level rise in land-use planning to conserve native species and habitats in your county currently?

Climate change was "very important" for 6.6% of counties and "important" for 9.8% of counties in land use planning to conserve native species and habitats. The issue was "of little importance" for 39% of counties and "unimportant" for 25% of counties (median and mode = 2, "of little importance") (Fig. 22).
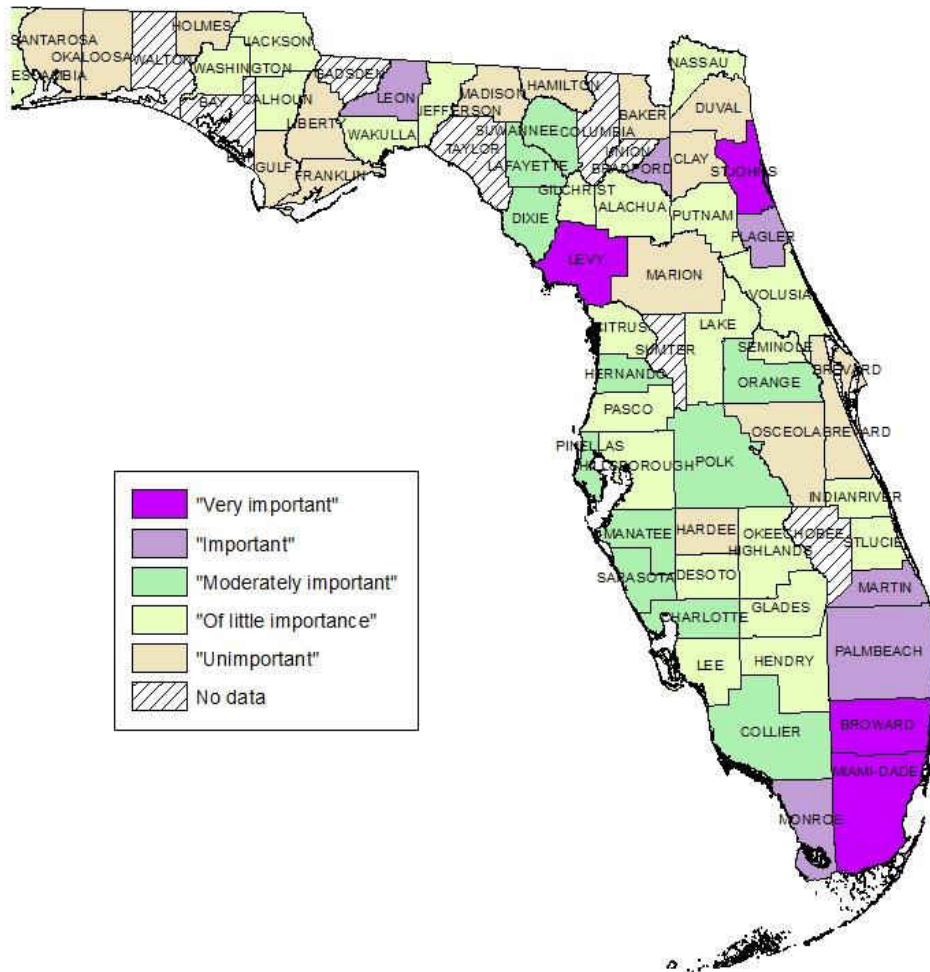
Figure 22. Florida county rankings of the importance of the issue of climate change in land-use planning.

This issue was considered "very important" by 7% (2 of 27) of Inland counties and 13% (4 of 32) of Coastal counties (Fig. 23). The difference between Inland and Coastal counties in the importance of climate change as a part of land-use planning was significant (U = 299, n_I = 27, n_C = 32, p = 0.032). There was also a significant difference among Regions under the Kruskall-Wallis test (H = 8.63, df 3. p = 0.030), between Region 1 (Panhandle) and Region 4 (South Florida) (U = 43.50; p = 0.003) based on a Bonferroni correction of 0.008 (0.05/6 possible comparisons = 0.008).

Figure 23. Percentage of responses indicating the importance of climate change in conservation planning for Inland (n=27) and Coastal (n=32) counties in Florida.

Sea level rise was similarly held to be "very important" for 6.8% of counties and "important" for 8.5% of counties in land use planning to conserve nature. The issue was "of little importance" for 34% of counties, and "unimportant" for 31% of counties, (median and mode = 2, "of little importance"). Coastal counties are more concerned with this issue, as 38% of Coastal counties held this issue to be "moderately important" while for Inland counties the issue was "of little importance" (41%) or "unimportant" (56%) (Fig. 24). The difference between Inland and Coastal counties in the importance of sea level rise as a part of land-use planning was also

significant ($U = 131$, $n_I = 27$, $n_C = 32$, $p < 0.001$) though there was no difference among Regions ($H = 7.10$, df 3. $p = 0.069$).

Figure 24. Percentage of responses indicating the importance of sea level rise in conservation planning for Inland (n=27) and Coastal (n=32) counties in Florida.

4) Survey question: How important is it for planners in your county to have education and training in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats) to perform their job?

Respondents indicated it is "very important" (11.5%), "important" (30.8%), and "moderately important" (30.8%) for planners to have education and training in conservation planning to perform their job. Training in conservation planning is "of little importance" to land-use planning for 23.1% of respondents and "not important" for 3.8%. The median and mean responses were both 3 ("moderately important'). The difference between Inland and Coastal Counties in the importance of conservation planning training for planners was not significant ($U = 339.5$, $n_I = 26$, $n_C = 32$, $p = 0.211$), nor was the difference among Regions ($H = 1.64$, df 3. $p = 0.650$).

5) Survey question: How would you best describe the conservation values of the public in your county?

For this question, the manner in which the public values conservation was based on the planners' perceptions of public values in each county. Conservation of nature was reported to be "very important" to the public by 22.8% of all respondents, "important" by 28% and "moderately important" by 40%, (median = 4, "important"; mode = 3, "moderately important". Coastal counties had a higher value for the importance of nature conservation (median = 4, "important") than Inland counties (median = 3, "moderately important). For Coastal counties, 28% indicated conservation of nature is "very important" compared to 16% for Inland counties. Similarly, conservation of nature is "important" for 31.3% of Coastal counties compared to 24% of Inland counties (Fig 25). The difference between Inland and Coastal Counties in the conservation values of the public was not significant (U = 325, n_I = 25, n_C = 32, p = 0.201). The difference among Regions was significant (H = 12.31, df 3. p = 0.006) between Regions 1(Panhandle) and 3 (Central Florida) (U = 17.50, p = 0.001).
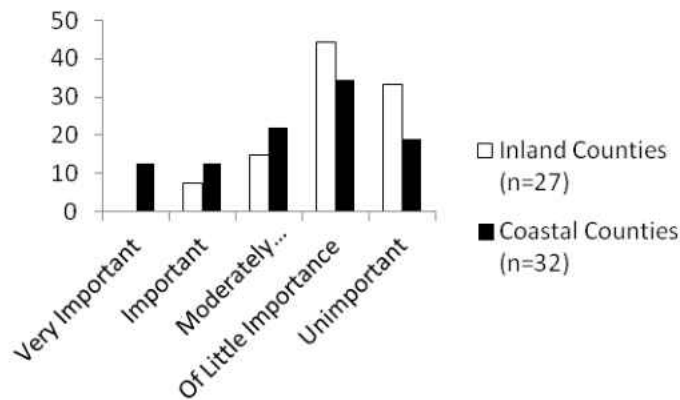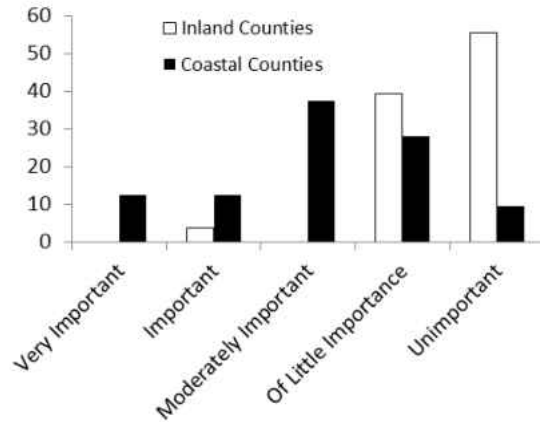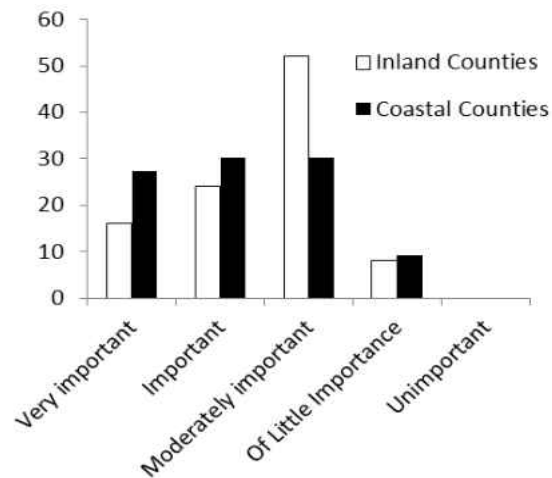
Figure 25. Percentage of responses indicating importance of nature conservation for Inland (n=25) and Coastal (n=22) counties in Florida.

6) Survey question: When land-use planning decisions designed to avoid loss of native species and habitats are made in your county, how would you best characterize those decisions?

The majority of respondents indicated that and land-use planning decisions to avoid loss of native species and habitats are "routine and proactive" (26.7%), "frequent and proactive" (25%), or "occasional and proactive" (30%). The median response was 6 ("frequent and proactive"), and the mode response was 5 ("occasional and proactive"). For Inland counties, 14.3% of respondents indicated land-use planning decisions to avoid loss of species are "occasional and reactionary," versus 6.3% of Coastal counties. 14.3% of respondents from Inland counties indicated there were no land use planning decisions designed to avoid loss of native species and habitats versus 0% of Coastal counties (Fig. 26). The difference between Inland and Coastal Counties in the nature of land-use planning decisions to preserve nature was significant (U = 309, n_I = 28, n_C = 32, p = 0.031). The difference among Regions was significant

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(H = 9.97, df 3. p = 0.019); however, pairwise comparisons using the Mann-Whitney U test found differences between Region 1 and 3 (U = 38.5, p = 0.012) and Region 1 and 4 (U = 53.5, p = 0.015) that did not meet significance levels required by the Bonferroni correction (0.008).

Figure 26. Percentage of responses characterizing land-use planning decisions to avoid loss of native species and habitats for Inland (n=28) and Coastal (n=32) counties in Florida.

7) Survey question: How would you best characterize the level of commitment for proactive planning for the conservation of native species and habitats currently by decision-makers in your county, (for example, county manager or Board of County Commissioners)?

Respondents indicated the levels of commitment for proactive planning for nature conservation were "high" (29.1%), "much" 20%, and "some" (30.9%) across Florida counties. The median and mode responses were both 3 ("some" commitment). A greater percentage of Coastal counties indicated "high" levels of commitment for proactive planning (35.5%) than Inland counties (20.8%) as well as overall commitment to proactive planning (Coastal counties: median =4, "much,"; Inland counties: median = 3, "some") (Fig. 27). The difference between Inland and Coastal Counties in the level of commitment for proactive planning for nature

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conservation was not significant ($U = 334$, $n_I = 24$, $n_C = 321$, $p = 0.502$), nor was the difference

among Regions ($H = 6.12$, df 3. $p = 0.106$).
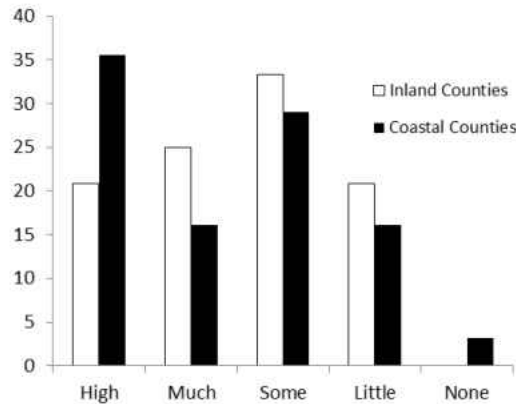
Figure 27. Percentage of responses characterizing the level of commitment for proactive planning for the conservation of nature by decision-makers for Inland (n=24) and Coastal (n=31) counties in Florida.

8) Survey question: Where proactive land-use plans for the conservation of nature (native species and habitats) have been developed in your county, how often have those plans been implemented?

Proactive land-use plans for the conservation of nature were reported to be "always" implemented by 25.9% of respondents, "frequently" implemented by 42.6% of respondents, and "occasionally" implemented by 25.9% of respondents. The median and mode responses were both 4 (proactive plans are "frequently" implemented). Coastal counties reported higher levels of such plans being "always" implemented (35.5%), than Inland counties (13%) (Fig. 28). There was a significant difference between Inland and Coastal Counties in the implementation of land-use plans for nature conservation ($U = 244.5$, $n_I = 23$, $n_C = 31$, $p = 0.032$). There was no significant difference among Regions ($H = 1.69$, df 3. $p = 0.638$).
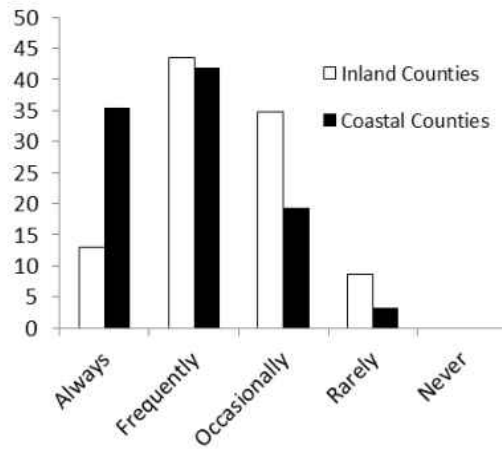
Figure 28. Percentage of responses characterizing the frequency of implementation of proactive plans for the conservation of nature for Inland (n=23) and Coastal (n=31) counties in Florida.

Resource Availability Category

1) Survey question: What is the size of the planning staff in your county, including planners and support staff?

The median for the size of planning staff was 6-10 people, though the mode was a planning staff size of 2-5 people. Coastal counties have larger planning staffs (median = 3, (6-10 people); mode = 5, (over 20) than Inland counties (median = 2, (2-5 people); mode = 2) (Fig. 29), a significant difference (U = 295, n_I = 27, n_C = 33, p = 0.025). There was also a significant difference among Regions (H = 12.58, df 3. p = 0.006); however, pairwise comparisons using the Mann-Whitney U test found a difference between Region 1 and 3 (U = 30.5, p = 0.008) that did not meet significance levels required by the Bonferroni correction (0.008).
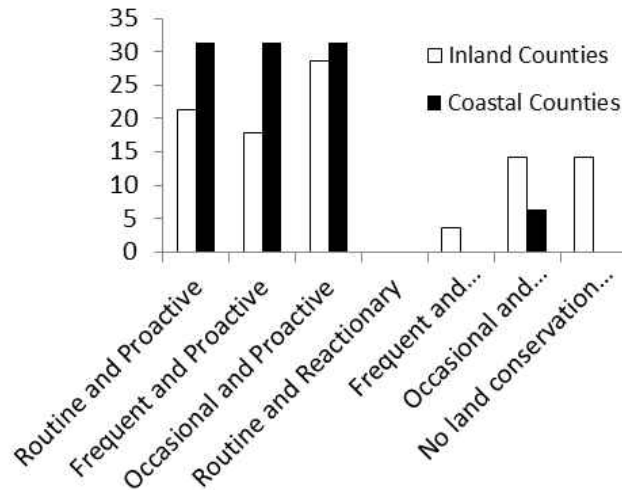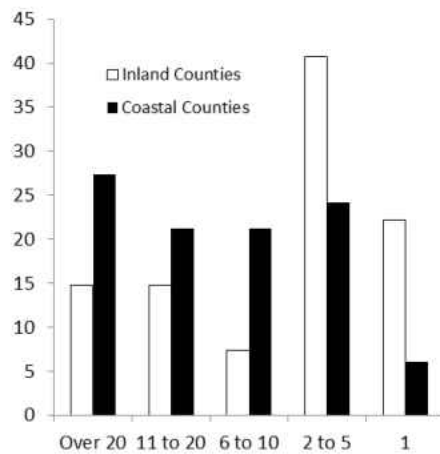
Figure 29. Percentage of responses characterizing the size of the planning staff for Inland (n=27) and Coastal (n=33) counties in Florida.

2) Survey question: Does your county provide training, funding, or other active opportunities for planners to learn about conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?

5.0% of respondents indicated that conservation planning training is routine and 11.7% indicated that conservation planning training opportunities occur "often." The majority of respondents indicated that conservation planning training occurs "on occasion" (38.3%) or rarely (16.7%). 28.3% of respondents indicated opportunities to learn about conservation planning are not provided. Median and mode responses were both 3, ("on occasion"). Medians and modes for both Inland and Coastal counties were identical (median = 3 ("on occasion"); mode = 3), and frequency distributions were similar among Inland and Coastal counties (Fig. 30). The difference between Inland and Coastal Counties in the provision of conservation planning training for planners was not significant (U = 435.5, n_I = 26, n_C = 33, p = 0.87), nor was the difference among Regions (H = 2.36, df 3. p = 0.501).
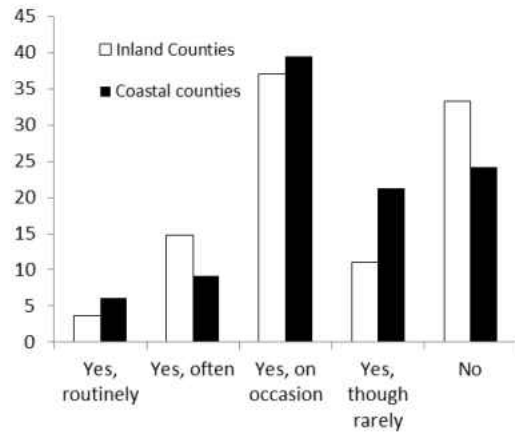
Figure 30. Percentage of responses characterizing the availability of training in conservation planning for land-use planners in Inland (n=27) and Coastal (n=33) counties in Florida.

3) Survey question: To the best of your knowledge, how well are most planners in your county trained in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats)?

No respondents indicated that planners have "extensive" training in conservation planning. The majority of respondents indicated that planners have "a great deal of" (10.2%), "basic" (45.8%) or "limited" (31.1%) training in conservation planning, with 11.5% indicating planners have no training in conservation planning. Medians and modes for both Inland and Coastal counties were identical (median = 3 ("basic training"); mode = 3), and frequency distributions were similar among Inland and Coastal counties (Fig. 31). The difference between Inland and Coastal Counties in the degree to which planners are trained in conservation planning was not significant (U = 408, n_I = 26, n_C = 33, p = 0.73). There was no significant difference among Regions as well (H = 5.45, df 3. p = 0.141).
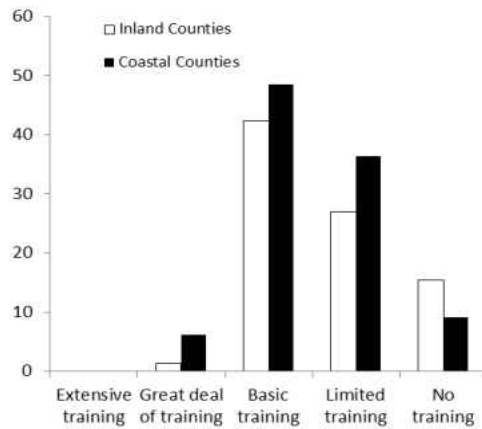
Figure 31. Percentage of responses characterizing the extent of education of land-use planners in conservation planning for Inland (n=26) and Coastal (n=33) counties in Florida.

4) Survey question: Are there currently one or more people employed by the county who are conservation specialists or biologists with specific knowledge of conservation science, and who are employed to utilize this knowledge in conservation planning (land-use planning methods to ensure the representation and long-term preservation of plants, wildlife, and their habitats), either directly or as a liaison or advisor?

55% of respondents answered "yes," and 45% answered "no" (Fig. 25). 71.9% of Coastal counties had biologists or other conservation specialists on staff, versus 35.7% of inland counties (Fig. 32).
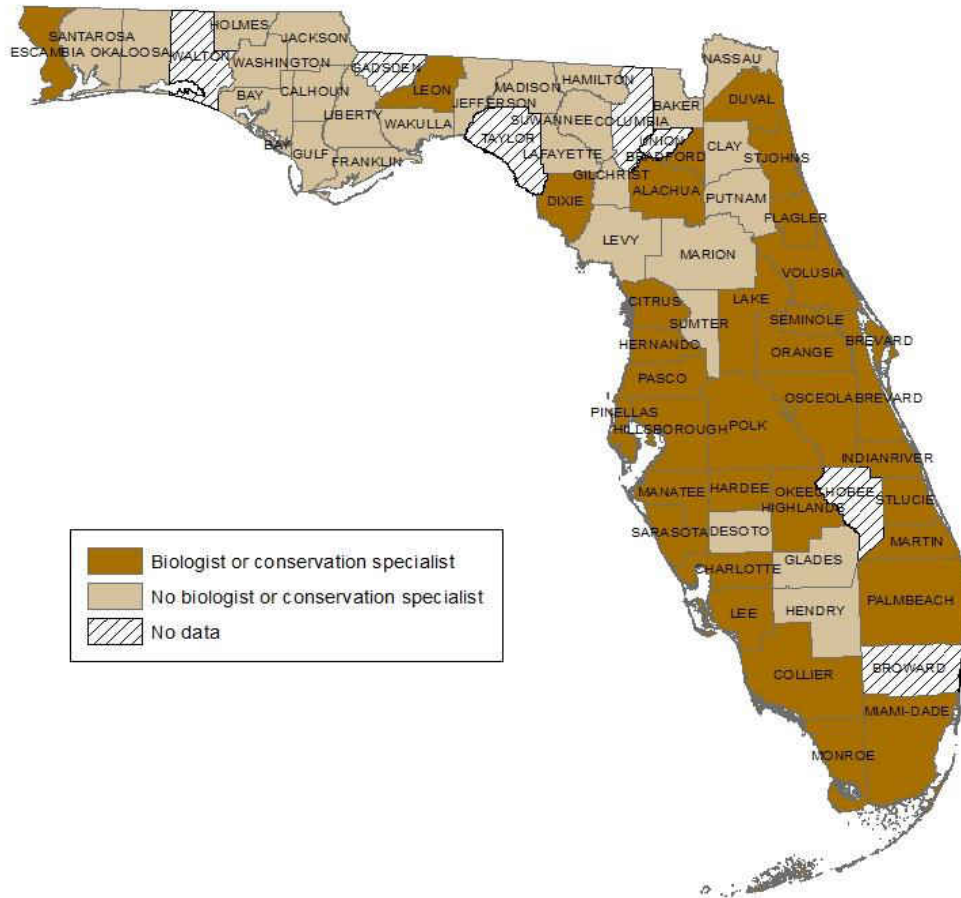
Figure 32. Florida county governments employing a biologist or conservation specialist for conservation planning.

The difference between Inland and Coastal Counties in the employment of a conservation specialist was significant (U = 286, n_I = 28, n_C = 32, p < 0.001) (Fig. 33). The difference among Regions was also significant (H = 21.87, df 3. p < 0.001) between Regions 1 and 3 (U = 19; p < 0.001) and between Regions 1 and 4 (U = 37, p < 0.001).
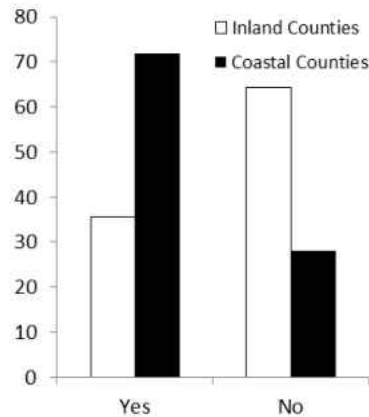
Figure 33. Percentage of responses indicating the presence of a conservation specialist on staff for Inland (n=28) and Coastal (n=33) counties in Florida.

5) Survey question: Does your county have a department, agency, or program responsible for acquiring conservation lands (lands acquired to protect native species and habitats)?

46.7% of Florida counties have a conservation lands acquisition program or department, while 53.3% do not (Fig. 34).
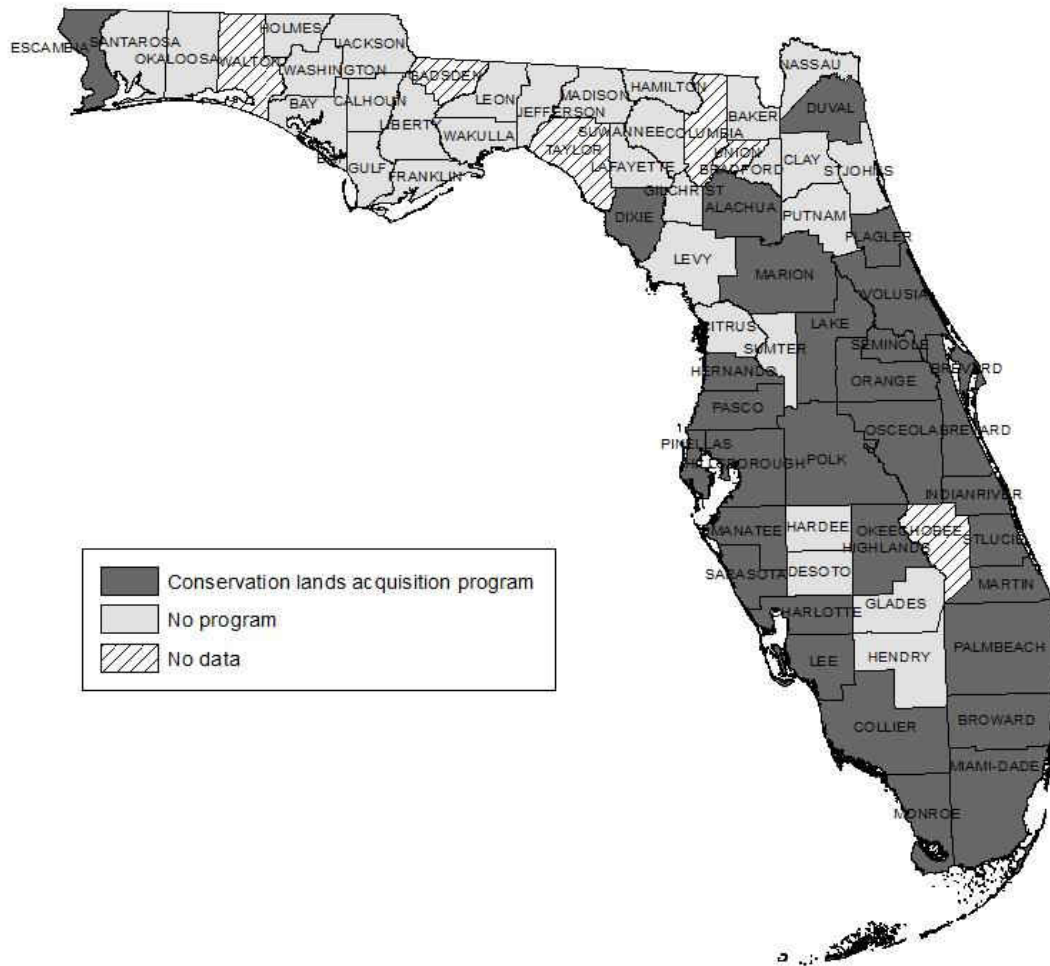
Figure 34. Florida counties with a conservation lands acquisition program or department.

Land acquisition programs or departments are more prevalent in coastal counties (65.6%), than in inland counties (25%) (Fig. 35). The difference between Inland and Coastal Counties in the existence of a conservation lands acquisition department or program was significant ($U = 266$, $n_I = 28$, $n_C = 32$, $p < 0.001$). There was a significant difference among Regions ($H = 18.79$, df 3. $p < 0.001$) between Region 1 and 3 ($U = 27$, $p = 0.001$).
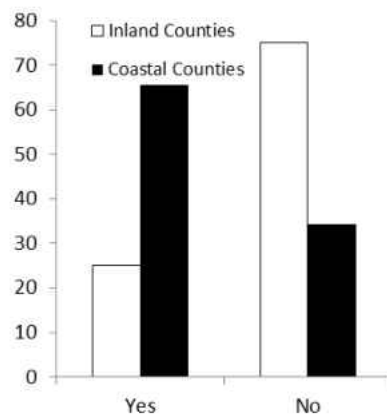
Figure 35. Percentage of responses indicating the presence of a conservation lands acquisition department or program for Inland (n=28) and Coastal (n=33) counties in Florida.

<u>6) Survey question: Does your county have a department or agency responsible for managing conservation lands (lands acquired to protect native species and habitats)?</u>

A greater number of counties have departments responsible for managing conservation lands than acquiring them. 56.7% of counties have a conservation lands management department, while 43.3% do not. Conservation lands management departments are more prevalent in coastal counties (71.9%), than in inland counties (39.3%) (Fig. 36). The difference between Inland and Coastal Counties in the existence of a conservation lands management department was significant ($U = 302$, $n_I = 28$, $n_C = 32$, $p = 0.01$), as was the difference among

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Regions (H = 13.67, df 3. p = 0.003) between Regions 1 and 3 (U = 32, p = 0.002) and Regions 1 and 4 (U = 53.5, p = 0.003).
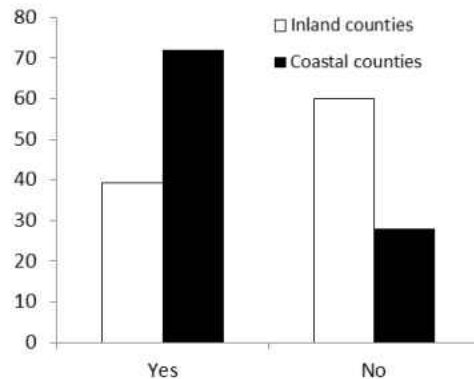
Figure 36. Percentage of responses indicating the presence of a conservation lands management department or program for Inland (n=28) and Coastal (n=33) counties in Florida.

7) Survey question: Which of the following best characterizes the nature of funding for conservation lands purchases (lands acquired to protect native species and habitats) in your county since the 1980s?

Funding for conservation lands purchases has been a limited resource but varies among counties. Of the 58 respondents to this question, 8 (13.8%) indicated there has been "a dedicated source of funding of a consistent amount each year." 19.0% of respondents indicated there has been a "varying source of funding each year though there has always been some funding," and 27.6% indicated there has been "an occasional source of funding though some years there has been no funding." There has been no funding for conservation lands purchases for 25.9% of respondents. Coastal counties have more reliable funding for conservation lands acquisitions (median = 3 ("dedicated, varying amount, though sometimes no funding"; mode = 4 (dedicated, varying amount, though always funding") than Inland counties (median = 2 ("occasional,

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sometimes no funding"); mode = 1 ("no funding") (Fig. 37). The difference between Inland and

Coastal Counties in the availability of funding for conservation lands purchases was significant

($U = 283$, $n_I = 26$, $n_C = 32$, $p = 0.031$) as was the difference among Regions ($H = 14.87$, df 3. $P =$

0.002) between Regions 1 and 3 ($U = 21.5$, $p = 0.002$) and Regions 1 and 4 ($U = 41.5$, $p =$

0.005).
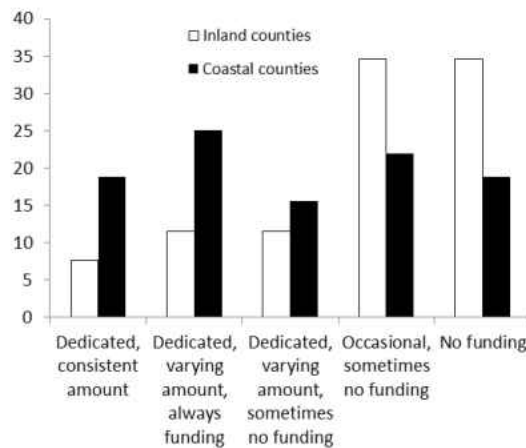
Figure 37. Percentage of responses characterizing funding for conservation lands purchases since the 1980s for Inland (n=26) and Coastal (32) counties in Florida.

8) Survey question: Which of the following best characterizes the nature of funding for conservation lands management, such as prescribed burning, other vegetation or hydrologic management, and control of non-native species, in your county since the 1980s?

Funding for conservation lands management has also been limited, though not as limited

as funding for conservation lands acquisition. 14% of respondents indicated there has been a

"dedicated source of funding of a consistent amount each year," and 19.3% of respondents

indicated there has been a "varying source of funding each year though there has always been

some funding." 31.6% indicated funding has been "occasional, though in some years there has

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been no funding", and 24.6% of respondents indicated there has been no funding since the 1980s

for conservation lands management. Coastal counties have more reliable funding for

conservation lands management (median = 3 ("dedicated, varying amount, though sometimes no

funding"; mode = 2 ("occasional, sometimes no funding") than Inland counties (median = 2

("occasional, sometimes no funding"); mode = 2 (Fig. 38). The difference between Inland and

Coastal Counties in the availability of funding for conservation lands management was

significant ($U = 270$, $n_I = 27$, $n_C = 30$, $p = 0.032$) as was the difference among Regions ($H =$

14.01, df 3. $p = 0.003$) between Regions 1 and 3 ($U = 16$, $p = 0.001$) and Regions 1 and 4 ($U =$

55, $p = 0.025$) though the latter did not meet the statistical threshold of the Bonferroni correction

of 0.008.
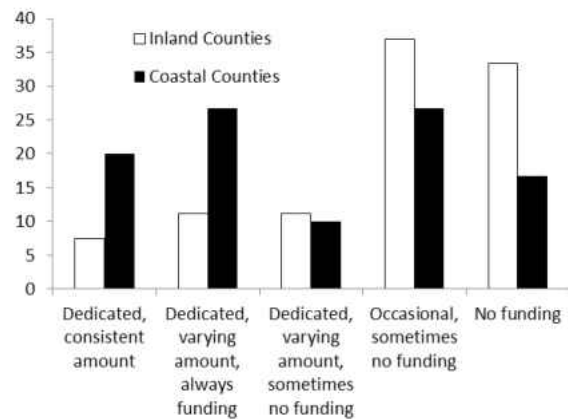
Figure 38. Percentage of responses characterizing funding for conservation lands management since the 1980s for Inland (n=27) and Coastal (n=30) counties in Florida.

9) Survey question: The Florida Forever Act provides state match funding for Florida local governments to acquire land for the conservation of nature (native species and habitats). If Florida Forever funding is decreased or eliminated, what impact would this have on your county's ability to conserve native species and habitats in the long term?

The majority of respondents (86.0%) indicated that decreases in Florida Forever matching funding would have an effect on the ability of local governments to acquire conservation lands, ranging from a "large impact" (31.6%) to "some impact" (40.4%), to "little impact" (14%). 14% of respondents indicated decreases in Florida Forever matching funding would have "no impact" (Fig. 39). The difference between Inland and Coastal Counties in perceived impact of a decrease or elimination in Florida Forever funding was not significant (U = 290.5, n_I = 27, n_C = 30, p = 0.053 though there was a significant difference among Regions (H = 6.48, df 3. p = 0.090) between Regions 1 and 4 (U = 42, p = 0.025) though this did not meet the statistical threshold of the Bonferroni correction of 0.008.
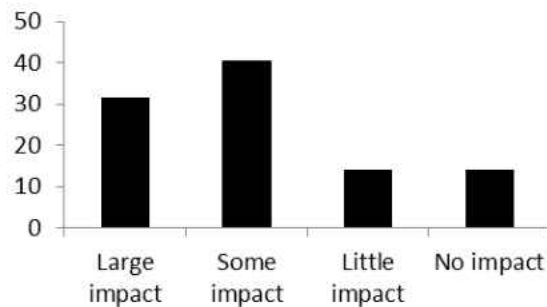
Figure 39. Percentage of responses from all Florida counties (n=57) characterizing the impact of decreases in Florida Forever matching funding on county governments' ability to conserve native species and habitats in the long term.

10) Survey question: How aware are planners of the availability of the following types of biological information, and how often are they used by planners and/or others assisting planners in developing land-use plans?

The most frequently used types of biological information in land-use planning are vegetation surveys and maps and listed species and native species occurrence data. The least frequently used are population models, The Nature Conservancy Ecoregional Plans, and

population genetics data (Table 13). The difference between the ranking of the frequency of use

of different types of biological information was significant (H = 120.23, 8 df, p < 0.001). Coastal

counties had significantly higher scores than inland counties for the use of vegetation surveys or

natural community mapping (U = 295.5, p = 0.033), endangered species lists (U = 272.0, p =

0.020), habitat distribution models for listed species (U = 199.0, p = 0.020), and population

models (U = 167.0, p = 0.007). Significant differences were found among Regions in the use of

vegetation surveys or natural community mapping (Regions 1 and 3: (U = 42.5, p = 0.045);

Regions 1 and 4: (U = 28.5, p = 0.000), species lists (Region 1 and 3(U = 33, p = 0.037); Region

1 and 4: U = 30; p = 0.003), and listed species occurrence data (Region 1 and 4: U = 37, p =

0.004).

Table 13. Rank of awareness of planners and frequency of use of different types of biological information in land-use planning from highest to lowest.

Rank	Objective	Mean*	Median	Mode
1	Vegetation surveys or natural community mapping	5.76	6	7
2	Listed species occurrence data	5.69	6	7
3	Species presence or absence data	5.40	6	6
4	FFWCC digital maps or other data	5.07	6	6
5	Habitat distribution or niche models for listed species	3.88	4	1
6	Species richness data	3.71	4	1
7	Population or metapopulation data or models	3.57	4	1
8	Nature Conservancy Ecoregional Plans	3.37	3	1
9	Population or molecular genetics data	2.43	2	1

7 = very aware, always used, 6 = very aware, sometimes used, 5 = somewhat aware, sometimes used, 4 = somewhat aware, rarely used, 3 = very aware, never used, 2 = somewhat aware, never used, 1 = not aware, never used

11) Survey question: How aware are planners of the availability of the following sources of biological information, and how often are these information sources consulted by planners in developing land-use plans?

Planners most frequently utilize biological information from county extension service

scientists, the Florida Natural Areas Inventory, and consulting firms. The least frequently used

sources of biological information are academic scientists, nongovernmental organizations, and

city government agencies within the county (Table 14). The difference between the ranking of

the different sources of biological information was not significant (H = 16.78, 10 df, p = 0.083).

Significant differences were found between Inland and Coastal counties in the use of biologists

in other in-county departments (U = 185.5, p = 0.005), consulting firms (U = 250.0, p = 0.031),

academic scientists (U = 192.0, p = 0.006), county extension service scientists (U = 223.0, p =

0.002), state agencies other than FFWCC (U = 234.0, p = 0.013), and federal agencies (U =

220.0, p = 0.007) as sources of information. There were no significant differences between

Regions in the sources of biological information used.

Table 14. Rank of awareness of planners and frequency of use of different sources of biological information in land-use planning from highest to lowest, medians and modes.

Rank	Objective	Mean*	Median	Mode
1	IFAS/County Extension Service scientists	5.22	6	6
2	Florida Natural Areas Inventory (FNAI) data	5.04	6	6
3	Consulting firms	4.95	6	6
4	Regional Planning Councils	4.82	6	6
5	Florida Fish & Wildlife Cons. Commission (FFWCC) data	4.75	5	6
6	Federal government agencies	4.71	5	6
7	State government agencies other than FFWCC	4.64	5	5
8	Biologists in another within-county department	4.63	6	7
9	Scientists from outside the county or academia	4.45	5	6
10	Nongovernmental organizations	4.26	5	6
11	City government agencies within the county	3.98	4.5	6

7 = very aware, always used, 6 = very aware, sometimes used, 5 = somewhat aware, sometimes used, 4 = somewhat aware, rarely used, 3 = very aware, never used, 2 = somewhat aware, never used, 1 = not aware, never used.

12) Survey question: How aware are planners of the availability of the following resources for incorporating biological information into land-use plans, and how often are they used?

Planners most frequently use geographic information systems technology (GIS) for

incorporating biological information into land-use plans. Rarely used resources are human

population growth models or data, and sea level rise projections and vulnerability assessments. Planners indicated they are largely unaware of and never use threat modeling software, reserve-selection algorithms, and conservation planning software (Table 15). The difference between the frequency of use of different resources was significant ($H = 158.98$, 8 df, $p < 0.001$). There were significant differences between inland and Coastal counties in the use of climate change models and projections ($U = 180.50$, $p = 0.002$) and sea level rise projections and vulnerability assessments ($U = 121.50$, $p < 0.001$). There were significant differences among Regions in the use of geographic information systems (Region 1 and 2: ($U = 68$, $p = 0.035$); Region 1 and 3: ($U = 31.5$, $p = 0.006$); Region 1 and 4: ($U = 39$, $p = 0.001$), sea level rise projections and vulnerability assessments (Region 1 and 4: ($U = 21$, $p = 0.001$).

Table 15. Rank of awareness of planners and frequency of use of different resources for incorporating biological information in land-use planning from highest to lowest.

Rank	Objective	Mean*	Median	Mode
1	Geographic information systems (GIS)	6.27	7	7
2	Future human population growth models or data	3.54	4	1
3	Sea level rise projections and vulnerability assessments	3.06	2	2
4	Climate change models and projections	2.81	2	1
5	Land use change simulation models	2.67	2	1
6	Decision support software	2.52	1.5	1
7	Threat modeling software	1.90	1	1
8	Reserve-selection algorithms	1.82	1	1
9	Conservation planning software (e.g. Fragstats, FunConn, Link)	1.78	1	1

7 = very aware, always used, 6 = very aware, sometimes used, 5 = somewhat aware, sometimes used, 4 = somewhat aware, rarely used, 3 = very aware, never used, 2 = somewhat aware, never used, 1 = not aware, never used.

Collaboration Category

1) Survey Question: To the best of your knowledge, how often do planners and the parties listed below collaborate on developing land-use plans to conserve native species and habitats?

Respondents indicated that they collaborated most frequently with citizens of their own county in developing land use plans to conserve nature, followed by state agencies and other within-county departments. Respondents indicated they collaborated least with conservation scientists (Table 16). The difference between the frequency with which collaboration occurs with other entities was significant (H = 49.45, 9 df, p < 0.001). There was a significant difference between Inland and Coastal counties in the degree of collaboration of planners and federal agencies (U = 241, p = 0.011). There were no other significant differences between Inland and Coastal counties in collaboration, or among Regions.

Table 16. Rank of frequency of collaboration of planners with other entities from highest to lowest on nature conservation.

Rank	Entity	Mean*	Median	Mode
1	Planners and citizens	4.53	4	4
2	State agencies	4.48	4	4
3	Within-county departments	4.45	5	6
4	Private landowners	4.29	4	4
5	Conservation groups	4.28	4	4
6	Regional Planning Councils	4.03	4	4
7	City governments	3.75	4	4
8	Federal agencies	3.73	4	4
9	Other city and county government	3.53	4	4
10	Conservation scientists	3.40	4	4

6 = always, 5 = very frequently, 4 = occasionally, 3 = rarely, 2 = very rarely, 1 = never

Mandates Category

1) Survey Question: To the best of your knowledge, do federal and/or state laws currently require local governments to develop land-use plans to conserve and protect native species and habitats within the local government's jurisdiction?

The majority of respondents believe federal and state laws require local governments to develop land-use plans to conserve and protect native species and habitats (84.5%), while 15.5%

do not (n=58). No significant differences among Inland and Coastal counties ($H = 366$, $n_I = 27$, $n_C = 31$, $p = 0.192$) or Regions ($H = 0.65$, 3 df, $p = 0.885$) was found.

<u>2) Survey Question: To the best of your knowledge, do federal and/or state laws currently require local governments to work together to plan for development in such a way that will conserve and protect native species and habitats within the two or more local governments' jurisdictions?</u>

There was, however, less certainly regarding a mandate to collaborate with other jurisdictions for nature conservation, where 72.2% of respondents answered "yes" and 27.8% answered "no" ($n = 54$). No significant differences among Inland and Coastal counties ($H = 337$, $n_I = 25$, $n_C = 29$, $p = 0.569$) or Regions was found ($H = 1.38$, 3 df, $p = 0.710$).

<u>3) Survey Question: What impact does reduced state oversight of local government comprehensive planning under the Florida 2011 Community Planning Act have on your local government's ability to conserve native species and habitats in the long term?</u>

Reduced state oversight of local government growth management planning is not seen as a major impediment to local government's ability to conserve native species and habitats in the long term. An equal percentage of respondents indicated that the Community Planning Act of 2011 changes would have "some impact" (28.8%) and "little impact" (28.8%). 16.9% of respondents indicated these changes would have a "large impact," and 25.4% of respondents indicated these changes would have "no impact." The difference between Inland and Coastal Counties in the perceived impact of the 2011 Community Planning Act was not significant ($U = 419$, $n_I = 26$, $n_C = 33$, $p = 0.874$) nor was the difference among Regions ($H = 3.99$, 3 df, $p = 0.262$).

4) Survey Question: Is your county designating, or does you county plan to designate, such Adaptation Action Areas?

The majority of respondents (89.4%) answered "no." Those counties responding "yes," 5 out of 47, (10.6%) were all Coastal counties (Fig. 40). There were significant differences among Inland and Coastal counties ($H = 212.50$, $n_I = 25$, $n_C = 22$, $p = 0.013$) and between Regions ($H = 10.53$, 3 df, $p = 0.015$) between Region and 1 and 4 ($U = 42$, $p = 0.025$).
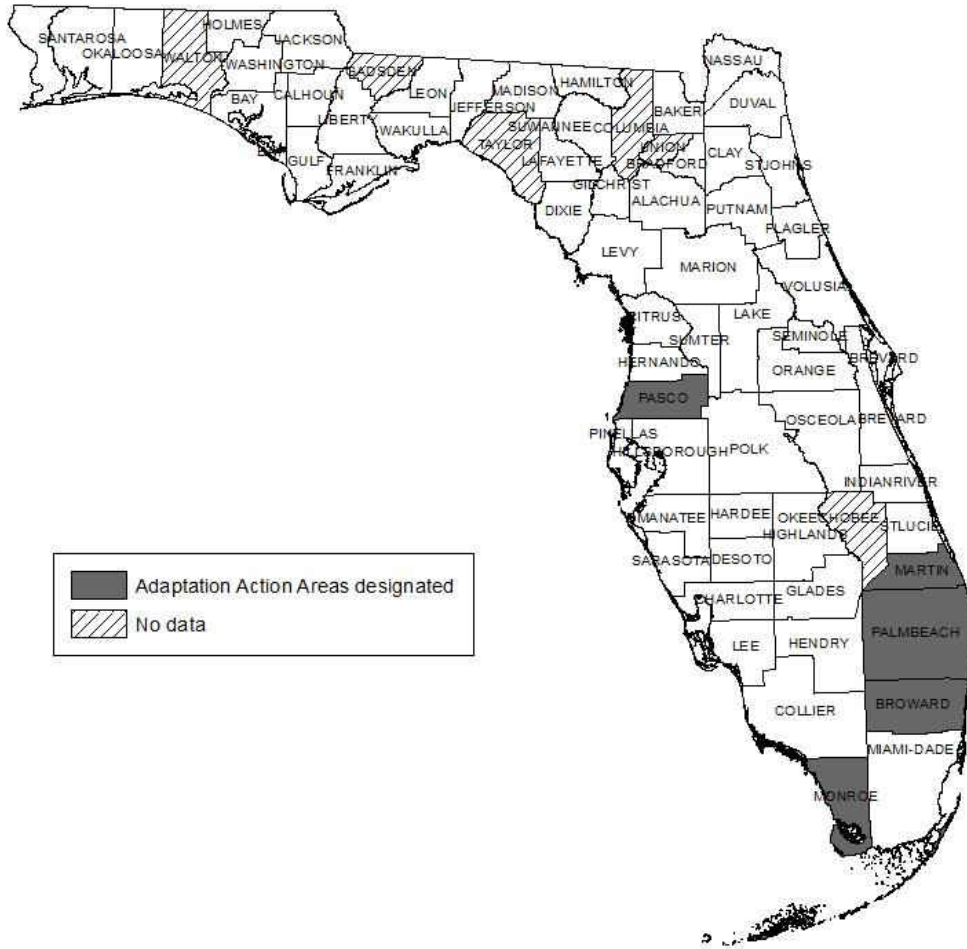
Figure 40. Florida counties designating Adaptation Action Areas under the 2011 Community Planning Act.

Statistical Analysis of Responses for Survey Questions Aggregated for Each Category

Summary results are discussed below for each category of questions in the survey. Summary results comparing inlands and coastal counties and comparing regions are also discussed.

General Position on the Value of Conservation Category

Respondents indicated that the top priority in county-level land-use planning is protecting open space from sprawl. "Open space," it is important to note, can range from lands of high conservation value (e.g., high-quality native ecosystems") to very low conservation value (e.g., athletic fields). Conservation of nature specifically was indicated to be of moderate importance. When means were calculated and ranked, "Preserve native species and habitats" (mean = 2.98) was ranked as a fourth priority after "Preserve open space and quality of life," (ranked first, mean = 3.67) "Creation of neighborhoods and communities," (ranked second, mean = 3.28) and "Cost of extending urban services" (ranked third, mean = 3.05). Respondents indicated that conservation of nature is a common consideration in land-use planning for a majority of counties (median = 4, "frequently" considered; mode = 5, "always and routinely" considered), and it is "moderately important" (median and mean responses were both 3 = "moderately important") for planners to have education and training in conservation planning to perform their job. Conservation of nature was reported to be "important" to the public (median = 4, "important"; mode = 3, "moderately important").[35] The majority of respondents indicated that land-use

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[35] For this question, the extent to which the public values conservation is based on the planners' perceptions of public values in each county.

planning decisions to avoid loss of native species and habitats are common and proactive (median = 6, "frequent and proactive"; mode = 5, "occasional and proactive"). Respondents indicated the levels of commitment of decision-makers for proactive planning for nature conservation were moderate (median and mode responses were both 3 = "some" commitment). Proactive land-use plans for the conservation of nature were reported to be usually implemented (median and mode responses were both 4 = proactive plans are "frequently" implemented). Climate change was held to be a low priority in land use planning to conserve nature (median and mode = 2, "of little importance"). Sea level rise was similarly held to be "of little importance" in land use planning to conserve nature (median and mode = 2, "of little importance").

<u>Differences Among Inland and Coastal Counties</u>

Coastal counties had significantly higher Total Value Scores than inland counties (inland mean = 30.56, SD = 5.56; coastal mean = 34.41, SD = 6.31); $t(45) = -2.129$, $p = 0.039$). Comparisons of responses from coastal and inland counties indicated that although coastal and inland counties did not differ significantly in the frequency with which nature conservation is considered in land-use planning ($U = 330.5$, $n_I = 27$, $n_c = 33$, $p = 0.065$), or in the conservation values of the public ($U = 325$, $n_I = 25$, $n_c = 32$, $p = 0.201$), nature conservation is a higher priority for coastal counties by decision-makers. Coastal counties engage in significantly more routine and proactive conservation planning than inland counties ($U = 309$, $n_I = 28$, $n_c = 32$, $p = 0.033$), and implement conservation plans more than inland counties ($U = 244.5$, $n_I = 23$, $n_c = 31$, $p = 0.034$).

<u>Differences Among Regions</u>

There was also a significant difference among regions in Total Values Scores $(F(3,30)=3.74$, $p = 0.016)$, which post hoc analysis using Tukey's HSD test indicated occurred between Region 1 (Panhandle) and Region 4 (South Florida) (Tukey HSD; $p = 0.031$). Region 1 also had significantly lower scores than Region 3 (Central Florida) in the conservation values of the public ($H = 12.31$, df 3, $p = 0.006$; $U = 17.50$, $p = 0.001$).

Resource Availability Category

Median county planning staff size was reported to be six to ten individuals (median = 3, "6 to 10 individuals"; mode = 2, "2 to 5 individuals"). Respondents indicated that conservation planning training for planners occurs occasionally (median and mode responses were both 3 ="on occasion"). Most planners have some training in conservation planning (median and mode responses were both 3 = "basic training"). Slightly more than half of the counties (55%) have a conservation specialist on staff, though 45% do not. Slightly less than half (46.7%) of Florida counties have a department or program responsible for acquiring conservation lands, while 53.3% do not, though 56.7% of counties have a department responsible for managing conservation lands, versus 43.3% that do not have such a department. Funding for conservation lands purchases and management are each "occasional, though sometimes there is no funding." (median and mode responses were both 2 = "occasional, though sometimes there is no funding"). A decrease in or elimination of funding from the Florida Forever program was reported to have "some" impact on the ability of counties to conserve native species and habitats in the long term (median and mode responses were both 3 = "some" impact).

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Respondents indicated the most commonly used types of biological information in conservation planning are vegetation surveys, and listed and native species lists, and other Florida Fish and Wildlife Conservation Commission (FFWCC) data (median = 6, "very aware, sometimes used"). Least used are population genetics data (median = 2, "somewhat aware, never used"). Planners are most aware of the availability of biological information from IFAS/County Extension service scientists, Florida Natural Areas Inventory, and consulting firms (median = 6, "very aware, sometimes used"). Least used for biological information are academic scientists, nongovernmental organizations, and city government agencies within the county (median = 3, "very aware, never used"). The most frequently used resource for incorporating biological information in land-use planning is Geographic Information Systems technologies (GIS) (median = 7, "very aware, always used"). Least used are threat-modeling software, reserve-selection algorithms, and conservation planning software (median = 1, "not aware, never used").

Differences Among Inland and Coastal Counties

Total Resources Score data were significantly higher for coastal counties (inland mean = 104.21, SD = 40.18; coastal mean = 148.06, SD = 41.19; $t(30) = -3.02$, $p = 0.005$). Coastal county planning departments have significantly more reliable funding for conservation lands purchases ($U = 283$, $p = 0.032$) and for conservation lands management ($U = 270$, $p = 0.035$), significantly more departments or agencies responsible for conservation lands acquisitions ($U = 266$, $p < 0.001$) and management ($U = 302$, $p = 0.010$), significantly more expertise ($U = 286$, $p < 0.001$), and significantly greater numbers of planning staff ($U = 295$, $p = 0.021$). Respondents indicated that coastal county planners are significantly more aware of and more frequently use

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different types and sources of biological information, and resources for incorporating biological information into land-use plans, than inland county planners.[36]

<u>Differences Among Regions</u>

There were also significant regional differences in Total Resources Score data between Region 1 (Panhandle) and Region 4 (South Florida) ($F(3,28) = 3.35$, $p = 0.033$; Tukey HSD $p = 0.021$; Region 1 Total Resources Score mean = 117.7; Region 4 Total Resources Score mean = 150.0). Significant differences also occurred between Region 1 and Regions 3 ($U = 19$, $p < 0.001$) and 4 ($U = 37$, $p < 0.001$) in the employment of a conservation specialist, between Regions 1 and 3 in the existence of a conservation lands acquisition department or program ($U = 27$, $p < 0.001$), between Region 1 and 3 ($U = 32$, $p < 0.001$) and Region 1 and 4 ($U = 53.5$, $p < 0.001$) in the existence of a conservation lands management department. Region 1 was also found to have significantly less available funding for conservation lands purchases than Regions 3 ($U = 21.5$, $p < 0.001$) and 4 ($U = 41.5$, $p < 0.001$), and significantly less available funding for conservation lands management than Region 3 ($U = 16$, $p < 0.001$). Results indicated that Region 1 planners are significantly less aware of and less frequently employ the types of biological information and the resources for incorporating biological information into land-use plans used by Regions 3 and 4.

Collaboration Category

Respondents indicated that planning departments collaborate most often with departments and agencies within their own county for conservation planning (median = 5, "very frequently"), and less often with all other groups (median = 4, "occasionally"). When mean responses were calculated and ranked, these data indicated planners collaborate most with citizens in their own county (mean = 4.53), followed by state agencies (mean = 4.48), and within-county departments (mean = 4.45). Planning departments collaborate least with conservation scientists in universities or elsewhere (mean = 3.40).

Coastal counties had significantly higher Total Collaboration Scores than inland counties (inland mean = 37.30, SD = 10.80; coastal mean = 43.48, SD = 8.52; $t(52) = -2.34$, $p = 0.023$). There were no significant differences among regions in Total Collaboration Score data, however $(F(3,50) = 0.15$, $p = 0.927)$.

Mandates Category

The majority of respondents indicated they understood federal and state laws to require local governments to develop land-use plans to conserve nature (84.5%), though 15.5% responded that federal and state laws do not require nature conservation in land-use planning. A majority of respondents (72.2%) also indicated that federal and state laws require local governments to collaborate with other governments in conservation planning, versus 27.8% that indicated there is no such mandate.

Total Mandates Score data were not significantly different between inland and coastal counties (inland median: 4, coastal median: 4; U = 325.5, p = 0.787) or between regions (H = 0.75, 3 df, p = 0.862).

The other two questions in this category concerned how planners perceived changes to the 1985 Growth Management Act by the Florida Community Planning Act of 2011 would impact their conservation planning ability. As to the reduced state oversight of local government comprehensive planning under the Act, the median response was that the changes would have "little impact" on local governments' abilities to conserve biodiversity in the long term. Coastal and inland counties (U = 419, p = 0.874) and regions (H = 3.99, p = 0.262) did not differ on this issue. As to the optional classification of designating Adaptation Action Areas under the Act, however, only 10.6% of all counties (5 of 47) reported doing so, all of those being coastal counties. There were significant differences between coastal and inland counties (U = 212.5, p = 0.013) and between regions between Region 1 and 4 (U = 42, p = 0.025).

Climate Change and Sea Level Rise

There were significant differences in Climate Change/Sea Level Rise Planning scores between inland and coastal counties (U = 87, p = 0.028) but not among regions (H = 5.68, 3 df, p = 0.128). The survey results reveal that climate change and sea level rise are currently not considered to be important issues overall for conservation planning in Florida counties, however. As would be expected, though, these issues were found to be significantly more important in land-use planning for coastal than inland counties. Coastal counties are incorporating climate change and sea level rise projection information in land-use planning more than inland counties,

and all of the counties designating Adaptation Action Areas under the Community Planning Act of 2011, (5 of 47 respondents) are coastal counties. Nonetheless, the median survey responses were that planners are only "somewhat aware" of climate change and sea level rise projection models and that they are "never used." Although regions did not differ significantly in their aggregated responses to questions concerning climate change and sea level rise, climate change is a more important issue in land use planning for Region 4 (South Florida) than Region1 (Panhandle), and Region 4 counties also reported a significantly greater use of sea level rise projection data than Region 1. The results here support the findings of recent environmental knowledge surveys that the public still has a lack of knowledge about climate change, which deficiency likely negatively influences climate change mitigation and adaptation policies (Robelia & Murphy 2012).

APPENDIX E: RESULTS OF ANALYSIS OF SOCIOECONOMIC VARIABLES

Socioeconomic Variables Analysis Results

Differences Among Inland and Coastal Counties

There were significant differences between inland and coastal counties for many of the socioeconomic variables set forth in Table 9. Demographics category variables were nearly all significantly higher for coastal counties versus inland counties. For example, coastal counties are wealthier than inland counties in terms of both median household income (inland median: $41,288.00, coastal median: $ 48,225.00, U = 230.00, p = 0.001) and total county revenues (in $thousands) (inland median: $58,052.50, coastal median: $341,055.00, U = 243.00, p = 0.002). Coastal counties also have more highly educated populations than inland counties (in percent bachelors degree or higher) (inland median: 12.4%, coastal median: 25%, U = 206.00, p < 0.001). Political party affiliation differences are also significant. Coastal counties have higher percentages of Republican registered voters (inland median: 34.15%, coastal median: 39.8%, U = 319.00, p = 0.038), and inland counties have higher percentages of voters registered as Democrats (inland median: 49.4%, coastal median: 35.3%, U = 233.00, p = 0.001). Coastal counties have significantly higher population density (in persons per square mile) (inland median: 58.95, coastal median: 277.30; U = 261.00, p = 0.004), although the other measures of urbanization, percent population growth from 1980-2012 and percent housing growth from 2000-2011, were not significant.

For the Resource Availability category, there were significant differences in the character of conservation lands between coastal and inland counties. Coastal counties had significantly more county land area held as conservation lands (inland median: 16.68%, coastal median:

26.32%, U = 270.00, p = 0.005), a higher percentage of conservation lands owned by the county (inland median: 0.37% , coastal median: 2.58%, U = 264.00, p = 0.004), and a higher percentage of the county land area comprised of state and federally-owned conservation lands (inland median: 14.86%, coastal median: 23.11%, U = 310.00, p = 0.028).

Differences Among Regions

The results of the Kruskall-Wallis test confirmed significant differences in median ranks among regions for the majority of the Demographics category variables, including total county revenues (H = 22.233, 3 df, p < 0.001), percent bachelor's degree (H = 7.810, 3 df, p = 0.050), persons per square mile (H = 19.645, 3 df, p < 0.001), percent Democrat (H = 8.511, 3 df, p = 0.037), percent population growth 1980-2012 (H = 10.226, 3 d., p = 0.017). Pairwise comparisons of these regional data were computed via Mann-Whitney U tests with a Bonferroni correction of 0.008 (0.05/6 possible comparisons = 0.008) to maintain the overall probability of a Type I error at 0.05. Region 1 (Panhandle) has significantly lower total county revenues than Regions 3 (Central Florida) (U = 14.00, p < 0.001) and 4 (South Florida) (U = 37.00, p = 0.001), and Region 2 (North Florida) also has lower total county revenues than Regions 3 (Central Florida) (U = 27.00, p < 0.001) and 4 (South Florida) (U = 67.00, p = 0.007). Regional differences in percent bachelor's degree and percent democrat data were not significant at the p = 0.008 threshold level. Regions 1 and 2 had significantly fewer persons per square mile than Region 3 (Central Florida) (Region 1: U = 16.00, p < 0.001; Region 2: U = 21.00, p < 0.001). Region 1 had significant lower percent population growth 1980-2012 than Region 3 (U = 33.00, p = 0.004). There were no significant differences among regions for the other Demographics

category variables which were median household income, percent Republican, and percent housing growth.

For the Resource Availability category, there was also a significant difference between regions in percent conservation land that is county-owned ($H = 11.889$, 3 df, $p = 0.008$). Region 1 had a significantly lower percentage of conservation land that is county-owned (median = 0.06%) than Region 3 (median = 6.8%) ($U = 30.00$; $p = 0.002$). No significant differences were found among regions in percent county land area in conservation, or percent county land area owned by state and federal government as conservation lands.

APPENDIX F: RESULTS OF ANALYSIS OF FLORIDA COUNTY CONSERVATION ELEMENTS

Results of Analysis of Conservation Elements

Component Plan Score Data

The majority of indicators used by counties in the Biodiversity Status Assessment component were survey data (31.8%) and FFWCC data (31.8%), followed by FNAI data (18.1%). The GIS data indicator had a frequency of 9%. Spatially explicit population models and population viability analyses indicators did not occur in any county documents (Fig. 41).
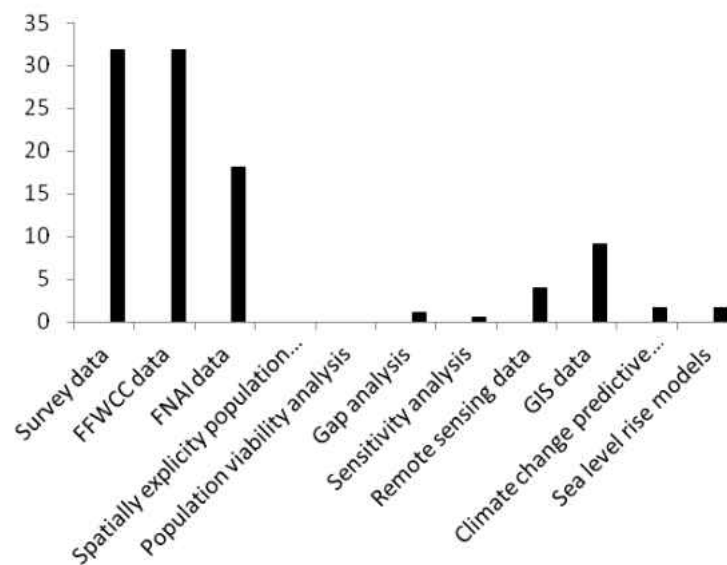
Figure 41. Frequency of occurrence of indicators in the Biodiversity Status Assessment component of Conservation Elements for the 67 counties in Florida.

The most common indicators for the Goal-Setting component were "minimize threat of development" (12.3%), "conserve listed species" (12.3%), "protect critical areas" (11.6%), "sustain ecological processes" (11.4%), and "enlarge protected areas" (11.4%.) Four indicators that were not found in any documents were "conserve or increase genetic diversity," "assist

colonizations due to sea level rise," "select surrogates to represent levels of biodiversity," and

"use fine filter and coarse filter approaches to conserve biodiversity" (Table 17).

Table 17. Frequency of occurrence of indicators in the Goal-Setting component of Conservation Elements for the 67 counties in Florida.

Indicator	Frequency of occurrence
Minimize threats from development	12.38
Conserve listed species or communities	12.38
Protect critical sites	11.64
Sustain ecological processes	11.46
Enlarge protected areas	11.46
Protect unique and/or endemic species	9.05
Protect rare species	7.76
Increase linkages and/or corridors	4.25
Maintain viable populations of all native species in region	3.88
Identify and quantify targets	3.88
Ensure long-term persistence	3.51
Consider multiple levels of biodiversity	2.95
Represent all ecosystem types	1.84
Protect sensitive species, communities, or habitats	1.47
Consider different spatial scales	0.92
Sustain evolutionary processes	0.18
Identify and/or utilize focal species	0.18
Create networks adaptable to changing environment	0.18
Consider different temporal scales	0.18
Prevent dynamic threats	0.18
Increase resilience to climate change	0.18
Conserve and/or increase genetic diversity	0
Assist colonizations due to sea level rise	0
Select surrogates	0
Use a fine filter, coarse filter approach	0

Indicators for the Coordination component were nearly equally represented. Most

frequently occurring indicators were "interjurisdictional coordination across political

boundaries" (23.9%) and "coordination with planning and zoning department" (23.9%) (Fig. 42).

Figure 42. Frequency of occurrence of indicators in the Collaboration component of Conservation Elements for the 67 counties in Florida.

For the Reserve Selection and Design Component, "protect hydrology" was the most frequently occurring indicator (21.2%), followed by "create buffer areas" (19.6%) and "protect ecosystem, community, and habitat heterogeneity" (12.4%). Indicators for "increase connectivity between protected areas" and "create continuous areas of protected land" were nearly equally represented (8.4% and 8.1%, respectively). No indicators were found in county documents for "utilize of decision support software" or "utilize reserve selection algorithms," or "protect of natural disturbance regimes" (Table 18).

Table 18.Frequency of occurrence of indicators in the Reserve Selection and Design component of Conservation Elements for the 67 counties in Florida.

Indicator	Frequency of occurrence
Protect hydrology	21.24
Create buffer areas	19.60
Protect ecosystem, community, and habitat heterogeneity	15.68
Create corridors	12.41
Increase connectivity between protected areas	8.49
Create continuous areas of protected land	8.16
Consider protecting reserves of large size	6.20
Minimize fragmentation	3.92
Protect habitat that has no roads or has minimal roads	2.61
Protect edge habitats	0.98
Protect core areas	0.65

Indicator	Frequency of occurrence
Utilize decision support software	0
Utilize reserve selection algorithms	0
Protect natural disturbance regimes	0

For the Management component, the indicators that occurred most frequently were "impose human use restrictions" (17.8%), "prevent and control erosion" (17.2%), and "restore degraded habitats and systems" (15.7%). Indicators that were absent for this component were "increase genetic diversity," "assist colonizations and dispersal," "conserve peripheral and disjointed populations," "consider patch dynamics," and "consider metapopulation dynamics" (Table 19).

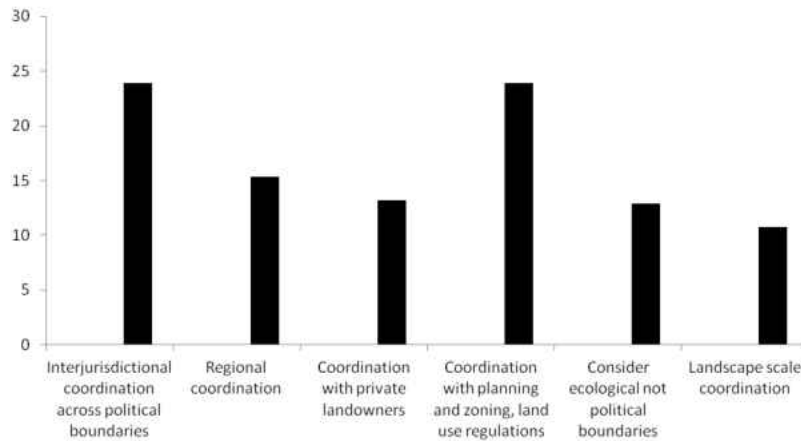Table 19. Frequency of occurrence of indicators in the Management component of Conservation Elements for the 67 counties in Florida.

Indicator	Frequency of occurrence
Impose human use restrictions	17.80
Prevent and/or control erosion	17.21
Restore degraded habitats and systems	15.72
Monitor populations, habitats, systems, and human activities	13.64
Control invasive exotics	12.46
Protect dispersal, nesting, and/or breeding	7.12
Employ adaptive management, evaluate indicators, set and evaluate performance measures to evaluate plan effectiveness	6.23
Employ management techniques to mimic natural disturbances	5.93
Employ an ecosystem management approach	5.63
Translocate biota when necessary	4.45
Manage for habitat and/or species heterogeneity	4.15
Protect migrating species and habitats used for migrating species	1.78
Restrict hunting, poaching, and/or fishing	1.18
Use natural areas for scientific research and/or as controls for ecosystem management	1.18
Give special attention to species confined to a small portion of their range	0.89
Manage for ecological processes	0.89
Manage for dynamic threats	0.29
Manage for evolutionary processes	0.29
Protect and facilitate gene flow	0.29
Manage for climate change	0.29
Manage for sea level rise	0.29
Increase genetic diversity	0
Assist colonizations and dispersal	0
Conserve peripheral and disjointed populations	0

Indicator	Frequency of occurrence
Consider patch dynamics	0
Consider metapopulation dynamics	0

Analysis of Component Plan Score Data for Normality. Component Plan Score data for

all five components were determined to be non-normally distributed under the Shapiro-Wilk test.

Outliers were identified for the Component Plan Score data based on analysis of boxplots. The

outlier data points were reviewed for error in each case. Because no entry error, measurement

error, or sample bias was identified, outliers were removed and replaced with the next highest

score, or winsorized, in each case because they represented less than five percent of the data in

each category (Table 20).

Table 20. Outliers in Component Plan Scores and Total Plan Scores for each Florida county in order from highest to lowest.

Component	Outlier County	Outlier score	Mean score	Winsorized score
Biodiversity Site Assessment	St. Lucie	4.09	1.37	3.18
	Lake	3.64		3.18
Goal Setting	Alachua	5.0	2.27	3.80
	Lake	4.40		3.80
	Sarasota	4.40		3.80
Coordination	Sarasota	9.17	5.07	7.50
	Alachua	8.33		7.50
	Manatee	8.33		7.50
Reserve Selection and Design	Collier	6.07	2.12	5.00
Management	Manatee	4.07	1.45	3.33
	Alachua	3.70		3.33
	Sarasota	3.70		3.33

Although winsorization alone did not cause the data in any category to be normally distributed,

log-transformation successfully normalized winsorized data for the Goal-Setting component (W

= 0.97, df 67, p = 0.054), and square-root transformations normalized winsorized data for the

Reserve Selection and Design (W = 0.971, df 67, p = 0.123) and Management components (W = 0.974, df 67, p = 0.184). Biological Status Assessment (skewness = 1.139, kurtosis = 2.411) and Coordination (skewness = 0.352, kurtosis = -0.179) component scores could not be normalized. These Component Score data were used in spatial analysis to examine the diffusion of conservation policy among Florida counties discussed in Chapter Three.

Total Plan Score Data

    Analysis of Total Plan Score Data for Normality. Total Plan Score data were non-normally distributed under the Shapiro-Wilk test (W = 0.95, df 67, p = 0.008) (Table 3) due to right-skew (skewness = 0.767, kurtosis = 0.175) (Fig. 43).
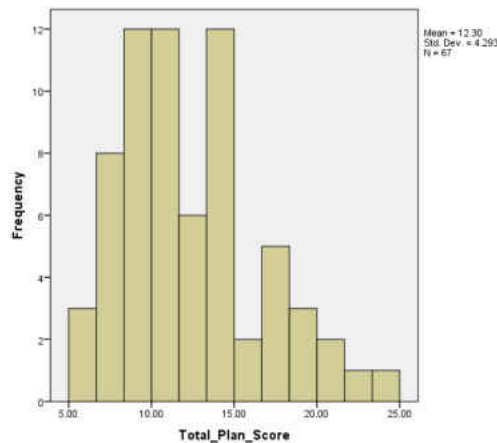
Figure 43. Frequency of Total Plan Score data for 67 counties in Florida showing right-skew, kurtosis, and non-normal distribution.

Alachua County's score was an outlier based on boxplot analysis; however, because no measurement error was found, the value was retained in the data. The data were log-transformed to fit a normal distribution (W = 0.99, df 67, p = 0.700) (Fig. 44).
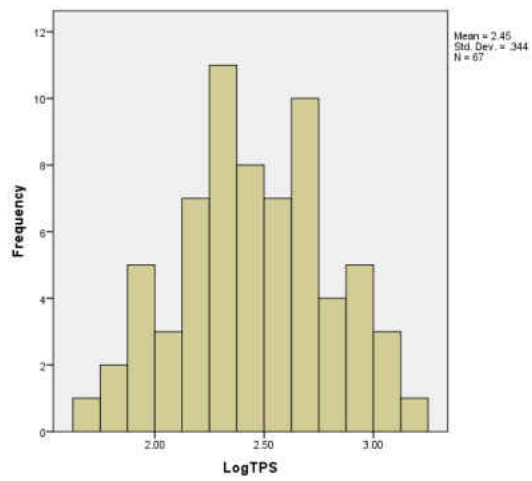
Figure 44. Frequency of log-transformed Total Plan Score data for 67 counties in Florida which is normally distributed.

Differences in Total Plan Score Among Coastal and Inland Counties

Total Plan Score data from coastal and inland counties were first analyzed for normality. Coastal counties data were found to be normally distributed ($W = 0.98$, df 35, $p = 0.810$, n = 35). Total Plan Score data for inland counties, however, were right-skewed and non-normally distributed ($W = 0.84$, df 32, $p < 0.001$, n = 32) (Fig. 45).
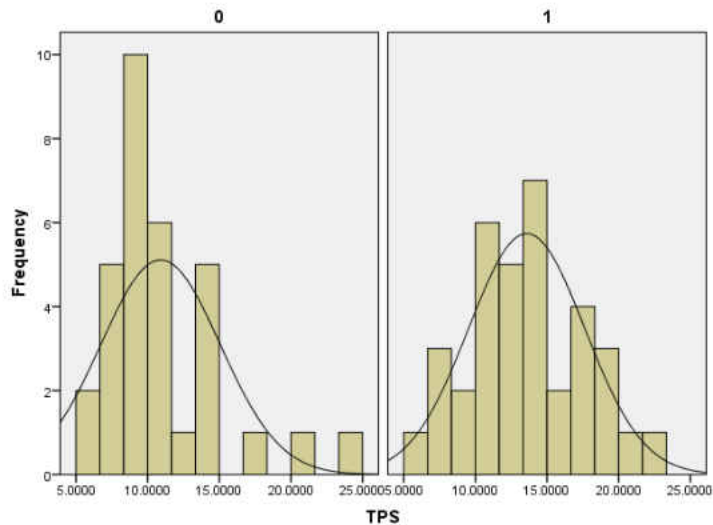
Figure 45. Comparison of frequency of Total Plan Scores with normal distribution curve for Inland (0) n=32, and Coastal (1) n=35, counties in Florida.

The Total Plan Scores of Alachua and Lake County (24.76 and 21.48, respectively) were determined to be outliers and extreme values, despite the fact that no measurement error was detected. I attempted winsorization of both data points to the next highest score (16.70), though this did not result in a normal distribution (W = 0.93, df 32, p = 0.048). Inland County Total Plan Score data were then log-transformed, resulting in a normal distribution (W = 0.96, df 32, p = 0.288). However, under Levene's test coastal county Total Plan Score Data and log-transformed inland county Total Plan Score had unequal variances (F = 53.88, p < 0.001) requiring use of the unequal variance t-test to compare Total Plan Scores among inland and coastal counties (Ruxton 2006). Differences in Total Plan Score between coastal (mean = 13.58, SD = 4.06) and log-transformed inland counties (mean = 2.33, SD = 0.33) were significant (t(-16.35) =-34.50, p < 0.001).

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Differences in Total Plan Score Among Regions

Total Plan Score data for the four regions was first analyzed to ensure the data met the

assumptions for a One-Way ANOVA, which requires 1) the data are normally distributed, 2) the

data have equal variances 3) data are sampled independently, and 4) the residuals are normally

distributed.

Total Plan Score data for Regions 1, 3 and 4 were found to be normally distributed under

the Shapiro Wilk test (Region 1: W = 0.93, df 16, p = 0.230; Region 3: W = 0.98, df 13, p =

0.952; Region 4: W = 0.96, df 18, p = 0.554). However, Region 2 data were right-skewed (W =

0.74, df 20, p < 0.001) due to high scores for Alachua County (24.76) and Duval County (18.82)

(Fig. 46).
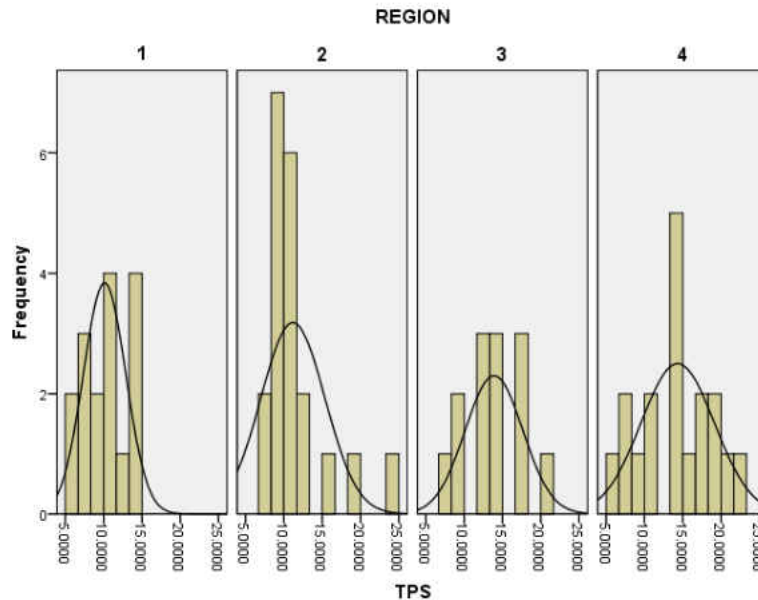
Figure 46. Comparison of frequency of Total Plan Scores with normal distribution curve imposed for Region 1 (Panhandle, n=16) , Region 2 (North Florida, n=), Region 3 (North Florida, n= 20) and Region 4 (South Florida, n= 18) counties in Florida.

The Alachua County score was again determined to be an outlier under the Outlier Labeling Rule but was not removed from the data. Winsorization of this score did not result in a normal distribution (W = 0.81, df 20, p < 0.001). Log- and square root-transformation of the Region 2 data also did not result in a normal distribution (log-transformed data: W = 0.86, df 20, p < 0.001; square-root transformed data: W = 0.80, df 20, p < 0.001). Data for all four regions were determined to be homoscedastic under the Levene's test for equal variances (W = 1.02, df_1 3, df_2 63, p = 0.394). However, examination of normal probability plots of the residuals for Regions 1, 3 and 4 indicated the error terms were non-normally distributed (Fig. 47).
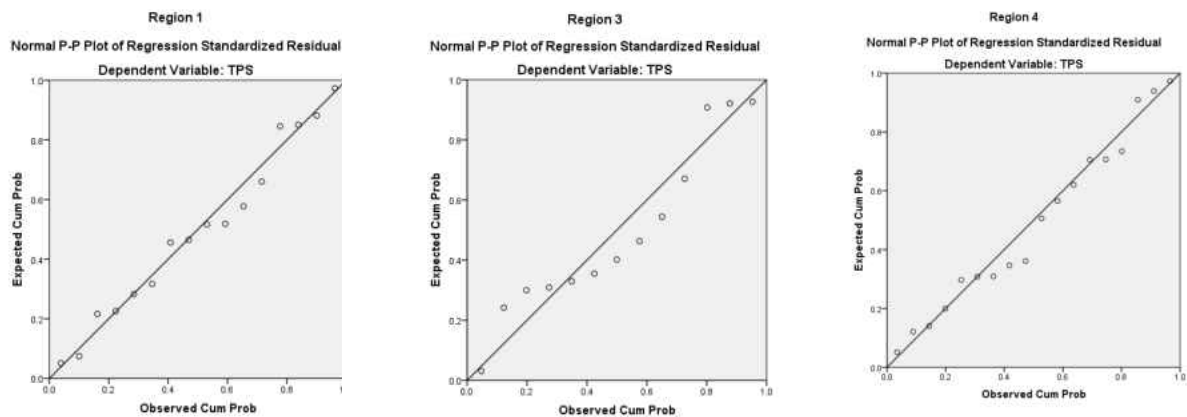
Figure 47. Comparison of normal probability plots of residuals for Region 1 (Panhandle, n=16), Region 3 (Central Florida, n= 13), and Region 4 (South Florida, n= 18) counties in Florida.

Also, data for all four regions had unequal sample sizes (n_1 = 16, n_2 = 20, n_3 = 13, and n_4 = 18). Because of the non-normal distribution of the Region 2 data, the non-normality of the residuals of Regions 1, 3 and 4 data, and unequal sample sizes of the data, the assumptions for a parametric One-Way ANOVA test were not met. Therefore, the Kruskall-Wallis non-parametric test was used to determine if Total Plan Scores differ among regions, which only requires

homogenous variances among groups. The results of the Kruskall-Wallis test indicated

significant differences in Total Plan Score median ranks among regions (H = 12.37, 2 df, p <

0.001). Pairwise comparisons of regional Total Plan Score data were computed via Mann-

Whitney U tests with a Bonferroni correction of 0.008 (0.05/6 possible comparisons = 0.008) to

maintain the overall probability of a Type I error at 0.05. Significant differences in Total Plan

Score were detected between Region 1 (Panhandle) and Region 4 (South Florida) (U = 61; p =

0.004) (Fig. 48).
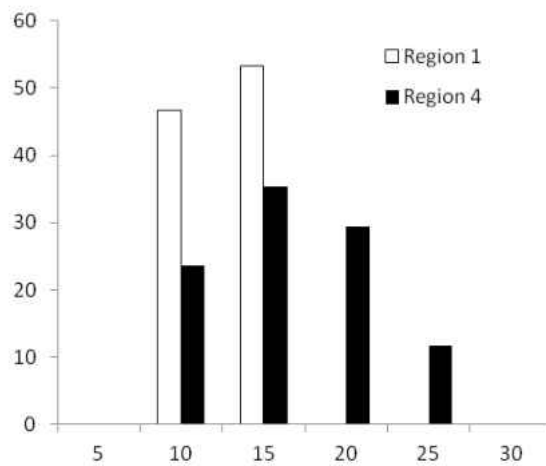
Figure 48. Comparison of percentages of Total Plan Scores for Region 1 (Panhandle, n=16) and Region 4 (South Florida, n= 18) counties in Florida.

Climate Change and Sea Level Rise

Most indicators for climate change and sea level rise occurred in the Biodiversity Status

Assessment category, which indicators reflect that the county is using climate change (Indian

River, Pinellas, St. Lucie) or sea level rise (Collier, Pinellas, St. Lucie) predictive models in

conservation planning. The Goal-Setting category indicator "create networks adaptable to a

changing environment" was present for one county (Flagler), which indicator was interpreted as applying to climate change and sea level rise threats. Indicators in the Management category also interpreted as applicable to climate change and sea level rise were "manage for dynamic threat" (Monroe), "manage for climate change" (Pinellas), and "manage for sea level rise" (Sarasota).

APPENDIX G: RESULTS OF ANALYSIS OF ASSUMPTIONS FOR MULTIPLE
REGRESSION

Analysis of Dependent Variable for Normality

Outcome variable data (Total Plan Score data) were non-normally distributed under the Shapiro-Wilk test (W = 0.95, df 67, p = 0.008). Using the Outlier Labeling Rule, which uses 25th and 75th percentile ranks from the data to calculate upper and lower boundaries for outliers, no outliers were identified. The data were log-transformed to fit a normal distribution (W = 0.99, df 67, p = 0.700).

Analysis of Independent Variables for Normality

Independent variables were analyzed for normality using the Shapiro-Wilk test. Results are presented in Table 21.

Table 21. Results of Shapiro-Wilk test for normal distribution of independent variables.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Median Household Income	.074	61	.200[*]	.979	61	.369
Total County Revenue	.322	61	.000	.477	61	.000
Percent Bachelors Degree or Higher	.083	61	.200[*]	.964	61	.070
Persons Per Square Mile	.255	61	.000	.633	61	.000
Percent Republican	.065	61	.200[*]	.989	61	.867
Percent Democrat	.097	61	.200[*]	.958	61	.034
Total Values Score	.112	61	.056	.972	61	.182
Percent Housing Growth 2000-2011	.192	61	.000	.779	61	.000
Percent Population Growth 1980-2012	.178	61	.000	.715	61	.000
Percent County Land Area Conservation Land	.128	61	.014	.881	61	.000
Percent Conservation Land County-Owned	.307	61	.000	.562	61	.000
Percent County Land Area State and Federal Conservation Land	.170	61	.000	.850	61	.000
Total Resources Score	.092	61	.200[*]	.984	61	.631
Total Collaboration Score	.077	61	.200[*]	.977	61	.318
Total Mandates Score	.347	61	.000	.702	61	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The median household income, percent bachelors degree, percent Republican, and Total Values, Total Resources, and Total Collaboration independent variables from the survey data were normally distributed, though the other independent variables were non-normally distributed and required transformation to meet the requirements for multiple regression analysis.

Log-transformation successfully normalized all but the percent county land area state and federal conservation lands data and Mandates Total Score data under the Shapiro-Wilk test. These data were further transformed (exp, inv, log10, sqrt), and the square-root transformation normalized the percent county land area state and federal conservation lands data (W = 0.97, df 61, p = 0.137). Mandates Total Score data were not normalized by transformation. Mandates Total Score data were left-skewed and kurtotic.

Analysis of Model 1 for Multiple Regression Assumptions

Model 1 was analyzed to determine if it met the assumptions for multiple regression analysis: 1) the dependent and independent variables are normally distributed, 2) the independent variables are measured without error, 3) the dependent variable error terms are normally distributed and independent, 4) the variances of the residuals are homogenous, 5) a linear relationship exists between the dependent and independent variables, 6) the independent variables are not highly correlated (Field 2000; Osborne & Waters 2002; Gotelli & Ellison 2004).

The dependent and independent variables were previously determined to be normally distributed, satisfying the first assumption (see above). Independent variables data were collected from websites and from survey questions, without any known error, satisfying the second assumption.

Next, to determine if the dependent variable values have normally distributed error terms, I examined the normal probability plot of the log-transformed Total Plan Score residuals. The normal probability plot shows the points distributed close to and along the diagonal line, which

indicates the residuals are normally distributed. Furthermore, the histogram of the residuals affirms that the error terms are normally distributed (Fig. 49).
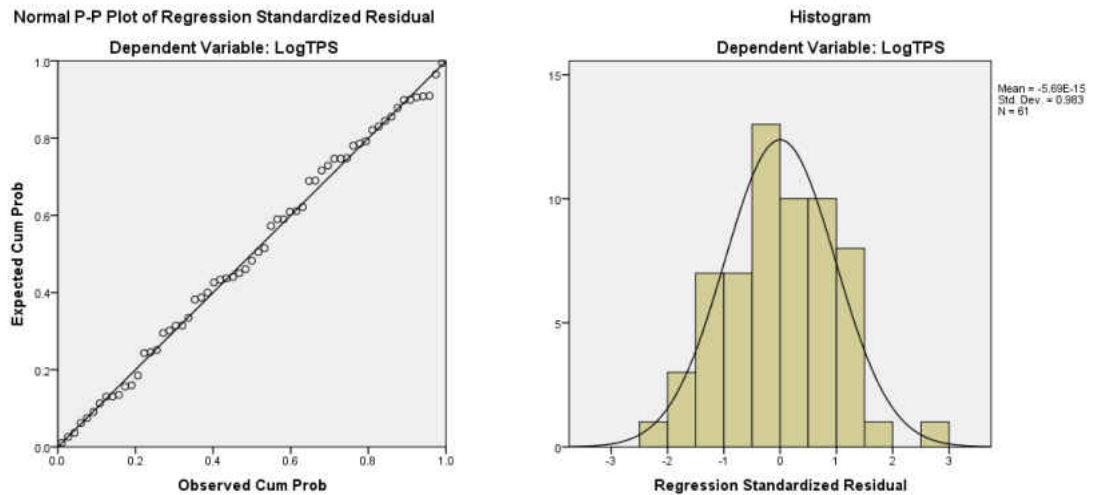
Figure 49. Normal probability plot and histogram of the residuals showing they are normally distributed.

To determine if the assumption of independence of the residuals was met, I examined the Durbin-Watson test statistic, which tests for correlations among residuals. A value of 2 for this statistic means that the residuals are uncorrelated. Values less than 2 indicate positive correlations and values greater than 2 indicate negative correlations. Values less than 1 and greater than 3 indicate adjacent error terms are correlated and thus not independent (Field 2000). Here, the Durbin-Watson statistic was 2.280, indicating that error terms are not significantly correlated and the assumption of independent errors has been met. I also analyzed the model residuals for spatial autocorrelation using ArcGIS 10.0. I used a conceptualization of spatial relationships based on inverse distance and no distance band. The residuals were determine to be

statistically random and independent (Moran's I = 0.000, p = 0.407), indicating no spatial

autocorrelation.

Data were next analyzed to determine if the variances of the residuals were homogenous.

I obtained residuals and created a scatterplot of the standardized residuals versus the

standardized predicted values for the log-transformed Total Plan Score Data. The scatterplot

shows the residuals scattered randomly around the horizontal line. The flattened shape of this

distribution indicates the residual values are homoscedastic, having a constant variance as the

predicted value increases (Fig. 50).
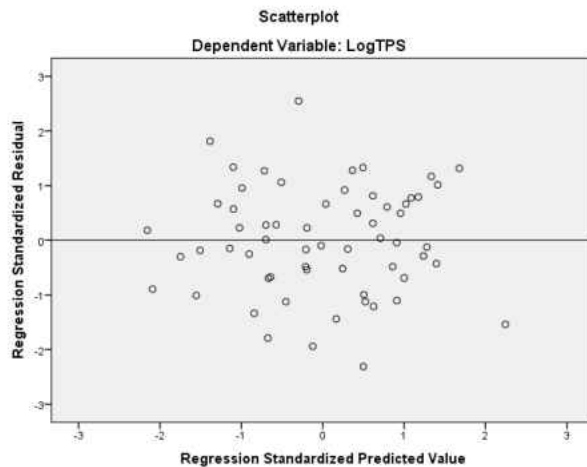
Figure 50. Scatterplot of the standardized residuals and the standardized predicted values showing the residuals are continuous for increased predicted values.

I also created scatterplots of the residuals of the outcome variable and each predictor

variable. The residual plot of the Total Resources data shows an evenly spaced distribution of

points along the fitted line and does not show a curve or a funnel shape, indicating constant

variance. Similarly, the residual plot of the percent bachelor's degree data shows an

approximately evenly spaced collection of points around the line, thus meeting the assumption of homoscedasticity of residuals (Fig. 51).
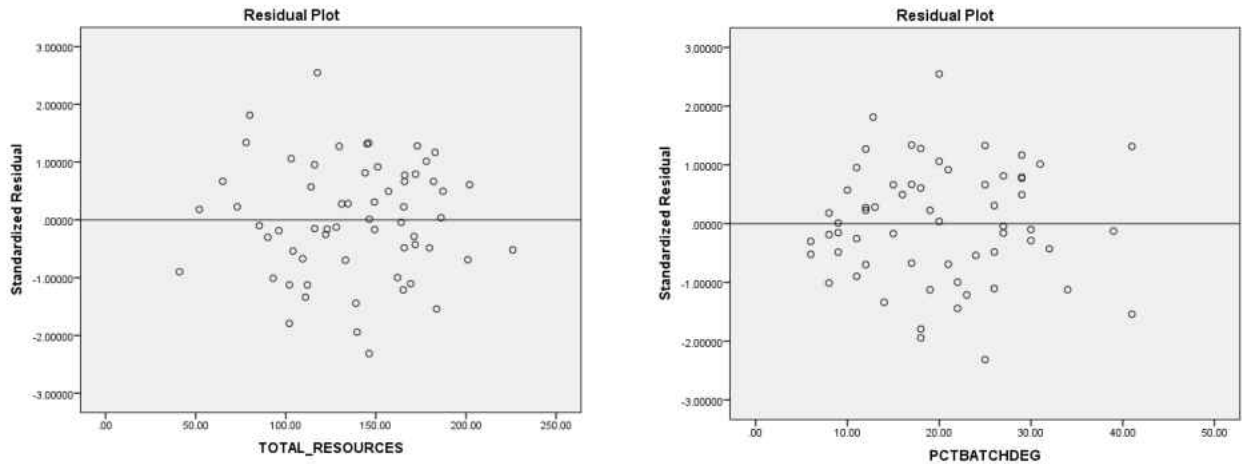
Figure 51. Scatterplots of standardized residuals of the Log-Total Plan Score data and each predictor variable (Total Resources and Percent Bachelor's Degree) regressed separately indicate the residuals are homoscedastic due the random scatter or points and constant spread in each scatterplot.

One standardized residuals stood out as being larger than the other residuals and, as such, a value that could influence the predictive ability of the model. Lake County had a standardized residual of 2.548, which is slightly larger than the expected value of residuals between 2.5 and -2.5 for 99% of values in a normally distributed sample (Lake County represent 1/61 counties, or 1.6% of the study sample). Examination of the Cook's distance statistic (mean = 0.015) indicates this case has very little influence on the model, however (Cook's distance statistic greater than 1 indicates the value may impact the ability of the model to predict other cases) (Field 2000). Similarly, the centered leverage statistic was 0.033, indicating the case has nearly no influence on the model (leverage values of zero indicate no influence, leverage values of 1 indicate complete influence) (Field 2000).

Next, to confirm the assumption that there is a linear relationship between the dependent and independent variables, I examined scatterplots of each predictor variable and the log-transformed Total Plan Score data. Log Total Plan Score appears to be strongly positively related to both of the predictor variables with no marked outliers or influential observations (Fig. 52). Thus, the fifth assumption for multiple regression has been met.
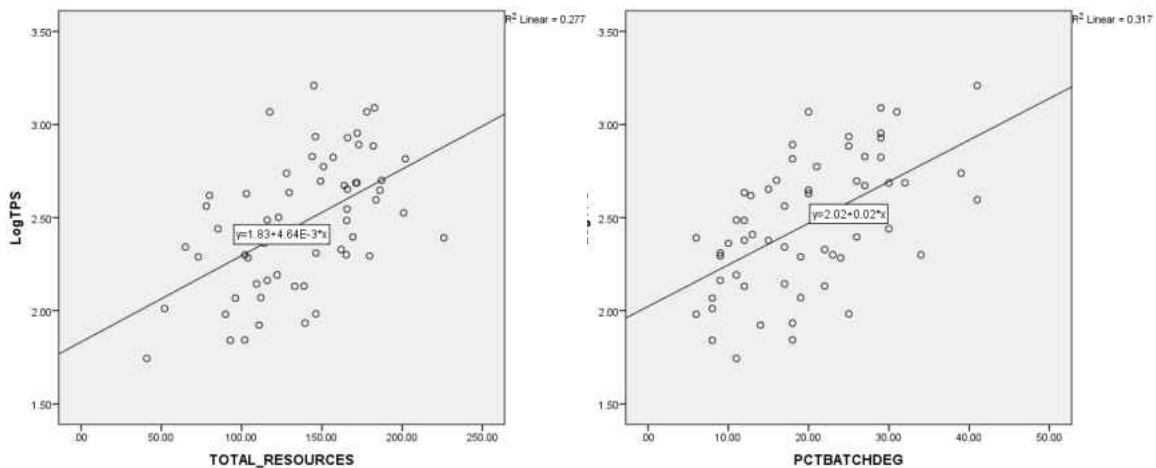
Figure 52. Scatterplots of Total Resources and Percent Bachelor's Degree Independent Variables versus log-Total Plan Score indicating linear relationships.

Lastly, the predictor variables were analyzed for multicollinearity by examining collinearity and correlation statistics. Multicollinearity among predictor variables is a concern where the largest variance inflation factor (VIF) is greater than 10, where the average VIF is substantially greater than 1, or if the tolerance statistic is below 0.2 (Field 2000). Both predictor variables had a variance inflation factor of 1.103, and the tolerance statistic for both predictors was 0.906. Furthermore, Total Resources and percent bachelor degree are not highly correlated (R=0.308, p=0.008). High correlations among predictor variable of 0.8 or 0.9 can indicate multicollinearity (Field 2000). Therefore, there was no multicollinearity among predictors,

meeting the sixth assumption for multiple regression, and it can be safely concluded that the

predictor variables are measuring different elements.

APPENDIX H: RESULTS OF MULTIMODAL INFERENCE AND MODEL SELECTION
ANALYSIS

Multimodal Inference

The relative importance of the individual parameters was next examined by summing the weights for each of the three top candidate models that contains the parameter of interest to determine importance weights for each parameter (Table 22).

Table 22. Importance weights calculated for parameters of all three candidate models.

Parameter	Candidate models			Importance weight
	Model 1	Model 2	Model 3	
Total Resources	0.3731	0.2545	0.2544	0.8820
Percent Bachelors Degree	0.3731	0.2545	0.2544	0.8820
Log Total County Revenue	0.3731	0.00	0.00	0.3731
Total Collaboration	0.00	0.00	0.2544	0.2544
Log Percent Conservation Lands County-Owned	0.00	0.00	0.2544	0.2544

Importance weights indicate that Total Resources and percent bachelor's degree are the most plausible explanations for the response variable. Both of these are (0.882/0.3731 = 2.36) 2.36 times more likely explanations for the outcome than the log-transformed total county revenue predictor, and (0.882/0.2544 = 3.47) and 3.47 times more plausible than Total Collaboration and log-transformed percent conservation lands county-owned variable. However, the parameter estimates differ in the three candidate models. To determine the reliability of the parameter estimates for each candidate model, I examined the standard errors of the parameter estimates (Table 23).

Table 23. Standard errors of parameter estimates for all three candidate models.

		Parameter	
Model 1	Intercept	Estimate	Standard Error
	Total Resources	1.171	0.298
	Percent Bachelors Degree	0.003	0.000
	Log Total County Revenues	0.011	0.005
Model 2	Intercept	0.054	0.031
	Total Resources	1.640	0.129
	Percent Bachelors Degree	0.003	0.000
Model 3	Intercept	0.017	0.004
	Total Resources	1.840	0.157
	Percent Bachelors Degree	0.004	0.001
	Total Collaboration	0.016	0.004
	Log Percent Conservation Land County	-0.007	0.004

None of the parameter estimates had standard errors that were large (greater than 2X the parameter estimate), therefore, all of the parameter estimates were reliable for predicting the outcome.

Because the confidence set of models were all plausible explanations for the outcome, and because the parameter estimates were all found to be reliable predictors, I calculated model-averaged parameter estimates for the three confidence set models to obtain a composite model (Table 24).

Table 24. Model-averaged parameter estimates for all three candidate models.

Model	Model Relative likelihood: Exp(-0.5*Δ_i)	New weight: Exp(-0.5*Δ_i)/sum	Raw parameter estimate	Model-averaged parameter estimate (new weight x raw parameter estimate)
	Intercept estimate			
1	1.0	0.423	1.171	0.495
2	0.6821	0.289	1.640	0.474
3	0.6818	0.288	1.840	0.530
sum =	2.364			Sum = 1.499
	Total Resources estimate			
1	1.0	0.423	0.003	0.001
2	0.6821	0.289	0.003	0.001
3	0.6818	0.288	0.004	0.001
sum =	2.364			Sum = 0.003
	Percent Bachelor's Degree estimate			
1	1.0	0.423	0.011	0.005
2	0.6821	0.289	0.017	0.005
3	0.6818	0.288	0.016	0.005
sum =	2.364			Sum = 0.015
	Log Total County Revenues			
1	1.0	1.0	0.054	0.054
2	0	0	0.00	
3	0	0	0.00	0
sum =	1.0			Sum = 0.054
	Total Collaboration			
1	0	0	0.00	0
2	0		0.00	
3	0.6818	1	-0.007	-0.007
sum =	0.6818			Sum = -0.007
	Log Percent Conservation Lands County-Owned			
1	0	0	0.00	0
2	0		0.00	
3	0.6818	1	0.027	0.027
sum =	0.6818			Sum = 0.027

Incorporating the model-averaged parameter estimates, the composite model for log-transformed Total Plan Score has the following parameters:

Log Total Plan Score = 1.499+ 0.003(Total Resources$_i$) + 0.015(Percent Bachelors Degree$_i$) + 0.054(Log Total County Revenues$_i$) – 0.007(Total Collaboration$_i$) + 0.027(Log Percent Conservation Land County-Owned$_i$) + error

To determine the reliability of the model-averaged parameter estimates, I calculated the model selection variance (MSV). MSV was estimated using the model-averaged parameter estimates and the raw parameter estimates from the confidence set of models (Table 25).

$$MSV = (\text{model-averaged parameter estimate} - \text{raw parameter estimate})^2$$

Table 25. Model selection variance for each parameter for the composite model.

Model	Model averaged parameter estimate	Raw parameter estimate	(Model averaged parameter estimate – raw parameter estimate)	Model selection variance
	Intercept estimate			
1	1.499	1.171	0.328	0.1075
2	1.499	1.640	-0.141	0.0198
3	1.499	1.840	-0.341	0.1162
	Total Resources estimate			
1	0.003	0.003	0.000	0
2	0.003	0.003	0.000	0
3	0.003	0.004	-0.001	0.000001
	Percent Bachelor's Degree estimate			
1	0.015	0.011	0.004	0.000016
2	0.015	0.017	-0.002	0.000004
3	0.015	0.016	-0.001	0.000001
	Log Total County Revenues			
1	0.054	0.054	0.000	0
2	0.054	0.00	0.054	0.0029

3	0.054	0.00	0.054	0.0029
	Total Collaboration			
1	-0.007	0.00	-0.007	0.000049
2	-0.007	0.00	-0.007	0.000049
	-0.007	-0.007	0.000	0
	Log Percent Conservation Lands County-Owned			
1	0.027	0.00	0.027	0.00072
2	0.027	0.00	0.027	0.00072
3	0.027	0.027	0.000	0

Model selection variances were then used to calculate unconditional standard errors for the model-averaged parameters in the composite model. The unconditional standard errors (SE) are reported with 95% confidence intervals for each model-averaged parameter below (Table 26).

Table 26. Composite model estimates, standard errors, and 95% confidence interval.

Parameter	Estimate	SE	95% CI Upper	Lower
Intercept	1.499	0.6838	2.1328	0.7651
Total Resources	0.003	0.0007	0.0037	0.0022
Percent Bachelors Degree	0.015	0.0101	0.0251	0.0048
Log Total County Revenue	0.054	0.0604	0.1144	-0.0064
Total Collaboration	-0.007	0.0078	0.0008	-0.0148
Log Percent Conservation Land County-Owned	0.027	0.0351	0.0621	-0.0081

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