AN ABSTRACT OF THE DISSERTATION OF

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Signature redacted for privacy.

Dr. Courtland L. Smith

Since the 1890's, American federalism has been perceived as being unique in the world by having two different levels of government operating within the same jurisdiction without influencing one another. Modern scholars call into question the validity of this basic assumption, but few have published quantitative evidence to reject its application. Furthermore, even some of these theorists continue to suggest that national government programs established under the interstate commerce clause may resist influence from state counterparts.

This study tests this suggestion by examining how selected outcomes of the national wetland regulatory program may be influenced by similar statute-based state programs. In the process, three other voids in the wetland management literature are filled. First, wetland regulatory units are described for the first time as consequential components of the regulatory landscape. Second, relationships between the outcomes of the national wetland regulatory program and local socioeconomic and landscape conditions such as population size and growth rates, income, wetland abundance, and program funding levels are quantified. Finally, a model describing the amount of wetland fill permitted and the number of permits issued by the national government is constructed from these relationships. The accomplishment of these tasks produces

new evaluative tools that may be used by state and national government wetland managers to more efficiently and effectively implement their programs.

The results reveal that some, but not all measures of the national wetland regulatory program's outcomes are influenced by state programs. There is no evidence that the amount of wetland fill permitted by the national government differs measurably in accordance with the presence of any type of active state wetland regulatory program. There is, however, strong evidence that the number of permits issued is directly related to the presence of statute-based state programs. Furthermore, these programs exhibit the same relationship to the national program as do state programs that are empowered solely through federal authorizations.

Therefore, when it comes to wetland regulation, the traditional assumption of American federalism is inadequate. The United States does have two different levels of government operating within the same jurisdictions, however, their programs exhibit measurable influence upon one another.

Evaluation of the Intergovernmental Relationships between National and State Wetland Regulatory Agencies within Wetland Regulatory Units

by

Ryan W. Taylor

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Finally, I must thank God for the gifts of grace, strength, patience, and wisdom without which, this mountain could not have been moved. May this work be a testament to the truth and promise revealed in Philippians 4:13.

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LIST OF ACRONYMS

AIC .... Akaike's Information Criterion

AW .... Artificial Wetland

CIR .... Color Infra-Red

CWA .... Federal Clean Water Act

CZA .... Coastal Zone Area

CZM .... Coastal Zone Management

CZMA .... Coastal Zone Management Act

CZMP .... Coastal Zone Management Program

FRHA .... Federal Rivers and Harbors Act

FTE .... Full Time Equivalent

FW .... Farmed Wetland

FWP .... Farmed Wetland Pasture

GIS .... Geographic Information System

HGM .... Hydrogeomorphology

LIST OF ACRONYMS (Continued)

MOA .... Memorandum of Agreement

NFSA ....National Food Securities Act

NLCD .... National Land Cover Dataset

NOAA ....National Oceanic and Atmospheric Administration

NPDES ....National Pollution Discharge Elimination System

NRCS .... Natural Resources Conservation Service

NRI .... Natural Resources Inventory

NW .... Non-Wetland

NWI .... National Wetland Inventory

NWP .... Nationwide Permits

PC ....Prior Converted Cropland

PGPP ....Programmatic General Permit program

RAMS ....Regulatory Administrative Management System

RPP .... Regional Permit Program

LIST OF ACRONYMS (Continued)

USACE .... U.S. Army Corps of Engineers

USDA .... U.S. Department of Agriculture

USEPA .... U.S. Environmental Protection Agency

USFWS .... U.S. Fish and Wildlife Service

USGS .... U.S. Geologic Survey

W .... Wetland

WRU .... Wetland Regulatory Unit

DEDICATION

I dedicate the completion of this dissertation to the memories of Clifford "Pa" and Imogene "Mu" Murray, my beloved grandparents both of whom passed on to heaven during its development. I know this would make them both very proud.

Evaluation of the Intergovernmental Relationships between National and State Wetland Regulatory Agencies within Wetland Regulatory Units

INTRODUCTION AND HISTORICAL CONTEXT

Introduction

The Section 404 program is the national government's primary mechanism for regulating wetland impacts. Although nationwide in scope, the Section 404 program is administered regionally through 38 separate US Army Corps of Engineers (USACE) district offices. Despite the fact that all of the districts implement the same set of regulations, a preliminary investigation into USACE records revealed that between 1994 and 2003, there was considerable variation in the number of acres of wetland impacts permitted by each of these districts. This study seeks to assess how, if at all, the presence of statute-based state wetland regulatory programs may be related to the amount of wetland impacts permitted by USACE districts. The central hypothesis of this study is that the national government's Section 404 wetland regulatory program performs more restrictively in wetland regulatory units that are located within states having statute-based state wetland regulatory programs, than in wetland regulatory units that have are not located within such states.

Testing this hypothesis requires developing a new way of looking geographically at wetland regulation. Most wetland impact studies either focus on wetlands within state boundaries or within USACE district boundaries. A single USACE district, however, may have jurisdiction in parts of several states. Likewise, different regions of a single state may also be under the jurisdiction of different USACE districts. As a result, 152 different wetland regulatory units are potentially created by the overlap of these two jurisdictions (see Chapter Three). This study proposes breaking from conventional wetland impact studies and assessing wetland loss within each of these units.

Wetland regulatory units are well-suited areas of interest for this study because the national government is not the only level of government that can regulate wetlands.

State governments are also able to regulate wetland impacts. Currently, seventeen states administer their own statute-based wetland regulatory programs. Twenty-one states without statute-based programs regulate wetland impacts through active Section 401 water quality certification programs, while the remaining twelve have not yet developed active programs under either authority (Meeks and Runyon, 1990; Want, 1990; Taylor and Abderhalden, 1997; and Mitsch and Gosselink, 2000). Each region of overlap between a different state and a different USACE district, therefore, is an area that is subjected to a specific combination of different state wetland regulations and USACE conditions. In addition to creating unique wetland regulatory procedures, this overlap also leads to the development of potentially unique state-national intergovernmental relationships that are specific to the state and the USACE district within which a unit is located.

This study is intended to be more than just an investigation into the effectiveness of state and national wetland protection efforts. It is designed to also be an investigation into the discipline of intergovernmental relations. By answering the question of interest, this study will test the applicability of Diehl Wright's (1978) separated-authority model of intergovernmental relations. According to this model, national and state governments operate within completely separate spheres, and the decisions of one of these levels of government should not influence the outputs of the other. If a correlation between the outputs of both levels of government cannot be found, it will suggest that the hypothesis is incorrect, and it will produce quantitative evidence that supports the continued validity of the separated-authority model. If a correlation can be found, however, it will suggest that the hypothesis of this study is correct, and it will provide quantitative evidence that questions the validity of the separated-authority model. Furthermore, if this study is able to disprove the applicability of the separated-authority model, and it does so by demonstrating a positive correlation, it will also ultimately be describing for wetland managers situations in which wetlands are being better protected by the Section 404 program.

In addition to disproving the applicability of the separated-authority model, a positive relationship could also add to the body of literature supporting the broad applicability of Wright's second model of intergovernmental relations - the overlapping-authority model (1978). According to this model, as championed by Elazar (1962) and Grodzins (1966), state and national governments interact with one another with such frequency and in so many ways that on any given issue the outputs of one level of government can not help but influence the actions of the other.

Regardless of whether the separated-authority model is upheld or disproved by the results of this study, however, it is not expected that this investigation will provide evidence supporting or detracting from the applicability of Wright's third model of intergovernmental relations - the inclusive-authority model. The inclusive-authority model requires an entirely different set of assumptions. According to the inclusive-authority model, state-national relationships are completely one-sided. State governments act as mere minions, receiving their authority to act solely from the national government (Wright, 1978). A more thorough discussion as to why the inclusive-authority model of intergovernmental relations is not appropriately tested by this study is included in Chapter Two.

In addition to wetland regulatory units being subjected to one of three different types of state wetland regulatory programs (statute-based, active 401 and non-active programs); there are a number of other ways in these units differ substantially from one another. Some of these differences could, significantly affect the performance of the Section 404 program. Units vary in several bottom-up characteristics such as their size, the amount of wetlands that are present, population densities, local economic strength. They also vary in several top-down characteristics such as the presence of a state Coastal Zone Management Program, as well as funding and staffing levels of each USACE district and the identity of the USACE division providing oversight to each district. All of these variables could potentially impact the performance of a district's regulatory program. This study will, therefore, attempt to account for the influence of both of these classes of variations as best as possible by incorporating measures for each of them into the final analysis.

Although the Section 404 wetland regulatory program has many facets, the amount of permitted wetland impact has been a long-standing measure of performance that has interested wetland managers and researchers alike. This study, therefore, continues in that tradition by using the amount of permitted wetland fill as a measure of restrictiveness. It does so by using the amount of acres of wetland fill approved through Section 404 individual and general permits for both tidal and non-tidal wetlands as the dependent variables in this analysis.

The analysis not only produces quantitative evidence for the existence of a particular intergovernmental relations model, it also provides wetland managers with a better understanding of some of the forces that influence their programs. State wetland professionals could better appreciate the unique position they occupy in the regulatory process. National wetland professionals could better prepare for the potential repercussions arising from changes in state programs. Furthermore, professionals at both levels could better understand the relationships they have with one another and better seek opportunities to coordinate with one another in order to help maximize the impact and efficiency of their respective programs.

Historical Context

In order to have an appreciation of the timeliness and relevancy of this study, it is important to understand the historical context in which this study is being set. While there are currently numerous programs at all levels of government designed to protect wetlands, most of these programs are relatively new and do not have universal support from the general public. The United States has a long tradition of developing programs to encourage the conversion of wetlands to different land uses. As a result, the necessity of these new regulatory programs is continuously being called into question from opponents of wetland protection. Defensible evaluations of the performances of these new programs, such as the one proposed herein, are needed if these debates are going to be concluded.

During the 1800's, when European settlers began spreading across the United States, wetlands were mainly viewed as unproductive wastelands that harbored death and disease (National Research Council, 1995). Settlements built around large wetland areas often became afflicted with plagues of malaria, dysentery, and typhoid fever (Fischer, 1989). The soil belying wetlands can be very rich and productive, however and it was widely held that wetlands were better put to use by converting them into uplands that could be used for traditional agricultural practices or for urban development (Fisher, 1989; Dahl, 1990; National Research Council, 1995; and Tzoumis 1998). This view is best evidenced by the implementation of the various Federal Swamp Land Acts that were passed between 1849 and 1860 (National Research Council, 1995; and US Code Title 43 Chapter 23). These acts effectively gave extensive tracts of wetlands to states under the condition that the recipient states would convert these properties to agricultural lands in the name of "reclamation" (US Code Title 43 Chapter 23). Each state that was granted wetlands under these acts immediately developed robust programs designed to fulfill their terms of the bargain (National Research Council, 1995).

Most of the lands successfully converted through these efforts were the marginal lands that required the least effort. These were mainly those lands that could be reclaimed by simply providing positive drainage to the properties with the use of small ditch systems. The more difficult areas, however, had to be converted with assistance from nationally-funded U.S. Army Corps of Engineers projects (National Research Council, 1995).

As states institutionalized their drainage responsibilities over these newly deeded lands, new political subdivisions began to arise. Drainage districts dedicated to the mission of providing and maintaining positive drainage on "swamps or overflow lands" became integral parts of local governance that still exist to this day (Oregon Law Institute, 1998). The popular perception perpetuated by the Federal Swamp Land Acts and these drainage districts effectively drove national wetland policies for decades (National Research Council, 1995).

New public attitudes towards wetlands did not begin to emerge in America until the 1930's. By this time declining waterfowl populations prompted the passage of the 1935 Federal Duck Stamp Program (National Research Council, 1995; and US Code Title 16 Chapter 7 Subchapter 4). This program generated the funds and infrastructure necessary to purchase and manage a significant portion of the large wetland areas that make up the current National Wildlife Refuge system under the premise that they would become, "Waterfowl Production Areas" (National Research Council, 1995; and US Code Title 16 Chapter 7 Subchapter 4).

During the late 1960's and throughout the1970's, the environmental movement emerged and research began to suggest wetlands could provide many services that American society at large considered beneficial (Mitsch and Gosselink, 2000). Studies began to be published regarding the potential wetlands have to store floodwaters, improve of water quality, and provide critical habitat for highly valued as well as threatened and endangered species of plants and animals (National Research Council, 1995; and Mitsch and Gosselink, 2000).

Shortly thereafter three national policies were established that provided some protections to wetlands. The Federal Water Pollution Control Act of 1972, currently referred to as the Federal Clean Water Act (CWA), was passed containing certain provisions that have been interpreted by the courts as protecting wetlands (National Research Council, 1995; Taylor, 1998; Mitsch and Gosselink, 2000; and US Code Title 33 Chapter 26). These court decisions allowed the USACE to regulate wetlands under the premise that the placement of fill in wetlands was an issue of interstate commerce (National Research Council, 1995). The Coastal Zone Management Act was also passed in that same year, which was designed to help states provide separate protections to estuaries and coastal wetlands (Good et al., 1998; and US Code Title 16 Chapter 33). Then, in 1977 President Carter issued Executive Order 11990 establishing the protection of wetlands as an official government priority (Executive Order 11990; and Mitsch and Gosselink, 2000).

Although several court cases were defining the applicability of the CWA over wetlands throughout the 70's, it was not until 1985 that the national government's wetlands policy explicitly made a significant tangible shift away from wetland conversion and towards wetland protection and restoration (National Research Council, 1995; and Mitsch and Gosselink, 2000). The Food Security Act passed in that year was a historic piece of legislation in that it contained the first set of "Swampbuster Provisions" that completely reversed over 100 years of wetland draining policy by revoking subsidy privileges to agricultural producers who were found to be engaged in the process of wetland conversion (U.S. Department of Agriculture, 1996; and Taylor, 1998). Also established in this act were a number of monetary incentive and technical assistance programs, such as the Conservation Reserve Program and the Wetlands Reserve Program, designed to encourage agricultural producers to restore wetlands on their property (National Research Council, 1995; U.S. Department of Agriculture, 1996; Mitch and Gosselink, 2000).

Two years later, in 1987, the National Wetlands Policy Forum was convened by the U.S. Environmental Protection Agency. This conference recommended the establishment of a national goal of No-Net-Loss of wetlands (National Research Council 1995, The Conservation Foundation, 1988). This goal was eventually adopted as a national policy a few years later by President Bush Sr. (National Research Council, 1995; and Mitsch and Gosselink, 2000). It was also in that same year that the U.S. Army Corps of Engineers wetland regulatory program had matured to the extent that it adopted its first manual for the field delineation of wetlands (U.S. Army Corps of Engineers, 1987). However, it is estimated that by the time these changes in policy direction occurred, over half of the historical wetlands in the conterminous United States had already been drained or filled, and that some individual states had already lost as much as 90% of their historical wetlands (Dahl, 1990).

While national and state government agencies have been working since the 1980's to pursue this new policy direction, it appears that public opinion about wetlands has also shifted in a complimentary manner over recent years (Rude, 1997; Tzoumis, 1998; and Kaplowitz and Kerr, 2003). This mutual reinforcement between policy and public opinion has led to a snowball effect in the development of many new and creative public policies and programs that are aimed at preventing the continued loss of wetlands and encouraging the restoration of wetland areas (National Research Council, 1995).

The number and types of programs designed to improve the status of wetlands has now grown to the point that landowners interested in protecting wetlands on their property often need the assistance of specialists just to help them wade through all the details of the different programs (Taylor, 1998). In addition, recent reports suggest the rates at which wetlands are being converted have decreased considerably over the last two decades from historic rates (Dahl, 2000; and U.S. Department of Agriculture 2002). However, at the national level, the "No-Net-Loss" has still yet to be achieved, and wetlands do continue to be converted to other uses on a regular basis (Dahl, 2000; and U.S. Department of Agriculture, 2002).

Furthermore, in the last decade there have been two major national government court cases that have served to restrict the USACE's jurisdiction over certain types of wetlands and activities. Over the years the USACE has broadly interpreted its authority to regulate "waters of the United States" to reach beyond navigable waterbodies and their tributaries to include isolated wetlands. It was argued that waterfowl hunting is an important interstate commerce, and that these birds clearly use isolated wetlands as they journey from state to state. In addition, although the USACE is only authorized to placement of material in wetlands, they had also traditionally regulated the removal of dredge material by using the argument that all techniques used to remove dredge material ultimately resulted in some amount of incidental fallback of fill material into the wetland (Christie and Hausmann, 2003).

In 1998 a United States' District Court ruling, often referred to as the "Tulloch Decision", reversed the USACE's policy regarding the regulation of wetland draining activities thereby exempting a number of actions that had previously been subject to USACE review. Then, in 2001, the U.S. Supreme Court's "SWANCC Decision" ruled that the USACE's logic concerning their ability to regulate isolated wetlands went beyond what was their intended scope of authority and exempted all activities in isolated wetlands from USACE jurisdiction (Christie and Hausmann, 2003; and Selmi and Kushner 2004).

These two major reversals in USACE policy have caused some state governments to pass legislation creating isolated wetland regulatory programs and programs that specifically regulate the draining of wetlands as well as the filling of them, and have caused several others to consider passing similar laws. These court decisions have also encouraged several wetland-protection interest groups and some state governments to argue for changes in the CWA and to request enhancements in the national government's wetland regulatory program (Christie and Hausmann, 2003). As more and more states are considering getting into the business of wetland regulation in bigger and bigger ways, this study could help state and national government wetland managers better understand the potential consequences of these proposals by bringing to light the types of intergovernmental relationships that these programs establish, and creating an awareness about the types of challenges and workloads these relationships bring.

Clearly, the United States has seen a shift in its public policy regarding wetlands and a reduction in the rate of wetland fill over the last 30 years. New programs have been developed with the intention of halting, and in some cases reversing, 200 years of wetland conversion practices. Many organizations are suggesting that the observed decreases in wetland conversion rates in recent years are the result of the combined efforts of state and national government agencies and conservation groups to educate the public about wetland functions and values, regulate the conversion of wetlands to other land uses, and restore wetlands where possible through these new programs (Dahl, 2000; U.S. Department of Agriculture, 2002; and Norton and Veneman, 2003).

To date, however, no nationwide, comprehensive study has been conducted to verify these claims or to explain in what ways these programs may actually be related to the behavior individual entities take towards wetlands. Likewise, no study has been conducted that attempts to quantify how the outputs of any one of these programs may be singularly responsible for any of these reductions in wetland conversion activities. Furthermore, no study has been published that describes how any given program's outputs may be related to the outputs of any other specific program. This study seeks to fill a portion of this void, by investigating a specific behavior of the permit issuing agency acting in the national government's wetland regulatory permit process, and establishing a relationship between that behavior and the presence of statute-based state wetland regulatory programs.

Conclusion

Wetland management has changed a lot over the past two hundred years in America. There has been a near-complete reversal in public policy regarding the draining and filling of wetlands. Positive public perceptions regarding the functions and values of wetlands is not unanimous, but has followed this trend and increased over the last forty years. At the same time, the rates at which wetlands are being destroyed has decreased, but has not stopped.

Despite these steps that have been taken towards the protection of the nation's wetland resources, wetland filling is still a practice that is permitted by both state and national levels of government. While the national government enforces wetland regulations across the nation, only certain states have taken up the challenge of doing the same. The patchwork of regulations that is created as a result of the lack of uniformity between states provides the backdrop for this study. Furthermore, national government wetland regulatory records indicate that wetlands may be enjoying better protection in some regions of the country than others.

The following chapters describe how this study seeks to determine if these areas of increased protections can be explained by the types of programs states have introduced to deal with wetlands and the types of relationships these programs create with the national government. The results will provide answers to questions of both students of the discipline of intergovernmental relations and to wetland managers alike.

LITERATURE REVIEW AND BACKGROUND

Introduction

This investigation looks at wetland loss as an intergovernmental relations issue. Geographic variations in the amounts of wetland loss permitted by the national wetland regulatory program are hypothesized to be, in part, a function of the relationships that arise between state and national agencies as a result of state efforts to protect wetlands. To understand the nature of these particular state-national government relationships, the major regulatory, geographic, and philosophical settings surrounding wetland loss must first be examined. Discussions of these three settings are specifically of interest because together they provide a holistic picture of the way intergovernmental relations theory can be related to wetland regulations, the legal groundings of wetland governance, and the socio-economic variables associated with wetland loss.

It is of primary importance to have a clear understanding of the regulatory framework around which the bureaucratic programs being investigated operate. The regulatory context sets the boundaries of operations by which the government agencies must abide as they execute their daily charges. These operational boundaries are the mechanisms that create opportunities for the intergovernmental relationships being studied to develop. In the instance of wetland regulation, these relationships arise between state agencies charged with the responsibility of administering statute-based programs and the USACE, which is charged with the responsibility of administering the national wetland regulatory program.

Because the relationships being studied involve land-use regulation, it is also important to describe their geographic context. The jurisdictions of the agencies involved in a wetland regulatory action are determined both by the physical condition of a property of interest and the specific location of that property. As a result, geography not only determines those agencies that can get involved to address a situation, but also whether or not any agency involvement is necessary at all. The need for agency involvement then determines whether or not any intergovernmental relationships will develop.

Most importantly, however, this study is designed to test the applicability of just one of several intergovernmental relations models. When investigating relationships between intergovernmental agencies, it is critical to understand the potential philosophical context under which the regulatory programs that created those relationships were established. The particular model in question here is Deil Wright's separated-authority model. Having a thorough understanding of the various other theories, however, is essential to crafting a solid study design and interpreting any results in a way that can provide evidence for alternative proposals. For this reason, several intergovernmental relations models are explored in this literature review.

Philosophical Context

The American federalist system of government is a puzzle that has vexed political scientists around the world since its inception. American Federalism is a unique brand of government that has no real precedent for comparison. It was designed at a time when there was great concern about the oppressive tendencies of strong, central governments, but also great need for the types of essential functions that can only be accomplished by an effective national government. The type of government structure that the compromise between these two needs ultimately created has been matter of debate for over two centuries and is still not yet resolved (Elazar, 1962; Wright, 1978; and Benton and Morgan, 1986).

Even the founding fathers were not in complete agreement about the system of government they had created at the time they wrote the Constitution. As a result, some of the framers such as Alexander Hamilton, John Jay, and James Madison set pen to paper early in the formation of the republic and attempted to explain their intentions and motives in documents such as the Federalist Papers. These writings have since become essential tools for scholars attempting to understand the way state and federal governments should properly interact in America (Cooley, 1880; Bryce 1891, and Wright, 1978).

What can be agreed upon is that the Constitution establishes the justification for both the national government and state governments to exist. Furthermore, the Constitution designs a framework within which both levels of government are intended to function. What has been debated over the years, however, is the way in which state and national governments are supposed to relate to one another within this framework. Some scholars contend that states are intended to be subservient to the national government while others feel that states should be equal partners with the national government and many more suggest that that the actual relationship lies somewhere in between those two views (Wright, 1978; and Benton and Morgan 1986).

By the 1960's, this continued uncertainty finally gave rise to an entirely separate discipline of study for students of American federalism. This new discipline is the study of intergovernmental relations. Intergovernmental relations has become an academic discipline absorbing most of American federalism's old debates and discussions. The term is now synonymous with the study of American federalist system, and many scholars no longer debate the merits of "federalism" at all; instead they only illustrate their arguments within the terms of "intergovernmental relations". The predominant thought of this school is that this new name more accurately describes what specifically it is about American federalism that is being questioned and should be investigated (Elazar, 1962; Grodzins, 1966; and Wright, 1978).

Deil Wright's Three Major Models

Deil Wright suggests three simplified competing models have been used to describe the nature of intergovernmental relations in the United States. He labels these three models the separated-authority, inclusive-authority, and overlapping-authority models.

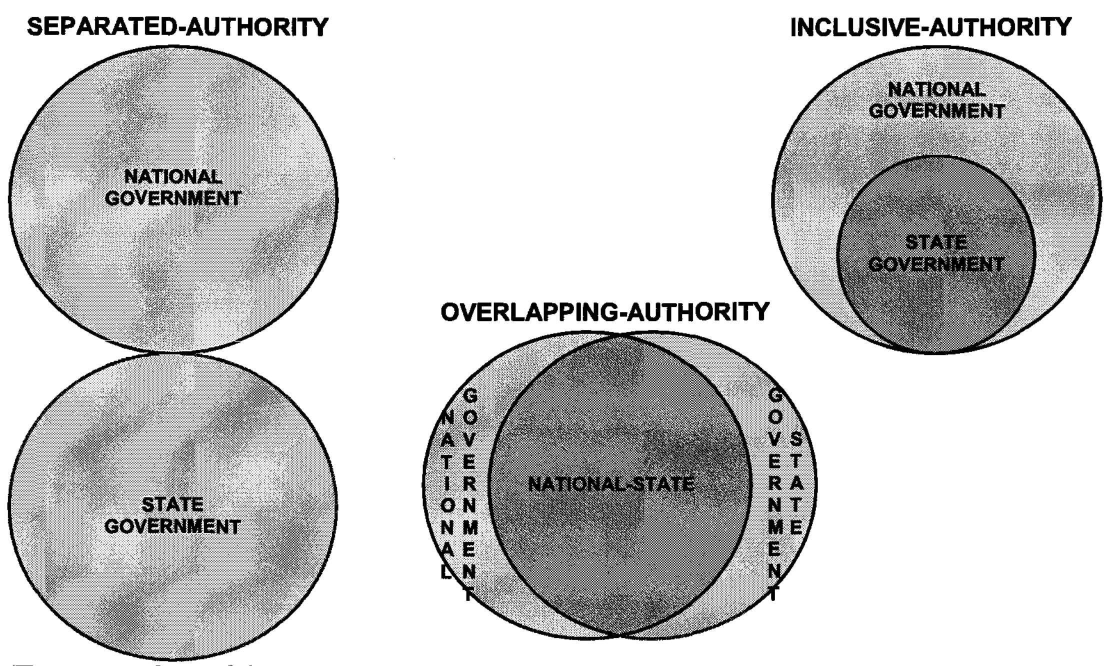
He contends that all three models have merit, but each model's acceptance as legitimate political theory has gone through phases of popularity (Wright, 1978).

It should be noted that Wright and others typically include local governments in their discussions about intergovernmental relations. Generally, intergovernmental relations scholars discuss three levels of government; lumping municipalities, special districts, counties and township governments all into the "local" category (Elazar, 1962; Grodzins, 1966; Wright, 1978; and Scheberle, 1998). Each one of these types of local governments are capable of playing a role in implementing state government wetland regulations or developing their own types of wetland protective measures. There are, therefore, several examples of model wetland protection ordinances that have been drafted and presented to local units of government for their adoption. Likewise, there are some examples of state wetland management and land-use programs that delegate some of their implementation responsibilities regarding wetland regulations to local units of government. The numbers of instances where local governments have actually adopted their own sets of wetland regulations, however, appear to be very limited. Furthermore, the instances where local governments are involved in the implementation of state regulations are also limited and are not broadly distributed across the nation (Kusler, 1978; Kusler and Opheim, 1996; and Want, 1996). In addition, the issue of relationships between local and national or state governments is not the focus of this study.

This study, however, is an investigation solely into the relationships between the national and state levels of government. Because there is such sparse participation from local governments in the wetland regulatory arena, the primary authority and responsibility for wetland regulation is largely shared between the national and state governments. In addition, considering that the vast majority of the thousands of local governmental units in the United States are not engaged in the practice of wetland regulation, it would be difficult to obtain a representative sample of local governments engaged in this practice that would allow for any extrapolation to the broader population of local governments. Furthermore, incorporating different units of local government into this study design would require obtaining datasets for a variety of different scales, not all of which are available.

Furthermore, the inclusion of these local programs is not necessary in order to test the hypothesis of this study. The central hypothesis is focused only on the relationships between state and national government agencies. By excluding the potential role of local governments, the investigation does not become unnecessarily complicated. As a result, the discussion of the various intergovernmental relations models is simplified even further by removing the local government layer from the descriptions and only illustrating the national-state government relationships (Figure 2.1).

*Figure 2.1 Three models of intergovernmental relations – simplified.**



**(Figures Adapted from Wright 1978)*

Wright's separated-authority model embodies the classical view of American federalism as it was described by Thomas Cooley (1880) and Lord Bryce (1891) and as it has been interpreted for the majority of American history (Elazar, 1962;

Grodzins, 1966; and Reagan, 1972). His inclusive-authority model describes the view of American Federalism as it has been best illustrated by Scheberle (1998) and Reagan (1972) and as it has been adapted by a number of modern intergovernmental relations scholars (Elazar, 1962; Grodzins, 1966; Reagan, 1972; Benton and Morgan, 1986; and Scheberle 1998). His overlapping-authority model captures the most recently dominant view of intergovernmental relations as it has been described by Elazar (1962) and Grodzins (1966) and as it has become most popular among scholars in the later part of the twentieth century (Reagan, 1972; Benton and Morgan, 1986; Kamieniecki et al., 1986; Wassenberg, 1986; Hamilton and Wells, 1990; and Scheberle, 1996).

Separated-Authority Model

According to the separated-authority model, the national government and state governments are "independent and autonomous" entities. Furthermore, the two levels of government are separated by clearly defined boundaries of authority, within which each government has absolute sovereignty (Wright, 1978). This model is based upon an 1872 the Supreme Court ruling that stated, "There are within the territorial limits of each state two governments, restricted in their sphere of action, but independent of each other, and supreme within their respective spheres" (Wright, 1978: 21-22). The court further observed that, "Each [government] has its separate departments, each has its distinct laws, and each has its own tribunals for their enforcement" (Wright, 1978: 21-22). Finally it was the court's opinion that, "neither government can intrude within the jurisdiction of the other or authorize any interference therein by its judicial officers with the action of the other" (Wright, 1978: 21-22). Morton Grodzins (1966) describes this traditional separate-spheres description of American federalism with his famous analogy of a layered cake, where the authorities of each level of government are represented by a distinct and separate layer within the cake.

The model was further exhorted by the late nineteenth century observations of Lord Bryce, who in his work dedicated to explaining American federalism to European readers opened a chapter dedicated to the topic of the working relations between the national and state governments with the following characterization of the system he was describing:

> *The characteristic feature and special interest of the American Union is that it shows us two governments covering the same ground, yet distinct and separate in their action. It is like a great factory wherein two sets of machinery are at work, their revolving wheels apparently intermixed, their bands crossing one another, yet each other doing its own work without touching or hampering the other* (Bryce 1891: 318).

These types of generalizations about American federalism, however, are no longer widely held. This view came under attack during the late twentieth century for being an oversimplification of the relationships that exist between state and national governments. In fact, Wright (1978) suggests that by the late twentieth century, most modern intergovernmental relations experts agreed that the separated-authority model of intergovernmental relations did not really describe most situations under the American brand of federalism.

Many scholars now believe that the separated-authority model does not adequately describe how "nationalistic" American federalism has become. They suggest that often times either the overlapping-authority or the inclusive-authority model more appropriately describe American federalism. These scholars present arguments that either of these two models better express the nationalistic tendencies of American Federalism and apply to the vast majority of instances where attempts have been made to apply the separated-authority model (Wright, 1978). Reagan (1972: 154) contends that these relationships may have once been present, but that, "those days are gone forever". Benton and Morgan (1986) agree that the separated-authority model was once sufficient; however, they argue it became obsolete during the early twentieth century as governments began to experience overwhelming requests for services that could only be met if all government agencies worked together across boundaries and shared resources. Elazar (1962) and Grodzins (1966), on the other hand, contend these types of relationships have never really existed in America in the first place.

Martin Diamond (1961) agrees that the separated-authority model was never accurate. He goes further, however, and suggests that a review of way the framers discussed the topic in the Federalist Papers reveals how they ultimately decided upon a form of government that was neither completely a true nationalist government nor completely a true federalist government, but, instead was something that contained components of both types of governments (Diamond, 1961).

Both Elazar (1962) and Grodzins (1966) reference a number of situations that they contend illustrates the flawed nature of the separated-authority model. As time has progressed, these scholars have gained more followers and the number of examples that support their arguments has continued to grow. Hedge and Scicchitano (1994) reported that in the case of surface mining regulations, the agendas of national policy-makers have been compromised during the implementation stages by "bottom-up" influences from state and local interests. Wood (1992) argued that in the case of clean air act enforcements, federal implementation of the program could not be described by national government outputs alone. State and national government actions were so closely linked and interrelated by common influences that the program had to be evaluated with by giving consideration to the actions of both levels of government. In two separate studies, it was twice concluded that in all 50 states there was evidence that national Occupational Safety and Health Administration programs routinely integrated considerations of state and local agencies (Scholz, 1986 and 1991).

Wright, however, does not concede that the separated-authority model is completely dead. He suggests that certain national government activities that are invoked on the premise of the interstate commerce clause can create relationships between the national and state governments that potentially satisfy the criteria of this model. He then holds up a Supreme Court ruling that confirms that the national government has the right to establish a minimum wage law to which private citizens and corporations must submit, but with which state government employment practices are not required to comply, as they have the right to establish their own minimum wage standards as a matter of running a sovereign state government (Wright, 1978).

A similar decision was more recently reached by the Supreme Court regarding the state of California's ability to regulate the usage of marijuana for medicinal purposes. In this case, the nation's highest court upheld the national government's assertion that it had the authority to prosecute California residents in possession of medicinally-prescribed marijuana for violations of the Federal Controlled Substances Act, despite there being a California State Law in effect making such a possession legal. This ruling did not, however, completely subjugate the will of the California State Legislature to the will of Congress. It did not question the constitutionality of the state law or the State of California's ability to regulate the use of medicines within its boundaries, nor did it require state law enforcement officers to enforce the federal regulation. The opinion of the court seems to provide a twenty-first century affirmation that both the state and national governments have the authority to independently regulate citizen actions within California (Gonzales V. Raich 2005).

Hamilton and Wells (1990) also support Wright's position. They argue that the idea of "dualism" that is expressed by the separated-authority model is still a functional part of intergovernmental relations in the United States. They suggest that for many policies, there is a clear and distinct division of labor between the national and state governments. In their view intergovernmental relations are very practical. One level of government will take a clear lead on a given issue such as the national government taking the lead in defense and the state governments taking the lead in education. While the non-lead level of government may also be involved in the issue, most of the time, it will have a specific role that compliments instead of competes with the role of the lead agency (Hamilton and Wells, 1990).

Overlapping-Authority Model

According to the overlapping-authority model, state and national governments share some kind of joint-authority over most issues. Both levels of government are autonomous actors. However, they cooperate closely with one another in order to accomplish most of their tasks. Each level of government has relatively dispersed and limited powers, and rarely, will either act alone. In addition, the terms of each relationship concerning a specific issue are not dictated by the national government. The terms and conditions are freely negotiated and are bargained for between the two governments (Wright, 1978).

When engaged in relationships that meet the conditions of this model, states become involved in an issue by their own volition. They are not required to take any specific action dictated by the national government. Instead, they can negotiate what they would like to do. State governments are able to seek out partnerships with the national government in exchange for the receipt of resources or other special considerations it would like to obtain (Wright, 1978).

Wright suggests that in the 1970's this model became the more widely accepted view of American intergovernmental relations. He contends that this model has relevancy in more modern times. According to Wright (1978), the proliferation of national government grants to state governments has created a boom in the number of overlapping-authority model relationships that exist (Wright, 1978).

Clearly, the works of Elazar and Grodzins in particular are best described by this model. In his famous work, Grodzins contends that the overlapping-authority model describes national and state government relations in a way that resembles the structure of a marbled cake (Grodzins, 1966). According to this view the lines between the responsibilities and authorities of state and national governments are blurred and mixed together. His central theme revolves around the different ways state and national governments are found to "share" authorities and complement one another.

Elazar, in particular, claims that by looking closely enough at every national government program it can be found to fit this model. He contends that there is a long history of partnership development between state and national governments, and that every program must involve negotiations between both levels of government in order to be implemented. As a result, the majority of the examples both he and Grodzins use to describe the lack of independent action by state governments can easily be described by this more general model (Elazar, 1962; and Grodzins, 1966).

In addition, Denise Scheberle's "volunteer" relationship provides another, more recent, example of a modern scholar's view that is described by the overlapping-authority model. In her view, state and national governments bargain with one another for shared responsibilities for a number of issues. Furthermore, no agreement meets her conditions for a "volunteer" agreement if a state is not able to participate by its own free will (Scheberle, 1998).

Wright suggests, however, that even though a large number of relationships can be described by the overlapping-authority model, there appears to be enough evidence to suggest that not all state-national relationships are voluntary. He argues that there are a number of relationships that seem to exist because the state government is required to accomplish a task by the national government. In fact, a number of Elazar and Grodzins' examples fit this description (Elazar, 1962; and Gordzins, 1966). In addition, Scheberle suggests there are two other types of relationships that exist concerning environmental issues in which there is interaction between the two levels of government, but where state governments are not free-willed participants (Scheberle, 1998).

Inclusive-Authority Model

According to Wright's nationalistic inclusive-authority model, state governments are not autonomous actors freely coming to the bargaining table with the national government as equals or partners. The national government's sphere of authority is all-encompassing, and states only truly receive their authority to act on an issue from the national government. Under this model, instead of a multi-layer or a marble cake, the American federalist system looks and functions more like a single layer cake, with state and local governments being key ingredients of a single homogenous national government layer. Wright argues that under this model, there can be no question that it is the national government that governs, and that the constituent states are merely functioning as its "minions" (Wright, 1978).

The inclusive-authority model suggests that national leaders are the ones who actually set the stage for policy decisions in individual states and that they steer the direction states may go. State and local governments are effectually, totally dependent upon directions and influences that are nationwide in scope and arrived at by the national government, powerful nationalistic economic interests, or by some combination of the two (Wright, 1978).

Michael Reagan agrees that this model sufficiently describes the vast majority of relationships that exist between state and national governments. To Reagan, state governments currently function as little more than "administrative subdivisions" of the national government. Reagan's central supportive argument is that states have become solely dependent upon national government grants-in-aid in order to provide many of their key services. Because of the demand for the services the grants provide, states really do not participate in them as true volunteers. Furthermore, these grants are routinely crafted with input from private groups that have national interests. As a result, he claims states have lost their ability to fundamentally direct public policy and are mainly just along for the ride (Reagan, 1972).

Reagan is not alone in his support of Wright's model, as his argument is one that Wright recounts has also been made by many of his contemporaries (Wright, 1978). In addition, Denise Scheberle's "delegated" and "direct-order" relationships actually describe two types of intergovernmental relations that seem to function very well under this model (Scheberle, 1998). In addition, many of the examples Elazar and Grodzins use to support their arguments that states do not act on their own, can also be described very well by this model. In fact, both of them point very heavily towards increased grants-in-aid as evidence for their views. On the other hand, many of their examples can not be fully described by this model, as they point to numerous situations where it appears that states are able to willingly negotiate the terms of their participation in programs (Elazar, 1962; and Grodzins, 1966).

Elazar and Grodzins' Influence

Elazar and Grodzins have both argued that the concept of each level of government having "separate spheres" of influence inaccurately describes any relationship that actually exists between the national and state governments in America. They have easily been the sharpest critics of what Wright is calling the separated-authority model of intergovernmental relations. Neither Elazar nor Grodzins feel that the framers of the constitution ever really intended for there to be two strict spheres of authority. Furthermore, they both argue that if any artificial separation between the two levels of government did once exist in the United States, the proliferation of national government grants-in-aid to state governments has worked to effectively erase that line of separation, completely (Elazar, 1962; and Grodzins, 1966).

Elazar argues that many of the responsibilities that appear to be separate on paper do not function separately in practice. In his view, national and state governments do not act exclusively on a given issue. They routinely cooperate with one another and share resources and responsibilities over almost every topic. He supports his argument by recounting numerous examples of cooperation that have occurred between the national and state governments since the adoption of the constitution. He explains that everything from the creation of a national bank, to the completion of topographic surveys, and the development of large water projects have all required some type of cooperation that is indicative of the type of intergovernmental relations that are at work in the United States. He explains that much of the time one level of government will lack either the resources or the infrastructure it needs to accomplish its goals, and it will rely upon a partnership with the other level of government to make up its deficiencies (Elazar, 1962).

Grodzins agrees that on any given issue, state and national governments do not evenly divide their responsibilities and act completely separately from one another. He suggests that national and state governments are always sharing responsibility and authority with one another in some way. He argues that although the pattern of sharing is often chaotic at times, national and state governments usually wind up sharing authority and responsibility over an issue either by design, because of proximity, or through professional association with one another. He illustrates his concept by describing outdoor recreation opportunities in the United States, and discuses the multiple state, national, and local government agencies that collectively create these opportunities in a given area such in the coastal redwoods region of Northern California. In his view, each level of government works to provide a recreational opportunity that another level is lacking. He contends that the recreation planners and site managers work together through a variety of avenues to share the burden of providing specialized services to meet the recreational needs of visitors (Grodzins, 1966).

Grodzins further demonstrates his point by conducting a quantitative study into the availability of both state and national public recreation lands within in each state. In his analysis, he found a general, nationwide, inverse relationship between these two variables. He suggests this discovery of a negative correlation provides support for his assertion of cooperation between the two levels of government (Grodzins, 1966).

The writings of Elazar and Grodzins have been considered almost revolutionary by many intergovernmental relations scholars. In fact, since they published their views, the number of texts on the subject has proliferated (Reagan, 1972; Wassenberg, 1982; Benton and Morgan, 1986; and Hamilton and Wells, 1990). Interestingly, despite the publication of numerous writings on the topic, Grodzins' investigation into the availability of public lands provides the only example of a test of his and Elazar's theories that looks quantitatively at government outputs for evidence (Grodzins, 1966; and Reagan, 1972).

Scheberle's Description of Environmental Policies

Denise Scheberle shares Elazar and Grodzins nationalist view of intergovernmental relations. In her view, no intergovernmental relationships fit the separated-authority model. While, like her predecessors, she does not speak quantitatively about these relationships, she has attempted to apply the principles of the discipline to a higher level of resolution. Scheberle has looked at the specific public policy field of environmental regulations. She has attempted to distill from that field some general policy relationships between the national and state governments that she feels are created by environmental regulations and policies. As a result of her investigations, she has reached a conclusion similar to Elazar and Grodzins about the way intergovernmental relations function in the United States. In her view, state governments do not regulate environmental issues in a vacuum. All relationships between the national and state governments concerning environmental regulation always take the form of some kind of partnership. In contrast to either of her counterparts, however, Scheberle makes an attempt to classify the types of nationalistic relationships she observes into three general categories. She suggests all environmental regulations or policies result in the development of what she calls; "delegated", "voluntary", or "direct order" relationships between the national and state government (Scheberle, 1998; and Steel et al., 2003).

"Delegated" relationships are those that occur when the national government sets certain standards for environmental quality and gives the state government the responsibility of implementing programs in order to achieve those standards. In this relationship, the state government does not have the authority to address an environmental issue on its own. A state receives the necessary authority from the national government. By assuming this authority, the state is then able to act on behalf of the national government in response to an environmental issue. States issuing National Pollution Discharge Elimination System permits (NPDES) on behalf of the U.S. Environmental Protection Agency (USEPA) provide a good example of this type of relationship (Scheberle, 1998; Houck, 2002; and Steel et al., 2003).

“Voluntary” relationships occur whenever a state government implements a program that the national government would like to have developed in exchange for receiving certain incentives from the national government. In this relationship, the state government does not address an environmental issue in its own way. It approaches an environmental problem the way that the national government would like and in exchange it receives the resources it needs from the national government to implement the program. State indoor radon abatement programs are good examples of this type of relationship. States are not required to develop these programs, but the national government has a number of incentives it offers states that do create them through the Indoor Radon Abatement Act (Scheberle, 1998; and Steel et al., 2003).

“Direct order” relationships are created whenever the national government requires a state government to do something specific about an environmental issue. The state is not acting on behalf of the national government in this relationship, nor is it voluntarily choosing to act; it is simply being accountable to the national government for certain actions. Direct order relationships often take the form of "unfunded mandates" as the state does not generally receive compensation for its mandatory participation. The Clean Air Act establishes this type relationship by requiring a state to develop and follow an implementation plan that will achieve air quality standards set by the national government (Scheberle, 1998; and Steel et al., 2003).

Scheberle's three models describe intergovernmental relations in a greater level of detail than Elazar and Grodzins were able to in their works. Furthermore, her models specifically describe a large portion of the relationships that actually develop between state and national governments over environmental issues. However useful her models may be though, they still seem inadequate to describe the intergovernmental relationships that potentially exist in the wetland regulatory efforts.

All three of Scheberle's models assume a nationalistic view of intergovernmental relations. They do not, therefore, adequately account for state governments asserting their own intrinsic authorities. As a result, none of her models consider a state voluntarily creating an environmental regulation that overlaps in scope with a national government program without receiving incentives from the national government or without usurping the national government's authority over the issue. Wright's separated-authority model, however could possibly describe these types of relationships. If this investigation demonstrates the applicability of the separated-authority model to these types of relations, it could address that deficiency in Scheberle's description, and would be helpful in providing a more accurate picture about the way state and national governments can interact when developing and implementing environmental regulations and policy.

Fitting an Intergovernmental Relations Model

For years the predominant thought in political science circles had been that there was a separation of powers between the national and state layers of government. It is largely thought now, however, that the state and national governments work cooperatively in so many ways that there are no longer any such things as separate spheres of influence. States are either mere "minions" of the national government, or they routinely barter with the national government. If this is a true assumption, it would seem Justice Brandeis' assertion that states function as laboratories for change in the American Federalist System has been greatly compromised (285 U.S. 262, 1932). The only state-derived policy innovations would be expected to come from compromises reached through each state's ability to negotiate with the national government.

This would mean that many of James Madison's reassurances in the Federalist Papers that the State governments will always exercise more influence over the national government than the national government will have over them has also fallen by the wayside. As a result, it should be expected that a great homogenization would be visible in state programs across the nation, and that an equal or greater amount of major public policy innovations should be arising from the national government than from states. Wright suggests, however, that these expected trends are not always present and that not all national-state relationships conform to this new view of intergovernmental relations (Wright, 1978). Indeed numerous examples can be found of policies and laws that have been developed at the state level and were later adopted by other states, without intrusion by the national government (Gray, 1999; and Ferrey, 2001). Wright (1978), along with Hamilton and Wells (1990), therefore, argues that some intergovernmental relationships still exist that are based upon a separation of authority.

This analysis of the situations in which the Section 404 program performs more restrictively will produce evidence to help identify the model of intergovernmental relations that most adequately describes the relationship that is created by states passing their own wetland regulations. Wetland regulation is an issue that is an ideal laboratory for this kind of study into intergovernmental relations. The state-national government relationships created by states passing their own wetland regulatory legislation can create a complex and duplicative permitting process for potential applicants. This becomes a unique situation in environmental policy where a state and a national government agency may both require separate, but similar, permits in order for a single activity to occur, instead of one level of government just operating on behalf of the other in some capacity.

The idea that there may be some actual overlap between these theoretically autonomous programs is not a recent one. In 1982, a Congressional Research Service report to the U.S. Senate Committee on Environment and Public Works raised questions about the potential effects of intergovernmental relations on the Section 404 program when it informed the Senate that there appeared to be, "problems with federal and state duplication of paperwork during the review of [wetland fill] permit applications". This report further inferred that the potential effects may be the result of a correlation between state wetland regulatory programs and the Section 404 program when it further suggested that, "[these] problems of duplication and even contradictions are most likely to occur in cases of states that have strong wetland protection programs authorized by their own statutes". Even at this early stage of the development of national and state wetland regulatory programs this report seemed to discount the applicability of the separated-authority model. It, instead, seemed to assume an overlap or a delegation of national government authority over state programs as it also recommended that, "the federal regulatory role may well serve to make existing state and local programs more effective and more consistent" (United States Senate, 1982).

The uniqueness of this situation, however, makes it possible that this relationship may still meet the conditions of the separated-authority model. Implicit to either of the alternative models is the assumption that states do not function as if they have true autonomy. Both the inclusive-authority and the overlapping-authority models assume that states only exercise those authorities that have either been given them by the national government, or for which they have bargained from the national government. However, Thomas Cooley observed in his investigation of the constitutional basis for law in the United States that the Tenth Amendment guarantees, “the mere grant of a power to Congress does not itself, in most cases, imply a prohibition upon the states to exercise the like power...” (Cooley, 1880). Furthermore, the courts have upheld in cases involving interstate commerce, which is the constitutional foundation under which wetlands are regulated by the national government, that states do have the constitutional freedom to create their own separate program involving an issue or resource that is not subject to national government approval even when the national government has a similar program to address that same issue or resource (Wright, 1978; and Ferrey, 2001). The theoretical autonomy that is then provided for under the commerce clause is what makes it possible to create state programs that mirror national government programs in their purpose and functions without there being any formal linkage between the two.

In light of this understanding, it appears that the relationship being evaluated herein could still meet the description of the separated-authority model. Wetland permitting sets up a situation under the commerce clause that lends itself to being quantitatively tested to see if there truly is a separation of influence. In this relationship, there are two clearly separate and distinct regulatory programs applicable to wetlands located on the same ground within a state's territorial limits. Both the actions of the national government program and the state government program come from authorities that are clearly granted, limited, and defined by the separate congressional and statehouse acts that created them. Furthermore, each program is administered through a different agency and has its own path of recourse to ensure compliance. In this relationship, the programs are not designed to hamper one another. Applicants must seek completely separate permits from both governments, and the receipt of a permit from one government is not a prerequisite for the receipt of a permit from the other. Furthermore, one government cannot revoke a permit granted from the other government. All of these conditions seem to match well the criteria of the separate-authority model, and allow this model to be applied. The applicability of the separated-authority model to the way the relationship functions, therefore, is the central focus of the study.

If it is indeed possible that the relationship functions in a way that can be empirically described by the separated-authority model, it is predicted there should be no observable correlation between the presence of a state wetland regulatory program and the performance of the overlapping national wetland regulatory program. If a correlation is found, however, it could add to the body of literature that suggests that this model of intergovernmental relations does not adequately describe the way

American federalism functions. It is possible that because of shared features such as professional associations, customer bases, and interest groups, the relationship may function more in line with Grodzins' view of the overlapping-authority model. It is less likely, however, that the relationship would function in a way that could be described by the inclusive-authority model, as it does not meet any of the fundamental assumptions of that model. Regardless, a correlation would suggest that states may be cooperating and interacting with the national government in so many other ways that the state programs do not ultimately operate in a policy vacuum. This realization could potentially enlighten and empower state and national wetland administrators alike, by illuminating to both their dependence upon one another and the added strength to the wetland regulations that is generated by their cooperation (Elazar, 1962; Grodzins, 1966; and Wright, 1978).

There is, however, a growing sentiment of skepticism towards the ability of modern state agencies to provide genuine environmentally-oriented protection for natural resources. This movement has been bolstered in recent years by Koontz's conclusions regarding the outcomes of federalism in the discipline of forest management. Followers of Koontz's view of federalism's outcomes would question the assertion, implicit to this study, that interaction between state and national government natural resource management agencies could result in a decrease in the amount of negative impact inflicted upon a particular resource of interest by the national government. Based upon his analysis of state and national government agencies' efforts to manage their respective forest resources, Koontz has concluded that state governments are more likely to institute practices that favor the development of natural resources for commodity production and revenue generation, than is the national government. Furthermore, he argues that the national government, instead, tends to manage natural resources more with environmental considerations and opportunities for citizen involvement in mind (Koontz, 2002).

Along Koontz's spectrum of commodity production and environmental protection, the practice of granting a wetland fill permit is the regulatory equivalent of managing a resource for commodity production and revenue generation, whereas withholding that permission is an action that is more environmentally focused. Koontz' conclusions suggest that even if the overlapping authority model can be used to accurately describe the issue of wetland regulation, and it is possible for a state wetland regulatory program to influence the outcomes of the national government's wetland regulatory program through that model, it is not likely that a reduction in the amount of wetland fill permitted would be observed (Koontz, 2002).

Koontz's view of government stewardship argues, instead, that state wetland regulatory programs are likely to behave less restrictively than the national government, permitting the occurrence of more wetland fill activities as a result. Creating an opportunity for the less-restrictive state programs and the national program to interact could only serve to influence the national government program to lower its standards and permit more wetland fill to occur than it would absent that interaction. They could conclude, therefore, that the national government is more likely to permit more wetland fill activity within those wetland regulatory units where state agencies have wetland regulatory programs, than in those wetland regulatory units where there are no such state programs (Koontz, 2002).

Ostrom, however, cautions against drawing such extrapolations from a model without first testing the applicability of that model to the situation in question. She acknowledges the power of a theory such as Koontz's lies in the diversity of situations it can explain, but reminds scholars that, "all theories have limits" (Ostrom, 1990: 24). She goes on to explain how a theory's limits are dictated by the number of variables that must be controlled and that it is easy to attempt to apply a model to a situation that does not fit.

In the case of wetland regulation, applying the principles of Koontz's theory of resource management requires the assumption that state and national government natural resource agencies will approach their responsibility towards the regulation of the private use of a natural resource the same way they approach their own management of a publicly-held resource. This may not, however, be the case when it comes to wetland regulation. Many states established their own wetland regulatory programs because they politically perceived a need to protect wetlands to a higher degree than was being provided by the national government (Kusler, 1978). Furthermore, Koontz acknowledges that there is a whole school of thought that can demonstrate situations where states take very active roles in environmental protection (Koontz, 2002).

Ostrom famously summarized that, "scientific knowledge is as much an understanding of the diversity of situations for which a theory or its models are relevant as an understanding of its limits" (Ostrom, 2002: 24). If this study ultimately demonstrates that wetlands are better protected from permitted wetland fill activity as a result of the national government's interaction with state wetland regulatory programs it will demonstrate both an increased understanding of the situations to which the overlapping authority model can be applied, and the limits of both Koontz's assumptions of state agency stewardship of natural resources and the separated-authority model of intergovernmental relations.

Regulatory Context

Because it is difficult, if not impossible, to restrict the majority of private citizens from enjoying the benefits provided by wetlands, wetland systems can be considered common pool resource systems. These benefits are provided to the general public regardless of a particular wetland's location on private or public lands. As a common pool resource, the use of wetlands can be regulated by the government under the organizational construct described by Ostrom as "neo-institutionalism". Neo-institutionalism recognizes the ability of the government to perform the role of an appropriator, regulating the management and long-term care of the resource. Room is also made, through this model, for there to be multiple appropriators for a given common pool resource, opening the door for both state and national government agencies regulating the use of wetlands (Ostrom, 2002).

The current wetland regulatory landscape is very much a reflection of the process of neoinstitutionalism at work. Wetland regulation is a complex quiltwork of national and state government authorities. Individual entities wishing to convert a wetland to some other land-use may be required to seek permissions from any number of agencies or may be exempted from having to comply with any regulations. Technically, no true national government regulation has ever been passed for the explicit purpose of protecting wetlands for their own sake. Wetlands do, however, still receive a fair amount of indirect protection through a mosaic of regulations that pursue other intended goals of managing navigation, public safety, and water quality, or by pseudo-regulations that are aimed at dissuading the application of poor land-use practices.

In many places across the country state governments have decided to join the national government by getting in the business of regulating wetlands. The different regulations derived in each state are based on many different sources and as a result have been woven together with the national regulations to form a type of cross-jurisdictional wetland protection safety net. Because there are several different laws that are used to protect wetlands at both levels of government, there can also be overlapping authorities given to different government entities. As with any net, this overlap also can create a number of large holes in the fabric of protection. In addition, some of these entities also use slightly different wetland definitions to define their jurisdiction. With so many laws, regulatory entities, and wetland definitions, determining who has authority over a specific wetland or activity, understanding what procedures must be followed can get confusing. This study attempts to break-down the regulatory landscape into logical groupings based upon jurisdiction and to describe it in a way that makes it possible to conduct a meaningful analysis of the interrelationships between its components.

National Government Regulatory Programs

Contained within the first group of regulators are the national government agencies. Currently, five national government agencies are involved in the management and regulation of wetlands in the United States to some degree; the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS), the U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration (NOAA). Two of these agencies have direct legislatively-established regulatory authority over wetlands. One additional agency possesses a type of pseudo-regulatory authority, while two other agencies lack regulatory authority but formally provide technical assistance and expertise to the regulators.

Through a combination of legislative language, a number of administrative rules, and several memorandums of understandings these agencies attempt to work cooperatively with one another for the protection of these resources. The two wetland regulatory agencies are the USACE and USEPA. The USDA/NRCS has authority over a pseudo-regulatory program. The two assisting agencies are the USFWS and NOAA. While neither of these last two agencies is responsible for the implementation of a wetland regulatory program, both are formally consulted for their technical expertise regarding the functions, values, and physical condition of wetland resources. (U.S. Army Corps of Engineers, 1987; Strand, 1993; National Research Council, 1995; U.S. Environmental Protection Agency, 1995; U.S. Department of Agriculture 1996; and Good et al., 1999).

Each regulatory agency is granted specific wetland regulatory authorities through separate national government legislative acts. The USEPA receives its broad authority from the 1972 Water Pollution Control Act, also known as the Clean Water Act (CWA). Regulatory authority is granted to the USACE both through Section 10 of the Rivers Lakes and Harbors Act (FRHA), and Section 404 of the 1972 Clean Water Act. The USDA/NRCS receives its authority from the National Food Security Act of 1985 (NFSA) and its subsequent amendments. Neither the USFWS nor NOAA, on the other hand, has its own specific authorizing regulatory legislation. Instead, both are granted the authority to provide technical expertise and assistance to these other regulatory programs through a variety of memorandum of understandings, and by explicit statutory language (National Research Council, 1995; and Good et al., 1999).

Section 404 Program.

The U.S. Army Corps of Engineers (USACE) has primary regulatory authority over any non-agricultural conversion of wetlands in the United States. This authority is granted to the USACE through both Section 10 of the FRHA of 1899 and Section 404 of the CWA. Section 10 of the FRHA assigned the USACE the responsibility of maintaining "navigable waters" by regulating the placement or removal of any dredge material within them (National Research Council, 1995; and Ferrey, 2001). Section 404 of the CWA added to the USACE's responsibility by prohibiting the discharge of dredged or fill material into any, "waters of the United States" without a permit from the U.S. Army Corps of Engineers (Hubbell et al., 1995). These waters of the United States include, "all waters and wetlands that could be important for interstate commerce purposes, and have traditionally included: territorial seas; coastal and inland waters; lakes, rivers and streams that are navigable; tributaries to these waters; wetlands adjacent to these waters or their tributaries; interstate waters and their adjacent wetlands; tributaries to these waters and their adjacent wetlands; and all other waters not identified above" (Taylor, 1998: 18). Congress chose to grant these authorities to the USACE by invoking the authority they claimed to have to regulate these types of activities under the interstate commerce clause of the Constitution. Because interstate waters, especially navigable ones, are considered to be important pieces of infrastructure for the transport of goods across state boundaries the regulation and maintenance of these waterways is assumed to be the responsibility of the national government (Kusler, 1978; Natural Resource Council 1995; Mitsch and Gosselink, 2000; and Ferrey, 2001).

The USACE jointly administers Section 404 authority with the USEPA, the administering agency for the entire CWA, and receives formal consultations from the USFWS and NOAA. Under a Memorandum of Agreement between the USEPA and the Department of Defense (DOD), the USACE is given sole responsibility for making final permit decisions pursuant to Section 404 and conducts jurisdictional delineations associated with the day-to-day administration of the Section 404 program (U.S. Department of Agriculture, 1996). The USEPA retains the authority to enforce compliance with Section 404 and maintains the power to overrule USACE decisions on the issuance or denial of permits (U.S. Environmental Protection Agency, 1995). If there is a dispute about whether an area can be regulated, the USEPA has the ultimate authority to determine the actual geographic scope of waters of the United States subject to jurisdiction under all sections of the Clean Water Act, including the Section 404 regulatory program (U.S. Department of Agriculture, 1996).

Notice should be paid at this point that neither Section 10 of the FRHA nor Section 404 of the CWA uses the term "wetland" in its legislative language. In addition, neither act specifically requires the USACE to become involved in a permitting exercise for any reason other than navigational or interstate commerce needs. However, over the years, both acts have been broadly interpreted as requiring the USACE to consider ecological damages when granting permits (National Research Council, 1995; Want, 1989; and Ferrey, 2001). It is upon these broad interpretations that much of the substance of the national government wetland regulatory program has been built (National Research Council, 1995).

Attention should also be paid that because the Section 404 program is more broadly interpreted and has more direct linkages to other clean water requirements, the majority of the USACE's wetland permitting workload is generated by this authority. In addition since most all Section 10 permit-requiring activities also require a Section 404 permit, the USACE has taken numerous steps to operationally consolidate both of these programs. As a result, most wetland practitioners generally only focus on the outputs of the Section 404 programs. This study follows in that tradition by investigating only the performance of the entire 404 program, and not focusing on the subset of actions generated by the USACE's Section 10 authority.

Section 404 Permit Process

Currently, any entity wishing to, "discharge dredge or fill material into a waters of the United States", must first receive a permit from the USACE. The USACE's regulatory authority extends over every State and U.S. Territory. Section 10 permits are required for any activity that may occur in a navigable waterway. For the purposes of facilitating the Section 10 regulatory process, each district has developed and maintains a list of those waterways within its boundaries that meet the criteria of being "navigable". Section 404 permits are required for activities in any other regulated water body (Mitsch and Gosselink, 1986; National Research Council, 1995; and Ferrey, 2001).

Entities wishing to place dredge or fill material into waters of the United States may be required to seek a Section 10 permit, a Section 404 permit or both. If an activity is planned to take place that is likely to result in the discharge of a dredge or fill material into a wetland or any other water of the United States, the USACE must be contacted so the activity may be considered for a section 404 or a section 10 permit, or for an exemption. The USACE must respond to the applicant with a decision regarding their permit request within a certain period of time, otherwise the applicant is entitled to assume that their activity is exempt from these national government regulations and may commence their project (Strand, 1993; U.S. Environmental Protection Agency, 1995; Taylor, 1998; and Ferrey, 2001).

The USACE is not required to approve every application that is submitted, however. A district has the authority to deny any permit request that does not comply with established criteria or meet minimum standards. The most important of these standards is the "avoidance and minimization test". To pass this test, an applicant must prove the wetland impact cannot be avoided and that every feasible step has been taken to minimize the effects of the activity. Any entity that places dredge or fill material into waters of the United States without the appropriate USACE permits, is subject to enforcement actions, which may include cease and desist orders and possible fines (U.S. Army Corps of Engineers, 1987; Strand, 1993; U.S. Environmental Protection Agency, 1995; and Ferrey, 2001).

USACE district office personnel process all national government wetland regulatory permits. There are 38 district offices in the United States, employing over 1,100 regulatory staff members (Sudol, 2003). Most districts use an automated database to keep track of their regulatory workload. This database is known as the Regulatory Administrative Management System (RAMS). Other districts, however, keep track of their workload in other systems. For the last ten years, however, every district, regardless of the tracking system they use, has been required to submit summary activity reports at the end of each fiscal quarter to their respective division office. Each of the eight division offices then consolidate the district reports and submit them to headquarters in Washington DC. This report is titled the "Regulatory Quarterly Report". Each report contains exactly the same information for each district. Among other things, this report identifies how many total acres of wetlands were permitted to be filled in each district (Newling, 2003).

Section 404 Exemptions

In addition to the CWA not specifically using the term "wetlands" in its authorizing language, the authority of the Section 404 program is further weakened by a number of exemptions. Not every dredge or fill activity occurring in a wetland requires a permit from the USACE. The Section 404 program has provisions that exempt certain activities from the permitting process. The specific details of these exemptions are sometimes complex and lengthy. Generally, speaking, however, in addition to providing exemptions for "normal farming, ranching, and silviculture activities" exemptions are also provided for activities such as: "maintenance and emergency reconstruction of damaged structures; construction and maintenance of farm or stock ponds, irrigation ditches, or temporary sedimentation basins; and construction of farm, forest, or temporary roads". All other activities resulting in the discharge of dredge or fill material into wetlands including: "land-clearing efforts, stream channelization, bridge piling operations, and discharges subject to other authorities" are subject to Section 404 regulations (Hubbell et al., 1995; and Taylor 1998).

Nationwide Permits

Because the USACE handles a large volume of applications and is under pressure to process them efficiently, an expedited Nationwide Permit (NWP) system has been established. A NWP is a general permit intended to apply throughout the United States and its territories. A NWP is designed to eliminate the need to issue an individual permit for specific small-scale activities that minimally affect wetlands. NWPs allow certain activities to take place in waters of the United States that meet precise limitations and result only in minimal impacts. As a result, entities engaged in these activities are able to proceed with their projects in a more efficient manner. NWPs have become a popular tool with USACE regulators and have come to account for approximately 80 percent of all the permits they process (Strand, 1993).

Each NWP is subject to a set of nationwide general conditions established by the USACE through a series of public notice and comment periods. Each USACE district, in turn is authorized to establish its own set of regional conditions that it may apply to any NWP it sees fit. These regional conditions must also be subject to a public notice and comment period and may be more restrictive, but shall not be less restrictive than the general conditions established at the national level (Taylor, 1998).

Programmatic and Regional General Permits

Each individual USACE District has the authority to abandon the Nationwide Permit program in order to pursue the development of a unique Regional Permit Program (RPP) or a Programmatic General Permit Program (PGPP). A district may choose to adopt a RPP if it intends to replace the NWP program over a geography that does not conform to political boundaries. A PGPP, however, may be pursued if a district intends to replace the NWPs across an entire political subdivision such as a state or a county over which it has jurisdiction. Some districts have undertaken this task in order to develop programs that are better tailored to their specific situations. Districts that are generally more urban, cover more uniform geographic areas, or possess disproportionate amounts of many rare and valuable aquatic resources have generally been the most active in pursuing the development of these programs. Generally, the goals of these programs are to cover the same suite of activities as the replaced NWPs, while at the same time providing more stringent protection of aquatic resources, establishing more straightforward requirements and conditions, and maintaining or reducing the existing District workload. As with the NWPs, the terms and conditions of RPPs and PGPPs limit the types of authorized activities to those that require no more than minimal adverse impacts on the aquatic resource (Sudol, 2003).

Individual Permits

If a district determines that an activity is not exempted or does not fall under a NWP or another valid RPP or PGPP, an individual permit must be secured. Once an application requiring an individual permit has been filed, it is posted for 30 days to allow the public to comment on the activity. This comment period opens the application to review by individual citizens, special interest groups, and local, national, and state agencies. At this time the state water quality agencies must certify that the proposed activity complies with the water quality standards of the state. At the end of this public review period, the USACE may issue or deny the permit or hold a public hearing before making a final determination. If a permit is denied, a project cannot legally proceed. If a permit is approved, the project may proceed providing it follows the specifications required by the USACE in the permit (Strand, 1993; and U.S. Environmental Protection Agency, 1995).

Section 404 wetland permits are generally granted to applicants if their activity complies with a set of nationwide general conditions applied to all individual permits. It is rare that applications are denied if they are written in a manner that demonstrates their project will meet these general conditions. In fact, in 1992 it was estimated that of the 90,000 permit applications the USACE received only approximately 600 permits, less than 1 percent, were denied (Ferrey, 2001). Districts do, however, have the authority to require applicants to meet an additional set of regional conditions. These conditions may be more restrictive than the general conditions, but they shall not be less restrictive. These regional conditions are developed and routinely reviewed through a formal public comment period that incorporates input from both public and private entities. Often, state and national government agencies will expend a considerable amount of resources providing input to their respective USACE district offices during the development of these regional conditions (Strand, 1993; and U.S. Army Corps of Engineers, 1997).

Section 404 Enforcement

If an adverse impact to a wetland involving the discharge of dredge or fill material occurs without the proper permits having first been secured from the USACE and the activity is not exempted, the entity performing the activity is out of compliance with national government law and is subject to penalties. If the proper permits were secured from the USACE, but the terms and conditions of those permits have not been followed, the entity performing the activity is still considered out of compliance with national government law and is subject to penalties. Both the USACE and the USEPA have the authority to enforce Section 404 violations through several avenues. In a 1989 Memorandum of Agreement between the two agencies it was decided the USACE would have the lead responsibility for enforcing violations when the terms and conditions of an issued permit have not been followed. When the violation involves non-permitted activities the USACE and USEPA determine the agency that will take the lead in enforcing the activity based upon the criteria contained in the MOA (Strand, 1993; and U.S. Environmental Protection Agency, 1995).

Both the USACE and the USEPA may issue orders requiring violators to cease activities and/or undertake steps to correct the violations. Cease and desist letters can be issued to any public or private entity. The recipient of such a letter must immediately stop the illegal activity and apply for a permit and/or reconcile the damages or risk prosecution (Strand, 1993; U.S. Environmental Protection Agency, 1995; and Ferrey, 2001).

In addition to issuing cease and desist orders and requiring remediation, the USACE and USEPA may levy administrative penalties up to $25,000 per day, per violation. A violator may also be faced with criminal penalties as high as $250,000 and 15 years imprisonment for an individual, and as high as $1,000,000 for an organization. In addition, an individual may face civil penalties up to, but not exceeding, $125,000 per activity (Strand, 1993; and U.S. Environmental Protection Agency 1995).

Section 404 Recordkeeping

Ever since President Bush Sr. expanded upon President Carter's executive order 1190 by declaring that there should be "no net loss" of all wetlands in 1991, there has developed a rich tradition of studies using the amount of wetland fill permitted by USACE districts as a key variable. Most of these studies have either looked at the amount of wetlands permitted in individual cases, or for individual districts. These studies also usually look at the amount of mitigation that was required, the amount of fill that was requested, and the amount of mitigation that was actually constructed (Dagget et al., 1998; Stein, 1998; Gwin et al., 1999, Schaich, 2000; and Robb, 2002).

USACE district offices keep comprehensive records of the wetland permit activity they oversee. These records are often the source of the data included in the studies mentioned above. Routinely each district compiles those records and reports a summary of their activity to headquarters in Washington D.C. These reports are the official record of district activities. They are written in a manner that makes it possible to distinguish the amount of fill that has been permitted in tidal wetlands from the amount of fill permitted in non-tidal wetlands. These reports also make it possible to distinguish the amount of fill that was approved through streamlined NWPs and RPPs from the amount approved through more stringent Individual Permits (Newling, 2003).

Swampbuster Program

The USDA/NRCS is the primary national government authority over wetland impacts related to agricultural activities. This authority is established by the "swampbuster" provisions of the NFSA of 1985 and its subsequent amendments. Although "swampbuster" demonstrated a significant shift in national government's policy towards wetlands, it should be noted that the "swampbuster" provisions do not create a true regulatory program in the classic sense of the term. Agricultural producers are not required to seek permits from the USDA/NRCS if they plan to convert wetlands to agricultural lands. In addition, if a producer fails to comply with the "swampbuster" provisions he or she will not be subject to fines or criminal charges. Instead, the NFSA only authorizes the USDA/NRCS to declare agricultural producers who are in violation of the provisions to be ineligible for certain USDA subsidies (National Research Council, 1995; and U.S. Department of Agriculture 1996).

Swampbuster Review Process

If agricultural producers intend to engage in activities that could potentially negatively impact wetlands on their property and if they are concerned with the potential of losing these subsidies as a result, they need to contact their county USDA/NRCS field office in order to have a field determination conducted on the parcel land in question prior to conducting the activity (U.S. Department of Agriculture, 1996). Field determinations identify the location of wetlands on a piece of property and are conducted by USDA/NRCS field staff with a standardized set of criteria that were developed with the assistance of the USEPA, USFWS and NOAA. In addition, all field determinations are conducted following these criteria and with reference to technical information provided in three other national government documents. The *Hydric Soils of the United States* and *Field Indicators of Hydric Soils of the United States* are two documents created by the National Technical Committee for Hydric Soils and are detailed lists of all the hydric soil types in the United States, and lists of all of their characteristics (U.S. Department of Agriculture, 1987; and U.S. Department of Agriculture/Natural Resource Conservation Service, 1996). Hydric soils are important field indicators because their presence is often a good marker for the location of wetlands. Also referenced is the *National List of Plant Species that Occur in Wetlands*, a detailed list of plant species that appear in wetlands developed by the USFWS (Reed, 1988). All three of these technical documents are also referenced and used by the USACE and USEPA in the implementation of the Section 404 regulatory program, and are also used by the USFWS in its wetland inventory and management programs (U.S. Army Corps of Engineers, 1987; and U.S. Department of Agriculture 1996).

If a field determination reveals that an activity will result in a negative wetland impact USDA/NRCS personnel will then decide if that activity is eligible for an exemption. If the activity is not eligible for an exemption, the USDA/NRCS will then advise the agricultural producer that pursing the activity will disqualify him or her for USDA subsidies and documents the decision on the field determination forms that are added to the agricultural producer's official USDA subsidy eligibility review file (U.S. Department of Agriculture, 1996; and Taylor 1998).

Swampbuster Exemptions

As with many national government regulations, the NFSA establishes a list of criteria under which activities may be exempted from being subject to the "swampbuster" program. Each exempted activity is described in considerable detail in the legislative language, however the exemptions fall into a few general categories. In general, an action may be exempted either by the nature of the activity itself, or by the nature of the land upon which the activity is going to be conducted. Specifically, any activity is exempted if the USDA/NRCS determines it will only have an insignificant effect on the functions and values of the wetland and the wetlands in the area. Secondly, any conversion activities that are based upon erroneous wetland determinations performed by the USDA/NRCS are also exempted. In addition, any activities that commenced prior to the passage of the act or occur on lands that had been converted prior to the passage of the act are "grandfathered" in the program and also considered exempt. This "grandfather" exemption is the most complex and widely used exemption in the set. Another notable exemption, however, applies to those conversion activities that do not "make production possible" on the converted land (U.S. Department of Agriculture, 1996). It is through this last exemption that activities such as the felling of timber on forested wetlands in an agricultural setting is considered an exempted activity, while the removal of the stumps that have been left is not exempted. The removal of the stumps makes it possible to convert the land to other agricultural purposes, while the simple act of harvesting of logs traditionally does not.

Although field determinations are conducted solely in respect to the existing hydrology, soil types, and vegetation, these determinations may identify parcels of property that may be eligible for the "grandfather" exemption. The USDA/NRCS therefore, categorizes any area determined to be a wetland according to NFSA exemption criteria. According to the NFSA there are four categories of wetlands subject to the "swampbuster" provisions and three categories of wetlands eligible for the NFSA "grandfather" exemption (U.S. Department of Agriculture, 1996).

The four categories of wetlands in which activities could be subject to the "swampbuster" provisions are *Wetlands, Farmed Wetlands, Farmed Wetland Pastures or Haylands, and Converted Wetlands*. *Wetlands (W)* are areas meeting wetland criteria under natural conditions that have typically not been manipulated by altering hydrology and/or removing woody vegetation. Wetlands as defined here include abandoned areas. *Farmed Wetlands (FW)* are wetlands that were drained, dredged, filled, leveled, or otherwise manipulated before the NFSA went into effect on December 23, 1985, "for the purpose of, or to have the effect of, making the production of an agricultural commodity possible," and continue to meet specific wetland hydrology criteria. *Farmed Wetland Pastures or Haylands (FWP)* are wetlands manipulated and used for pasture or hayland, including native pasture and hayland, prior to December 23, 1985 that still meet specific wetland hydrology criteria and are not abandoned; or were in agricultural use and met this criteria on December 23, 1985. *Converted Wetlands (CW)* are wetlands that have been "drained, dredged, filled, leveled, or otherwise manipulated for the purpose of, or to have the effect of, making possible the production of an agricultural commodity". These lands must have been W, FW, or FWP and not highly erodable prior to the conversion. They may have been converted by any activity, "including the removal of woody vegetation that impaired or reduced the flow, circulation, or reach of water; provided the conversion activity was such that agricultural production on the land would not have been possible without its application" (U.S. Department of Agriculture, 1996).

The three categories of wetlands in which activities are not subject to the "swampbuster" provisions are *Prior Converted Cropland, Artificial and Irrigation-Induced Wetlands, and Non-Wetlands. Prior Converted Croplands (PC)* are converted wetlands where the conversion occurred prior to December 23, 1985; an agricultural commodity had been produced at least once before December 23, 1985; and as of December 23, 1985, the converted wetland met certain specific hydrologic criteria and did not support woody vegetation. *Artificial and Irrigation-Induced Wetlands (AW)* are wetlands in areas that were not wetlands, but now meet wetland criteria due to human activities. This definition includes wetlands created by an irrigation system on an area that was formerly non-wetland. *Non-Wetlands (NW)* are lands that under natural conditions do not meet wetland criteria. This definition includes wetlands that were converted to the extent that wetland criteria were not present prior to December 23, 1985 but were not cropped (U.S. Department of Agriculture, 1996).

Swampbuster Enforcement

As indicated, the only authority the USDA/NRCS has to enforce compliance with the "swampbuster" provisions of the NFSA is to deny agricultural producers eligibility for selected USDA benefits. According to the National Food Securities Act Manual, persons are ineligible to receive USDA benefits for any year in which they plant an agricultural commodity on wetlands converted between December 23, 1985 and November 28, 1990, unless the converted wetlands have been mitigated. Producers who convert wetlands after November 28, 1990, "in such a way as to make the production of an agricultural commodity possible," remain ineligible for USDA benefits until the converted wetland is mitigated. Ineligibility remains with the producer even if they are no longer associated with the land (U.S. Department of Agriculture, 1996).

Swampbuster Recordkeeping

Despite this program's applicability over a large portion of the country's wetland resources and potential wetland impacting activities, there is no practical way to incorporate its outputs into this study. Because it is not a true regulatory program with actual permits, there is no way to measure what amount of wetland loss has been directly facilitated by program participants. Actions with a negative impact are either exempted from compliance and therefore not tracked, or they are forbidden and no impact should occur. Furthermore, the "swampbuster" program is administered at the county level by local field staff, and there is no standardized comprehensive reporting system at the state or national level that collects data concerning their "swampbuster" activity on a regular basis. All of these records are maintained in the field offices. Most importantly, however, many activities covered by this program are exempted by most state wetland regulatory programs, therefore, there is little to no overlap in authority between the two programs, and therefore no justification for analyzing the correlation between the two.

State Government Regulatory Programs

Contained within the second group of regulators are the state government agencies. Currently, there are three types of programs through which state governments become actively involved in wetland regulation. The first type of program is created when a state agency adopts regulatory components that are encouraged by the national government in exchange for certain incentives. The second type of program is created when a state exercises the authority granted to it by the national government over certain activities that are solely within the jurisdiction of the national government. The final type of program is created when a state takes the initiative to pass its own law and establish a regulatory program of its own design.

States that have established Coastal Zone Management (CZM) programs have developed the first type of wetland regulatory program. They choose to regulate certain types of activities in specific wetlands in exchange for assistance form the national government. States that have developed strong Section 401 water quality certification programs have developed the second type of wetland regulatory program. The authority of their program is completely derived from the activities of the national government. States that have passed their own autonomous wetland regulatory laws have created the final type of wetland regulatory program. They are not dependent upon the national government for the resources or for authority they need to regulate wetlands.

Section 401 Programs

Section 401 of the CWA requires all permits or licenses issued by the national government for activities affecting waters of the United States to be certified by the state in which the discharge is to occur that the proposed activity meets the minimum water quality standards of that state. While 401 water quality certifications are technically required as a part of any national government permit that may result in an impact to waters of the United States, they are most closely associated with the Section 404 permitting process because Section 404 permits are the most commonly pursued permit for activities that may potentially impact water quality. When applied to Section 404 permits, the Section 401 certification process has the potential to be used as an effective wetland regulatory tool because it allows a state to void an activity for not meeting water quality standards even if the activity complies with all other conditions (U.S. Army Corps of Engineers, 1987; U.S. Environmental Protection Agency, 1989; and Kusler and Opheim, 1996).

The interaction forced by this requirement establishes a classic example of what Scheberle would call a "delegated" relationship between the national and state governments (Scheberle, 1998). Under Section 401 of the CWA the national government establishes a set of standards with which all national government permits must comply. It then delegates to the states the responsibility of reviewing permits to ensure compliance with those standards (U.S. Environmental Protection Agency, 1989). The states were not given the option to decline from accepting this authority as would be expected if it were a voluntary relationship, and the national government does not stipulate the details of their certification criteria as would be the case if it were a direct-order relationship (U.S. Environmental Protection Agency, 1989; and Scheberle, 1998).

Active Section 401 programs are also clear examples of Elazar and Grodzins' nationalistic view of American federalism. The CWA is a broad piece of legislation that was created by national interests. Through the act, the national government sets the boundaries and establishes the criteria under which state 401 programs can operate. As a result, the jurisdiction of each state that participates is determined by the will of the national government (Elazar, 1962; Grodzins, 1966; U.S. Environmental Protection Agency, 1989; and Want, 1989).

The regulatory authority delegated to states by this section of the CWA is restricted to only those activities that require a national government permit or license. Section 401 does not give states the authority to review any other activities (U.S. Environmental Protection Agency, 1989). Wright would therefore claim that because the state's authority was not bargained for and its ability to exercise this authority rests solely upon the national government's decision to issue a permit, this relationship also complies with his "inclusive-authority" model of intergovernmental relations. Under this model the state government derives all of its authorities to act from the national government and has no other autonomous claims to that authority. They become "minions of the national government" doing their bidding (Wright, 1978).

State authority under Section 401 can also be very broad. Whereas the USACE only regulates specific activities resulting in a discharge of *dredge* or *fill material* into a wetland, Section 401 of the CWA authorizes state water quality protection agencies to regulate specific activities resulting in a discharge of *any pollutant* into a wetland. The different language used in this program's authorizing language allows state agencies to have more inclusive and potentially more stringent regulations concerning the types of activities that might occur in a wetland than the national government could enforce through the 404 program. As with Section 404, however, Section 401 also does not explicitly use the term "wetlands" in its authorizing language. Instead the term "waters of the United States" is again used and has been interpreted to include several landscape features including certain wetlands (U.S. Environmental Protection Agency, 1989).

States often only issue 401 certification of a 404 permit if an applicant agrees to meet certain specific conditions. States have the freedom to develop any standards for water quality and certification conditions that they choose, provided that the standards are at least equal to or are more stringent than those established in Section 303 of the CWA. Not all states, however, have chosen to develop active Section 401 certification programs. Some states have chosen only to simply adopt or minimally expand the restrictions described in Section 303. Often times, if additional restrictions are proposed by a state they will only target specific water bodies, usually resources that are the primary community drinking water supplies or are critical habitats for certain threatened or endangered species. Several states, such as Ohio, Indiana, Texas, Kentucky, and Virginia, however, have chosen to develop strong Section 401 certification programs and have developed specialized sets of water quality standards specific to certain types of activities or to certain types of water bodies. Some states have even chosen to develop specific water quality standards for activities that occur solely in wetlands (U.S. Environmental Protection Agency, 1989; and Taylor and Abderhalden, 1997).

By 1997, 21 states had developed robust wetland protection programs around their Section 401 certification programs. Table 2.1 is a list of the 21 states that have developed these active Section 401 programs (Want, 1990; and Taylor and Abderhalden, 1997). Many of these states were considered to have active programs because they had incorporated specific mitigation ratios and monitoring requirements above as conditions of their Section 401 certifications that go above beyond what the USACE may otherwise have required. In addition, several of them were also tracking the amount and location of wetland impacts they are certifying and provide oversight to the development of mitigation projects and the approval of mitigation banks. Other states, however, had chosen to not develop these program components and had either channeled their energies and resources into the development of their own statute-based programs, or operate more passive Section 401 programs that mainly defer to the USACE and USEPA for most decisions regarding wetlands (Taylor and Abderhalden, 1997).

Table 2.1 States with active Section 401 wetland regulatory programs.

Alaska	Missouri	Oklahoma	Washington
California	Montana	South Carolina	West Virginia
Idaho	Nebraska	South Dakota	Wyoming
Indiana	Nevada	Tennessee	
Kansas	North Carolina	Texas	
Kentucky	Ohio	Virginia	

Many states have chosen to adopt active Section 401 programs, and are able to use the authorities they are granted to try and provide more stringent protections for wetlands than may have otherwise been given them. By taking this authority to invalidate USACE permits, direct and tangible relationships are created between the actions of the national government and those of the state governments. The resulting relationships between the presence of these programs and the outputs of the Section 404 program, therefore, is accounted for in this study in order to isolate and describe the relationship that exists between the outputs of the Section 404 program and the presence of comprehensive statute-based state wetland regulatory programs.

Coastal Zone Management Programs

The Coastal Zone Management Act of 1972 (CZMA) was created in order to encourage states and local governments to more closely scrutinize the type of development they were allowing along the coastal regions of the country. At the time of its passage there was considerable concern about unabated construction on highly erodable beaches, increasing costs of flood and hurricane damage, aging seaport infrastructures, and loss of the critical habitats of endangered species and commercial shellfish and finfish spawning grounds. Contained within the CZMA are a number of standards and initiatives that the national government wanted to see coastal states implement in order to address some of these concerns (Kusler, 1978; Want, 1989; Kusler and Opheium, 1996; Good et al., 1998; and Hershman et al., 1999). Some of the most fundamental policy objectives of the CZMA include: Protection of wetlands and estuaries; protection of beachfront features areas such as dunes, bluffs, and rocky shore resources; public access; urban waterfronts restoration; and seaport development (Hershman et al., 1999).

CZM programs are classic illustrations of Elazar and Grodzins' nationalistic view of American federalism. The CZMA is a piece of legislation that was created by national interests. Through the act, the national government clearly sets the boundaries of coastal zone protection efforts and establishes the criteria for qualifying state CZM programs. As a result, each state that participates acquiesces to the general policy of the national government on certain key issues (Elazar, 1962; Grodzins, 1966; Want 1989; and Good et al., 1998).

The CZMA does not, however, require states to participate in any of the initiatives or implement any of the standards nor does it delegate to the states the responsibility of developing core policy objectives it has established (Want 1989). The CZMA instead creates an opportunity for what Scheberle would describe as a "voluntary" relationship between the national and state governments (Scheberle, 1998). Contained within the CZMA is the authority for the national government to provide a number of incentives to eligible states that develop Coastal Zone Management Programs (CZMP). States are free to develop a CZMP that meets their needs and can receive compensation from the national government for those components that meet certain criteria and accomplish its core policy objectives (Good et al., 1998; Want, 1989; and Hershman et al., 1999).

Wright would further claim that the relationship established between the national government and the state governments through the CZMA also fits his overlapping-authority model of intergovernmental relations (Wright, 1978). States are not given the authority to regulate land-uses in coastal areas by the CZMA. The states already intrinsically have that right and can choose to exercise it at their own discretion (Want, 1989). States do not, therefore, become, "mere minions of the national government" when they establish a CZMP as they would be if this relationship followed Wright's inclusive-authority model (Wright, 1978). States are instead able to freely go to the bargaining-table with the national government as autonomous actors and negotiate the receipt of additional resources in exchange for agreeing to accomplish the national government's goals for coastal areas. The result is the creation of a national-state government partnership to protect coastal areas (Kusler, 1978; Wright, 1978; Want, 1989; and Good et al., 1998).

As with Section 401 water quality certification programs, states have the opportunity to develop relatively aggressive wetland regulations through CZMPs. All states have the opportunity to define the coastal zone management area within which their CZMP will have jurisdiction (Hershman et al., 1999). Generally, states with a CZMP require some kind of permit similar to a Section 404 permit for placing fill or constructing structures in coastal wetlands within these areas. Other states, however, attempt to further guide development throughout their coastal zone management areas by instituting restrictions similar to zoning (Kusler, 1978; and Kusler and Opheim, 1996). Some states such as Alabama, California, Delaware, Florida, and Hawaii have even chosen to make certain landscape features such as wetlands the foundation for these zoning decisions, and have restricted certain activities within these identified landscape features. It is through this zoning process that these states have chosen to empower agencies to regulate a broader suite of impacts than just fill activities that might occur in wetlands within these coastal areas (Kusler, 1978). Other states such as Minnesota, Washington, and Wisconsin have chosen to expand the shoreline protection components of their CZMP beyond coastal areas and have created broader shoreline protection programs that include inland stream and lake shores thereby extending protections to these traditional wetland areas (Kusler and Opheim, 1996). There are then some states such as Maine that have even chosen to do both (Kusler, 1978; and Kusler and Opheim, 1996).

Currently 28 of the 30 eligible states have created CZMPs. Table 2.2 is a list of the 28 states with CZMPs. Indiana and Illinois are the only eligible states that did not have approved programs in 2005. Indiana was in the process of developing one. Illinois, however, with its sole basis for eligibility being the narrow strip land upon which the almost entirely developed Chicago waterfront is located, has not yet taken the necessary steps to create one (National Oceanic and Atmospheric Administration Website, December 2, 2004).

Table 2.2 States with approved coastal zone management programs.

Alabama	Hawaii	Mississippi	Pennsylvania
Alaska	Louisiana	New Hampshire	Rhode Island
California	Maine	New Jersey	South Carolina
Connecticut	Maryland	New York	Texas
Delaware	Massachusetts	North Carolina	Virginia
Florida	Michigan	Ohio	Washington
Georgia	Minnesota	Oregon	Wisconsin

Through their CZMPs, these 28 states are currently involved in exercising some portion of regulatory authority over at least the coastal wetlands within their jurisdiction. This authority operates in addition to any other authority that may be generated either by a state statute or by an active Section 401 certification program. Particular attention must be given to these 28 CZMPs because section 307 of the CZMA requires that the national government completely comply with the regulations established by those states. These requirements are commonly referred to as the "federal consistency provisions". As a result of these provisions, the USACE is restricted from issuing any fill permits in any wetland within a coastal zone area that do not meet the standards that have been established by the state. This practice of applying federal consistency in coastal zones could, therefore, have a direct effect on the amount of wetland fill permitted by a USACE district. The relative amount of that influence, however, would vary depending upon the amount of wetland fill activity that occurs within the coastal zone of any given USACE district (National Oceanic and Atmospheric Administration Website, December 2, 2004).

For this study to successfully isolate and describe the correlation that may exist between the presence of state-statue derived comprehensive wetland regulatory programs and the performance of the national Section 404 wetland regulatory program, it would ultimately be necessary to account for the amount of influence these state CZMPs may have on the overall wetland impact permitting process.

Statute-Based Programs

State-national government partnerships in their various forms clearly represent a significant portion of the wetland regulatory systems that are at work in the United

States. It has been discussed how several states have chosen to regulate wetlands as voluntary partners with the national government through the implementation of active 401 water quality certification programs. Furthermore, it has been described how most coastal wetlands are regulated by states that serve as delegated agents for the national government by regulating coastal wetlands through their coastal zone management programs. Although these partnerships may create fairly effective programs, limiting a state's regulatory authority to only national government actions or to only activities in coastal areas potentially leaves a large portion of the nation's wetlands without regulatory protection (Kusler, 1978; and Want, 1990).

In the American federalist system, however, states do not have to rely solely upon authorities either delegated or volunteered by the national government in order to regulate wetlands. States are free to impose autonomous regulations upon the usage of wetlands within their boundaries if they choose. Decisions regarding land use are not reserved by the national government; therefore state decisions on these matters are sovereign (Want, 1990). Since the 1970s, approximately one third of the states have passed legislation to establish comprehensive programs that include inland wetlands and allow them to make completely autonomous decisions regarding wetland regulation (Meeks and Runyon, 1990; Want, 1990; Taylor and Abderhalden, 1997; Mitsch and Gosselink, 2000). Table 2.3 lists the 17 states that currently have comprehensive statute-based wetland regulatory programs.

Table 2.3 States with statute-based wetland regulatory programs.

Connecticut	Maine	New Hampshire	Vermont
Delaware	Maryland	New Jersey	Wisconsin
Florida	Massachusetts	New York	
Illinois	Michigan	Oregon	
Iowa	Minnesota	Rhode Island	

It should be noted that Section 401 water quality certification is still required for all Section 404 permits in all of these states; however the state agency responsible for issuing the Section 401 certification is often a different agency than the one responsible for implementing the state statute, and those 401 programs are usually not aggressively administered (Kusler, 1978; and Want, 1990). In addition, all but three of these states; Iowa, Illinois, and Vermont, also have CZMPs and are able to exercise control over coastal wetlands both though their own separate authorities and through the federal consistency provisions of the CZMA (Good et al., 1998). Again, however, the administration of the 401 and CZM authorities can sometimes be given to separate state agencies (Want, 1990; and Good et al.,1998).

In addition to the national-state wetland regulatory relationships that already exist, when a state goes out on its own and passes legislation establishing a separate and autonomous wetland regulatory program it creates a new and different type of relationship. This new relationship does not fit any of Scheberle's three categories of intergovernmental relationships. In this situation, the state government is not dependent upon the national government mandating, delegating, or volunteering this regulatory authority to it. Her theory of intergovernmental relations concerning environmental policy does not account for a situation in which a state does not receive its direction or incentive from the national government (Scheberle, 1998).

These circumstances are also not well explained by Elazar's nationalistic view. The national government does not create the state wetland regulations. Furthermore, any national interests that seek to influence these programs have to operate at the state level. The boundaries and criteria for the programs are created by the states for the states. It is not necessary for any state to comply with the will of the national government in order to implement its program (Elazar, 1962; and Want, 1989). This situation does not conform to Elazar's description of the national government's overbearing, ever-present influence. Under these conditions, there is no opportunity for the national government to influence the performance of these state programs. The only possible method of influence could come indirectly as national government staff members participate with state government staff members as colleagues in professional organizations, or through daily conversations (Grodzins, 1966).

This paper attempts to establish, however, that this new relationship fits Wright's separated-authority model of intergovernmental relations (Wright, 1978). Both levels of government have authority over actions in wetlands but act independently of one another. The national government continues to regulate those activities that meet its Section 404 criteria, while the state government can regulate the very same or different activities provided they meet its statutory requirements. In addition, neither level of government is able to interfere with the actions of the other. Therefore, the actions of one level of government should not affect the outputs of the other.

Because state legislatures are free to develop programs they feel will meet the specific needs of their constituency, there is considerable variation in the types of state wetland regulations that have been passed. Over the last 25 years, several investigations have been conducted to determine those states that have passed comprehensive wetland regulatory legislation and to describe how the programs they create operate (Kusler, 1978; Meeks and Runyon, 1990; Want, 1990; and Taylor and Abderhalden, 1997).

When Kusler (1978) investigated the handful of state wetland laws that had been passed by the end of the 1970's he determined that although they were each creating different programs, all of the establishing laws had eight commonalities. Each law included a finding of fact section concerning wetland losses and the need for their protection. They all also included a statement of purpose and standardized policies. Each act included a specific definition of what would be considered a wetland under the law, authorization of an agency to map these wetlands, a clear and direct delegation of authority to regulate wetlands, requirements that landowners seek permits for specific acts or uses in wetlands, penalties for violations, and an appeals procedure (Kusler, 1978).

By the 1990s the number of states with comprehensive wetland programs had grown to the current level of seventeen. At that time, Meeks and Runyon (1990) again recited the general context of the wetland regulatory efforts in the United States and provided broad overviews of six of these statute-based programs. Their review was not exhaustive, but it did provide a concise narrative of the programs and provided examples of the types programs enacted elsewhere (Meeks and Runyon, 1990).

At the same time Want (1990) retrieved copies of each state's authorizing legislation and developed detailed summaries of the different programs that were created. While he discovered many of the same similarities as Kusler, several new laws had been enacted that he was able to evaluate. He was, therefore, able to better describe the differences that existed between the states concerning the specific details of each program component (Want, 1990).

Toward the end of the 1990's Taylor and Abderhalden (1997) revisited both states with and without comprehensive wetland regulations. They identified a number of key programmatic policies that were considered critical for effective wetland regulatory programs and reported on the similarities and differences between the states in the adoption of those policies. Generally they found that states with statute-based regulatory programs had adopted more of these policies than had states that were implementing Section 401 or CZM programs alone (Taylor and Abderhalden, 1997).

In this study, the seventeen states previously identified as having comprehensive statute-based wetland regulatory programs are the states of the most interest. If the state-national government relationships that are created by these kinds of programs do fit the separated-authority model of intergovernmental relations, it is expected that there will be no correlation between the presence of these state programs and the performance of the Section 404 program. Furthermore, it would not be anticipated that any relationship will be found regardless of what policies a state has adopted. If a correlation can be found, however, it would suggest that some relationship does exist between these statute-based programs and the national government's Section 404 program.

Ultimately, the Section 404 program has become, by default, the only true national government wetland regulatory program in the United States. Although a Section 404 permit can be approved solely by a decision of the national government, all permitted activities regulated by the USACE also require Section 401 certifications from state water quality agencies to be valid. Furthermore, in coastal states, federal consistency provisions of CZM programs result in certain wetlands receiving an additional layer of protection from state government programs that are, in-part, funded by the national government. In addition, the types of activities the USACE regulates are very similar to the types of activities that most statute-based state wetland programs also regulate. As a result, the fate of a state's wetland resources does not have to rest solely in the hands of the national government. Furthermore, states can have an influence on the outcome of national wetland regulatory program in a variety of ways. It is the nature of that influence that is the central focus of this study. The correlations, or lack thereof, discovered by this investigation will, hopefully, shed a new light into this aspect of the study of intergovernmental relations, especially as it pertains to environmental regulations and policies.

Geographical Context

Any analysis of a wetland regulatory program's performance requires that the geographic context of that program be understood. Inherent to all wetland regulations is a certain spatial dimension. The jurisdictions of all state and national government programs are related to one another not only intellectually, but also spatially. Because this nation is so large, it spans many different landscapes with widely different human population centers. The nation is also made up of so many different individually sovereign states that it does not create a uniform setting in which to apply wetland regulations. Because wetland regulations could not be expected to have the same results in these different settings, it is important to know where the regulations being studied are being applied. This can allow the study an opportunity to try and control for some variations in both the nation's physical and political landscapes.

Physical Landscape

There are many different kinds of wetlands in the United States and equally as many different ways to inventory them. As a result, several different systems have been developed to describe wetlands in the United States. The most complex and detailed inventory systems classify wetlands according to the type of habitat they provide. This method of wetland description is best demonstrated by the Cowardin Classification System, which makes it possible to describe 56 different wetland and deepwater types (Cowardin et al., 1978). Wetlands can also be described by the functions they perform in the landscape and values society places on those functions. This method is demonstrated best by the hydrogeomorgphic (HGM) classification system, which takes into consideration a wetland's landscape position and more complicated features such as site-specific hydrology, chemistry, and physical structure (Gwin et al., 1999). While many areas on the ground may fit the definition of a "wetland" from one or more of these perspectives, because of regulatory exemptions and loopholes, they may not necessary be considered "jurisdictional" wetlands. "Jurisdictional" wetlands are those areas that are subject to regulatory restrictions. Therefore, it is also possible to describe wetlands by their legal standing, such as it is done by the CWA and NFSA (US Army Corps of Engineers, 1987; and US Department of Agriculture, 1996).

When attempting to determine if a wetland might be subject to the Section 404 wetland regulatory program, a very specific definition must be followed. The USACE defines wetlands as, "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a predominance of hydrophytic vegetation" (US Army Corps of Engineers, 1987). It is, however, currently, technologically impossible to determine if an area meets this definition without conducting a field delineation on a site-by-site basis (National Research Council, 1995; and Mitsch and Gosselink, 2000). None of the nationwide wetland mapping or inventory efforts collect enough appropriate information to determine if the areas they describe as wetland meet the regulatory definition. Instead, they either identify wetlands by the presence of a dominant feature such as hydrology or vegetation type with remote sensing technology such as color-infrared photography or from satellite imagery or they rely on informal or rapid field determinations. As a result, no national wetland status tracking or mapping effort can be considered an inventory of regulated jurisdictional wetlands. At best, all of the currently available datasets can only be considered to be inventories of potential wetland areas and only used as indicators of the likelihood that jurisdictional wetlands are present (National Research Council, 1995; Dahl, 2000; and Mitsch and Gosselink, 2000).

Notwithstanding the limitations of identifying and classifying actual jurisdictional wetlands, estimating the amount of potential wetlands present in the United States is a complicated task. The size of the nation and the variety in the types of wetlands makes conducting any large-scale survey difficult. Several state, county, and municipal governments have conducted very accurate and regularly updated wetland inventories, however due to inconsistencies between their various inventory methods and due to the incomplete coverage provided by these inventories, they cannot be pieced together to create a complete national picture (National Research Council, 1995; and LaPeyre et al., 2000). Over the last thirty years, however, three different national government agencies, the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture (USDA), and the U.S. Geologic Survey (USGS) have made attempts at comprehensively quantifying and describing the nation's wetland resources (National Research Council, 1995; and Mitsch and Gosselink, 2000).

The USFWS has been charged with the responsibility of collecting and maintaining a comprehensive inventory of all the wetlands in the country. This large undertaking is administered through the agency's National Wetland Inventory (NWI) program. The NWI is the most detailed of the national wetland datasets. NWI maps are generated from high-elevation Color Infra-Red (CIR) photographs. The land cover represented in each photograph is then interpreted and the boundaries of potential wetland areas are traced as polygons onto 7.5 Minute USGS topographic base maps. USFWS staff then classifies the habitat type of each wetland polygon in accordance with the Cowardin classification system (Dahl, 2000).

Despite the relatively high level of resolution and detailed description of wetland types in the NWI, using it exclusively for a national study such as this one could lead to some serious limitations. Primarily, the NWI has not been completed for the entire country, so dependence upon this dataset alone would lead to an underestimation of the amount of potential wetland acres in a specific area. Secondly, much of the NWI has not yet been digitized. Getting estimates of the amount of wetland acres from un-digitized areas would require the costly acquisition of many NWI hard-copy maps and a time-consuming hand tabulation of large numbers of wetland polygons. In addition, the aerial photography used to produce NWI maps was taken over many years. As a result, making valid comparisons between areas could be difficult because of temporal differences in the base scenes (Wilen, 2003).

The USDA, on the other hand, does not generate a detailed map of wetland areas. Instead, it uses a random sampling approach to quantifying wetlands. Every five years the USDA conducts a survey known as the Natural Resources Inventory (NRI). The NRI is a statistical survey of various types of natural resources, including wetlands, located on non-federal lands. The NRI program randomly selects a certain number of plots in each county or parish in the nation. USDA personnel in each county or parish are then required to quantify the amount of each type of natural resource within that plot, and describe, if any, the amount of change that has occurred since the last time that plot has been surveyed (Brady and Flather, 1994; and U.S. Department of Agriculture 2002).

Using NRI data exclusively in a nationwide study such as this one also has drawbacks. The NRI contains much less detail about the habitat types of individual wetlands than does the NWI. Instead, it classifies wetlands in more general terms. Furthermore, the NRI does not collect data on wetlands located on federal lands. Therefore, using NRI data in a national study such as this one could lead to an underestimation of the amount of potential wetland acres in areas that contain significant tracts of federal land. While, unlike the NWI, the NRI does provide a complete dataset for the entire nation, the number of sample sites that are selected have been chosen in order to only generate a statistically valid estimate for each state. The number of sites was not chosen in order to provide valid estimates for WRUs. In order to use NRI data for this study, the location of each sample plot used in the NRI would have to be identified and reclassified by USACE district. A statistical analysis would then need to be conducted to determine if enough sample sites were selected to generate a valid estimate for each district. The exercise of validating this dataset could become exhaustively large and extend well beyond the scope of this particular study (Brady and Flather, 1994; and U.S. Department of Agriculture, 2002).

The USGS has developed and is in the process of updating a high-resolution National Land Cover Dataset (NLCD). The NLCD is generated from remotely sensed satellite imagery, using 30 square meter resolution multi-spectral Landsat Thematic Mapper ™ imagery. Unlike the NWI or the NRI, no lands are excluded from the NLCD dataset. The NLCD categorizes the land cover of the entire nation into 21 different classifications including specific classifications for forested and emergent wetlands as well as open water habitats. Like the NWI, the NLCD generates a map of potential wetland areas. Unlike the NWI or the NRI, there are no excluded lands; therefore, the NLCD generates a complete dataset for the entire conterminous 48 states (Sohl, 2003).

Although it is a very large and cumbersome dataset, the NLCD is the best suited for conducting a national study such as this one. It is the only wholly digitized and complete map-based national wetland dataset. It is, therefore, possible to use Geographic Information System (GIS) software to clip the NLCD by the boundaries of the USACE districts and get new summary statistics for the amount of the different wetland and deepwater habitats in each district. The largest criticism of using the NLCD is that the pixel size is large enough it could cause some small, isolated, wetlands to not register, and result in an under representation of these wetland types. To help address this concern, the USGS has actually incorporated digitized NWI data into the NLCD wherever possible to try and reduce these concerns (Sohl, 2003).

Despite each using a different approach to making their approximations, all three agencies have arrived at similar estimates for the current amount of wetlands in the United States. The USFWS' latest estimate was calculated in 1997, and determined that there were approximately 105.5 million acres of wetlands in the conterminous 48 states (Dahl, 2000). The USDA has generated a more recent estimate from a 2002 study that suggests there are 110.6 million acres of wetland areas in those same states (U.S. Department of Agriculture, 2002). The USGS' estimate from satellite imagery is the least conservative of the three and approximates that during the early part of the 1990's there were 112.2 million acres of wetlands (U.S. Geologic Survey, 2004).

Wetland Status and Trends

It has been estimated that by the 1980s the amount of wetlands that were present represented as little as 50 percent of the wetlands that were present in the conterminous United States at the time of European settlement (Dahl, 1990; and Dahl and Johnson, 1991). The rest had been converted to some other land-use type, predominantly agricultural lands (Dahl, 1990). This conversion has not occurred uniformly across the country, however. In Midwestern states such as Ohio, Indiana, Illinois and Iowa, the amount of conversion is estimated to be near 90 percent, whereas in less densely populated and less arable states such as Arizona, Montana, and South Dakota the amounts converted are estimated to be closer to 30 percent. In 1990, Dahl reviewed a number of historical documents and modern land cover surveys and projected the amount of wetland loss that occurred during the first 200 years of the republic. Table 2.4 lists Dahl's estimates of wetland losses of all the states.

*Table 2.4 Estimated state wetland loss (1780-1980).**

STATE	STATE SIZE (ACRES)	1780 WETLAND (ACRES)	1980 WETLAND (ACRES)	1780 ABUNDANCE	WETLAND LOSS
AK	375,303,680	170,200,000	170,000,000	45.30%	-0.1%
AL	33,029,760	7,567,600	3,783,800	11.50%	-50%
AZ	72,901,760	931,000	600,000	0.80%	-36%
AR	33,986,560	9,848,600	2,763,600	8.10%	-72%
CA	101,563,520	5,000,000	454,000	0.40%	-91%
CO	66,718,720	2,000,000	1,000,000	1.50%	-50%
CT	3,205,760	670,000	172,500	5.40%	-74%
DE	1,316,480	479,785	223,000	16.90%	-54%
FL	37,478,400	20,325,013	11,038,300	29.50%	-46%
GA	37,680,640	6,843,200	5,298,200	14.10%	-23%
HI	4,115,200	58,800	51,800	1.30%	-12%
ID	53,470,080	877,000	385,700	0.70%	-56%
IL	36,096,000	8,212,000	1,254,500	3.50%	-85%
IN	23,226,240	5,600,000	750,633	3.20%	-87%
IA	36,025,600	4,000,000	421,900	1.20%	-89%
KS	52,648,960	841,000	435,400	0.80%	-48%
KY	25,852,800	1,566,000	300,000	1.20%	-81%
LA	31,054,720	16,194,500	8,784,200	28.30%	-46%
ME	21,257,600	6,460,000	5,199,200	24.50%	-20%
MD	6,769,280	1,650,000	440,000	6.50%	-73%
MA	5,284,480	818,000	588,486	11.10%	-28%
MI	37,258,240	11,200,000	5,583,400	15.00%	-50%
MN	53,803,520	15,070,000	8,700,000	16.20%	-42%
MS	30,538,240	9,872,000	4,067,000	13.30%	-59%
MO	44,599,040	4,844,000	643,000	1.40%	-87%
MT	94,168,320	1,147,000	840,300	0.90%	-27%
NE	49,425,280	2,910,500	1,905,500	3.90%	-35%
NV	70,745,600	487,350	236,350	0.30%	-52%
NH	5,954,560	220,000	200,000	3.40%	-9%
NJ	5,015,040	1,500,000	915,960	18.30%	-39%
NM	77,866,240	720,000	481,900	0.60%	-33%
NY	31,728,640	2,562,000	1,025,000	3.20%	-60%
NC	33,655,040	11,089,500	5,689,500	16.90%	-49%
ND	45,225,600	4,927,500	2,490,000	5.50%	-49%
OH	26,382,080	5,000,000	482,800	1.80%	-90%
OK	44,748,160	2,842,600	949,700	2.10%	-67%
OR	62,067,840	2,262,000	1,393,900	2.20%	-38%
PA	29,013,120	1,127,000	499,014	1.70%	-56%
RI	776,960	102,690	65,154	8.40%	-37%
SC	19,875,200	6,414,000	4,659,000	23.40%	-27%
SD	49,310,080	2,735,100	1,780,000	3.60%	-35%
TN	27,036,160	1,937,000	787,000	2.90%	-59%
TX	171,096,960	15,999,700	7,612,412	4.40%	-52%
UT	54,346,240	802,000	558,000	1.00%	-30%
VT	6,149,760	341,000	220,000	3.60%	-35%
VA	26,122,880	1,849,000	1,074,613	4.10%	-42%
WA	43,642,880	1,350,000	938,000	2.10%	-31%
WV	15,475,840	134,000	102,000	0.70%	-24%
WI	35,938,560	9,800,000	5,331,392	14.80%	-46%
WY	62,664,960	2,000,000	1,250,000	2.00%	-38%

** (Table modified from Dahl et al. 1990)*

While it is not contested that wetland losses over the first 200 years of American history occurred for the purpose of improving agricultural production, the primary cause of modern wetland losses is the subject of much contention (Dahl, 1990). Several studies have been conducted to try and understand the nature of these wetland losses. The USFWS has conducted two separate 10 year status and trends reports. The first was released in the 1990s and the second was released in 2000 (Dahl, 1990; and Dahl and Johnson, 2000). In addition, the USDA has conducted its five-year and annual NRI studies regularly since 1992 (U.S. Department of Agriculture, 2002). All of these studies indicate that wetland loss rates have decreased over the years, however they disagree as to whether the continued conversions are a result of the development of wetlands into urban uses, or if it has been the result of agricultural uses (Dahl and Johnson, 2000; and U.S. Department of Agriculture, 2002).

The disagreement between the two perspectives concerning the causes of modern wetland loss in the United States is not likely to be resolved soon. Because of the different methods used by the USFWS and the USDA, it is difficult to discredit the estimates of one study with the results of the other (Dahl, 2000). In addition, past efforts to quantify the amount of influence the Section 404 program has on reducing wetland conversions to urban uses have been met with limited success. Many studies have shown that when Section 404 permits require the construction of mitigation sites, compliance with those requirements is sorely lacking. In many repeated studies it has been discovered often times required mitigation sites are never constructed and in many cases when mitigation is actually constructed it does not adequately create the necessary amount of wetlands (Allen and Freddea, 1996; Stein, 1998; Brown, 1999; Brown and Veneman, 2001; and Robb, 2002). In addition, it has been discovered that often times wetlands have been filled without permits when one should have been required (Daggett et al., 1998; Gwin et al., 1999; and Schaich, 2000). The USGS, however, is in the process of updating the 1990 NLCD with 2001 satellite imagery. Because this analysis will allow a comparison between two complete datasets from two different time periods using the same 21 category land-use classification system, it should be possible to determine in more accurate terms the type of land-use that has replaced wetland areas with the most frequency over the last 10 years (Sohl, 2003).

Wetland Distribution

In addition to wetland loss rates not occurring uniformly from state to state, wetland resources in their various forms are not uniformly distributed across the nation. Some regions of the country have higher densities of wetlands than others. Figure 2.2 illustrates the relative distribution of wetlands in the United States in terms of the percentage of each state's area that is wetland. Although it has been demonstrated that some states have experienced higher rates of wetland loss than others, Dahl and his associates propose the current disparity in wetland distribution is not completely an invention of modern land-conversion practices. Their investigation of soil surveys suggest that the inequality of wetland distribution has always existed on the North American continent. In addition, their review of general land survey records verifies that this natural variation was certainly present at the time of European settlement. Figure 2.3 illustrates the estimated distribution of wetlands during 1780's in terms of the percentage of each state's area that would have been wetland at that time. Notice should be made, however, that these are at best rough estimates. By 1780, not all of the area that currently comprises the United States was yet considered the territory of the nation, and the landscape was not completely surveyed. (Dahl et al., 1990; Mitsch and Gosselink, 2000; and National Research Council, 1995).

More important than human alterations, natural variations in climate and topography have made some regions of the country more suitable for the development of wetlands than others. In general, wetlands are present in far greater concentrations in low-lying, flat, and humid regions of the country such as around the Great Lakes, the Mississippi Delta and around coastal areas than in more arid, rugged, higher-elevation regions in the West (Dahl et al., 1990; Mitsch and Gosselink, 1990; and National Research Council, 1995).

In addition, different wetland types are found in higher abundances in some locations of the country than others. Large tracts of forested swamps with standing water dominate the wetland composition in the Mississippi Delta region, but are found with much less frequency elsewhere in the country. Furthermore, isolated marshes with herbaceous emergent vegetation and small areas of open water are found prolifically in the prairie pothole region of North Dakota and at far less densities in other places of the country (Dahl, 1990; National Research Council, 1995; and Mitsch and Gosselink, 2000). Likewise, tidal wetlands are not found equally distributed across the country's coastlines. In the 1980's it was estimated that approximately 58% of all the estuarine coastal wetlands in the conterminous 48 states are found along the gulf coast, with less than 2% of them found along the entire west coast. The remaining 40% were found along the rest of the eastern seaboard (Chabreck, 1988).

It can be safely concluded that there is a large diversity in the distribution of wetlands across the country. This is of some significance because both the national and state wetland regulatory programs are only necessary when applied to wetland areas. As a result, the likelihood that a wetland permit will be requested is directly dependent upon the presence of a wetland. It is, therefore, reasoned here that the more wetlands that are present within a jurisdictional area, the more likely it is that a wetland permit request would be made. Conversely, if there are no wetlands within a jurisdictional area, the need for a wetland permit declines and so does the likelihood of a permit request being filed.

As the presence of actual wetlands within a jurisdictional area could help drive the demand for wetland permits in that area, this study includes an estimate of the amount of potential wetlands in each wetland regulatory unit that is derived from the NLCD. The intention is to try and account for the potential variation in the number of wetland permits in each district that might be related to discrepancies in wetland abundance between districts. It is hoped that by accounting for this variation a more accurate description of the relationships between the national and state wetland regulatory programs is developed.

*Figure 2.2 Percentage of state area as wetlands (1980).**

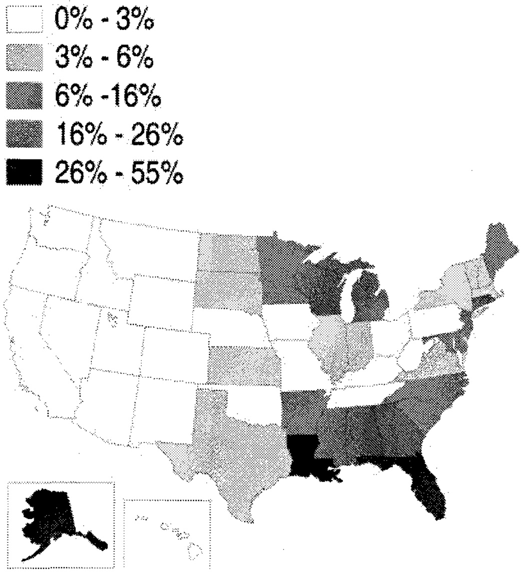
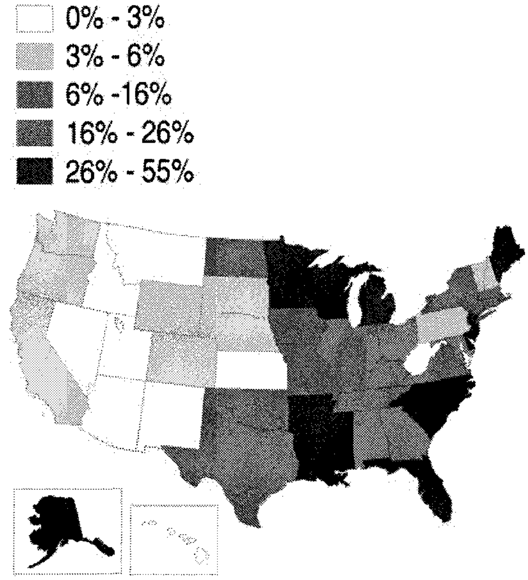


*Figure 2.3 Percentage of state area as wetlands (1780).**



**(Figures adapted from Dahl 1990 by T.E. Dahl for* USGS Water Supply Paper 2425 *http://water.usgs.gov/nwsum/WSP2425)*

<u>Political Landscape</u>

Just as the amounts and types of wetlands in the country are not uniformly distributed, neither are the pressures to fill or drain them. As there must be a wetland present on a piece of property in order to invoke the authority of a wetland regulatory program, it is equally as necessary to have an applicant who wishes to fill that wetland. Obviously, potential permit applicants are also not evenly distributed across the country. In addition, the economic conditions making the pursuit of section 404 permits likely for those applicants also do not appear to be evenly distributed across the country.

Preliminary conversations with USACE and state wetland regulatory staff about this study has revealed that members of the wetland regulatory community believe areas with more prosperous economies and with higher population densities generate more interest in wetland permit activities than other areas. It is argued by regulators that the better the economy is doing the more likely an applicant is to have the resources necessary to convert wetlands. Furthermore, the higher the density of an area's population, the higher the demand becomes to turn marginal areas such as wetlands into more developed landscapes (Newling, 2003; and Sudol, 2004).

The suspicions of the wetland regulatory community about the influence of economic conditions and population densities have some academic justification. In 2000, the International Commission on Dynamics of Marginal and Critical Regions published a compilation of studies that demonstrated that one of the greatest limiting factors to the conversion of marginal lands such as wetlands is the high likelihood of a conversion to be unprofitable. Many factors, from market-forces to the cost of the conversion itself, can cause a conversion project to be unprofitable. Several of the studies presented in the publication, therefore, demonstrated how state efforts to reduce market-risks for land-conversion practices have routinely resulted in an increased development of marginal lands across the globe (Gutierrez and Furlani, 2000; Hill 2000; and Singh, 2000). Furthermore, urban growth theory also demonstrates how increases in land values can lead to a reduction of market-risks for developers. The theory argues that land values increase proportionately with population density. While land values increase, however, the costs of land conversion techniques remain relatively constant. Therefore, the potential profits to be made from the conversion of lands increases proportionately with the land value (Cadwallader, 1996). Ultimately, these two theories work together to illustrate how an increase in population density can lead to an increase in pressure to develop wetlands into some type of production.

The Commission on Dynamics of Marginal and Critical Regions compilation mainly focuses on the conversion of lands for agricultural production. A common theme among some of the studies is that the development of marginal lands is more likely to occur as the economic strength of an area grows. This is because under weak economic conditions there is not enough available capital to invest in the infrastructure necessary to convert lands that have marginal returns (Gutierrez and Furlani, 2000; Hill, 2000; and Singh, 2000). Urban growth theory also demonstrates how economic vitality can be a driving force of development pressure in another way. Cadwallader

(2004) specifically illustrates how income classes drive the development of new residential lands in a number of scenarios. This increased pressure to develop new lands could also, ultimately, result in an increase in the amount of wetland fill requests.

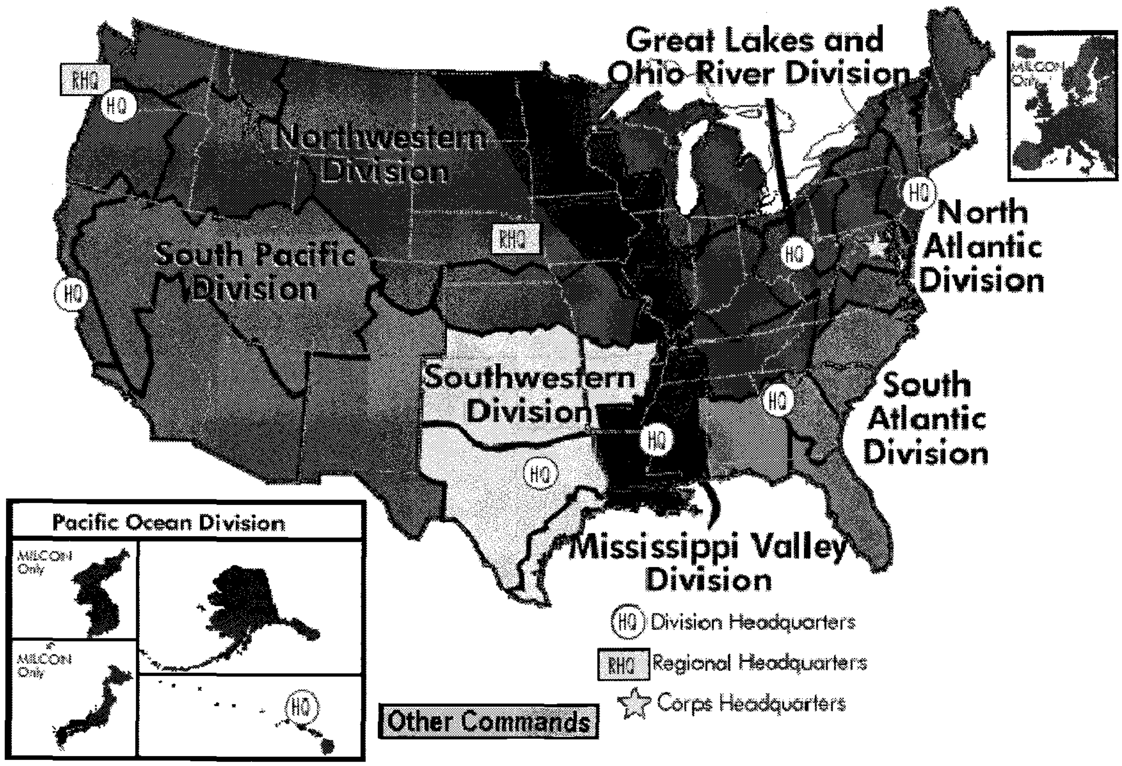
Wetland regulatory professionals have expressed concern that both variations in population densities and levels of economic prosperity between districts could be so large that drawing comparisons between predominantly urban and rural districts with unequal populations or economies could be difficult (Newling, 2003; and Sudol, 2004). To date, no quantitative studies focusing on Section 404 permit workload genesis have been published that validate either of these concerns. Several investigations into wetland loss trends, however, have demonstrated that, especially in estuarine systems, the most significant losses of wetlands have routinely occurred near more densely populated areas and in areas that have stronger economies (Tiner, 1984; Howe, 1987; Chabreck, 1988; and Bildstein 1991). Furthermore, the most recent wetland status and trends reports from the USFWS and the USDA both indicate that conversions associated with higher density development activities account for anywhere between 1/2 and 2/3 of all the wetland losses in the country (Dahl, 2000; and U.S. Department of Agriculture, 2002). In none of the above studies were the projected amounts of wetland losses based upon permitting records. In general, however, losses of wetlands to these types of land-uses generally involve the types of activities that have a high likelihood of being subject to wetland regulations and requiring a permit in order to legally proceed.

To account for the potential influence that economic and population growth rates may have on the likelihood that a Section 404 permit might be sought within an area; this study derives and includes measures of both. Population density and growth rates from 1990 to 2000 are calculated for each wetland regulatory unit from the decennial US Censuses for that time period. The 2000 dataset is used to determine population density and the combined dataset is used to determine growth rates. The 2000 data source is also used to determine the median family incomes in any given area during those years. Ryscavage (1994) argues the validity of the census socioeconomic data, and makes a case for using the measure of median family income as an indicator of economic strength. By devising a method for calculating these socioeconomic measures during this time period, this study also provides a much needed building block that could be used by other studies hoping to better estimate and understand the performance of the Section 404 program and potential influences upon it.

There is also a need to account for other variations between different USACE districts. These variations, however, are internal to the USACE's bureaucratic structure. Although there is one national Section 404 wetland regulatory program, it is administered locally by USACE district staffs. There are 38 different USACE districts. The average USACE district covers approximately 87,000 square miles. Each district, does not, however have an equally-sized jurisdiction. USACE districts range from being as small as approximately 6,381 square miles to being as large as 576,749 square miles. In addition, each USACE district receives regional oversight from one of eight different USACE Division offices. Figure 2.4 illustrates each of these USACE districts and the divisions to whom they report.

Each USACE district receives its funding from national headquarters, and gets support from division headquarters, but the funding and expertise is not distributed equally throughout each district. Resources are distributed proportionate to the amount of workload each district must handle. Separate studies by Brundney and Hebert (1987), Wood (1988), and Teske (1991) suggest that for government agencies, institutional factors and regulatory resources such as funding levels, and agency structural characteristics can directly affect regulatory program outputs. As a result, the devolved decision-making model that the USACE is following along with the differences in district and division staff and resource allocation allows for the possibility of variations in implementation particulars (Sudol, 2004).

*Figure 2.4 USACE district and division boundaries.**



(USACE Website http://www.usace.army.mil/divdistmap.html)

Further complicating the lack of uniformity in the applicability of wetland regulations is the fact that USACE district boundaries do not follow state boundaries. This lack of continuity with state boundaries, however, is not a result of the USACE's regulatory authority. Before the USACE was given authority to administer the nation's wetland regulatory program it was first charged with the responsibility of developing and maintaining the nation's flood control and navigation infrastructure. The nature of these civil works projects dictates that the USACE must plan project development and management strategies within the context of related watersheds. As a result, the USACE has organized its respective district civil works boundaries to roughly approximate major watershed boundaries. Because civil works projects remain a central focus of the USACE today, these watershed-based boundaries continue to define the jurisdictional areas of USACE districts (Sudol, 2004).

As there are only 38 USACE districts and 50 states, most districts contain portions of multiple states, and most states are not completely contained within the jurisdiction of a single district. In fact, the average district has jurisdiction in parts of at least four different states, but can have jurisdiction in as many as nine states or be completely contained within an individual state. Furthermore, the average state shares its geographical jurisdiction with three USACE districts, but can share it with as many as seven districts, or be completely contained within a single district. For comparison, Figures 2.5 and 2.6 respectively illustrate the 36 USACE districts and the 48 states in the conterminous United States.

The unequal overlap that exists between USACE district and state boundaries is, in many cases, a necessary part of the USACE's civil works program. The USACE's authority rests in the management of "interstate waters", which by definition cross state boundaries. Furthermore, these civil projects are required to manage for flood control or navigation, both of which routinely affect areas across multiple states (National Research Council, 1995).

Figure 2.5 USACE districts of the conterminous United States.

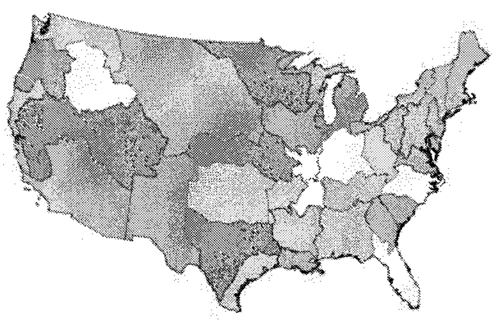
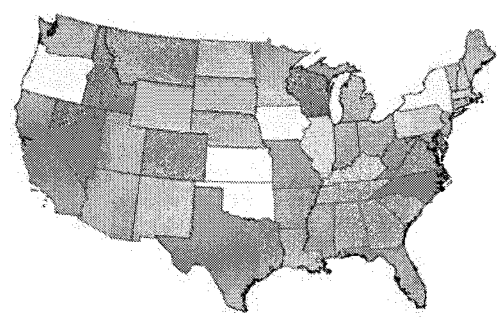


Figure 2.6 States of the conterminous United States.

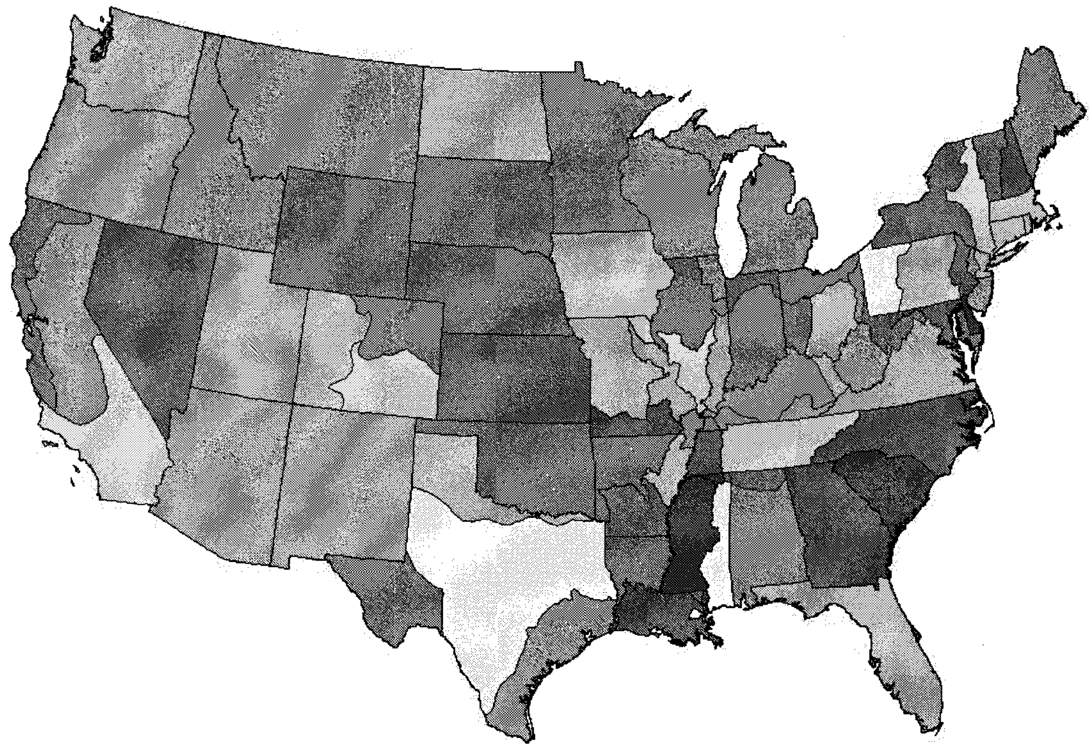


The same necessity of multi-state overlap does not, however, exist in the USACE's regulatory program. Although they may be adjacent or hydrologically connected to interstate waters, many wetland fill projects that are regulated by the USACE do not directly lie in multiple states. Nonetheless, the unequal overlap between state and USACE district boundaries ultimately, has the potential to create 152 areas in the country that could have their own unique set of state and USACE wetland regulations.

Because USACE districts have some autonomy in how they administer the wetland regulatory program and states have the authority to create their own wetland regulations or choose to be more or less actively engaged in the Section 401 water quality certification of USACE projects, each area created within a given USACE district by the overlap with state boundaries may be subject to a different combination of state and USACE regulatory programs. This potential for there to be 152 different combinations of state and USACE regulations to which wetland fill applicants may be subjected that are solely dependent upon the location of the project increases the complexity of the wetland regulatory permitting process.

Recognizing the complexity of creating such a large number of different wetland regulatory units (WRUs), many USACE districts have entered into informal agreements with neighboring districts to simplify their boundaries for regulatory purposes. This has lead to the creation of a separate set of regulatory jurisdictional boundaries for many USACE districts. In many cases, districts that might have otherwise had authority in small regions of two or three different states have chosen to use state boundaries to define their own jurisdictional reach and restrict their activity to only one state. Not all USACE districts have undertaken theses efforts to create these additional, more simplified, boundaries, but many have. As a result, the overlap between USACE districts and states actually creates only 87 functional wetland regulatory units instead of the potential of 152. Figure 2.7 illustrates these 87 wetland regulatory units.

Figure 2.7 Overlap of USACE and state boundaries – wetland regulatory units.



The existence of WRUs is a real and important aspect of the wetland regulatory landscape in the United States. WRUs represent 87 potentially different state-federal governmental relationships and therefore 87 potentially different wetland regulatory scenarios. Each of these regulatory scenarios establishes the rules to which any potential wetland fill applicant is subjected. It should, therefore, be necessary that any study investigating the interrelationships between state and national wetland regulations take the WRU concept into consideration. After all, every wetland fill applicant in the country has to take into consideration in which WRU their project is located in order to seek the appropriate necessary permits.

If the separated-authority model is correct, the amount of wetland fill permitted within a wetland regulatory unit through the Section 404 program is not expected to vary in relation to the presence of a statute-based state wetland regulatory program. Inside a wetland regulatory unit, the state and the national programs are considered to be operating within two completely different spheres and not influencing one another. If the separated-authority model is incorrect, however, the amount of Section 404 wetland fill permitted within a wetland regulatory unit may vary in relation to the presence of a statute-based state wetland regulatory program.

Because the separated-authority model assumes that the separate spheres occupy the same territorial limits, the use of wetland regulatory units establishes distinct geographical study areas where a district's jurisdiction corresponds with specific state's jurisdiction. The separated-authority model also assumes that both the state and national government have restricted spheres of action. That is to say that the authorities of each are able to be limited to specific instances and situations. In the case of wetland regulation, the authorities of both state and national programs are limited by only being applicable to wetlands. Since wetlands are not evenly distributed across the nation, the amount of potential wetlands that are located within each wetland regulatory unit is also be included to describe this potentially shared restricted sphere of action. The combination of using WRUs and including a measure of the amount of potential wetlands meet both the conditions of the separated-authority model of being a shared territory and a shared limiting condition of both programs (Wright, 1978).

At its essence, wetland regulation is an attempt to control the condition of a piece of property located within a specific area of governance. This effort is an intersection between human interests and the physical world. No attempt to understand the relationships between two separate programs that both operate at this intersection can be complete without accounting for the conditions at the location being studied. Therefore, in addition to accounting for the variation in the amount of wetland impacts within wetland regulatory units that are potentially caused not only by the amount of potential overlap between the state and national programs, this study also includes measures to account for the amount of that variation that is related to the political and physical landscape.

Conclusion

This literature review provides a comprehensive view of the U.S. wetland regulatory system. Unlike most reviews of this system, however, it has done more than just recite the various laws and programs that are in place. It has been broadened to also provide detailed descriptions of the philosophical, regulatory, and geographic contexts behind the system. Understanding each of these contexts has forced a wider view of the issue to be taken, and as a result it has provided critical insights into the way wetland regulatory programs are administered.

Through the efforts that were taken to describe the wetland regulatory system, a number of key variables have been identified that could ultimately influence the amount of wetland fill requests that are approved within a WRU. These variables account for the geographic and socio-economic variety within the American landscape. Furthermore, this review has lead to the establishment of a philosophical framework for the study that provides us the proper perspective for evaluating the outputs of the national wetland regulatory program and helps form the foundation of this study.

After reviewing a number of investigations into the performance of the Section 404 program, it seems appropriate that this study should follow in the tradition of past wetland regulatory investigations by incorporating the amount of wetland loss that is permitted by each USACE district into its response variables. New ground in this discipline is broken by this endeavor, however, by using a dataset for these values that has not before been presented in the published literature.

By reviewing various intergovernmental relations models, it was possible to visualize the ways in which the outputs of statute-based wetland regulatory programs and the

Section 404 program could theoretically interrelate. This visualization enables the construction of potential measures to describe the ways in which the national and state wetland regulatory programs could theoretically overlap, if the separated-authority model of intergovernmental relations is invalid. These measures of potential overlap, therefore, serve as the explanatory variables of the study.

By evaluating the various wetland mapping and loss estimation efforts, it became obvious that wetlands are not evenly distributed across the country. Variations in the landscape could be bottom-up conditions that influence the permitting process as some wetland regulatory units seem more likely to contain higher concentrations wetlands than others. These variations are addressed by including a measure of potential wetland abundance in each wetland regulatory unit.

Through the investigation of the driving forces behind the development of marginal lands, it became apparent that other bottom-up variables such as pressures to convert wetlands may also be unequally distributed across the nation. Variables, therefore, are included for three key driving forces of land development pressures. Income measures as well as population density and population growth are calculated for each wetland regulatory unit and included in this study in order to serve this purpose.

As a result of reviewing the structure and genesis of wetland regulatory programs in the United States, it became evident that the presence of some programs could exhibit confounding influences on the outcomes of this investigation. The study, therefore, attempts to account for the amount of influence a state's CZM program may have on permits in coastal wetlands. An attempt is also be made to account for the amount of influence active Section 401 programs may have on section 404 permits in states without statute-based programs. Variables for both of these variables are, therefore, included in the study.

Likewise, the same review suggested that variations in the amount of several top-down variables such as administrative resources assigned to each USACE district could also confound the outputs of the study. As a result, variables are included for the amount of funding and staff each district receives as well as for the division from which each district receives its oversight.

By including both these bottom-up and top-down variables, this study provides a framework around which a meaningful investigation into the types of intergovernmental relationships that arise from wetland regulations can be conducted. This is accomplished by constructing a model that describes some of the major factors that are related to the amount of permitted wetland impacts and attempting to account for variations that can be linked to the types of intergovernmental relationships that are present. As a result, this investigation not only increases the amount of knowledge that is available concerning the way environmental regulations are administered, but it also provides quantitative evidence for this understanding, which is something that has not been widely produced, to date.

Ultimately, this study is testing the hypothesis that the presence of statute-based state wetland regulatory programs are related to the amount of wetland impact permitted by the USACE. If this hypothesis is upheld, it will provide evidence suggesting that the Section 404 program provides better protection to wetlands in those states that have statute-based wetland regulatory programs, than in those states that do not have such programs. A positive relationship will also suggest that the overlapping-authority model of intergovernmental relations could be used to describe the types of intergovernmental relationships that exist between state and national wetland regulatory agencies.

If this hypothesis is disproved, however, it would suggest that the Section 404 program provides no better protection to wetlands in those states that have statute-based wetland regulatory programs than in those states without such programs. The lack of a correlation also suggests that the separated-authority model of intergovernmental relations is still applicable to some aspects of American federalism and can be used to describe this relationship.

RESEARCH DESIGN AND METHODS

Introduction

The previous chapters described state and national government wetland regulatory efforts in both their historic and current forms and established the relevancy of a study that investigates the ways in which state and national wetland regulatory agencies interrelate. Both the philosophical context within which these programs operate as well as the practical and theoretical benefits an intergovernmental relations focused investigation of wetland regulation could provide have also been discussed. Furthermore, documentation was provided suggesting that the amount of wetland fill that is permitted through wetland regulatory programs could be related to a number of geographical, socio-economic, and administrative variations existing in the wetland regulatory landscape.

Most importantly, however, a clear hypothesis emerged from this discussion of state and national government regulatory efforts that is firmly rooted in the discipline of intergovernmental relations. The central hypothesis is that the national government's Section 404 wetland regulatory program permits less wetland fill in wetland regulatory units that are also subject to statute-based state wetland regulatory programs than in wetland regulatory units that have are not subject to such programs.

The results of the efforts contained herein to test this hypothesis ultimately have both practical and philosophical implications. This study has the practical result of increasing the understanding wetland regulatory practitioners have about the nature of the programs they administer. The study also helps answer a specific philosophical question of interest regarding the nature of intergovernmental relations. The results accomplish the latter task by providing evidence that suggests whether or not the separated-authority model of intergovernmental relations is applicable to the way the Section 404 wetland regulatory program is administered.

Described below are the methods this study uses to test the practical hypothesis in a way that also answers the philosophical question of interest. First a defense of an appropriate unit of analysis and the temporal extent for the study is presented. These sections are followed by a discussion of the most appropriate means for measuring the wetland impact dependent variable, and a description of the independent variable that will be used to group the units of analysis according to the type of state wetland regulatory program to which they are subjected. Procedures are also presented that have been developed to measure and incorporate the key sources of climactic, geographic, socio-economic, and administrative variation in the wetland regulatory landscape that have previously been discussed. Finally, there is a discussion of the methods of analysis that were chosen to analyze the results.

Unit of Analysis

The intended unit of analysis for this investigation is a politically defined geographical area termed herein as the "wetland regulatory unit" (WRU). WRUs are geographical regions of the United States that are subjected to unique sets of wetland regulatory scenarios and potentially different intergovernmental relationships that are created as a result of the intersection of state and US Army Corps of Engineers (USACE) district regulatory boundaries. WRUs are a unit of analysis that is being introduced into the wetland regulatory literature for the first time by this study. It is both a term and a concept that has not been described in any previous publication. In fact, it is anticipated that one of the most significant contributions of this study will be the introduction of the WRU into the literature as an acceptable and useful unit of analysis for future academic assessments of wetland regulatory programs.

USACE districts are unequal in size and their regulatory boundaries do not necessarily follow state boundaries. Sometimes they roughly approximate major watershed boundaries. Furthermore, USACE districts generally include portions of multiple states. There are 38 USACE districts in the United States. Each of these USACE districts is under the command of a different US Army Colonel or Lieutenant Colonel.

These commanders are capable of influencing the performance of their staff by injecting their own perspectives on regulatory matters both through informal means, such as conversations, and through formal means, such as through the issuance of written directives. Each district also has its own unique set of local priorities, and staff members who may let their own personal values about wetland regulation influence their job performance. Furthermore, each USACE district has a certain amount of leeway in how it administers its Section 404 wetland regulatory responsibilities. USACE districts are free to establish additional "regional conditions" for Nationwide Permits that increase the restrictiveness of these streamlined permits, or to create unique and simplified Statewide Programmatic General or Regional Permit processes. Each USACE district is also able to create unique guidelines concerning mitigation requirements and standards. As a result, although there is only one Section 404 wetland regulatory program, the way it is regionally administered allows for 38 somewhat different versions of that program to exist.

Like USACE districts, states are also unequal in size. In addition, each state is capable of developing its own wetland regulatory program, or Section 401 water quality certification process. States can also choose to forgo the pursuit of a wetland regulatory program altogether. In any case, each state program can be individually tailored to the needs of the state and incorporate unique sets of standards and exemptions. This creates the possibility of 50 different state wetland regulatory programs.

As discussed in the previous chapter, WRUs are created as a result of the lack of consistency between the 38 USACE district regulatory boundaries and 50 state boundaries. As a result of this mismatch, the geographical extent of many states is under the authority of more than one USACE district. As a result, potential wetland permit applicants may be subject to a single set of state wetland regulatory program standards regardless of the location of their project within the state, but could be subjected to different Section 404 requirements depending upon which USACE district has authority in the location of their project site. This means that applicants do not only have to consider either in which state or USACE district their project is located, they have to consider both. These areas within states that are subject to different USACE district oversight are individual WRUs. Each of these units has a wetland regulatory scenario that is established through its own set of state-national government relationships.

In order to give physical form to the WRU concept, a Geographic Information System (GIS) shapefile has been created that represents the real geographic extent of these units. The WRU shapefile was created by executing a routine that intersects the boundaries of a GIS shapefile of state boundaries that has been provided by the manufacturer of the Arcview (C) GIS Software with a shapefile of USACE district regulatory boundaries.

USACE headquarters does not, however, have a comprehensive nationwide GIS shapefile of district regulatory boundaries. The USACE only has a nationwide GIS shapefile for the district civil works boundaries. A search of the regulatory branch websites for each of the 38 USACE districts produced district-specific maps that described the physical limits of regulatory boundaries for most of the districts. For those districts that did not provide the necessary descriptions on their website, a personal contact was made with a member of the regulatory staff in order to retrieve the necessary description. The district civil works boundary shapefile provided by the USACE was then used as a base map and was manually corrected by referencing the district-specific maps to reflect the current regulatory boundaries of each USACE district.

This procedure of intersecting the newly created USACE district regulatory boundary shapefile with the state boundary shapefile creates 87 new polygons. These WRUs vary greatly in size with an average area of 41,221 square miles and a standard deviation of 67,795 square miles. They can, therefore, be as small as approximately 36 square miles or as large as approximately 576,748 square miles. Figure 2.7 is a product of the final output of this GIS file manipulation procedure (Page 79).

The creation of this new WRU shapefile represents a major milestone for this study. It is a layer of GIS data that did not previously exist. Furthermore, it required the development of another important GIS shapefile that also did not previously exist. The WRU shapefile is the physical cornerstone of the remainder of this study. It serves as the fundamental base layer upon which all the additional spatially-dependent variables were collected for this analysis. This study ultimately investigates the performance of the Section 404 wetland regulatory program within each of these units. Furthermore, because WRUs are an intersection of USACE district and state boundaries, it allows these data to be aggregated both at the USACE district level or the state level for other future analyses. In order to accommodate this and future analyses, two nominal columns of data were recorded in a Microsoft Excel spreadsheet to help uniquely identify each of these regulatory units. One column indicates the name of the USACE district within which the WRU is located, and the other indicates the name of the state.

Temporal Extent of Study

This study looks at the performance of the Section 404 wetland regulatory program over the ten year period from1994 through 2003. While it might be ideal to see how the Section 404 wetland regulatory program performed in each WRU during the time prior to the creation of specific states' wetland regulatory programs and compare that performance to the way it performed after such programs were created, the available data do not exist to allow such a comparison. Most states with statute-based wetland regulatory programs adopted their authorizing legislation in the late 1980's, but USACE Districts did not begin extensively using a standardized wetland permit tracking system until the mid-1990's (1990; Taylor and Abderhalden, 1997; LaPeyre et al., 2000; Williams-Derry, 2005). Furthermore, as large bureaucracies are rarely perceived to be able to quickly adopt and implement new programs, such as a wetland impact tracking system, it is not expected that the early USACE permit records from the early 1990's would be as reliable as more recent entries. In addition, although many individual USACE districts retain wetland permit records for as long as 10 years, they are not required to retain any official records for longer than six years, as a result, it is not possible to obtain complete permitted wetland impact records dating back any further than 1994.

Within a given year, it is generally expected that the regional occurrence of wetland fill activity varies seasonally along with the presence of more favorable earthmoving and construction periods. Because of the time involved in the permit process, however, increased levels of permit activity might not match the same trend. Some permits require several months of review and revision, while others are processed in a matter of a few weeks or days. As a result, preliminary investigations into the Regulatory Quarterly Reports reveal no noticeable seasonal trends in the amounts of wetland impact permits being processed by USACE districts. This study, therefore, does not consider seasonal variations, but instead, investigates the annual amount of wetland fill permitted over the entire temporal extent of this investigation.

The amounts of annual wetland fill activity used in this study are derived from formal reports created by USACE Headquarters that are titled, "Annual Summaries of Wetland Impacts." The data in these annual summaries are compiled directly from the Regulatory Quarterly Reports provided to Headquarters by the Districts. Copies of the Annual Summaries of Wetland Impacts were obtained from USACE headquarters for every year from 1994 to 2003. These annual summaries of the activity recorded in the quarterly reports make it possible to create detailed wetland impact accounts for ten successive years for each of the 87 WRUs.

Having wetland permit data available for this time period also allows future exploratory trend analysis to be conducted into the way each WRU's permit activity may have changed over these ten years. This exploratory trend analysis would further be enhanced by the data's temporal extent including two major judicial decisions that affect the USACE regulatory Program. This temporal extent generates data points that bracket both the 1998 Tulloch Decision and the 2000 SWANCC Decision. These two federal court cases are considered to have severely restricted the jurisdiction of the USACE, and potentially have a significant impact on the number and types of activities that the USACE might regulate through the Section 404 program. As a result, some exploration into trends with respect to these court decisions could potentially yield some incidental results that will help wetland policymakers understand the impact of these decisions.

Dependent Variable

The dependent variable for this study is the amount of wetland impact permitted by the Section 404 program. According to the language of the Clean Water Act and the interstate commerce clause of the U.S. Constitution under which the Section 404 program is enforced, the national government is solely responsible for the administration of Section 404 wetland regulations. If the separated-authority model accurately describes the types of intergovernmental relationships that are established by this regulatory scenario, the amount of wetland impact permitted through this program in any given WRU should not be correlated to the presence of a statute-based state wetland regulatory program in that unit. If a correlation does exist between the presence of statute-based state wetland regulatory programs and the performance of the Section 404 wetland regulatory program in these units, it suggests that perhaps the overlapping-authority model of intergovernmental relations could be applicable instead.

As mentioned in the previous section, the amount of wetland fill activity permitted within each WRU has been derived from official annual wetland impact summaries of USACE Regulatory Quarterly Reports that have been provided by USACE Headquarters. These reports disclose detailed information concerning the workload of each of the districts. In addition to the total amount of wetland fill that was permitted, these reports also include information concerning the amount of wetland fill that was requested of the USACE and the amount of mitigation that was required as a result. Information is also included that describes whether the permits were requested in tidal or non-tidal wetlands or if the types of permits that were issued were general or standard permits.

The use of these summaries of USACE Quarterly Regulatory Reports as the primary source of data for the dependent variable breaks new ground in the field of wetland policy research, as these data have been historically underutilized by policy analysts. To date, no nationwide wetland policy study has included this dataset in its analysis. In fact, it is anticipated that another significant contribution of this study will be the introduction of the Quarterly Regulatory Reports into the literature as an acceptable and useful source of data for future academic assessments of wetland regulatory programs.

Although the quarterly wetland regulatory reports have not been extensively cited in the wetland policy literature, permitted wetland fill is a variable that does have a long tradition of being a response variable in the literature (Natural Resources Council, 1995; Daggett et al., 1998; Stein, 1998; Gwin et al., 1999; Mitsch and Gosselink, 2000; U.S. Department of Agriculture, 2000; Schaich, 2000; and Robb 2002) Analyzing the permitted wetland fill directly as a continuous variable continues in that tradition by providing a way to measure the amount of wetland fill permitted in each district. Permitted wetland fill has long been a top issue in the wetland policy literature, since achieving a "no-net-loss" of wetlands was suggested by President Carter in 1976 and established as a national priority by President Bush Sr. in 1991, and it remains a performance standard by which wetland programs are still measured today.

While the central focus of this study remains on the total amount of wetland fill permitted by the USACE, information gathered from these reports concerning these additional variables has also been recorded to allow for further exploratory investigation into other potential relationships. One potential relationship of particular interest involves the types of wetland permits. Wetland fills approved through standard actions are those that are subject to the more stringent and complete review of an individual permit, while those approved through general actions are those that were subject to the more streamlined review process of regional general permits or nationwide permits. All general permits are supposed to result in only minimal negative wetland impacts, whereas standard permits are intended for larger amounts of wetland impacts (National Research Council, 1995; Taylor, 1988; and Mitsch and Gosselink, 2000).

There is considerable variation concerning the amount of duplication that exists between the types of permits issued by individual state wetland regulatory programs and those issued by individual USACE districts. Many state programs have expedited review processes for minimum impact activities that are similar to the USACE's general permit program. Other state programs chose to regulate general-permit requiring activities and avoid regulating the types of activities that would require a standard permit. Therefore, combining the general permit data and the standard permit data into a single measure may make it more likely to discern if any general relationship exists between section 404 permits and statute-based state wetland regulatory programs. In order to allow each group of permits to be looked at separately as the analysis may dictate, however, the general and standard permit data was entered in two separate columns.

Furthermore, in some WRUs, the majority of the wetlands that are present are located in coastal areas. Likewise, preliminary investigations into the quarterly reports reveal that in some WRUs the majority of Section 404 permits issued occurs in tidal wetlands. As a result, excluding tidal wetland fills from the study could potentially skew the data. It may therefore, also be necessary to group both of these types of permitted wetland fills into a single dependent variable that describes all the wetland impacts permitted within a WRU. As with the general and standard permit data, however, the tidal and non-tidal data will also be coded in a manner that will allow each group of permits to be looked at separately as the analysis may dictate.

Finally, also recording both the amount of wetland fill that was requested of the USACE and the amount of mitigation that the USACE requires allows for some exploratory comparisons to be made regarding the conditions of the permits that have been issued within each WRU. The ratios between the amount of wetland fill requested and the amount permitted or between the amount of fill permitted and the amount of mitigation required could indicate how restrictive given USACE districts are on issuing specific permits.

While the annual wetland impact summaries of the Quarterly Regulatory Reports that provide the detailed information discussed above were retrieved from USACE Headquarters in Washington D.C., their accuracy and validity for use in each WRU was discussed with the chief of the regulatory branch from each of USACE district before they were included in the study. Each USACE district records a field of data in their wetland permit tracking system that indicates the state in which a permit is being sought. Through a combination of telephone and email conversations and formal Freedom of Information Act requests, each district verified what proportion of the wetland impacts disclosed in their regulatory reports over the time period of this study was located in each state under their jurisdiction. Most of these verifications were performed by conducting a query of the district's RAMS wetland permit tracking systems, while others were performed by referencing historical staff reports or other permit records, still others with more limited resources called upon their best professional judgment to estimate the distribution. The total amount of wetland fill activity for each WRU within a USACE district was ultimately calculated by applying these distribution estimates to the annual wetland impact summary data provided by Headquarters.

For the purposes of data storage and manipulation, the permitted wetland fill variable was recorded as an individual column within a Microsoft Excel database. This column includes a cumulative total of all the acres of wetland fill that were permitted in a WRU during this ten year period. There are also additional columns of wetland permitting data associated with each WRU. These columns record the amount of wetland fill requested and the amount of mitigation required for tidal general permits, non-tidal general permits, tidal standard permits, and for non-tidal standard permits. Also included, are two columns indicating both the average number of standard and general permits issued annually. Although it is expected that any relationship between state program type and the Section 404 permitting program should be observable in the amount of wetland fill permitted, recording these additional columns of data provide the ability to evaluate relationships between different aspects of the wetland permit process and opens the door for some extensive exploratory analysis.

Independent Variables

In order to evaluate the relationship that may exist between variations in the amount of permitted wetland impacts in WRUs and the presence or absence of statute-based state wetland programs, a working model for permitted wetland impact first needed to be constructed. This wetland impact model includes a number of the geographic, socio-economic, political, and administrative variables discussed in Chapter 2. Rinquist (1993) created a similar working model, which accounted for many of the same variables, when he determined that state air pollution control programs made a difference in terms of the national government achieving attainment of Clean Air Act standards.

Intergovernmental Relationship Variable

Of the various independent variables that will be included in the study, the intergovernmental relationship variable is the one that specifically addresses the principal hypothesis. This variable is described by the type of state wetland regulatory program present within a WRU. As discussed in Chapter Two, all states fall into one of three different categories with regards to the regulation of wetlands: those with statute-based programs, active Section 401 certification programs, or no active programs.

Of these three types of programs, only statute-based programs potentially fit the assumptions of the separated-authority model of intergovernmental relations. Table 2.3 listed the states that are considered to have statute-based state wetland regulatory programs (Page 58). This study examines the validity of the separated-authority model of intergovernmental relations, by asking if there are differences between the amounts of wetland impacts in WRUs subject to statute-based state wetland regulatory programs and in WRUs subjected to active Section 401 certification programs or no active programs.

Instead of passing their own legislation, some states have pursued strong wetland regulatory programs through state-administered Section 401 water quality certification programs. Table 2.1 listed the states with these types of programs (Page 57). These programs are statutorily inseparable from the Section 404 program. Therefore, although they are not established by state laws, they can yield the same types of correlations with the Section 404 program that are being investigated with the statute-based programs. It is therefore, necessary for analytical purposes to identify those WRUs that consist of regions of states that have developed active section 401 programs in addition to those that have statute-based wetland programs.

The remaining states are considered as having no active state wetland regulatory program. Further separating the WRUs that are in states with active Section 401 programs from those with no active state wetland regulatory programs serves to reduce the within-group variation of the WRUs that do not have statute-based state wetland regulatory programs. Furthermore, this allows for more consistent analysis of variations between the group of statute-based WRUs and the other two groups.

Grouping each WRU into one of three mutually exclusive categories creates a nominal dataset with a unique code each for statute-based programs, Section 401 programs, and no active programs. Finding that the statute-based group of WRUs varies significantly from the other two groups may provide sufficient evidence to suggest more than just the inadequacy of the separated-authority model of intergovernmental relations. In addition to suggesting that state and national wetland regulatory agencies are interacting in previously unspecified ways to restrict wetland impacts, if the amount of wetland impact permitted in statute-based WRUs is significantly less than in the other units, it could also suggest that wetlands in these areas are more stringently protected under these circumstances. This result would be of particular interest to state and federal wetland policy-makers looking for opportunities to strengthen and streamline the regulatory process.

It is anticipated that the strength of any potential relationships between the state and national wetland regulatory programs may initially be significantly obscured by four sources of confounding variables. Two of these sources describe top-down influences. These are state-administered programs with overlapping spheres of influence; and variations between administrative resources of USACE districts available in the WRUs. The remaining two sources describe bottom-up influences. These are variations in WRU landscapes; and socioeconomic variations between WRUs. The study, therefore, estimates the importance of these sources of variation in explaining permitted wetland impacts by including the following variables in the data set (Figure 3.1).

Several sources discussed in the literature review as being viable datasets are used in order to quantify each of these independent variables. Records available through NOAA provide information regarding the status of CZM programs and estimates for the amount of tidal wetlands subjected to CZM regulations. Estimates for the amounts of wetlands and deepwater habitats in each WRU are derived from the USGS National Land Cover Dataset. Data from the 1990 and 2000 decennial censuses are used to determine the population densities, growth rates, and median family incomes for each WRU. A series of public information data requests submitted to each USACE district office provide the number of staff and the operating budgets for each USACE district during every year of the study, while the USACE district GIS shapefile provided by USACE headquarters already contains information regarding the division office to which each district reports. In total, over two years were required in order to collect, interpret, and format the data from all of these sources into a format suitable for analysis.

Figure 3.1 List of included variables

Regulatory Context - Overlapping State Government Regulatory Programs

- Potentially confounding state programs (Coastal Zone Management Programs)
    - Presence of a state CZM Program circa 2005
    - Amount of tidal wetlands subject to CZM program authority within each WRU

Geographical Context - Physical Landscape

- Variations in landscapes between WRUs (National Land Cover Dataset)
    - Wetland and deepwater habitat distribution circa 1990
    - Size of WRUs.

Geographical Context - Political Landscape

- Socioeconomic variations between WRUs (1990 and 2000 Census)
    - Population density circa 2000
    - Population growth rate from 1990-2000
    - Average family income circa 2000
- Administrative resource variations between USACE districts (USACE Headquarters)
    - Average annual operating budget of the regulatory branch for each district
    - Average number of regulatory branch staff assigned to each district
    - USACE regulatory division for each district

<u>Coastal Zone Management Program Variable</u>

Fill activities in both tidal and non-tidal wetlands are subject to the Section 404 wetland regulatory program regardless of where they are located in the nation. Some states, however, have developed additional regulations specific to tidal and coastal, non-tidal wetlands that they administer through their Coastal Zone Management Programs. Table 2.2 indicates those states that have CZM programs according to 2005 NOAA records (Page 57). Often states administer these coastal wetland protection programs separately from statute-based state wetland regulations. Federal consistency provisions of the Coastal Zone Management Act, however, require that any national government permits that are issued in wetland areas located within coastal zone management areas must comply with any additional restricts established by a state's CZM program. It is possible, therefore, that the results may show that wetlands are better protected in WRUs where states have developed a CZM program regardless of the type of state wetland regulatory program that is present.

To date, no study has quantified how much, if any, influence these CZM programs may have on Section 404 permits in tidal areas. Some resource professionals suspect, however, that wetlands located in coastal zone management areas may be better protected by the section 404 program than non-tidal wetlands located outside of these areas. Because CZM programs are generally considered to be relatively effective regulatory programs, it is possible that there is some relationship between the two programs that could obscure a trend that might otherwise be discerned between the statute-based state wetland regulatory program and the Section 404 program (Kamieniecki et al., 1986; Chabreck, 1988; and Good et al., 1998). In anticipation of this possible relationship, this study includes an estimate of the amount of wetlands contained within each WRU that are subject to state CZM programs. By identifying what portion of the total amount of wetland resources within a WRU assumed to be subjected to section 404 regulations that are also subjected to CZM program restrictions, this estimate serves as a measure of the amount of influence potentially generated by the CZM program on the Section 404 program.

Estimates for the amount of wetlands subject to a CZM program within a WRU are based upon NOAA's Physical and Hydrologic Estuary Characteristics (P&H) dataset. This dataset contains information regarding a number of characteristics for areas determined by the agency's Coastal Assessment Framework as directly or indirectly draining into the ocean, or estuaries. Collectively, these drainage areas establish a national coastal watershed boundary. Included in the list of recorded characteristics for the area contained within the national coastal watershed boundary is an estimate for the amount of wetlands that is based upon the same land use classification system developed by USGS for the NLCS and applied to 1990's era satellite imagery of these areas. While the national coastal watershed boundary does not match exactly with the coastal zone management area boundaries established by state CZM agencies, enough overlap between the two designated areas exists that the amount of wetlands located within these drainage areas roughly approximates the total amount of tidal and non-tidal coastal wetlands that would be contained within CZM areas (National Oceanic and Atmospheric Administration, 1992). Estimates for these wetlands were created by intersecting the GIS land-use classification shapefile of these drainage areas with the WRU GIS shapefile and recalculating the amount of wetland acres for each new polygon area. These estimates are then recorded as a continuous variable in a Microsoft Excel spreadsheet for each WRU.

Expectedly, the resulting dataset developed by these calculations is considerably skewed. Forty-seven, over half, of the 87 total WRUs have no wetlands subject to CZM restrictions. Furthermore, the distribution of the amount of wetlands subject to CZM regulations in the remaining 40 WRUs also varies widely. The mean acreage of wetlands subject to CZM regulations in these WRUs may be 1,306,452 acres, but the St. Paul-Minnesota WRU has as few as 290 acres while the Alaska-Alaska WRU has as many as 21,319,000 acres. This broad variance results in a standard deviation of 3,903,131 acres.

Landscape Variables

The investigation into the geographic context of wetland regulatory programs conducted in Chapter Two revealed that there is considerable variation in the sizes of the WRUs. It also revealed that there is considerable variation in the distribution of the amount and types of wetlands in the United States.

Because WRUs are unequal in size, it may be necessary to normalize many of the independent variable data by the amount of area each unit occupies. Therefore, a column was recorded into a Microsoft Excel spreadsheet that indicates the size of each unit. These calculated sizes of the units were retrieved from the WRU GIS shapefile, and may be used to facilitate the statistical analysis.

In order to account for variations in the amount of potential wetland areas between WRUs, the wetland and deepwater habitat layers of the 30 square meter resolution NLCD GIS shapefile were intersected with the WRU GIS shapefile. The wetland and deepwater habitat layers estimate that there is a total of approximately 318,732,295 acres of wetlands in the nation and describes them into each of three categories; forested wetlands, emergent wetlands, and open water areas. The total amount of each of theses habitat types in each WRU were tabulated with the GIS software, and affirmed the unequal distribution of wetlands within the WRUs. The mean amount of wetlands in each WRU is 3,663,590 acres with a standard deviation of 21,917,023 acres. However, the Baltimore-Washington D.C. WRU contains the fewest wetlands at only 4,324 acres, while the Alaska-Alaska WRU contains almost two-thirds of the nation's total wetlands at 204,554,300 acres. These individual wetland acreage totals were recorded for each WRU in a Microsoft Excel spreadsheet as continuous datasets for inclusion in the study as independent variables and so they can be normalized by the size of each WRU.

Furthermore, the capability of analyzing relationships between wetland impacts and the abundance of different types of wetlands is made possible by keeping separate totals for each of the three different wetland types. This level of resolution has been retained because different wetland types are more commonly found in certain regions of the country than others, and lend themselves more easily to different types of conversion practices. Some investigative analysis may reveal interesting relationships that might be otherwise obscured by consolidating all of the wetland types into a single variable.

Socio-Economic Variables

The socioeconomic variables of population density, growth rates, and income are also included because of the potential relationships between these variables and land development pressures that were discussed in Chapter Two. U.S. Census Bureau decennial statistics for 1990 and 2000 are the primary sources of data for the socioeconomic variables considered in this study. 1990 and 2000 Census data are available in many formats at the census tract scale. Because of their size, census tracts were reorganized by the WRUs within which they exist. In order to generate census statistics for the WRUs, GIS shapefiles of all the census tracts in the nation during both periods of time were joined with the appropriate corresponding data tables containing the socioeconomic variables of interest. An automated GIS software routine was then used for both time periods to identify all tracts whose center is contained within each WRU and organize them accordingly without duplication between units. The census data for each time period of all of the tracts within each WRU was then summed together to create new WRU measures of population size and median family income levels for both years.

The total 2000 populations for each WRU were calculated using the GIS software and produced a fairly normally distributed dataset. The Memphis-Illinois WRU has the lowest population levels at 2,135 residents and the Los Angeles-California WRU has the most residents with 19,996,277. The mean WRU population is 3,235,735 with a standard deviation of 3,634,827. The population estimate for 2000 was included in the study because it describes a period of time lying inside the temporal extent of the study. The percent change in the 1990 and 2000 populations for each WRU was also tabulated and used as a measure of the amount of population change occurring within each unit over that period of time. The calculated population change is also relatively normally distributed. The mean population change in WRUs during the 10 years of this study was an increase of 11% with a standard deviation of the same amount. The Memphis-Illinois WRU had the greatest loss of population during this time at 24% while the Sacramento-Nevada WRU population grew by the greatest amount at 66%. Both of these measures are recorded for each WRU as continuous and ratio datasets respectively in a Microsoft Excel spreadsheet for inclusion as independent variables in this study.

Median family income for 2000 was the final socioeconomic variable collected for this study. The 2000 median family income of each census tract within each WRU was used to recalculate a summary median family income for each WRU. These data from the 2000 census were chosen because they describe family economic conditions during a time that lies within the temporal extent of the study. The calculations revealed that median family incomes are fairly normally distributed among the WRUs. The mean median family income is $46,761 with a standard deviation of $8,521. The lowest median family income of $30,449 is earned in the Huntington-Kentucky WRU, while the highest median family income of $71,343 is earned in the San Francisco-California WRU. This measure was calculated and recorded for each WRU in a Microsoft Excel spreadsheet for inclusion as an independent variable in this study.

Administrative Resource Variables

Variations in the administrative resources of each USACE district were obtained through an information request from each USACE district. The information request solicited information concerning the annual operational budget for each district from 1994 through 2003. It also solicited information concerning the number of regulatory staff in each district for each year of that time frame. Conversations held with USACE staff throughout the development of this study proposal suggested that each district had this information and they were willing to provide it for inclusion in this study, and the received data confirmed these suggestions (Sudol, 2004 and McCorcle, 2005).

The mean budgets and staff sizes each USACE district received during the ten year span of this study were recorded. As most districts make little distinction along state lines as to how funding and staff resources are dedicated, it is assumed that these resources are available universally throughout a district. As a result, for those USACE districts that contain more than one WRU, both the average staff and budget sizes were recorded as ratios relative to the area of the USACE district occupied by each WRU. These calculations resulted in a mean WRU regulatory branch average annual staff size of 13.02 Full Time Equivalents (FTEs) with a standard deviation of 14.15 FTEs, and a mean WRU regulatory branch average annual budget of $1,257,189 with a standard deviation of $1,445,495. The Memphis Illinois WRU has the least amount of administrative resources with only an average annual of 0.02 FTEs and an average annual regulatory branch budget of approximately $1,746. The Jacksonville Florida WRU has the greatest amount of administrative resources with an average annual of 79.31 FTEs and an average annual regulatory branch budget of approximately $ 7,973,750. These continuous variables were then recorded in a Microsoft Excel spreadsheet for inclusion in the study as independent variables.

Identifying from which of the eight USACE divisions each district receives its oversight, however, was obtained in a more straightforward fashion. The USACE district GIS shapefile already contains a data field with that information. Once retrieved, this variable was recorded as a nominal variable in a Microsoft Excel spreadsheet.

Conclusion

This study has constructed a sizable database filled with both top-down and bottom-up variables related to state and national government wetland regulatory programs. In addition, it includes several previously unpublished measures of USACE program outcomes. This total dataset is the culmination of over 10 years of data collection, verification, analysis, and publication by several federal and state agencies. It also represents the expense of considerable resources from federal and state coffers. In addition, in order for the data to be processed, it has required over two years of assembly and manipulation and a year of testing and analysis.

Accordingly, this database has the potential not only to answer this study's questions of interest, but to be used as a stepping stone that could touch-off a variety of different research projects aimed at better understanding both wetland management policies and intergovernmental relations. This chapter outlined the methods that were used to identify, and collect the data as well as construct the final database. It included a defense of the chosen unit of analysis and the temporal extent for the study and a discussion of the most appropriate means for including a measure of wetland impact as the dependent variable. There was also a description of the primary intergovernmental relations independent variable as well as several sources of geographic, socio-economic, and administrative variation. While the assembly of this database represents a large undertaking unto itself, it is not the only intended contribution of this study. Ultimately, upon final analysis using the methods described in the following chapter, the results of this examination will help answer both a specific question of interest regarding the discipline of intergovernmental relations and provide wetland regulators with an increased awareness of the programs they administer.

ANALYTICAL METHODS

Introduction

This investigation fits the overall profile of a fixed design. The study depends heavily upon quantitative datasets that take the form of ratio, continuous, and categorical variables. The terms investigated were identified in advance of the data collection as were the data collection and classification methods. Table 4.1 describes all of the terms this study investigated. It describes each variable's role in the study, the unit of measure that was used and the data type produced by each value. Concluding the table is a sample of how the data collected for all of the WRUs was recorded.

Once the data were collected for each of the variables and compiled into a Microsoft Excel spreadsheet, it was imported into S-Plus Version 6.1 software that was used to conduct the statistical analysis. Seven sets of analytical tools were primarily used in the analysis of the data; two-sample t-tests, analysis of variance f-tests, multivariate analysis of variance f-tests, simple linear regressions, multiple linear regressions, extra sum of squares f-tests, and logistic regressions.

The centerpiece of this study was the creation of a multiple linear regression model that describes the total amount of wetland loss permitted in each WRU from 1994-2003. The applicability of this analytical model was chosen in consultation with the staff of the statistics student consulting services available through the statistics department at Oregon State University. The process of receiving this group's recommendations included sharing with the consulting staff, each of the datasets collected for this study along with a description of this study's primary questions of interest and the background of the problem. The staff members then met with faculty advisors and collectively developed a number of recommendations for the construction of the analysis section of this study. These recommendations included the suggestion to create a multiple linear regression design for the permitted wetland loss model.

Assumption Testing

In pursuit of constructing this study's model of permitted wetland loss, each of the datasets proposed for inclusion in this model were reviewed to check that they met the assumptions for a multiple regression analysis. The subpopulations of each dataset must have a normal distribution that is not affected by the presence of substantial outliers. There must be a linear relationship between each independent variable and the study's primary response variable. The variance from the mean of the values for each dataset must not vary with the values of the primary response variable. There must also be a lack of interdependence between all of the independent variables included in final regression model. Ensuring that the datasets used in this analysis meet all of these necessary assumptions reduces the chances of creating Type I statistical errors.

A series of graphical diagnostic tools were used to help identify any potential violations of each of these assumptions. Box and whisker plots of the distribution of each dataset in conjunction with Normal-QQ plots of the residuals from a simple regression between that dataset and the study's primary response variable were used to diagnose potential violations of the normal distribution assumption. A plot of the calculated Cook's Distance for each variable from a simple regression against the study's primary response variable was used to identify any potential outliers that might have both large enough departure and leverage to disproportionately influence the performance of the model. Linearity of the relationships between each dataset and the study's primary response variable was verified both with scatter plots of a variable against the response and a plot of the residuals from a simple regression against the response. The results of these simple regressions were also used to verify the linearity of the relationships. Constant variance was also diagnosed from this same plot of the residuals from a simple regression against the study's primary response variable. Finally, the lack of interdependence of each dataset was verified with a correlation analysis of each of the independent variables included in the final multiple regression analysis.

For some datasets, these graphical diagnostic tools suggested that no additional manipulation was necessary in order for the variables to be included in the final multiple linear regression model. For other datasets, these diagnostic analyses suggested that some of the datasets required additional manipulation before they could be included in the final multiple linear regression model. Some of these manipulations were extensive while others were minor. In some cases, data transformations and interactions between terms was necessary in order to eliminate some skewness in distribution, abnormality in spread, and interdependence that was encountered. Likewise it was also necessary to occasionally remove outliers from the analysis when they are shown to exhibit undue influence on the analysis, or were inaccurate. It was also necessary to exclude certain variables altogether that were found to be too strongly correlated with other independent terms. The results of the assumption tests for each of the independent variables included in the final multiple linear regression model are included in their respective appendices at the end of this study. The results of the assumption tests for the study's response variables are presented in Chapter 6.

Independent Variable Analyses of Variances

Preliminary analyses were also conducted to identify any potential individual relationships in each dataset with the type of state wetland regulatory program present in each WRU. These analyses were intended to point to potential characteristics that may be unique to WRUs subject to each of the three different types of state wetland regulatory programs. In order to asses these potential differences, each WRU was classified according to the type of state wetland regulatory program that was present. An analysis of variance F-test was then conducted for each variable that compared the amount of difference between groups of each of the three types of state wetland regulatory programs. The results of each of these analysis of variance F-tests are presented in their respective appendices at the end of this study along with the assumption tests for each of the independent variables included in the final multiple linear regression model.

Response Variable Analyses of Variances

The primary response variable of this study is the total amount of wetland fill permitted in each WRU. It was not, however, the only potential response variable that was investigated. The total amount of permitted wetland fill in a WRU is a summary of the amounts of fill permitted though both general actions and standard actions in both tidal and non-tidal wetlands. Because potential differences may exist in the amount of wetland fill permitted in WRUs that are dependent upon the type of wetland that is affected or the type of permit that is issued, this study also tested the applicability of the final multiple linear regression model to each of these subcategories of response variables.

As this study breaks considerable new ground within the discipline of wetland regulation research, there is a sizable exploratory component to the investigation. As a result, some secondary response variables are also evaluated by the analysis. In addition to the primary response variable of the amount of permitted wetland fill, the average annual total number of permits was also investigated. Like the total amount of permitted fill, this secondary dataset is also a summary of multiple subcategories of data. The total number of issued wetland fill permits is a sum of both the number of standard permits issued and the number of general permits issued in WRUs. The study, therefore, also investigated the applicability of the final multiple regression model to the average annual total number of permits issued as well as to the numbers of both of the subcategories of permits.

In addition to the average annual total number of issued permits, another set of secondary response variables were also evaluated. The total permit ratios and mitigation ratios of WRUs were also tested as potential response variables for the final multiple linear regression model. As before, these total ratios are the sum of the permit and the mitigation ratios for wetland fill activities permitted in both tidal and non-tidal wetlands and through both general and standard actions. The study, therefore, investigated both the total permit and mitigation ratios as well as each of the subcategories of these ratios.

After each of the subcategories and totals of the primary and secondary response variables were tested and/or manipulated in order to meet the necessary assumptions of the multiple linear regression model, preliminary analyses were conducted to identify any potential individual relationships in each dataset with the type of state wetland regulatory program present in each WRU. As with the independent variables, these analyses were intended to point to potential characteristics that may be unique to WRUs subject to each of the three different types of state wetland regulatory programs. As before, the ability to asses these potential differences was facilitated by classifying each WRU according to the type of state wetland regulatory program that was present. An analysis of variance f-test was then conducted for each variable that compared the amount of difference between groups of each of the three types of state wetland regulatory programs.

A more complete picture about how WRUs differ from one another in terms of permitted wetland fill activity was provided by additionally conducting a series of two-sample t-tests. These tests were conducted on each of the response variables in order to describe the amount of any potential differences that may exist between the subcategories of these variables. Specifically, these t-tests were used to determine how differently general and standard actions differ not only in the number of permits that are issued, but also in the total amounts of wetland fill that are permitted, as well as in the mitigation and permit ratios that are approved. They were also used to determine similar differences between the two types of wetlands within which wetland fill permits are issued. The results of these t-tests are described in Chapter 6 along with the results of the analysis of variance f-tests and the assumption tests for each of these response variables.

Multiple Linear Regression Analysis

Having tested the validity of the data for the response variable and each of the potential independent variables for inclusion in the study, it became possible to construct the study's multiple linear regression model for permitted wetland loss. The Akaike's Information Criterion (AIC) was used to select a final multiple linear regression model from all of the potential independent variables and the proposed interactions between them that were identified through the course of this research effort.

AIC scores are calculated for models based upon how well the terms of that model describe the data included after assessing a penalty for the total number of terms included in that model. The model with the lowest AIC score on a particular scale has the least amount of bias and the greatest amount of explanatory power. As a result, this model also includes the highest number of relevant terms. During a step-wise regression exercise, S-Plus software establishes a single scale of reference for the set of variables being evaluated. It then alternates individually adding and subtracting each of the proposed variables to a regression model until it arrives at a model with the lowest AIC score possible on that scale from the available variables. A model arrived at by this method includes the greatest number of terms that significantly improved the fit of the model and is therefore, the most rich model that can be constructed from the provided terms. The overall goodness of the fit of this model was then ultimately evaluated both by all of the graphical diagnostic tools previously described and by an examination of the R-squared standard errors and residual values produced by the model. The results of this model selection process and the analysis of the model's goodness of fit are presented in Chapter 7.

Hypothesis Testing

The central hypothesis of this study asks if the amount of permitted wetland fill is significantly different in WRUs subjected to statute-based wetland regulatory programs than in WRUs subjected to other types of state wetland regulations. This question was answered by adding an indicator variable for state wetland regulatory program type to the final multiple linear regression model of permitted wetland loss. An extra sum of squares f-test for the addition of this term was then used to determine if a significant difference could be measured. After this test was conducted on the model for the primary response variable, it was repeated on all of the other subcategory and secondary response variables. The results of these F-tests are presented at the end of Chapter 7.

Logistic Regression Analysis

Having found no evidence to support the hypothesis that there is a significant difference in the amounts of permitted wetland fill between WRUs under the authority of different types of state wetland regulatory programs, answers to a follow-up question were sought. In order to determine the characteristics of any of the discussed response variables that distinguish WRUs with statute-based wetland regulatory programs apart from WRUs with other types of state wetland regulatory programs a two-state logistic regression was constructed. This regression first identifies those WRUs subject to no active state wetland regulatory program from those WRUs subject to either the statute-based or section 401 state wetland regulatory programs. Next, it identifies those wetland regulatory program outcomes for which the measures are significantly different between each group.

The second stage of this logistic regression was conducted solely upon the subgroup of WRUs subjected either to statute-based wetland regulatory programs or Section-401 based wetland regulatory programs. This analysis then made it possible to determine those response variables for which their measures distinguish these two groups of WRUs from one another. The strength of the evidence behind each assessment of potential differences was supported by the results of a t-test for every program outcome measure. The results of these procedures are included in Chapter 8.

Potential Errors and Interpretation Standards

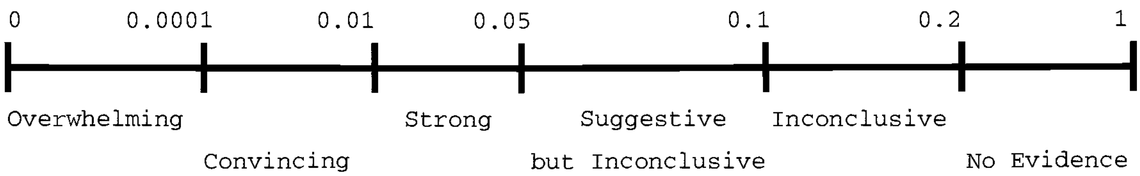
Although this study encompasses the entire universe of WRUs, it still only involves a relatively small number of cases, n=87. This small number of cases considerably reduces the analytical power of this study, making it highly susceptible to Type II errors. Because of the high likelihood of not rejecting a null hypothesis that should be, extra care must be taken in the interpretation of this study's analytical results. These concerns lead to the adoption of a standard of qualifications that were applied to each set of interpretations.

The traditional 5% confidence level that is widely accepted across the literature was still applied as the rejection threshold for the purpose of committing Type I errors. The relatively high potential for committing Type II errors, however, causes qualified interpretation of results especially in between the 5% and 10% confidence level. The purpose of expressing these qualifications on the strength of the evidence is not to reduce the significance standards of the study and to reject null hypotheses that would otherwise would not have been, but to establish a method for identifying those potential relationships that may likely be victims of Type II errors and highlight them for additional exploration by future analyses with larger population sizes or more sensitive instrumentation.

For this reason, a standard of interpretation was adopted from an adaptation of guidance presented in the Statistical Sleuth (Ramsay and Schafer, 2002). For evidence below the 0.0001 confidence level the results will be interpreted as producing overwhelming evidence that a null hypothesis should be rejected. For evidence between the 0.0001 and 0.01 confidence levels, the results will be interpreted as producing convincing evidence that a null hypothesis should be rejected. For evidence between the 0.01 and 0.05 confidence levels, the results will be interpreted as producing strong evidence that the null hypothesis should be rejected. No evidence that the null hypothesis should be rejected will be considered to be produced for any results above the 0.2 confidence level. For any evidence produced between the 0.05

and the 0.2 confidence levels, the results will be considered inconclusive, however, if the evidence lies between the 0.05 and the 0.1 confidence levels the results will still be considered suggestive. This confidence scale is illustrated below in figure 4.1.

*Figure 4.1 Confidence scale for results interpretation.**

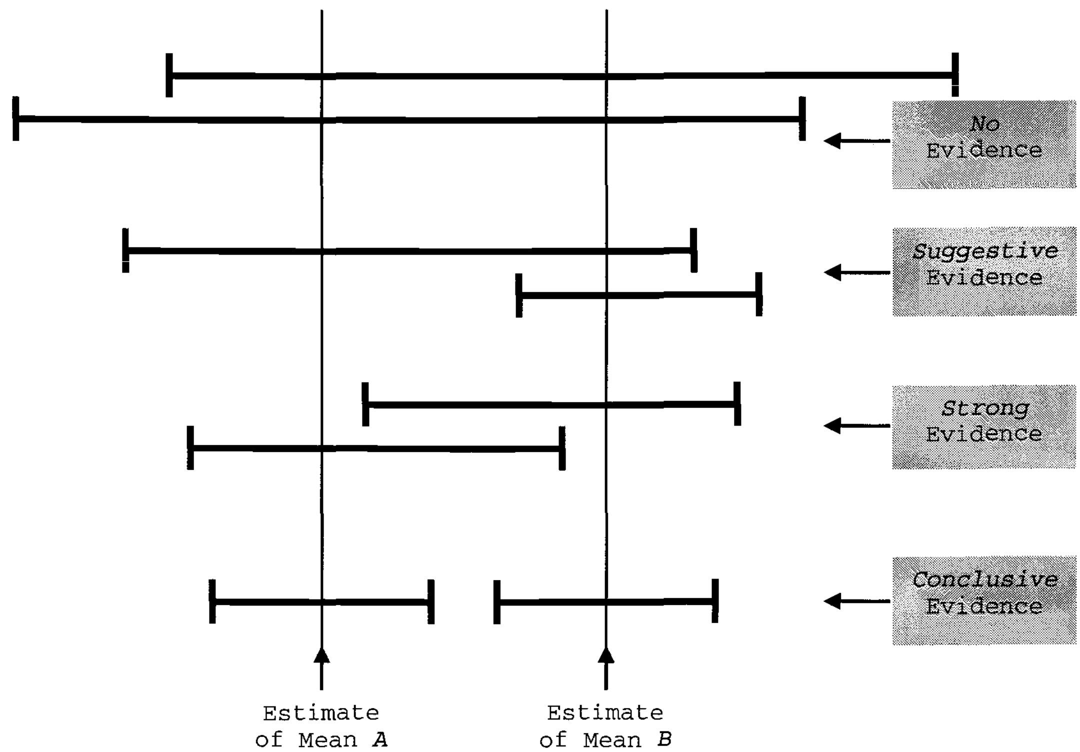


**(Adapted from Ramsay and Schafer 2002)*

The above confidence scale was applied without prejudice to the results from all logistic and linear regression tests as well as to any extra sum of squares f-tests and simple regression analyses. Interpretation of the strength of the evidence presented by each analysis of variance f-test or two sample t-tests with results within the 0.05 and 0.2 confidence region, however, was facilitated by an analysis of the amount of overlap that exists between the confidence intervals for each of the estimated means involved in the analyses. Analyses of the amounts of overlap between confidence intervals were facilitated by the graphical diagnostic tools provided by Tukey-Kramer 95% confidence level comparison produced by S-plus V6.1software.

In cases where confidence intervals for the estimated means are completely mutually exclusive the term "convincing" was used to describe the evidence of the differences in the means. In cases where the confidence intervals for the estimated means overlap, but they still mutually exclude the values of the estimated means themselves the term "strong" was used to describe the evidence of the differences in the means. In cases where only the confidence interval for one of the estimated means also incorporates the values of the other estimated means, the term "suggestive but inconclusive" was used to describe the evidence of the differences in the means. In cases where the confidence intervals of both estimated means mutually include the values of both estimated means, the term "no evidence" was used to describe the lack of any discernable differences in the means. The term "overwhelming", however, was reserved exclusively for those results for which the confidence level exceeds 0.0001. Figure 4.1 illustrates a modified version of the way the four cases of overlap were presented in *The Statistical Sleuth* (Ramsey and Schafer, 2002). In addition, as a rule, the size of the differences between those means for which there was sufficient evidence to reject the null hypothesis were fully discussed in the results of this study, whereas those differences for which evidence for rejection of the null hypothesis was inconclusive was not elaborated upon.

*Figure 4.1 Interpretation of overlap between confidence intervals.**



**(Adapted from Ramsay and Schafer 2002)*

Conclusion

The preceding analytical methods describe an attempt by this study to accomplish three tasks. Through the use of these methods it is intended foremost, that several potential characteristics that influence the output of the USACE wetland regulatory program will be identified and presented for the first time in the literature. Secondly, it is intended that characteristics that are both unique and meaningful to WRUs subjected to each of the three different types of state wetland regulatory programs will be discovered. Finally, a convincing argument will be built for the legitimacy of not only the dataset used to develop the response variables, but also the unit of analysis that was used. In the process of accomplishing these tasks, answers to the primary hypothesis regarding the nature of the intergovernmental relationships of the national wetland regulatory program will be revealed.

Table 4.1 Data characterizations and examples.

Variable Class	**Unit of Analysis**		**Dependent Variable**	**Independent Variables**									
	District	**State**		**IGR Variable**	**Landscape Variation**		**Confounding Program**	**Socioeconomic Variations**			**Administrative Variations**		
Variable Definition	Name	Name	Wetland Impact	Program Type	Potential Wetlands	Size	State CZM Program	Pop	Pop Growth	Family Income	Budget Size	Staff Size	USACE Division
Proposed Measure	Name	Name	Acres of Permitted Wetland Fill	Indicator	Acres	Acres	Indicator	People	Change in People	Dollar	Dollars	FTE	Name
Data Type(s)	Nominal	Nominal	Contin-uous	Nominal	Contin-uous	Contin-uous	Binary	Contin-uous	Ratio	Contin-uous	Contin-uous	Contin-uous	Nominal
WRU	**DATA EXAMPLES**												
Alaska Alaska	Alaska	Alaska	20985.18	401	204554300	369119241	CZM	626932	0.14	59036	6146457	61.18	Pacific Ocean
Buffalo New York	Buffalo	New York	1328.24	Statute	1200332	20625508	CZM	4669807	0.00	45007	2535948	23.73	GL & Ohio River
Buffalo Ohio	Buffalo	Ohio	2261.59	401	306400	7153192	CZM	4020539	0.04	49140	879499	8.23	GL & Ohio River
Charleston South Carolina	Charleston	South Carolina	6641.88	401	3636047	19795560	CZM	4012012	0.15	44227	2770584	26.67	South Atlantic
Chicago Illinois	Chicago	Illinois	1746.75	State Statute	138914	3424927	No CZM	8344158	0.12	59659	1779714	15.00	GL & Ohio River
Detroit Indiana	Detroit	Indiana	156.28	401	209124	4173157	CZM	1755441	0.08	47256	404299	4.04	GL & Ohio River
Detroit Michigan	Detroit	Michigan	1051.31	State Statute	7423625	37026478	CZM	9938444	0.07	53457	3587156	35.86	GL & Ohio River
Fort Worth Texas	Fort Worth	Texas	4340.98	401	2832504	93214198	CZM	12043377	0.24	48924	1429291	13.74	Southwestern
Galveston Louisiana	Galveston	Louisiana	105.17	No Program	89561	384968	CZM	14884	0.07	40808	54029	0.52	Southwestern
Galveston Texas	Galveston	Texas	5153.57	401	2437071	27400247	CZM	7285556	0.24	46542	3845517	37.12	Southwestern
Kansas City Kansas	Kansas City	Kansas	2389.00	401	925187	52608621	No CZM	2688418	0.09	49624	1806950	19.37	Northwestern
Kansas City Missouri	Kansas City	Missouri	2389.00	401	1108164	23210701	No CZM	2304363	0.11	44006	797219	8.54	Northwestern

ESTABLISHMENT OF WETLAND REGULATORY UNITS

Introduction

The unit of analysis chosen for this investigation is the Wetland Regulatory Unit (WRU). As previously discussed, the WRU is a geographic unit that combines state and U.S. Army Corps of Engineers (USACE) territorial units. The use of WRUs plays a significant role in the ability to analyze state and national wetland regulatory efforts. Furthermore, their identification makes relevant analyses of the socioeconomic and political aspects of wetland regulatory programs possible. WRUs are, however, only being formally described in the literature for the first time in this study.

To date, most wetland loss and management studies have focused on wetland conditions and trends at either the state or national scale. Furthermore, although USACE districts record data at the WRU scale, headquarters strictly assesses the performance of its wetland regulatory efforts along district regulatory boundaries. For the permit applicant, however, wetland regulations are WRU specific, and it is at the WRU scale that wetland permit programs actually operate.

This study could have followed suit with previous efforts and chosen either state or USACE district boundaries to delineate the units of analysis. Doing so, however, would have been to deny both the true anatomy of the national wetland regulatory program and an opportunity to better describe the nature of modern federalism in the United States. WRUs, more accurately reflect the layout of the current regulatory landscape than do state or district boundaries alone. Furthermore, in order to address the issue of state-national relationships, the identification of jurisdictions that discretely delineate the extent of each potential relationship is fundamentally necessary. It was decided, therefore, that establishing WRUs into the body of literature as a viable unit of analysis could help broaden the understanding of the complexities of wetland regulatory efforts.

Perceived Administrative Problems of WRUs

While the term "WRU", itself, is not used among wetland regulators, this study demonstrates that the concept behind the term is well known. In fact, it can be surmised from the data presented below that both regulators and the regulated community alike have not only identified the concept of operating in multiple WRUs as an impediment to the efficient implementation of wetland regulatory programs, but that they have also actively worked to reduce the impact the boundaries of these units have on the regulatory process.

While USACE district jurisdictional boundaries may not have been originally established with wetland regulations or resources in mind, the WRUs they have created have real implications both to participants in the wetland regulatory process, and to the wetland resource. Dividing individual states or USACE districts into multiple WRUs increases the complexity of the wetland regulatory landscape and has an impact both on the way state and national government wetland regulatory programs are administrated by their authorized agencies, and the way they are negotiated by their affected constituencies.

According to Mr. Marvin Hubbell, (former wetland regulatory program administrator for the State of Illinois, and special assistant to the Chief of the USACE), USACE regulatory staff whose district covers multiple states must review projects that are often times similar in purpose and amount of impact, but are subject to different sets of state water quality standards. The USACE district itself may also establish and enforce different regional conditions for similar projects that are located in different states, if they deem the conditions of those states to warrant such discrimination. It should be noted that these different regional conditions may exists regardless of the type of state wetland regulatory program that exists as they are developed internally by the USACE with public comment provided by any interested party with standing. As a result, district staff must be able to juggle different sets of standards for different permits (Hubbell, 2005).

Further evidence of the complexity of this management problem may be found by a search of USACE district websites which routinely post multiple pages of different state-specific conditions for similar permit actions. Sometimes districts even make entirely different application packets available that are specific to the different states under their jurisdiction.

These boundary inconsistencies also affect permit applicants that operate within a specific state. Depending upon where their project is located, applicants may be required to contact different USACE district offices, which can sometimes be located in different states. Furthermore, their projects may be subject to different regional conditions. Mr. Hubble also suggests that, a common complaint of the regulated community is that, because of the existence of WRUs, similar projects can have different requirements placed upon them even if they are located in the same state, or in the same district (Hubbell, 2005).

Boundary Realignment

The effort to articulate the existence of WRUs and to define their location and relevancy to this study has, until now, largely been a descriptive exercise. This process has, however, uncovered one predominant characteristic of this potential unit of analysis that warrants additional analytical scrutiny. The fact that a significantly smaller number of WRUs actually exist than are potentially possible creates a circumstance that brings forth additional understanding as to the importance of WRUs as a part of the nation's wetland regulatory landscape.

It has been discussed that the extent of overlap between USACE district civil boundaries and state boundaries could potentially create 152 WRUs (Figures 5.1 and 5.2). Many of these potential WRUs are small, and often either provide a given

USACE district with authority over tiny geographically isolated and remote regions of states, or split otherwise homogeneous regions of a single state into different USACE districts.

Figure 5.1 Civil boundary WRUs.

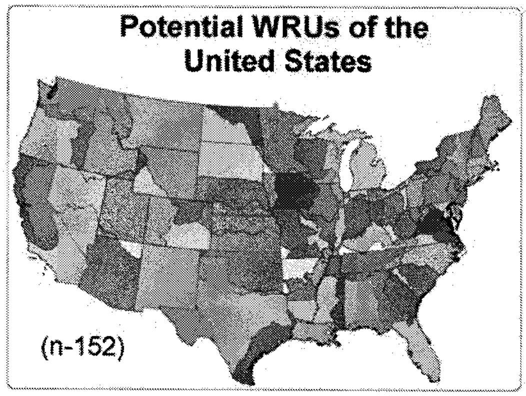
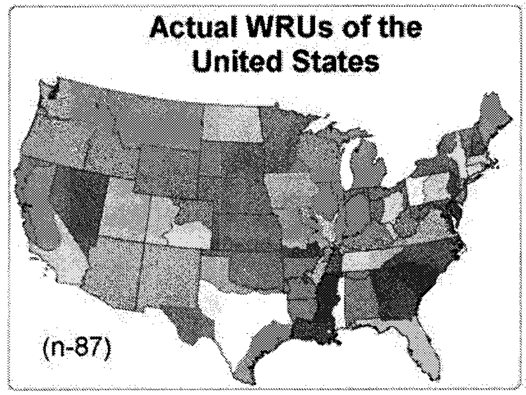
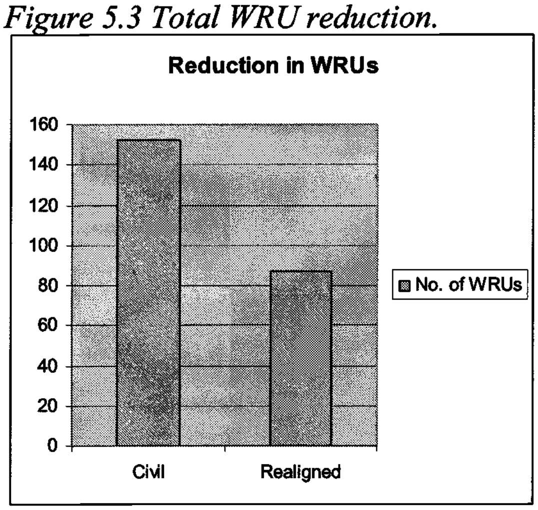


Figure 5.2 Regulatory boundary WRUs.



In the process of verifying that USACE district regulatory boundaries actually follow their formal watershed-based civil boundaries, it was discovered that, in many cases, USACE district regulatory boundaries deviate significantly from their civil boundaries. While the civil boundaries of USACE districts do intersect with state boundaries to create 152 unique regions of overlap, 84.2% (32) of the USACE's 38 districts have engaged in either formal or non-formal agreements with neighboring USACE districts and/or state agencies to realign their regulatory boundaries in an effort to reduce the number of states over which they administer their regulatory authority. As a result of these efforts, it has been determined that there are actually only 87 functional WRUs in the country (Figure 4.2). This is a reduction of 42.8% of the total number of WRUs in the nation (Figure 5.3). It is suggested here, that this

Figure 5.3 Total WRU reduction.



reduction in the number of WRUs represents a significant action on the part of USACE regulators to simplify the wetland regulatory process.

As a result of efforts to reduce the number of WRUs, there has been 44.1% reduction in the median number of states within each USACE district. Potentially, there is a median of 3.4 states per district, but because of boundary realignments the actual median is 1.9 (Figure 5.4). Furthermore, while there were originally only four potential districts completely contained within one state, these boundary realignments increased that number by two and a half times to 14. This translates to a 29.4% reduction in the total number of USACE districts split between multiple states, 34 reduced to 24 (Figure 5.5). Consequently the maximum number of states within one district also decreased from nine to six, a reduction of one-third (Figure 5.6). The significance of this reduction in the amount of states per district is supported by a two sample t-test with a p-value of 0.0001.

Figure 5.4 Median no. of states/district.

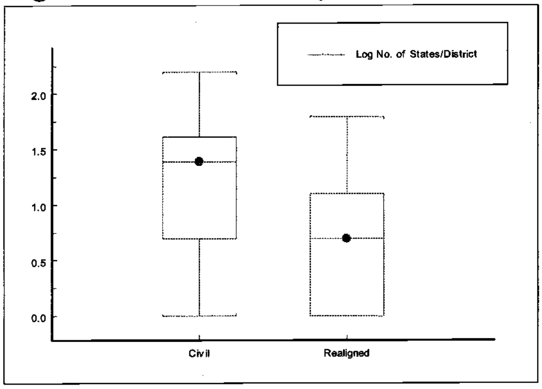


Figure 5.5 Multi-state district reduction.

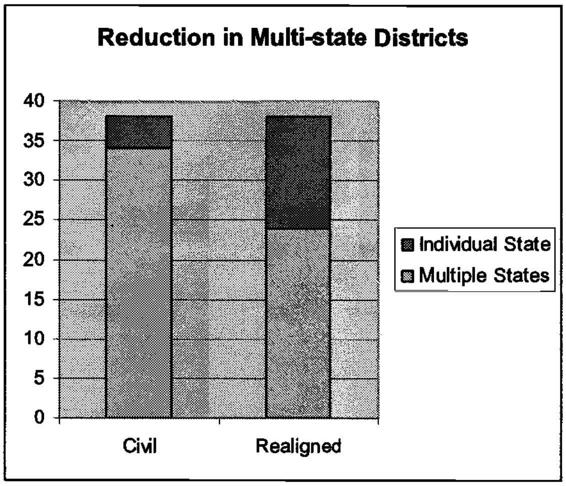
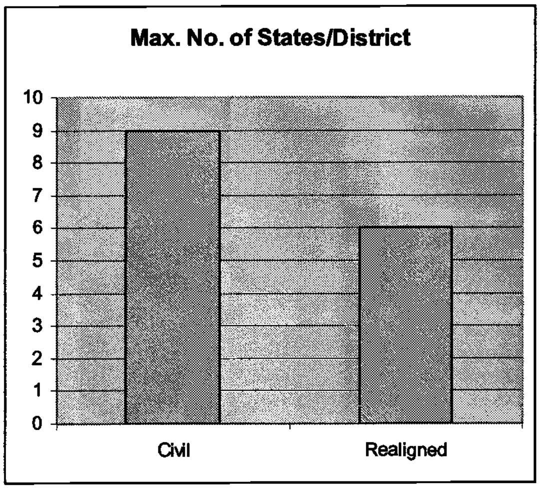


Figure 5.6 Max. no. states/district.



In addition, boundary realignment efforts have caused a 46.2% reduction in the median number of USACE districts within each state. While there is a potential median of 2.6 districts per state, boundary realignments have resulted in a median of 1.4 (Figure 5.7). Furthermore, while only seven potential districts were completely contained within one state, boundary realignments have increased that number five-times to 35. This results in a 63.6% reduction in the total number of states split between USACE districts, 44 reduced to 16 (Figure 5.8). Likewise, the maximum number of districts within one state also decreased from seven to five, a reduction of 28% (Figure 5.9). A two-sample t-test of this reduction in the amount of districts per state with a p-value <0.0001 demonstrates that this is also a significant change.

Figure 5.7 Median no. of districts/state.

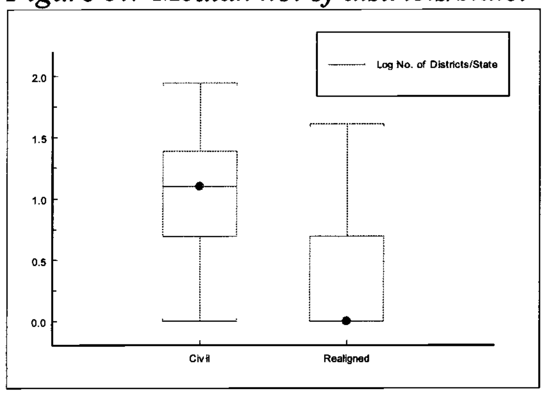


Figure 5.8 Multi-district state reduction.

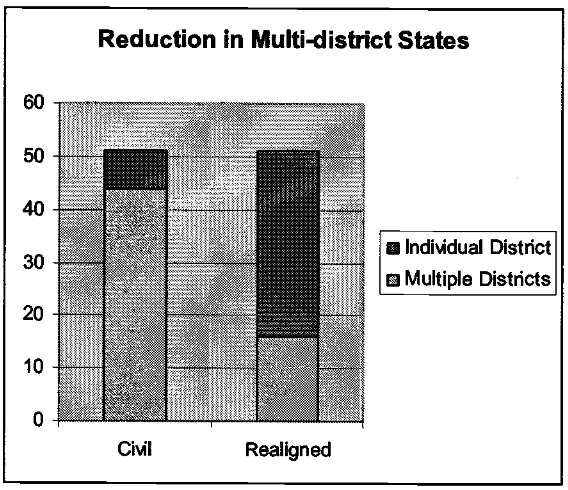
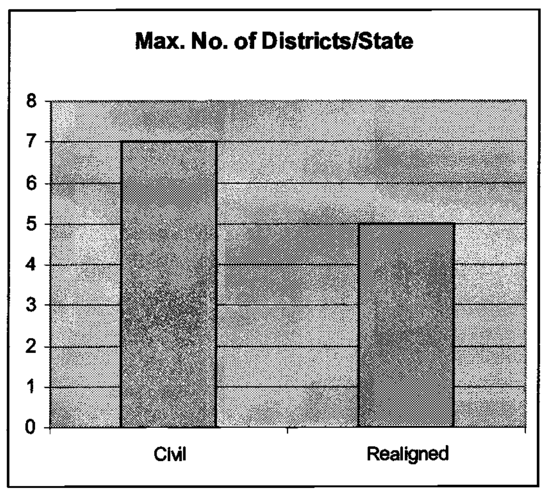


Figure 5.9 Max. no. districts/state.



Relevancy

When discussing the cause of the 42.8% reduction in the number of potential WRUs with USACE district administrators, the benefits to both the regulators and the regulated community associated with simplification were cited as the major reasons for pursuing the boundary realignments. It is perceived by the USACE that reducing the number of states per district to the fewest necessary provides a benefit to regulators by reducing the number of different state-specific regulations they must enforce. Furthermore, it is assumed that establishing a single district with authority in a given state provides a benefit to regulators by reducing the number of different potential contacts they have to make with regulators as well as the number of different district-specific regional conditions with which they must comply. The perceived need to reduce confusion for the regulated community and for regulators to administer as few different regulations as possible has driven the efforts to reduce the number of WRUs (Hubbell, 2005 and McCorcel, 2005).

Most of the USACE districts with realigned regulatory boundaries realigned them prior to the beginning of the time-period covered by this study. The current number of 87 WRUs does not, however, represent the fewest WRUs possible. It is still possible to obtain additional gains in streamlining the national wetland regulatory program by eliminating 36 more WRUs. There are enough opportunities to realign regulatory boundaries remaining within USACE districts to allow the total number of WRUs to be reduced to 51, the total number of states including the District of Columbia. With the few exceptions of districts operating in the states of California, Texas, and Colorado, the majority of these opportunities lie within the districts that have not yet completely realigned their regulatory boundaries along state lines are within the drainages of the mainstems of the Ohio and Mississippi Rivers.

Efforts to continue boundary realignment are currently being pursued in this region of the nation; however, as WRU elimination efforts are currently underway in some of these USACE districts. In fact, at the time of this study, the Huntington district had just issued a public notice declaring its intent to realign its boundaries in order to exchange Louisville's Ohio WRU for Huntington's Kentucky WRU (Berwick, 2005). In addition, as a result of requests by the State of Illinois in 1996, the Rock Island District is currently functioning as the "lead" district in the state of Illinois for the purpose of coordinating statewide consistency of nationwide permit regional conditions between the five USACE districts operating within in the state, while the Louisville District is performing a similar role in the States of Kentucky and Indiana. These latter types of efforts at statewide consistency do not serve the purpose of eliminating the number of WRUs, but they are intended to reduce some of the effects of administering multiple WRUs.

Currently, however, sufficient USACE district boundary realignment has already occurred to create enough single-district and single-state WRUs that, for the sake of analysis, the lines differentiating the geographical units are beginning to blur. In fact, a simple bivariate correlation analysis reveals that the total amount of permitted wetland fill recorded for each WRU is strongly correlated to both the total amounts of wetland fill recorded for each state and for each district. Table 5.1 illustrates a summary of this correlation analysis.

Table 5.1 Correlations between recorded amounts of permitted wetland fill.

	WRU Fill	State Fill	District Fill
WRU Fill	1.0000	0.8602	0.8838
State Fill	0.8602	1.0000	0.7916
District Fill	0.8838	0.7916	1.0000

To be sure, the amount of permitted wetland fill recorded for states and USACE districts are highly correlated to begin with (correlation of 0.7916). The amount of permitted wetland fill recorded for the 87 WRUs, however, is considerably more strongly correlated with the total amount recorded for each state (correlation of 0.8602). Furthermore, the amount of permitted wetland fill recorded for the 87 WRUs is even more strongly correlated with the total amount recorded for each district (correlation of 0.8838).

This correlation summary suggests that while there may not be much difference between states and USACE districts, at least in terms of permitted wetland fill, there is considerably less difference between WRUs and states, and even less difference still between WRUs and Districts. It appears, therefore, that the efforts of the USACE to reduce the number of WRUs has succeeded in reducing differences between states and districts by creating a common ground that is statistically more similar to both of them than they had been to each other.

This suggests that with some exception, the amount of wetland fill permitted for a WRU can be described almost as well by the amount of wetland fill permitted in the state or district of that WRU. Therefore, for the sake of future comparisons between this study and others, it may make little difference whether state, USACE district, or WRU boundaries are used to delineate the unit of analysis. WRUs do, however, have the inherent analytical advantage in this study over states and districts of being more robust because they have the largest population of subjects, n=87 instead of n=51 or n=38

Conclusion

WRUs are real components of the wetland regulatory landscape. The overlap of state and district jurisdictions has created unintended, but real administrative boundaries that have the real potential to affect regulators, applicants, and the wetland resource alike. The potential of these administrative boundaries to affect the national government's regulatory program is best evidenced by the amount of action taken by the USACE to eliminate unnecessary WRUs and the reason for those actions. Over the life of the national wetland regulatory program, the USACE has made, and continues to make, significant progress towards reducing the number of WRUs across which it must administer its authority. These efforts have been predicated on the grounds that the efficiency of the regulatory process is compromised by excessive numbers of WRUs.

The pursuit of WRU reduction has resulted in a virtual consolidation of most, but not all, state, district, and WRU boundaries. As a result, several boundary realignment opportunities still exist, but are becoming increasingly rare. Because there are fewer USACE districts than states, however, the existence of a baseline number of WRUs is necessary. As a result, they are likely to remain a part of the wetland regulatory landscape for some time to come.

Since WRUs appear to be a persistent and real feature of the regulatory landscape, it seems irresponsible to construct an analysis of the nexus between state and national government wetland regulatory programs that does not incorporate this feature. More broadly, however, if both wetland regulators and the regulated community perceive a reduction in the number of WRUs as a legitimate course of action that will improve wetland regulatory efforts, then the literature should explore the nature of these administrative units more fully or at least acknowledge their existence. It may be possible that the study of these units could play a significant role in increasing our understanding of the performance of wetland regulatory efforts.

NATIONAL WETLAND REGULATORY PROGRAM OUTCOMES

Introduction

The Federal Clean Water Act establishes a wetland regulatory program that, by design, should create a relationship between the national and state governments on issues regarding wetlands that fit a separated-authority-model of intergovernmental relations. The theory that has come to dominate the discipline of intergovernmental relations in recent years, however, suggests that national-state government relationships in the United States are never adequately described by this model. The currently popular overlapping-authority model reasons that there has come to be so much interdependence between the two levels of government that the actions of one level of government are bound to be influenced in some way by the other level of government.

National and state governments take action and interact with one another through the programs they implement. Likewise, the outcomes of these programs can be used as measures of government's performance. This study investigates program outcomes of the national wetland regulatory program, not to asses how efficiently the national government is protecting wetlands, but to asses the extent to which its performance may be related to state regulatory programs. If the overlapping-authority model does accurately describe the relationships between the national and state governments, the outcomes of the national wetland regulatory program may demonstrate a relationship to state wetland regulatory programs.

Amount of Permitted Wetland Fill (Primary Response Variable)

The primary program outcome being investigated in this study is the total amount of wetland fill permitted by the U.S. Army Corps of Engineers (USACE) during the time of this study. It is hypothesized that the amount of wetland fill permitted by the USACE may be related to state efforts to regulate wetlands thereby upholding the prevailing model of overlapping-authority of intergovernmental relations. If no clear relationship is demonstrated by the amount of wetland fill permitted, however, additional exploration into secondary outcomes will occur. Such secondary measures include the number of permits as well as the permit and mitigation ratios (acres of fill permitted/acres fill requested and acres of mitigation required/acres of fill permitted respectively). The exploration of these outcomes may also illuminate more subtle relationships between levels of government.

Assumptions of Normal Distribution and Constant Variance

Multiple regression analysis assumes a response variable with normal distribution and a constant variance among the groups being analyzed. The total amount of wetland fill permitted over a 10 year time span is the response variable for this analysis. During this time, a total of 247,580 acres of wetland fill were permitted by the USACE throughout all of the WRUs in the United States. When the amount of permitted wetland fill is assessed as a whole, the entire population of Wetland Regulatory Units (WRUs) exhibits a strong skewness (Figure 6.1). This skewness persists even when the WRUs are grouped according to type of state wetland regulatory program present (Figure 6.2). Furthermore the skewness makes it difficult to discern any patterns of constant variance within the different groups.

Figure 6.1 Wetland fill distribution.

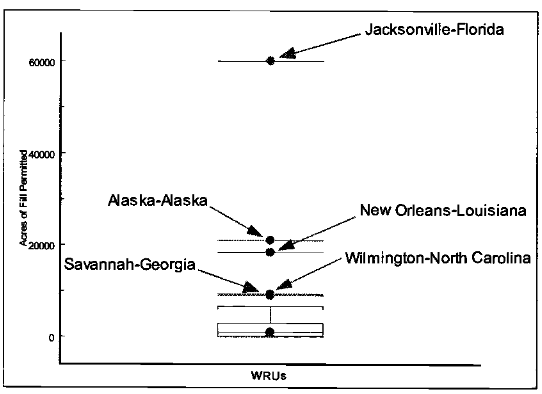
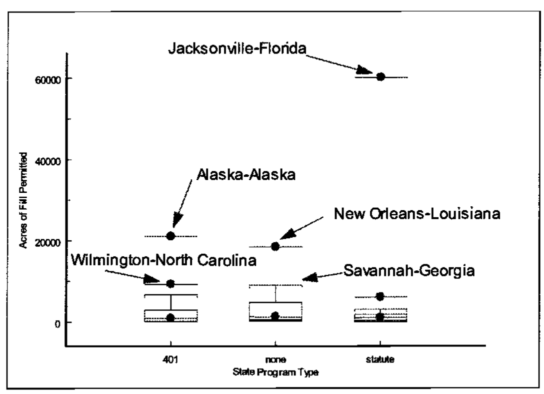


Figure 6.2 Wetland fill distribution by program type.



The scale of the skewness appears to be largely caused by a few WRUs with relatively high values of permitted wetland fill. Most notably, the Jacksonville-Florida WRU has a relatively large amount of permitted wetland fill. Likewise, the Alaska-Alaska, New Orleans-Louisiana, and Wilmington-North Carolina WRUs all also have large amounts of wetland fill. Removal of these WRUs as outliers does reduce the amount of skewness in the dataset, but so does a transformation onto the log scale (Figure 6.3). Without strong evidence to suggest that these values are out of context for WRUs with their relative characteristics the log transformation is the preferred method of realizing a normal distribution. Furthermore, the log transformation also reveals only slight violations in the constant variance assumptions within the three comparison groups (Figure 6.4).

Figure 6.3 Log wetland fill distribution..

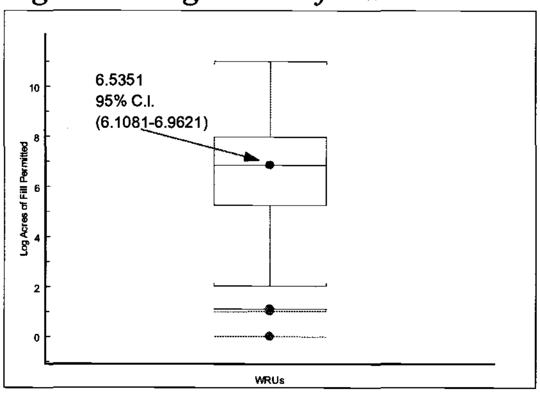
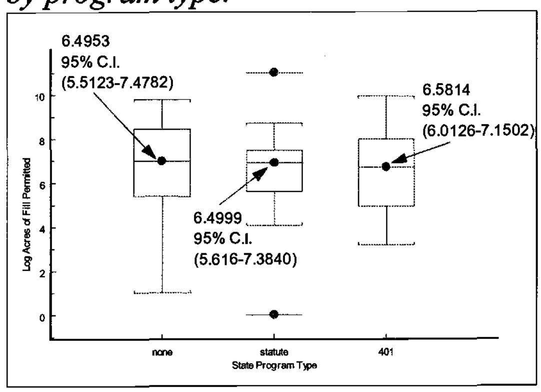


Figure 6.4 Log wetland fill distribution by program type.



Reliability

Each USACE district is solely responsible for the issuance of national government wetland fill permits within its boundaries. During the period of this study, the USACE recorded a variety of data on of every permit application it received, including the state in which the potential wetland fill activity occurred. When reporting permit activity, however, USACE districts do not routinely differentiate the data by state. For the purposes of this activity, though, it was necessary to request such a state-specific break-down from the USACE. In order to analyze data at the WRU level of resolution, it is necessary to know how program outcomes in a district are distributed among the portions of states within each district.

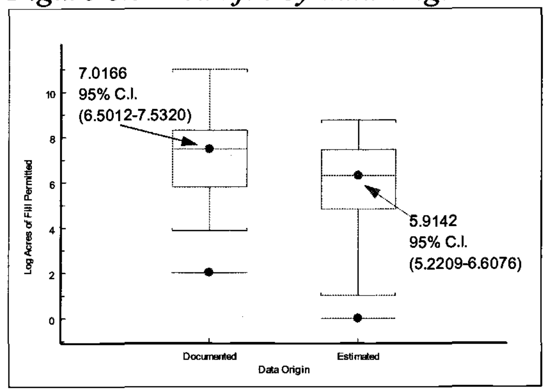
There was a range in the ease with which each district was able to accommodate the request for state-specific program outcome data. The program outcome data for 14 of the WRUs covered districts that are completely contained within the geographical boundaries of a single state. These data were the most easily obtained as they were retrieved directly from annual summaries of quarterly reports issued to USACE headquarters over the period covered by this study. The data for 36 of the WRUs was obtained through USACE districts conducting new queries in their project tracking databases to produce reports that parse the program outcomes by state. In combination, these two groups establish a total of 50 WRUs that have verifiably documented program outcomes.

Distribution of data for the remaining 37 WRUs was provided from USACE districts using a variety of other methods that collectively constitute the best professional judgments of the chiefs of the regulatory branches in each of the affected USACE districts. The choice, by these administrators, to not conduct queries of their local databases was made for either reasons of funding or data inaccessibility. Most USACE districts contract their database management to independent firms; therefore constructing new queries of their data requires amendments to their contracts with these operators. Several regulatory branch chiefs described the funding limitations associated with these contracts to be the main reason for providing best professional judgment estimates for the distribution of program outcomes.

More frequently, however, regulatory branch chiefs described that the reason for providing this study with an estimate instead of new query results was technological. As a part of a USACE-wide effort at modernization, several districts no longer operated the traditional RAMS database used by the majority of districts. Administrators of these districts explained that the new database is still in an embryonic form of adoption and as such it does not yet have fully customizable capacities. Because of this technological gap, these districts are not yet able to conduct the type of full-scale query that would allow them to parse regulatory program outcomes by state.

Under the best of circumstances, the USACE's wetland permit tracking system is not assumed to be error-free. There can be inaccuracies in this dataset due to everything from misplaced decimal points, to the omission of entire entries. Ultimately, all of the values used in this study should be considered approximations of program outcomes. Without question, the accuracy of this study is bound to be affected by errors in the values assigned to the program outcomes recorded in the permit database. As these datasets stand as the official records of the USACE, however, and this study is more interested in reported program outcomes than it is in landscape changes, their validity will be accepted at face value.

Figure 6.5 Mean fill by data origin.



Furthermore, it is difficult to determine, in those WRUs without documented data that has been queried from the official records, just how inaccurately the regulatory chiefs may have estimated the state-by-state distribution of their program outcomes. A cursory evaluation of these estimates, however, suggests one potential source of error (Figure 6.5). There is strong evidence suggesting that the median amount of wetland fill recorded for those WRUs with estimated distributions is 3.01 times lower than the median amount of wetland fill recorded for those WRUs with documented distributions (one-sided p-value 0.0101; two-sample t-test with 95% confidence of 1.31 to 6.93 times).

It is possible that the process of estimation, itself, may partially be the source of the discrepancy between these two groups of WRUs. USACE regulators may have consistently under-represented the amount of actual permitted fill occurring in many of their WRUs. A closer investigation of the data reveals that systematic underestimation is not, however, the only (or even the most likely), potential cause for the lower wetland fill values in these WRUs.

The total amount of wetland fill in every USACE district is documented against district-wide quarterly regulatory reports provided by USACE headquarters. The values of these district totals remain absolute, regardless of whether the relative values for the WRUs within these districts have been determined based upon verifiable documentation or best professional estimates. As a result, those regulators who estimated the distribution of the amount of wetland fill within their district actually had fewer acres of initial wetland impact to distribute among their WRUs than regulators who calculated the distribution from documented records. In fact, a total of 149,601.20 more acres of permitted wetland fill are located in WRUs with documented distribution values than in WRUs with estimated distribution values (Figure 6.6).

Figure 6.6 Total wetland fill distribution by data origin.

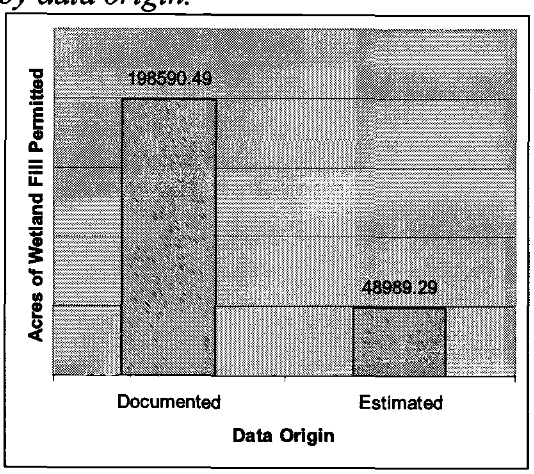
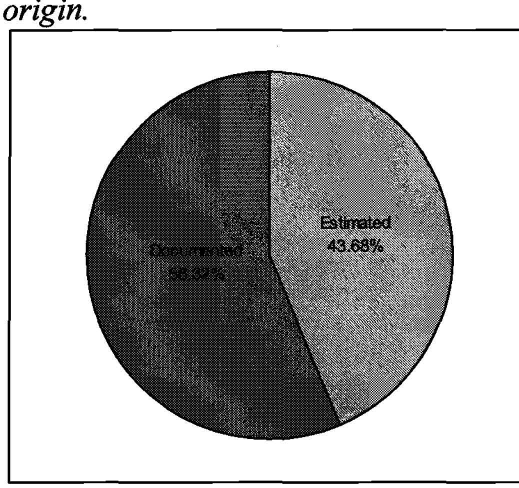


Figure 6.7 WRU distribution by data origin.



Furthermore, although the 49 WRUs with documented distribution values represent a slight majority of 56.32% of all WRUs they account for over 80.21% of all the acres of permitted wetland fill in the nation. This leaves the remaining 19.79% of all the permitted wetland fill being located in the remaining 43.68% of WRUs with estimated distribution values (Figure 6.7). Clearly, those USACE districts with the ability to document how wetland fill permits are distributed among the different states within their boundaries have many more acres of permitted wetland fill to document than those districts left to estimate the distributions of their wetland fill. Considering this additional understanding about how the nation's permitted wetland fill is distributed it seems more likely that those districts in which the distribution of wetland fill permits have been estimated have actual lower values because of any number of other legitimate characteristics of the WRUs and not necessarily because of distribution estimation errors made by the regulators.

Analysis of Variance

Having established the validity of the primary response variable, it is possible to perform an analysis of the variance within that variable. This study is primarily focused on potential differences in the amounts of wetland fill that have been permitted between groups of WRUs that have been subjected to three different types of state wetland regulations (Figure 6.4). Initial analysis, however, yielded no evidence that there is any significant difference between the median of the amounts of wetland fill permitted in each of these groups (p-value 0.9817; analysis of variance F-test on the log scale).

Number of Permits Issued (Secondary Response Variable)

Since the primary response variable of the total amount of permitted wetland fill produced no evidence of any significant differences between groups of WRUs subjected to different types of state wetland regulatory programs, analyses of the secondary program outcomes were conducted. The first such variable to be analyzed was the number of permits approved in each WRU.

Assumptions of Normal Distribution and Constant Variance

During the time of this study, the USACE approved an average of 86,427 permits per year. As with the total acreage of permitted wetland fill, the average annual number of these permits issued across the entire population of WRUs also does not exhibit a normal distribution. In fact, the wetland-rich, southeastern, WRUs of Jacksonville-Florida, Wilmington-North Carolina, New Orleans-Louisiana, Mobile-Mississippi, and Norfolk-Virginia WRUs provide the data with a long positive tail (Figure 6.8). Their relatively high values even cause them to remain as outliers even after they have been grouped by state program type (Figure 6.9). Furthermore, this long-tailed characteristic makes it difficult to determine potential violations of the constant variance assumptions.

Figure 6.8 No. of permits distribution.

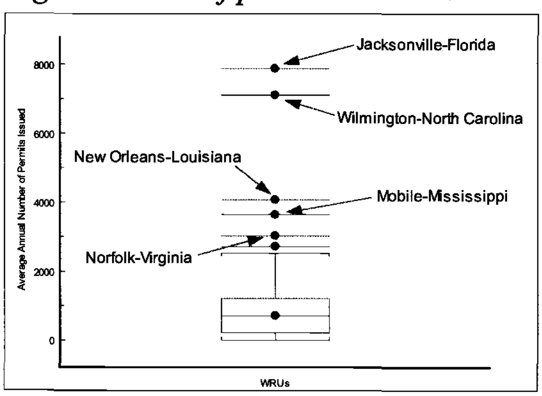
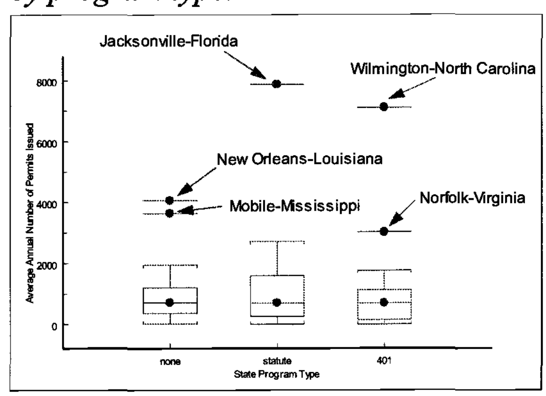


Figure 6.9 No. of permits distribution by program type.



Analysis of Variance

As a result of the data's long-tailed shape, a log-transformation is capable of reshaping this response variable into a more normal distribution (Figure 6.10). This transformation demonstrates relative constant variance between groups of WRUs identified by state program type and thereby allows for meaningful comparisons between them (Figure 6.11). Ultimately, however, the analysis of the number of permits produces results similar to those for the amount of permitted wetland fill. Even after the log transformation, the analysis provides no evidence that the median average annual number of permits approved by the USACE in WRUs varies depending upon the type of state program that is present (p-value 0.8604; analysis of variance f-test on the log scale).

Figure 6.10 Log no. of permits distribution.

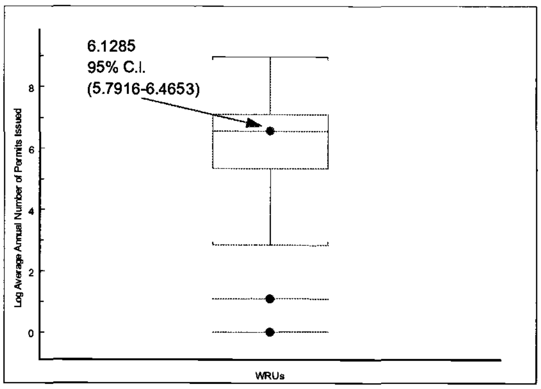
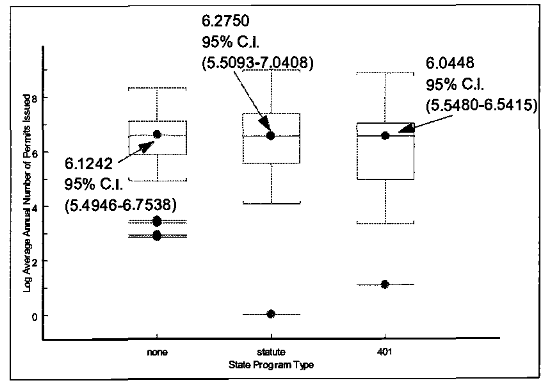


Figure 6.11 Log no. of permits distribution by program type.



Permit and Mitigation Ratios (Secondary Response Variables)

With no evidence of differences between groups of WRUs demonstrated by either the number of permits approved or the amount of wetland fill permitted two additional, more sophisticated program outcomes were investigated. These secondary variables were considered because it is possible that similar amounts of wetland fill could be permitted in WRUs, while at the same time those same WRUs could differ in the percentages of the requested amounts of fill that were approved, or the amounts of mitigation that were required in exchange.

Assumptions of Normal Distribution and Constant Variance

Ratio values between the total amount of wetland fill permitted and both the total amount of wetland fill requested, and the total amount of mitigation required were calculated for each of the WRUs over the 10-year duration of the study. As with the number of issued permits, the mitigation ratio values demonstrated a long-tailed distribution (Figure 6.12). All three of the WRUs under the authority of the Rock Island District as well as the Charleston-South Carolina and the Walla Walla-Idaho

WRUs require slightly higher than normal average mitigation ratios, making it difficult to determine the relative variances between groups of WRUs based upon state programs (Figure 6.13).

Figure 6.12 Mit. ratio distribution.

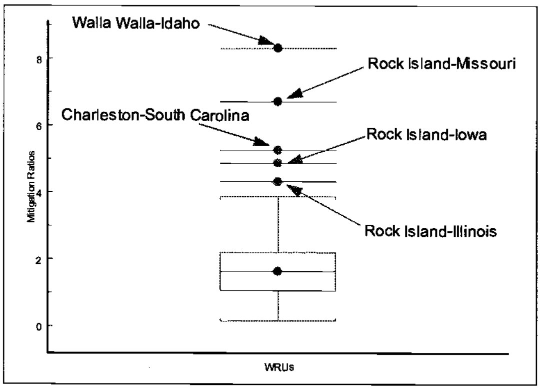
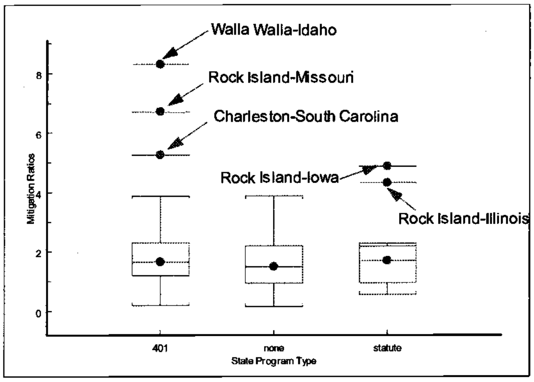


Figure 6.13 Mit. ratio distribution by program type.



A log transformation, however, was able to reshape this distribution into a more normal pattern for analytical purposes (Figures 6.14 and 6.15). The resulting set of permit ratios, on the other hand, demonstrated reasonably normal distributions with relatively constant variances between groups of WRUs determined by state program types and required no additional modification (Figures 6.16 and 6.17).

<u>*Analysis of Variance*</u>

Based upon these data, the grand mean permit ratio for all WRUs is 0.83 (Figure 6.16). This value can be interpreted to mean that for every one acre of wetland fill requested by an applicant, 0.83 acres of fill were approved by the USACE. In other words, on average, through the national wetland regulatory program, the USACE approves approximately 83% of the total amount of wetland fill that is requested of it.

The median mitigation ratio for all WRUs, on the other hand, is 1.55 (Figure 6.14). This means that for every one acre of wetland fill permitted, 1.55 acres of wetlands were required to be constructed in mitigation. In other words, on average through the national wetland regulatory program, the USACE requires the replacement of 155% of the entire amount of wetland fill it approves.

Figure 6.14 Log mit. ratio distribution.

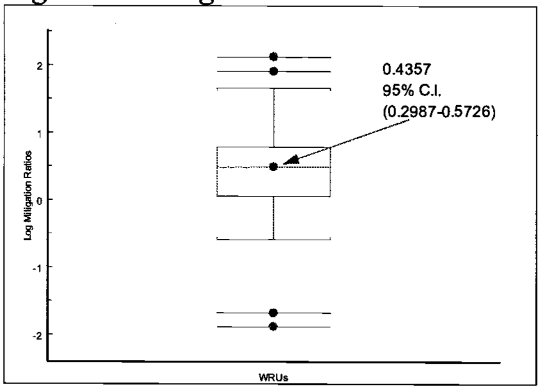
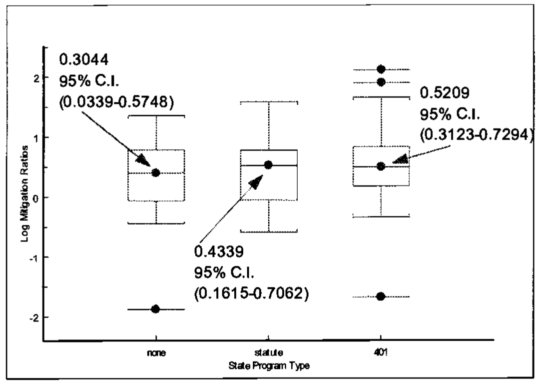


Figure 6.15 Log mit. ratio distribution by program type.



As with the amount of wetland fill and the number of permits, however, this analysis produced no evidence to suggest that the mean mitigation ratios were significantly different between groups of WRUs subject to different types of state wetland regulatory programs (p-value of 0.3869; analysis of variance F-tests). Furthermore, no conclusive evidence was produced to completely reject the equal means hypothesis regarding the permit ratios of the three different groups of WRUs (p-value 0.1910; analysis of variance F-test). A closer inspection of the confidence intervals of the estimated means, however, does suggest that the permit ratios of WRUs subjected to statute-based state programs may tend to approve slightly lower amounts of requested wetland fill than those of WRUs subjected to either of the other types of state programs. As this latter evidence is not entirely conclusive, additional data may ultimately need to be collected in order to bring to rest this speculation. It also flags this variable for a closer analysis through the study's multiple linear regression model. This potential relationship may be found to be quite significant if the influence of a few key potential confounding variables can be controlled.

Figure 6.16 Permit ratio distribution.

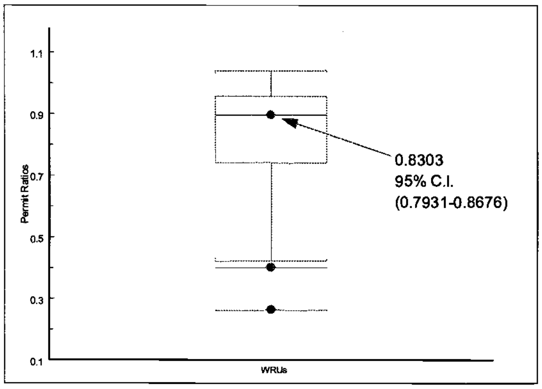
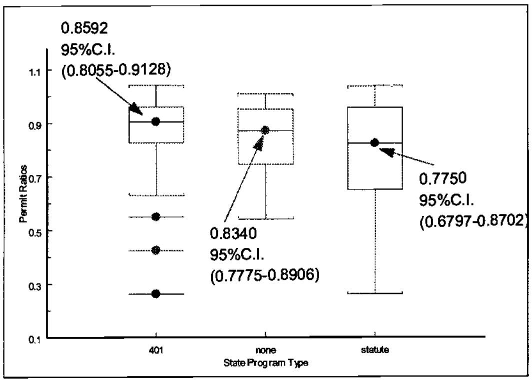


Figure 6.17 Permit ratio distribution by program type.



<u>Dependent Variable Subcategories</u>

Having discovered no conclusive evidence of significant differences between groups of WRUs in the performance of any of the four summary program outcome variables, four major subcategories of these program outcomes were evaluated. The USACE not only tracks the total amount of wetland fill it permits, it also categorizes that wetland fill activity by two broad classes of permit types, as well as by two different categories of wetland type. As previously discussed, all wetland fill permits fall into either the category of being a standard action, or a general action. Standard actions are reserved for activities of sufficient size or character that they are subject to the stringent requirements set for individual permits. General actions are applied to activities small enough in size or character that they receive less scrutiny under the relaxed conditions of letters of permission or general, regional, programmatic, or nationwide permits.

In addition, although it has been discussed that there are several ways to classify wetlands, the USACE only describes whether wetland fill activity occurs in tidal wetlands or non-tidal wetlands. Tidal wetlands are those wetlands that are subject to influence from tidal forces. They may be supported by freshwater sources, or by seawater. Non-tidal wetlands, on the other hand are located sufficiently inland that they are unaffected by tidal forces.

Standard Vs. General Actions

Standard action permits are supposed to be applied to those activities that may result in a significant impact to wetland resources. General action permits, on the other hand, are supposed to be reserved solely for those activities that will only result in minimal impacts to the wetland resource. Because of the intentions behind the establishment of these two different groups of permit types, it might be expected that there could be differences between their program outcomes.

Over the 10 years covered by this study, 141,626 total acres of wetland fill were permitted through standard actions. This amount accounts for 57.20 % of the entire amount of wetland fill permitted by the USACE. At the same time only 42.80% (105,954 acres) of the total wetland fill were permitted through general actions. Because the projects that require standard actions have larger impacts than those requiring general actions, it is not surprising that nationwide this category of activity might account for a majority of total amount of permitted wetland fill (Figure 6.18).

A comparison of the median amounts of wetland fill permitted through each type of action, however, provides no evidence, to suggest this inequality is a common occurrence among all WRUs (two-sided p-value 0.5285; two-sample t-test on the log scale). This analysis suggests that in any given WRU, the total amount of wetland fill permitted through general actions is roughly the same as the total amount permitted through standard actions (Figure 6.19).

A real difference between the two types of actions, however, becomes clearer when comparing the average number of permits approved each year. General actions make up 95.07% of this program outcome. In an average year the USACE approves 82,160 general actions nationwide. This volume is a testament to the efficiency of this expedited review process. In comparison only an average of 4,266 standard permits are issued across the nation each year (Figure 6.20). This smaller number of permits only accounts for 4.93% of the total number of permits issued by the USACE each year.

Figure 6.18 Total wetland fill permitted by permit type.

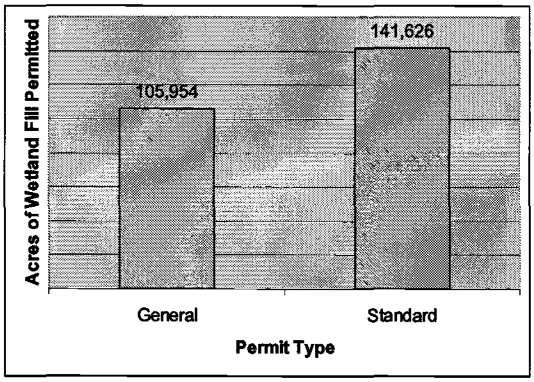


Figure 6.19 Median wetland fill permitted by permit type.

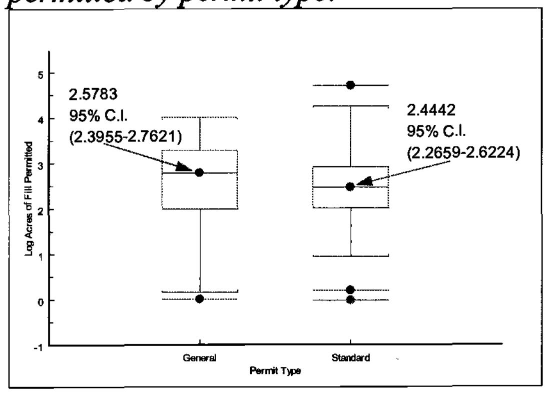


Figure 6.20 Annual no. of permits issued by permit type.

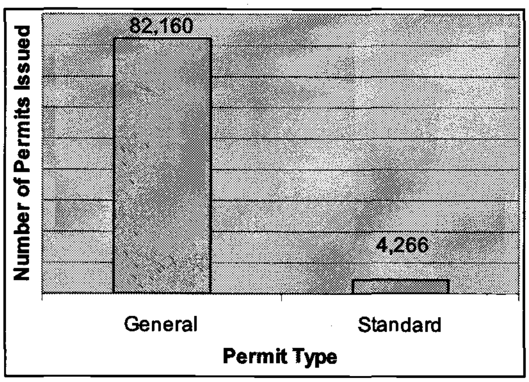
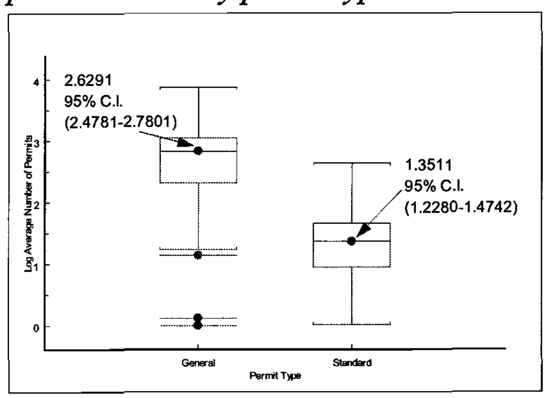


Figure 6.21 Median annual no. of permits issued by permit type.



Furthermore, when analyzed by WRU there is overwhelming evidence to suggest the 3.59 times increase in the median number of permits issued through standard actions over those issued through general actions is significant (two-sided p-value < 0.0001; two-sample t-test on the log scale with a 95% confidence of 2.96-4.36 times). The reported inequality in the numbers of permits issued through each type of action is not surprising, given the increased amount of review time afforded to standard actions.

Potential differences between general and standard actions are not solely restricted to the amount of wetland fill or permitted or the number of permits issued. Standard actions are supposed to be subject to higher standards of scrutiny and stiffer approval conditions than general actions. If the standard action process is more stringent for these types of permits it, would be expected that, on average, it would produce lower permit ratios and higher mitigation ratios than the general action process.

Figure 6.22 Permit ratio by permit type.

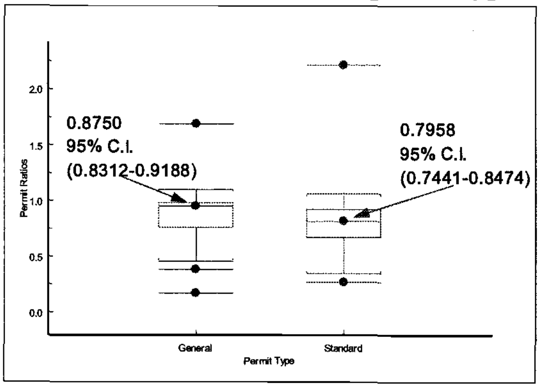
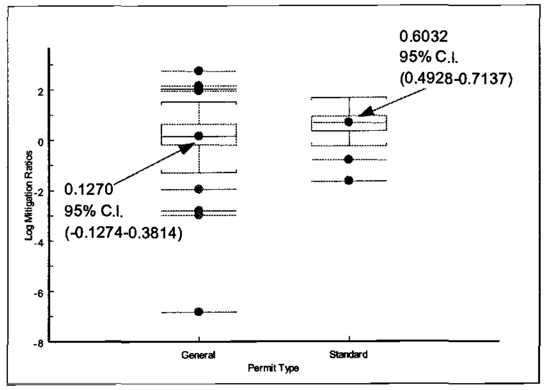


Figure 6.23 Log mit. ratio by permit type.



Across the whole population of WRUs, the mean permit ratio of general actions is 0.87, while the mean standard action permit ratio is a slightly lower 0.80 (Figure 6.22). At the same time, the median mitigation ratio for general actions is 1.13 while the median ratio for standard actions is 0.62 times higher at 1.83 (Figure 6.23). As expected, the slightly lower permit ratios of standard actions is supported by strong evidence of its significance (two-sided p-value 0.0210; two-sample t-test of WRU values). In addition, convincing evidence also exists to support the hypothesis that the observed difference between the median mitigation ratios is also significant (two-sided p-value 0.0008 two-sample t-test of WRU values on the log scale with 95% confidence of 0.47-0.82 times).

Because standard actions are applied to larger, more visible projects, it is suggested that these types of permits could also receive the greatest amount of attention by state wetland regulatory programs. Furthermore, even though there was no discernable difference between the median amounts of wetland fill permitted through standard actions and general actions, it is still possible that the amount of fill permitted through standard actions could be distributed in a different pattern among WRUs than the amount of fill permitted through general actions. It is likely, therefore, that any potential variation between groups of WRUs that are based on different state programs could be most discernable in the program outcomes of this category of permit.

To test for meaningful differences in the amount of all four previously discussed measures of wetland fill activity permitted through standard actions, a second set of analysis of variance f-tests were conducted that grouped WRUs by state program type. These analyses were identical to the previous ones conducted on the total summary measures for each of the program outcomes. This time, however, the analyses were only conducted on the portion of each of these measures that was produced by standard actions.

In none of the four program outcomes that were tested, however, do the tests provide any conclusive evidence to suggest that there are significant differences between groups of WRUs based upon state programs. Analysis of variance f-tests for the acreage of wetland fill and numbers of permits both on the log scale, and for the permit ratios, and mitigation ratios each yielded p-values of 0.4511, 0.2556, 0.6011, and 0.1477 respectively. Closer investigation of the confidence intervals for each of the measures revealed that only the estimated median number of standard permits produced enough evidence to even suggest a tendency towards any differences between the groups. In this case, the potential difference that may exist is only between those WRUs subjected to statute-based state programs and those subjected to Section 401 programs. Although not conclusive, the data suggests that groups of WRUs with statute-based programs may issue slightly more standard permits than groups of WRUs with 401 programs, but that neither group suggests any potential difference from those with no active programs. This suggested difference may become more apparent once other potentially confounding variables are accounted for in the study's multiple linear regression model or through the collection of additional data for this variable. All of the remaining investigations into the confidence intervals, on the other hand, produced no evidence of any potential differences.

Figure 6.24 Log standard wetland fill permitted by program type.

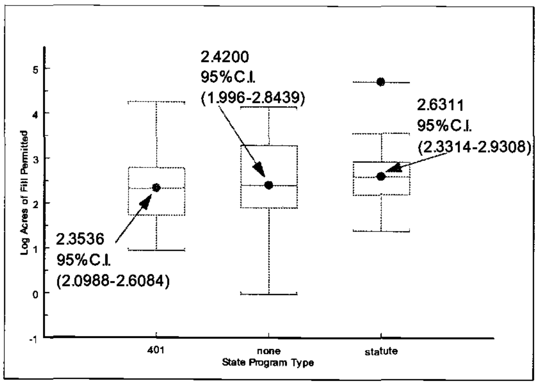


Figure 6.25 Log no. of standard permits issued by program type.

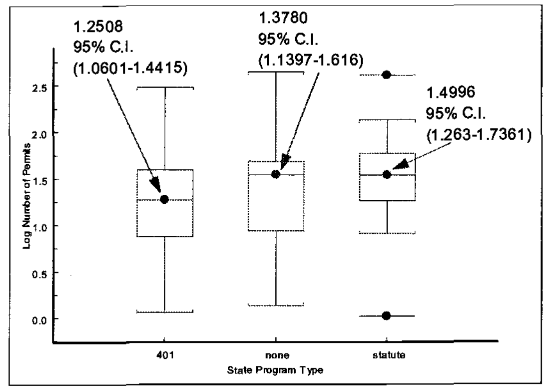


Figure 6. 26 Standard permit ratio by program type.

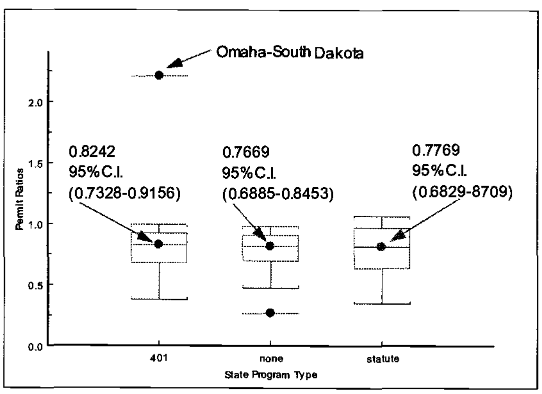
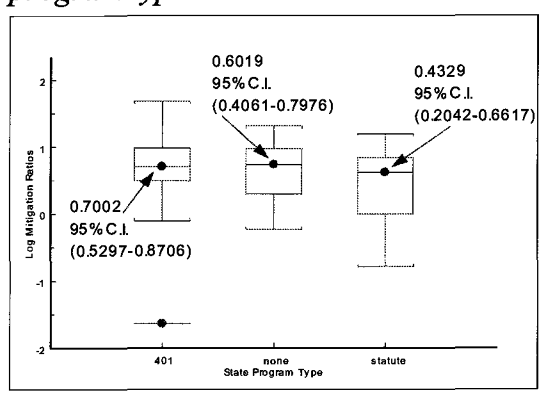


Figure 6.27 Log standard mit. ratio by program type.



Tidal Vs. Non-Tidal Permits

Regardless of the type of permit that is issued, the USACE considers all fill activities to occur in one of two types of wetland. The USACE makes a distinction between permits issued in wetlands subject to tidal influences, and those that are not. Nationally, there are estimated to be 52,258,072 acres of tidal wetlands. With 272,303,755 acres of non-tidal wetlands also estimated across the country, the total number of tidal wetlands ultimately account for only 16.10 % of the nation's wetland resource base (Figure 6.28). Furthermore, while virtually every WRU contains some non-tidal wetlands, only 40 WRUs (46%) contain any tidal wetlands with the remaining 47 (54%) containing no tidal wetlands at all (Figure 6.29).

Figure 6.28 Wetland abundance by wetland type.

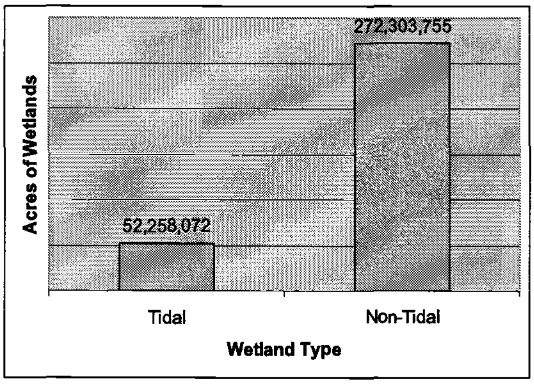
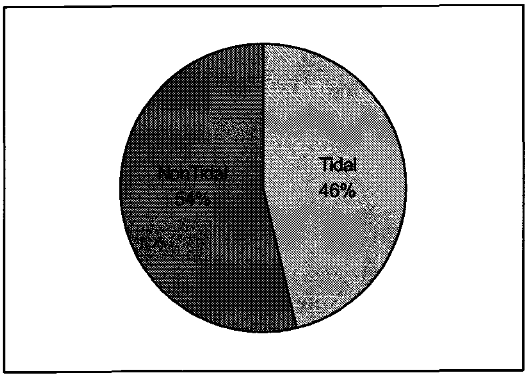


Figure 6.29 Number of WRUs containing tidal wetlands.



Because there is only approximately one-fifth as many tidal wetlands as there are non-tidal wetlands to begin with and since 54% of all WRUs contain no tidal wetlands at all, it is not surprising that that as a whole, the total amount of tidal wetland fill permitted over the ten years of the study, 17,918 acres, is considerably less than the total amount of non-tidal wetland fill of 229,662 acres (Figure 6.30). In addition, it is also not surprising that overwhelming evidence exists to suggest a similar difference exists within WRUs between the median acres of tidal wetland fill and the mean acres of non-tidal wetland fill permitted (two-sided p-value < 0.0001; two-sample t-test on the log scale). In fact, this difference translates into there being 2.70 times more acres of non-tidal wetland fill than tidal wetland fill permitted in the average WRU (Figure, 6.31: 95% confidence of 1.85-3.95 times).

It is possible that the amount of fill permitted for tidal wetlands is less than the amount of fill permitted for non-tidal wetlands due to strict development restrictions state coastal zone management programs and their federal consistency provisions place on tidal wetlands. With the exception of Illinois, however, every state eligible to create a CZM program has taken steps to do so. As a result, virtually all of the nation's tidal wetlands are located within WRUs that have CZM programs. Without a sufficient group of tidal wetlands not subjected to CZM regulations to compare these to it is difficult to determine if the lower amounts of wetland fill permitted in tidal wetlands is truly due to the existence of these programs or if they are only a product of the relative rarity of coastal wetlands. The multiple linear regression models for this study, may, however, provide additional insight about this potential relationship by controlling for varying amounts of different wetland types.

Figure 6.30 Total amount of wetland fill by wetland type.

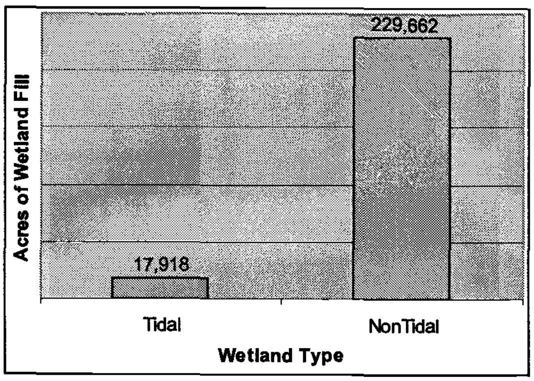
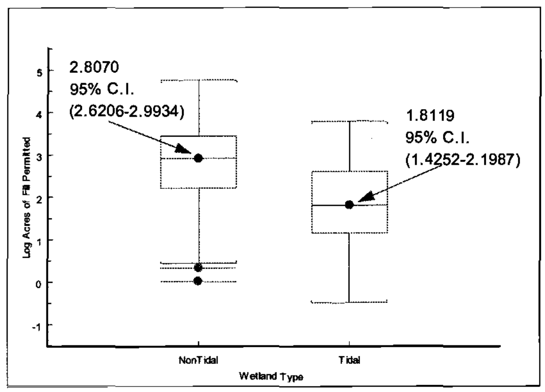


Figure 6.31 Median amount of wetland fill by wetland type.



Without much practical significance able to be determined for the statistically significant difference in the variance between the amounts of fill in different types of wetlands, an analysis of differences on the two program outcomes not determined by wetland abundance was also conducted. Since the USACE records both the amount of fill requested and the amount of mitigation required for permits issued in tidal as well as non-tidal wetlands, it is possible to analyze variances in both the permit ratios and the mitigation ratios of tidal wetland fill permits and non-tidal wetland fill permits. It is not likely that the relative scarceness of tidal wetlands within a WRU alone would influence either of these ratios, but restrictions by CZM programs that require tidal wetlands to be more stringently protected could explain lower permit ratios and higher mitigation ratios in tidal wetlands than non-tidal wetlands if such differences do exist.

The analysis produced no evidence, however, of any significant differences between the overall mean permit ratios for each type of wetland (two-sided p-value of 0.3860 from a two-sample t-test). Figure 6.32 illustrates the results of this comparison. It is possible, however, that the value for the Savannah-Georgia WRU may be obscuring an otherwise significant difference between the groups. In addition, the analysis also produced no conclusive evidence of any significant differences between the median mitigation ratios for each type of wetland (two-sided p-value of 0.1095 from a two-sample t-test). Even though the results are not conclusive, a closer investigation of the confidence intervals for these estimated medians, however, does suggest a possible tendency for the mitigation ratios of permits issued in tidal wetlands to be slightly less than those of permits issued in non-tidal wetlands (Figure 6.33). Additional data, however, may need to be collected in order to evaluate this potential relationship more fully. Furthermore, this tendency may also be more clearly revealed through the multiple linear regression model for this study.

Figure 6.32 Permit ratios by wetland type.

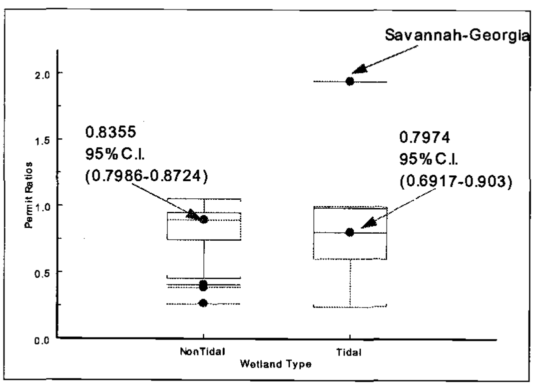
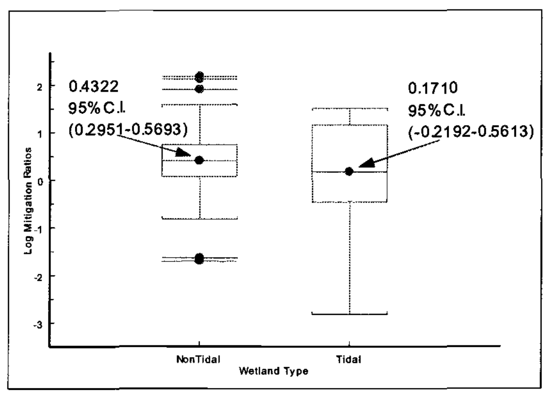


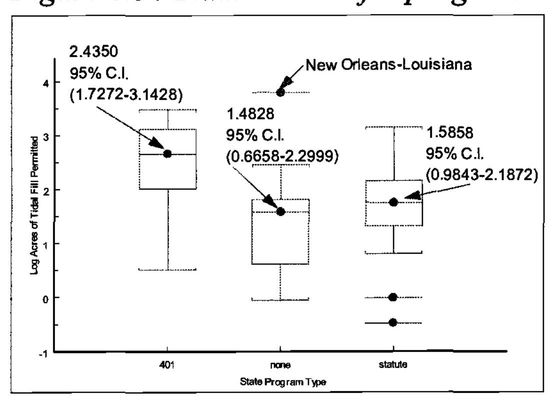
Figure 6.33 Log mit. ratio by wetland type.



Because some larger permits may authorize the fill of both tidal and non-tidal wetlands, the USACE was not able to provide a number for the amount of wetland permits that have been issued in just tidal wetlands or in just non-tidal wetlands. Therefore no analysis of differences in the amount of wetland permits based upon wetland type is a part of this study.

Since there is sufficient evidence to suggest that the amount of permitted fill for tidal wetlands is significantly different than the amount of permitted fill for non-tidal wetlands, it is possible that when the amount of permitted fill in WRUs is sorted into groups based upon tidal influence, the outcomes may also reveal different trends in relationship to the type of state program in place. It is, after all, possible that tidal wetland fill permit outcomes may sort more closely along state program types, because there is additional interaction between the state agencies that administer these programs and the USACE due to the federal consistency provisions of the CZM programs that also apply to these wetland types. In order to test for these variances, six separate analyses were constructed. Each evaluation grouped WRUs by state program type. Three tests, one each for the measures of permitted wetland fill amount, permit ratio, and mitigation ratio, were applied to tidal wetland outcomes, while three identical tests were applied to non-tidal wetland outcomes.

Figure 6.34 Tidal wetland fill/program.



The analysis of the amounts of tidal wetland fill did not produce conclusive evidence of any significant differences between the three groups of WRUs (p-value = 0.0907; analysis of variance f-test). Despite the lack of conclusive data, a closer investigation of the confidence intervals for the estimated medians, however, strongly suggest that the amount of tidal wetland fill permitted in WRUs subject to 401 programs may tend to be slightly larger than the amounts permitted in those WRUs subject to either statute-based programs or no programs (Figure 6.34). It may be that a real difference is being obscured by the value for the New Orleans-Louisiana WRU or that larger number of cases and more precise data might ultimately show a significant difference between these programs in this variable or through the study's multiple linear regression model.

In addition, the analysis also did not produce any conclusive evidence that the three groups vary significantly from one anther in terms of their permit ratios (p-value of 0.5628; analysis of variance f-test). A closer investigation of the confidence intervals for the estimated means, however, does suggest that permit ratios in WRUs subject to 401 programs may tend to be slightly higher than the permit ratios of WRUs subjected to statue-based programs or no programs (Figure 6.35).

As previously suggested, either a larger population size or more precise data may be necessary in order to ultimately show a significant difference between these programs in this variable. Furthermore, the value for the Savannah-Georgia WRU may be obscuring a potential difference, which may become more apparent through a closer analysis with the study's multiple linear regression model. At the same time, however, the analysis produced no evidence to suggest that either the permit ratios or the mitigation ratios differ significantly depending upon which type of state program is in place (p-values of 0.8908; analysis of variance f-test). Figure 6.36 illustrates the results of this test.

Figure 6.35 Tidal permit ratio by program type.

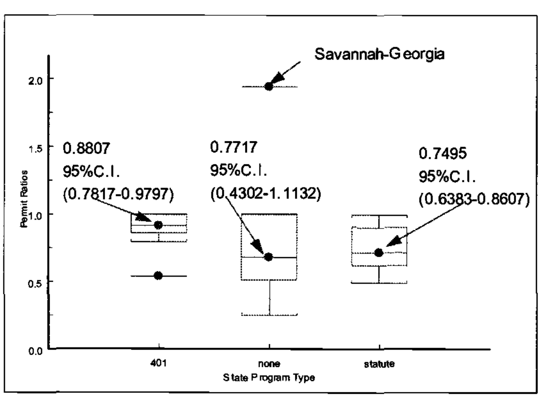
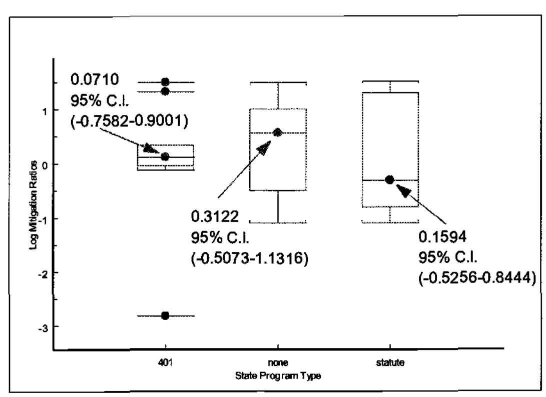
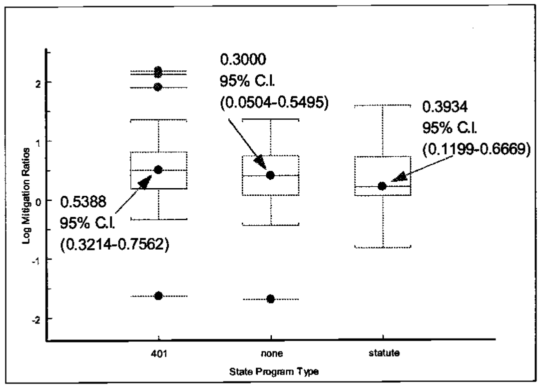


Figure 6.36 Tidal log mit. ratio by program type.



Unlike the analysis of tidal wetlands, the analysis of non-tidal wetlands produced no evidence that the there is any difference between the amounts of non-tidal wetland fill permitted in WRUs subject to different state wetland regulatory programs (p-value = 0.9597; analysis of variance f-test). Figure 6.37 illustrates these results.

Figure 6.37 Non-tidal fill/program.



Furthermore, the analysis also did not produce conclusive evidence of any significant differences between the permit ratios of the different groups (p-value = 0.1635; analysis of variance f-test). A closer investigation of the confidence intervals for this variable does, however, suggest that those WRUs subject to statute-based programs may tend to produce slightly smaller permit ratios for fill activity in non-tidal wetlands than WRUs subject to 401 programs or no state programs (Figure 6.38).

Figure 6.38 Non-tidal permit ratio by program type.

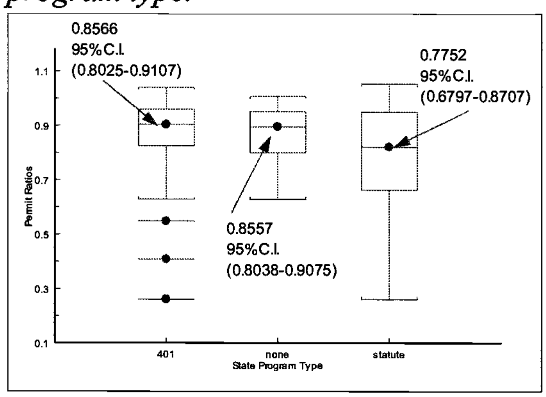
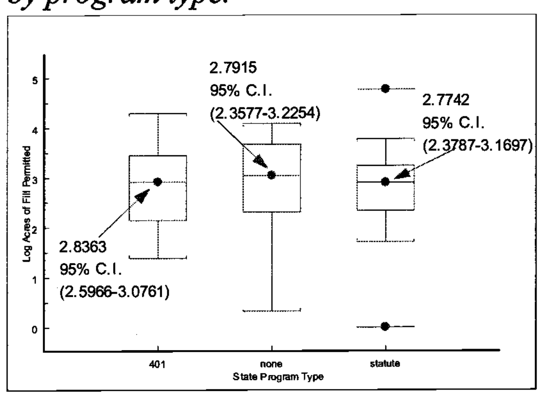


Figure 6.39 Non-tidal log mit ratio by program type.



This potential variation may be found to be more significant with the collection of a larger population size or with the collection of more precise data. It may also hint towards a variation that may be better described through the study's multiple linear regression model. The analysis did not, however, produce any such similar evidence to suggest that the mitigation ratios differ significantly depending upon which type of state program is in place (p-value = 0.3311; analysis of variance f-test). Figure 6.39 illustrates the lack of evidence of any difference through this analysis.

Conclusion

Amount of permitted wetland fill is a variable that is routinely focused upon in the literature. It is a measure of wetland regulatory program activity that has been derived many different ways in different studies. This study is the first attempt to utilize USACE quarterly reports as a source for an estimate of the amount of wetland fill. It is also the first nationwide study to attempt to determine amounts of permitted wetland fill for a unit of analysis that follows boundaries other than state lines or USACE district jurisdictions.

Upon first analysis, there appears to be reason to suspect the accuracy of methods used to distribute the values for the amount of wetland fill among the appropriate units of analysis. Closer inspection into the character of the data, however, reveals that it cannot be concluded that the suspect nature of any variable is the direct result of systematic data estimation errors and not due to confounding factors not taken into consideration by these evaluation methods. In fact, although there may potentially be some inaccurate values for some records in the dataset and its small size may make it prone to the influence of minor outliers and the occurrence of Type II errors, the data seems to behave very similarly to the way that is expected of a program that follows the separated-authority model of intergovernmental relations. This primary measure demonstrates no evidence of any differences between groups based upon state program type.

While wetland fill may be the primary program outcome evaluated in this study, values for the number of issued permits, permit ratios, and mitigation ratios in each WRU are also evaluated as secondary response variables. These secondary program outcomes revealed results similar to those derived from the analysis of the amount of permitted wetland fill. Each of the analyses of all three secondary outcomes provided no conclusive evidence to suggest that significant performance differences of the national wetland regulatory program exist in groups of WRUs that are subject to different types of state wetland regulatory programs. As a result, analyses of four subcategories of each of these variables were also conducted. These four subcategories included general actions, standard actions, actions in tidal wetlands, and actions in non-tidal wetlands.

In many ways, the summary and subcategory primary and secondary program outcomes investigated combine to produce a picture of the data that describe a national wetland regulatory program functioning as it has been designed. Fewer amounts of wetland are permitted to be filled than are requested while greater numbers of wetlands are required to be mitigated than are permitted to be filled. General actions account for the majority of permits issued, but only a slight minority of the amount of wetland fill permitted. Furthermore, general actions demonstrate higher permit ratios and lower mitigation ratios than standard actions. All of these are results are precisely the characteristics that would be expected of a permit type that is supposed to be more streamlined and easier to review and to only be applied to actions of limited scope and minimum impact. Likewise fewer amounts of wetland fill are permitted in tidal wetlands than non-tidal wetlands, which is consistent with both their smaller numbers and the greater protections afforded them.

Furthermore, in keeping with the intent of establishing a program that fits the separated-authority model of intergovernmental relations, in every case, no conclusive evidence has been produced by this initial investigation that any of the four summary program outcomes are significantly related to state wetland regulatory program type. This does not mean, however, that the separated-authority model is completely upheld by this preliminary evaluation. The data has also produced some inconclusive results that suggest rejecting this hypothesis and continue to keep the overlapping-authority model alive as a viable alternative hypothesis. It suggests that WRUs subject to statute-based state programs may consistently approve slightly fewer than normal amounts of wetland fill than are requested of them in all wetlands, but especially in those that are non-tidal. These results seem to corroborate the overlapping-authority hypothesis central to this study that statute-based programs are established by states concerned with exercising the ability of providing more stringent protection to wetlands and exercising that power somewhat over the USACE.

In addition, the data also suggest that WRUs subject to 401 programs may consistently approve higher than normal amounts of wetland fill than requested of them in all wetlands, but especially in those that are tidal. This latter tendency also ultimately provided 401 WRUs with higher than average amounts of approved tidal wetland fill. These results seem to corroborate the alternative overlapping-authority idea that states engaged in wetland regulatory efforts through the 401 program are concerned with the development of wetlands and are interested in influencing the USACE in order to better accommodate wetland development practices through the national wetland regulatory program.

Additional and more accurate measurements, however, would be necessary in order to confirm either or both of these conclusions. Without the collection of new and better data, this preliminary analysis will remain inadequate to completely reject the separated-authority model. Nor do these results suggest that this model is completely sound. If this model is to be ultimately rejected and/or the overlapping-authority model given validity without new data, a more sophisticated analytical tool must be applied. It is for this reason, the study's central multiple linear regression model was developed.

MODEL OF PERMITTED WETLAND FILL IN THE UNITED STATES

Introduction

This study is primarily focused on evaluating the relationship between the total amount of wetland fill permitted in different Wetland Regulatory Units (WRUs) across the country and the presence of different types of state wetland regulatory programs. A method of analysis that may produce this evidence is not, however, simply designed. A thorough review of the literature suggests that the amount of wetland fill permitted through the national wetland regulatory program is not likely to be described by a single condition within a WRU. In fact, several potential variables are identified that have a strong likelihood of demonstrating a direct relationship to the amount of total wetland fill permitted in WRUs. Because the amount of wetland fill permitted is likely influenced by several conditions present within WRUs, the construction of a multiple regression model provides the best opportunity for incorporating the potential influences of these several different characteristics.

In most cases, individual analyses of the different identified characteristics demonstrate their strong linear relationships with the amount of wetland fill permitted in WRUs. In other cases, preliminary analyses either produced no evidence of these potential relationships, or they identified significant regions of potential overlap between the variables. It was also revealed that some conditions themselves may have little direct relationships with this program outcome, but they may actually influence other variables in such a manner that this interaction itself may significantly influence the amount of wetland fill permitted.

Variable Selection

Although all WRU characteristics discussed in this study have been included because they all have some relevancy, not all have the potential to contribute equally to a model of permitted wetland fill. In addition, not every potential interaction between these variables is also equally as likely to increase the accuracy of the model.

Furthermore, if included, the overlap between some variables may actually interfere with the reliability of the model. As a result, it is necessary to select only those variables and interactions that contribute the most to the reliability of the model.

Because no permitted wetland loss model has been previously presented in the wetlands literature, the precedent for such a model needs to be built. Therefore, the criteria used to select the variables for inclusion in the study will not benefit from the vetting processes of other research efforts. The literature review alone suggests all of the variables discussed could potentially improve the fit of a model. Therefore, traditional model selection techniques were used to reinforce professional judgments aimed at selecting variables that contribute to the accuracy of the model.

In order to assist in the selection of the most relevant variables for the final model, the Akaike's Information Criterion (AIC) was used. AIC is a model testing statistic that takes into account both the explanatory power of a model as well as the number of terms it includes. By selecting the model with the lowest possible AIC value along the same scale, analysts are able to select a model that includes the greatest number of relevant variables without overly increasing the bias of the model. An AIC analysis requires the comprehensive assembly of measures for all of the discussed potential variables. This study, therefore, included measures for nine directly related variables that represent four different categories of WRU characteristics: landscape conditions, socioeconomic conditions, administrative resource availability, and coastal zone management program influence.

Five variables intended to account for bottom-up drivers of total wetland permit activity were included in the model. All of these variables come from two categories of characteristics: landscape conditions and socioeconomic conditions. Variances in the landscapes of WRUs were represented by continuous measures of both the total area of the WRUs and the total amount of wetlands within those WRUs (Appendix C). Socioeconomic variances were represented by continuous measures of the total population and the median family incomes of each WRU as well as ratio measures of the WRU population growth rates (Appendix B).

The ratio measurements for wetland densities and population densities that were previously discussed for inclusion in the model were not, however, ultimately tested for their relevancy. Because each of these measures are directly calculated from the measure of size for each of the WRUs, their inclusion into a multiple regression model that also includes a measure for the size of the WRU creates a condition of statistical singularity among the variables making it impossible to conduct a meaningful regression. Since WRU size has such strong relationships with the values of so many of the other independent variables of the study, its inclusion was chosen over that of either of the ratio values it was used to calculate.

Four variables intended to account for top-down drivers of total wetland permit activity were included from two other categories of characteristics: administrative resource availability and coastal zone management program influence. Variances in the amount of administrative resources available were represented by continuous measures for the sizes of both the budget and staff of the regulatory program in each WRU as well as a categorical representation of the divisional office that provides the WRU with its oversight (Appendix A). Variances in the potential influences of coastal zone management programs, on the other hand, were represented by indicator values (Appendix D).

The potential values and limitations for the inclusion of each of the above-mentioned variables have been recounted in their respective preceding sections. Also included in these sections are the assertions and justifications for the inclusion of three potential interactions between some of these selected variables. Specifically, interactions were identified for inclusion between the size of the populations and the total acres of wetlands present; the growth rates and the median family incomes of the populations in each WRU, and the budget and staff sizes of the USACE.

The list of variables contains nine primary terms and three interaction terms. A stepwise regression analysis was then conducted on these variables with S-Plus Version 6.1 statistical software. S-Plus' stepwise regression analysis method alternately applies forward and backward selection methods with all of the proposed variables until it arrives at a model with the lowest possible AIC value.

The multiple linear model ultimately constructed through the stepwise analysis method to describe the amount of permitted wetland fill has a calculated AIC value of 65.3508 on the scale of 0.6378987. As the richest possible model with the least amount of bias, it includes six of the nine proposed primary terms and two of the three proposed interaction terms. Evidence that each of the terms added to the model is significantly related to the response variable is supported by the analysis of variance table S-Plus V. 6.1 software generates for linear regression models (Table 7.1). This table provides the results from individual tests that the values for each term are significantly related to the values for the response variable in the model. From the p-values included in this table, it is possible to interpret that the values for all eight terms are significantly related to amount of permitted wetland fill.

Table 7.1 Analysis of variance table for total wetland fill linear regression.

Response: ltotpermit

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
Lwetlands	1	228.8668	228.8668	358.7824	0.00000000
lpopulation	1	18.0478	18.0478	28.2926	0.00000112
lincome	1	1.7784	1.7784	2.7880	0.09931662
Pop.Growth	1	7.0739	7.0739	11.0894	0.00137166
lbudget	1	2.8877	2.8877	4.5269	0.03679125
Division	7	31.1331	4.4476	6.9722	0.00000245
lwetlands:lpopulation	1	4.6777	4.6777	7.3330	0.00845158
lincome:Pop.Growth	1	4.7825	4.7825	7.4973	0.00778105
Residuals	72	45.9287	0.6379		

*Terms added sequentially (first to last)

From this analysis, the terms fall into three broad groups in terms of the strength of evidence supporting their relationship with the response variable. The amount of wetlands present, the size of the population, and the regulatory division within which the WRU is located make up the group with the most significant evidence (p-values < 0.0001). This set of variables are followed by the group that includes population growth rates of WRUs (p-value=0.0014); and the interactions both between income and growth rates (p-value =0.0077), and between the amounts of wetlands and the size of the population (p-value=0.0084). The USACE's budget has the next greatest amount evidence for being related to the response (p-value=0.0368) along with income (p-value=0.0993), which is also a component of the interaction term with the strongest evidence of its relationship It is often common that terms included in significant interactions such as this final one, however, may demonstrate very little evidence of a relationship by themselves.

The three primary terms excluded from the selected model by the calculated AIC values were the indicator variable for the presence of CZM programs, the number of USACE regulatory staff present and the size of the WRU. The single interaction term that was excluded was between the number of USACE regulatory staff and the amount of funding they are provided. This does not mean these variables do not demonstrate a relationship against the response variable. Exclusion only suggests any relationship they may have brought to the model is either already accounted for by other variables, or it is outweighed by the additional variance and bias they will also contribute.

In the case of WRU size, a very strong linear relationship with the response variable was previously demonstrated. It was suggested that size itself should have little to do with the amount of permitted wetland fill, but that it should influence many other characteristics that do have a great deal to do with the amount of permitted wetland fill. Size was able to be excluded, therefore, because the other individual variables were so strongly related they fully captured the influence it brought to the model.

The size of the USACE staff was able to be excluded because the budget variable is so strongly correlated with staff size, that its measure completely incorporates the staff size. It also goes further by describing the amount of other resources available to the staff such as training, equipment, and travel needs. Since USACE budget is a more comprehensive measure it was selected for inclusion over staff size. This complete overlap between these two variables also explains how no real interaction can exist between the two of them and why that term was also excluded from the study.

Preliminary analysis revealed that the CZM indicator variable was only found to have any relevancy with the number of permits. No direct linear relationship was found to exist with the amount of permitted wetland fill in a simple regression model, and the stepwise regression analysis suggests no evidence of such a relationship exists in a multiple regression model either. This variable may, however, be a viable term that could be added to a modified regression model for the number of issued wetland fill permits.

Selection of the remaining variables through this method adds to the body of evidence presented during the analysis of each individual potential variable, which suggests that they are directly related in a meaningful way to the amount of permitted wetland fill. With this additional evidence, a final multiple regression model for the amount of wetland fill permitted in WRUs was constructed with only one variable not on the log scale. Because each of the independent variables except population growth rates are presented on the log scale, the addition of each variable does not result in an additive effect on the response variable. Instead, the inclusion of additional variables produces a multiplicative effect.

A multiplicative effect potentially describes the relationships presented in this model in the most accurate manner. Each independent variable appears to have varying levels of influence upon amount of wetland fill permitted. As a result, when evaluated separately, every independent variable exhibits a different slope against the response variable. Should all of the variables have exhibited similar slopes, however, each one's inclusion would have resulted in uniformly raising the intercept of the model without altering the slope.

Assumptions

Because this is a multiple regression model, before the results can be correctly interpreted, the data included must meet tests against four basic assumptions. First, the means that the distribution of the independent variables and the amount of wetland fill permitted must be normal. Second, the spread of each independent variable and of the amount of wetland fill permitted must be equal. Third each of the independent variables of the WRUs must demonstrate linear relationships against the means of the amount of wetland fill permitted. Fourth, the values of each of the independent variables and the response variable must be completely independent.

Normality and Constant Variance

The log transformations that were conducted on the response variable and all but one independent variable served the purpose of establishing normal distributions and constant variances for all of the transformed variables. The remaining variable describing the population growth rates of the WRUs on the other hand already strongly exhibited both qualities and required no such transformations.

Linearity

Separate simple regressions of each of log-transformed independent variables against the log of the total amount of permitted wetland fill were conducted to justify their consideration for use in this model. These regressions, demonstrated that in every case, each potential independent variable exhibits at least a slight direct linear relationship with the amount of permitted wetland fill. A similar linear relationship was also demonstrated to exist between the untransformed variable describing the population growth rates for each WRU and the log of the total amount of permitted wetland fill. All of the variables, therefore, which are included in this model, also meet the assumption of linearity.

Independence

Once incorporated into the constructed multiple linear regression model, the calculated coefficient estimates for each independent ratio were once again checked for correlations with one another. Evaluating the correlation of coefficients for each included variable provided a test of independence for this model. This assessment revealed that the only correlations in the coefficients that were higher than |60%| existed between those variables that also already have interaction terms between them also included in the model (Table 7.2).

Table 7.2 Correlation of coefficients for total permitted wetland fill.

	Coeff.	lwet	lpop	lincome	PopGrow	lbudget	lwet: lpop	linc: PopGrow
lwet	-0.3486							
lpop	-0.2185	**0.9428**						
linc	-0.8755	-0.1331	-0.2636					
PopGrow	-0.3939	-0.4083	-0.4424	**0.6328**				
lbudget	-0.1146	-0.0711	-0.1456	0.0870	-0.1009			
lwet:lpop	0.3655	**-0.9804**	**-0.9525**	0.1213	0.4151	-0.0542		
linc:PopGrow	0.3977	0.4062	0.4410	**-0.6356**	**-0.9999**	0.0979	-0.4130	
Division1*	-0.0056	0.0048	0.1375	-0.0347	0.0129	0.0154	-0.0654	-0.0125
Division2*	0.4999	-0.0710	-0.0759	-0.4821	-0.1515	0.0873	0.0862	0.1526
Division3*	0.0311	-0.1290	-0.0659	0.0394	0.1036	-0.1899	0.1283	-0.1065
Division4*	-0.3518	0.3188	0.2763	0.2028	-0.1368	0.2475	-0.3761	0.1326
Division5*	-0.0342	0.0130	-0.0628	0.0465	0.0330	-0.0196	0.0413	-0.0408
Division6*	-0.0496	0.0802	0.1051	0.0004	-0.2021	0.0296	-0.0941	0.2001
Division7*	0.3777	-0.2485	-0.1267	-0.2624	0.0999	-0.3268	0.2665	-0.0970

*Correlations between categorical division coefficients excluded for clarity.

Total Acres of Permitted Wetland Fill

Satisfied that the model meets the necessary assumptions of a multiple regression analysis, and that it includes a select set of relevant variables that contribute significantly to its accuracy, it may be applied to the data in order to describe the total acres of wetland fill permitted in the entire population of the nation's WRUs. The response of this model will then be used to serve as the base from which this study's question of interest will be answered.

Prior to conducting this analysis, however, one adjustment was made to the data for the Memphis-Illinois WRU. One general permit for a value of one acre of total permitted fill was recorded for this WRU. During the time of this study, a query of the Memphis district's regulatory database revealed that no wetland fill permits were issued in this very small, rural, and relatively remote and economically depressed unit. Since this model uses the log of the total amount of permitted wetland fill as the value for its response variable, the null value for the Memphis-Illinois WRU prevents a log transformation from being calculated for it. In order to keep the model from excluding this seemingly valid measure because of the limitations of the log transformation, the null value was replaced with this value that closely approximates zero given the resolution of the data provided for this study. Given the relatively small number of data points it is intended that this approximation for the value of zero will help the overall fit by providing a corresponding response measurement for the characteristics of this WRU.

With Memphis-Illinois adjusted, this multiple linear regression analysis produces an R-squared value of 0.8669 for the total amount of permitted wetland fill in all WRUs, and a residual standard error of 0.7987 on 72 degrees of freedom (two-sided p-value $<$ 0.0001; f-statistic 33.51 on 14 and 72 degrees of freedom). This can be interpreted that there is overwhelming evidence that the model may describe all but 13.31% of the amount of variation in the amount of wetland fill permitted between WRUs (Table 7.3).

The model's results were next tested against four graphical diagnostic tools to determine its goodness of fit. A plot of the residuals values against the total fitted model was produced that illustrates the relatively constant variance of the data used in the model (Figure 7.1). The normal-QQ plot demonstrates the data's relatively normal distribution, while the plot of the fitted model against the response variable presents the linearity of the data (Figures 7.2 and 7.3). Finally, the plot of each WRU's Cook's

Distance value demonstrates that no single WRU expresses excessive influence through a combination of high amounts of potential and leverage on the performance of the model, to cause it to artificially overestimate or underestimate values for all of the WRUs (Figure 7.4).

Table 7.3 Linear regression results for total permitted wetland fill.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-17.7075	10.8345	-1.6344	0.1065
lwetlands	4.9780	1.0326	4.8208	0.0000
lpopulation	1.5986	0.3964	4.0327	0.0001
lincome	-1.0055	1.0143	-0.9914	0.3248
Pop.Growth	-194.2727	70.7393	-2.7463	0.0076
lbudget	0.3934	0.1406	2.7991	0.0066
Division1	0.5979	0.1470	4.0678	0.0001
Division2	-0.2717	0.1028	-2.6427	0.0101
Division3	0.1058	0.0724	1.4618	0.1481
Division4	0.2216	0.0921	2.4056	0.0187
Division5	0.1551	0.0571	2.7149	0.0083
Division6	-0.0436	0.0478	-0.9108	0.3654
Division7	-0.3170	0.0858	-3.6924	0.0004
lwetlands:lpopulation	-0.2622	0.0729	-3.5971	0.0006
lincome:Pop.Growth	17.9891	6.5698	2.7381	0.0078

Residual standard error: 0.7987 on 72 degrees of freedom
Multiple R-Squared: 0.8669
F-statistic: 33.51 on 14 and 72 degrees of freedom, the p-value < 0.0001

Figure 7.1 Residuals/fit for wetland fill.

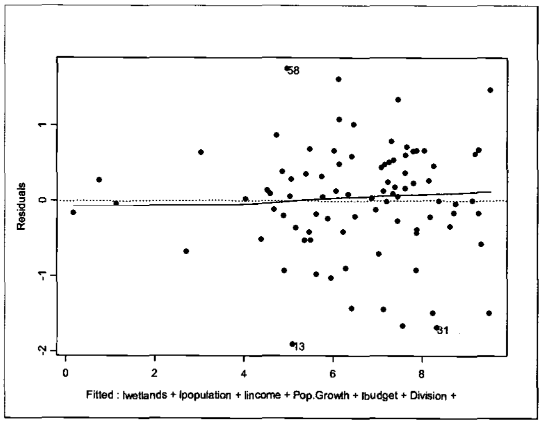
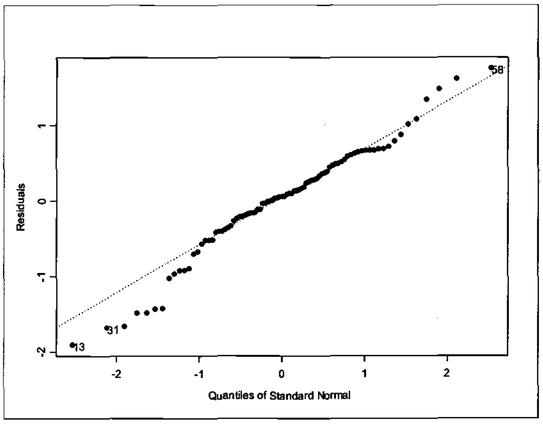


Figure 7.2 Normal QQ for wetland fill.



Considerable confidence may be placed in the results of this multiple regression model. It is a well-fit model that convincingly explains a large amount of variation in the data, with significant variables whose inclusion is strongly suggested in the literature.

Furthermore, it is of sufficient quality and relevancy that it may be a useful tool for answering the broader question of intergovernmental relations posed in this study.

Figure 7.3 Response/fit for wetland fill.

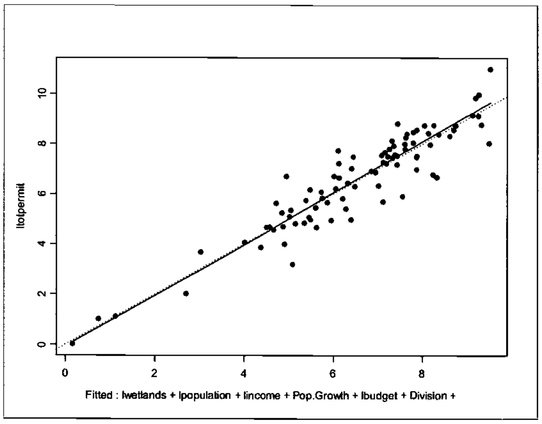
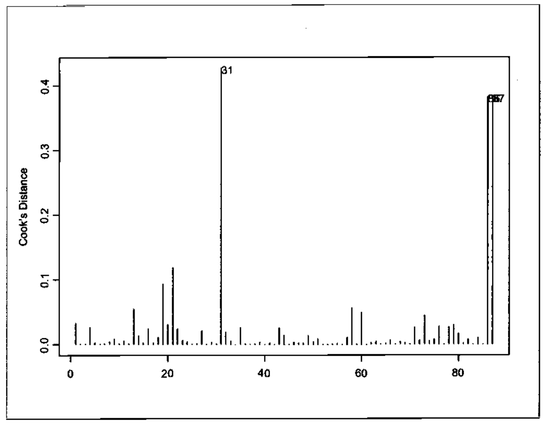


Figure 7.4 Cook's dist. for wetland fill.



Although this model appears to demonstrate a particularly good fit, it is not likely to be the only possible model that might describe the amount of permitted wetland fill in WRUs. For instance, it is possible to construct this model by substituting the direct measures of wetland abundance and total population for area-based measures of wetland density and population density. This alternative model, however, generates a lower R-squared value of 0.8035. with a larger residual standard error of 0.9707 on 72 degrees of freedom (p-value < 0.0001; f-statistic = 21.03 on 14 and 72 degrees of freedom). It also receives an AIC score of 96.1011 on a scale of 0.9421674. Since this AIC score is calculated on a different scale than the AIC score for the model of total wetland fill permits, the ratios between the AIC scores and their respective scales can be used to make comparisons between the models. The model with the highest ratio between its AIC score and its scale will explain the greatest amount of variance with the least amount of potential bias from the inclusion of variables not strongly related to the response variable. In this case, the AIC scores suggest there may be weaker evidence that some of the included variables help improve the fit of the data. These results suggest that this model that includes the density measures may not only describe less of the variation in the data than the model that included direct measures did, it may also do so less accurately.

Many other such models may potentially exist, but they have not yet been created. Most assuredly, these models may include similar variations on measures for the variables discussed in this study, or they may include other variables altogether. Some of these other potential models may describe more variation or they may ultimately prove to have smaller standard errors. As this model is the first such contribution to the literature, the longevity of its robustness is expected to be tested repeatedly by future research efforts to develop models such as these. Without additional evidence at hand, however, to support the inclusion of the different independent variables that would be necessary in order to construct these models at the present time, the current model is the one that will be used to test this study's question of interest.

Subcategories of Permitted Wetland Fill

This model was constructed for the sole purpose of describing the total amount of permitted wetland fill in WRUs. It is possible, however, that this is not the only program outcome that may be described by the model. It is likely that this model could be applied equally as well to describe different amounts of certain subcategories of permitted wetland fill. Without adjustment, this model may also be used to describe those separate amounts of wetland fill that have been permitted strictly through the general actions or standard actions. Minor modifications may also allow this model to be used to separately describe the amounts of permitted tidal and non-tidal wetland fill.

General and Standard Actions

As previously discussed, the total amount of wetland fill in the United States is permitted by the USACE through either general action reviews or through standard action reviews. The multiple linear regression model designed to describe the total amount of permitted wetland fill, may also be used to describe only the amount of wetland fill permitted through general actions. This cross-application is possible because none of the independent variables included in the model are in any way dependent-upon the type of permits the USACE issues. This model should, therefore, be able to describe the amount of wetland fill permitted through this subcategory of permit type almost as equally as well as it does the amount of wetland fill permitted through the total population of permits.

Ultimately, this multiple linear regression analysis still produces an R-squared value of 0.8283 with a standard error of 0.8968 for the amount of wetland fill permitted through general actions in all WRUs (two-sided p-value < 0.0001; f-statistic 24.80 on 14 and 72 degrees of freedom). This is a slightly less amount of variance than explained in the total amount of permitted wetland fill. It can still be interpreted, however, that there is overwhelming evidence that the model may describe all but 17.17% of the amount of variation in the amount of wetland fill permitted between WRUs (Table 7.4).

Table 7.4 Linear regression results for general permitted wetland fill.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-14.5739	12.1661	-1.1979	0.2349
Lwetlands	4.7902	1.1595	4.1312	0.0001
lpopulation	1.6021	0.4451	3.5992	0.0006
lincome	-1.2690	1.1389	-1.1142	0.2689
Pop.Growth	-215.8739	79.4335	-2.7177	0.0082
lbudget	0.3798	0.1578	2.4063	0.0187
Division1	0.6295	0.1651	3.8139	0.0003
Division2	-0.3011	0.1154	-2.6080	0.0111
Division3	0.1926	0.0813	2.3695	0.0205
Division4	0.1736	0.1034	1.6788	0.0975
Division5	0.2064	0.0642	3.2164	0.0019
Division6	-0.0702	0.0537	-1.3079	0.1951
Division7	-0.3513	0.0964	-3.6446	0.0005
lwetlands:lpopulation	-0.2584	0.0818	-3.1574	0.0023
lincome:Pop.Growth	19.9581	7.3773	2.7053	0.0085

Residual standard error: 0.8968 on 72 degrees of freedom
Multiple R-Squared: 0.8283
F-statistic: 24.80 on 14 and 72 degrees of freedom, the p-value < 0.0001

These results were then tested against the four graphical diagnostic tools to verify the model's goodness of fit. A plot of the residuals values against the total fitted model was produced that illustrates the relatively constant variance of the data used in the model (Figure 7.5). The normal-QQ plot demonstrates the data's relatively normal distribution, while the plot of the fitted model against the response variable presents the linearity of the data (Figures 7.6 and 7.7). Finally, the plot of each WRU's Cook's Distance demonstrates that no single WRU expresses excessive influence through a combination of high amounts of potential and leverage on the performance of the model, to cause it to artificially overestimate or underestimate values for all of the WRUs (Figure 7.8).

Figure 7.5 Residuals/fit for general fill.

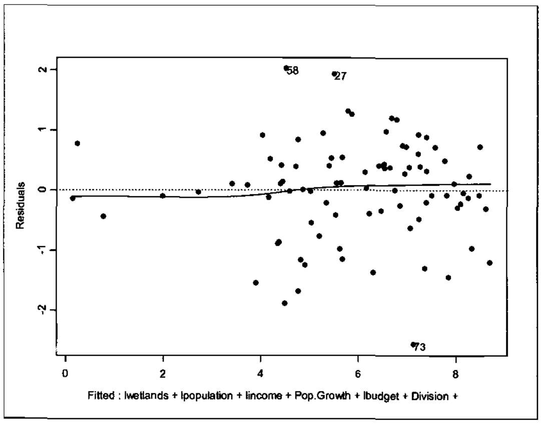


Figure 7.6 Normal QQ for general fill.

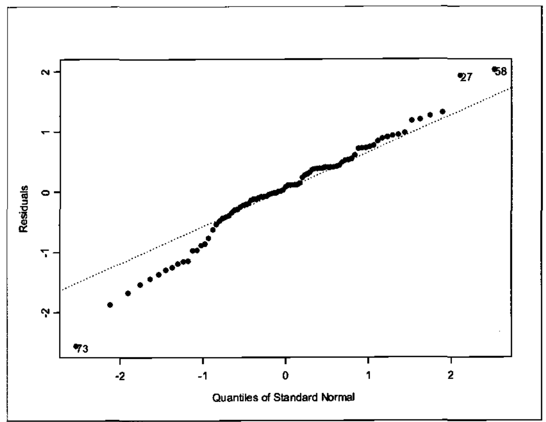


Figure 7.7 Response/fit for general fill.

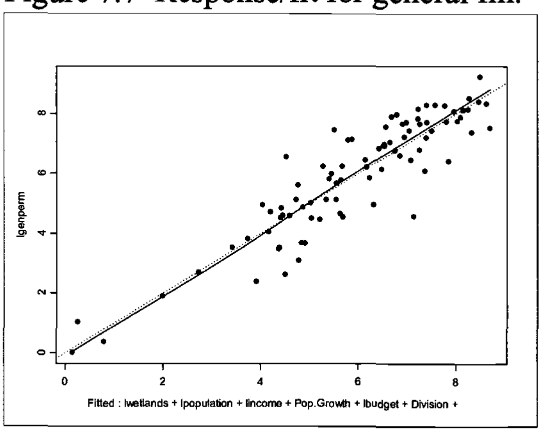
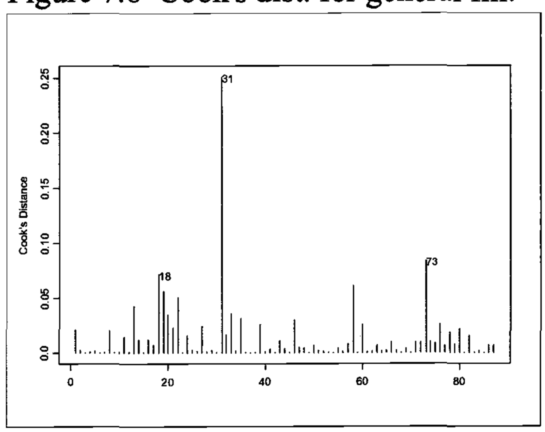


Figure 7.8 Cook's dist. for general fill.



When fitted, this model generated an AIC value of 82.042 on the scale of 0.80434, that suggests it may include some terms not ideally suited to explain this subset of wetland loss. A review of the analysis of variance table for each term does not, however identify any variable that's relationship has been reduced to the point that it is no longer considered significant (Table 7.5). Only the p-value for the income variable, when it is not a part of the interaction with population growth rates, demonstrates inconclusive evidence. Furthermore, all of the remaining terms still demonstrate strong evidence of their relationships to the response variable.

Table 7.5 Analysis of variance table for general wetland fill linear regression.

Response: lgenperm

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	192.9508	192.9508	239.8884	0.0000000
lpopulation	1	17.7541	17.7541	22.0730	0.0000123
lincome	1	2.1224	2.1224	2.6387	0.1086578
Pop.Growth	1	7.7826	7.7826	9.6758	0.0026757
lbudget	1	3.2128	3.2128	3.9944	0.0494282
Division	7	45.5509	6.5073	8.0902	0.0000003
lwetlands:lpopulation	1	4.0357	4.0357	5.0175	0.0281807
lincome:Pop.Growth	1	5.8868	5.8868	7.3188	0.0085122
Residuals	72	57.9122	0.8043		

*Terms added sequentially (first to last)

As with the amount of wetland fill permitted through general actions, the amount of fill permitted through standard actions may also be equally well described by the multiple linear regression model that was developed to describe the total amount of permitted wetland fill. In this model, however, both the Memphis-Illinois and the Nashville-Mississippi WRU were excluded because during the time of this study no standard action permits were approved in this WRU. Artificial values were not included in order to estimate their location near zero, in this model, however, because more than one WRU was affected, suggesting that zero values may actually be common occurrences. It was decided, therefore, that including inflated values for multiple WRUs that might otherwise not be modeled could cause the model to systematically overestimate means for other WRUs.

Furthermore, the multiple linear regression analysis produced an R-squared value of 0.8075 with a standard error of 0.9145 for the amount of wetland fill permitted through standard actions in all WRUs (two-sided p-value < 0.0001; f-statistic 20.97 on 14 and 70 degrees of freedom). This again is a slightly less amount of variance than explained in the total amount of permitted wetland fill, but is very similar to the amount of the general action permitted fill variation it explained. It can still, therefore, be interpreted that there is overwhelming evidence that the model may describe all but 19.25% of the amount of variation in the amount of wetland fill permitted between WRUs (Table 7.6).

Table 7.6 Linear regression results for standard permitted wetland fill.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-20.3493	15.2497	-1.3344	0.1864
lwetlands	4.8368	1.9668	2.4592	0.0164
lpopulation	1.4838	0.8023	1.8494	0.0686
lincome	-0.8208	1.1970	-0.6858	0.4951
Pop.Growth	-238.4857	88.8518	-2.6841	0.0091
lbudget	0.4439	0.1610	2.7564	0.0074
Division1	0.6160	0.1752	3.5160	0.0008
Division2	-0.2267	0.1179	-1.9235	0.0585
Division3	-0.1191	0.0839	-1.4197	0.1601
Division4	0.3009	0.1069	2.8138	0.0064
Division5	0.0268	0.0670	0.4006	0.6899
Division6	0.0236	0.0554	0.4260	0.6714
Division7	-0.3568	0.0988	-3.6102	0.0006
lwetlands:lpopulation	-0.2469	0.1393	-1.7732	0.0806
lincome:Pop.Growth	22.1689	8.2383	2.6910	0.0089

```
Residual standard error: 0.9145 on 70 degrees of freedom
Multiple R-Squared: 0.8075
F-statistic: 20.97 on 14 and 70 degrees of freedom, the p-value < 0.0001
2 observations deleted due to missing values
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These results were then tested against the four graphical diagnostic tools to determine the model's goodness of fit. A plot of the residuals values against the total fitted model was produced that illustrates the relatively constant variance of the data used in the model (Figure 7.9). The normal-QQ plot demonstrates the data's relatively normal distribution, while the plot of the fitted model against the response variable presents the linearity of the data (Figures 7.10 and 7.11). Finally, the plot of each WRU's Cook's Distance value demonstrates that both the Alaska-Alaska and the Hawaii-Hawaii WRUs may potentially express excessive influence on the performance of the model (Figure 7.12). However when the model was examined with the values of these

WRUs removed, it did not change the results (p-value is still < 0.0001). Therefore, although the potential and the leverage values of these WRUs were high, they are not significant enough to warrant their removal from the data so they were retained.

Figure 7.9 Residuals/fit for standard fill.

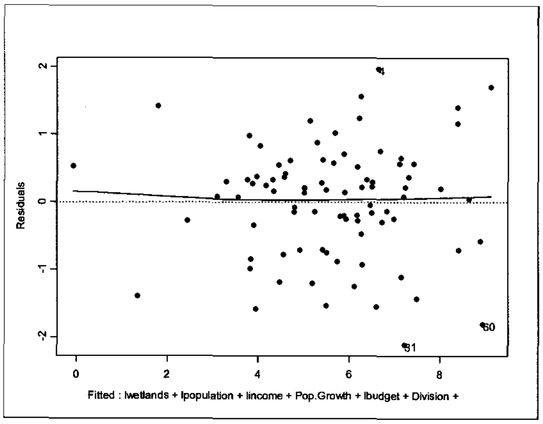


Figure 7.10 Normal QQ for standard fill.

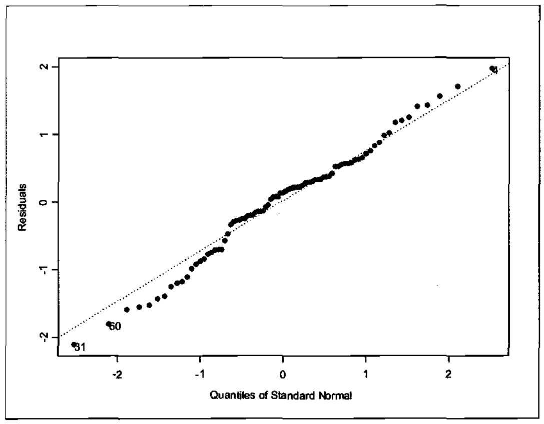


Figure 7.11 Response/fit for standard fill.

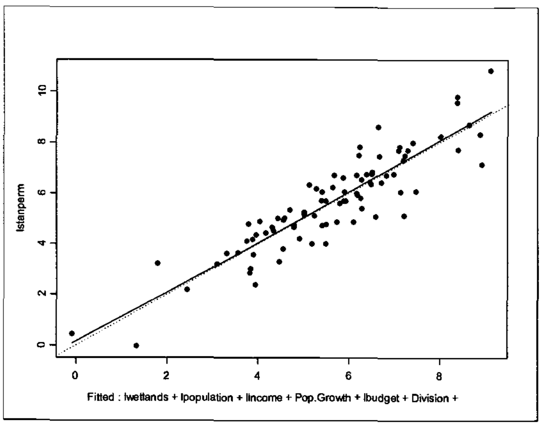
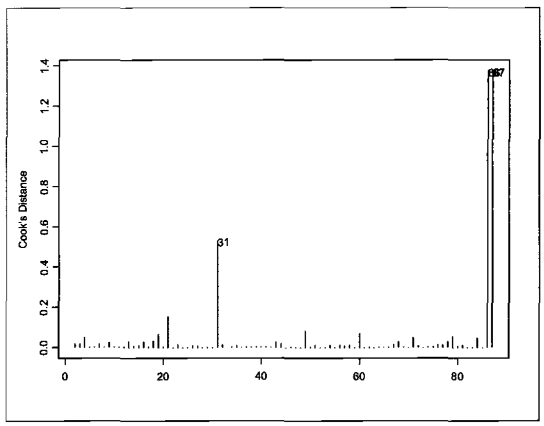


Figure 7.12 Cook's dist. for standard fill.



With two WRUs excluded from the data, this model generated an AIC value of 83.6381 on the scale of 0.836381, again suggesting it may include a few variables that are not ideally suited to explain this subset of wetland loss. A review of the analysis of variance table for each term confirms this suggestion (Table 7.7). Furthermore, it identifies those specific variables that no longer produce conclusive evidence of their relationship with the response variable. As expected, the p-values for each of the terms demonstrate that the income variable, when it is not a part of the interaction with population growth rates, begins to demonstrate far less of a relationship with the response variable. Likewise, the evidence for both the USACE budget term and the interaction between the amount of wetlands and the size of the population term both demonstrate similar drops in the amounts of evidence for their relationships. All of the remaining terms, however, still demonstrate strong evidence of their relationship to the response variable.

Table 7.7 Analysis of variance table for standard wetland fill linear regression.

Response: lstanperm

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	196.8102	196.8102	235.3116	0.0000000
lpopulation	1	11.1178	11.1178	13.2927	0.0005082
lincome	1	0.6066	0.6066	0.7253	0.3973142
Pop.Growth	1	4.1828	4.1828	5.0010	0.0285211
lbudget	1	1.2613	1.2613	1.5080	0.2235514
Division	7	23.8755	3.4108	4.0780	0.0008355
lwetlands:lpopulation	1	1.6485	1.6485	1.9710	0.1647665
lincome:Pop.Growth	1	6.0564	6.0564	7.2412	0.0089037
Residuals	70	58.5467	0.8364		

*Terms added sequentially (first to last)

Non-Tidal and Tidal Wetlands

Since this model has demonstrated that it remains relatively robust in its ability to describe subsets of the amount of permitted wetland fill that are sorted by the type of permit that is issued, it is possible that it is similarly robust to describing subsets that are sorted by the type of wetland within which the permits are issued. In order to conduct this analysis, however, the model must first be slightly modified. When describing the amount of wetland fill permitted in non-tidal wetlands, the total wetland abundance measure was substituted with a measure for the total amount of non-tidal wetlands. This ensures the performance of the model is not unduly influenced by estimates for amounts of tidal wetland abundance.

In this instance, the Jacksonville-Florida and the Honolulu-Hawaii WRUs excluded from the analysis because all of the wetlands in both are considered tidal wetlands and therefore no non-tidal wetland fill has been permitted within them. With the values for these two WRUs removed, the model produces an R-squared of 0.8456 with a residual standard error of 0.8228 on 70 degrees of freedom (p-value < 0.0001; f-statistic = 27.38 on 14 and 70 degrees of freedom). This suggests the model's ability to describe amounts of non-tidal wetland fill is still sufficient (Table 7.8).

Table 7.8 Linear regression results for non-tidal permitted wetland fill.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-20.5602	11.5860	-1.7746	0.0803
lntwetlands	2.2346	0.5417	4.1252	0.0001
lpopulation	1.7871	0.4434	4.0304	0.0001
lincome	-0.9019	1.0394	-0.8677	0.3885
Pop.Growth	-189.7491	74.2201	-2.5566	0.0127
lbudget	0.5238	0.1371	3.8215	0.0003
Division1	0.7210	0.1538	4.6888	0.0000
Division2	-0.3188	0.1078	-2.9580	0.0042
Division3	0.1211	0.0760	1.5936	0.1155
Division4	0.2212	0.0970	2.2808	0.0256
Division5	0.1229	0.0598	2.0566	0.0435
Division6	-0.0122	0.0502	-0.2434	0.8084
Division7	-0.1483	0.1410	-1.0515	0.2966
lntwetlands:lpopulation	-0.1324	0.0369	-3.5909	0.0006
lincome:Pop.Growth	17.5722	6.8905	2.5502	0.0130

Residual standard error: 0.8228 on 70 degrees of freedom
Multiple R-Squared: 0.8456
F-statistic: 27.38 on 14 and 70 degrees of freedom, the p-value < 0.0001
2 observations deleted due to missing values

The four graphical diagnostic tools for determining the model's goodness of fit produce similar results as in the previous analyses. A plot of the residuals values against the total fitted model illustrated the relatively constant variance of the data, while the normal-QQ plot demonstrates the data's relatively normal distribution, and the plot of the fitted model against the response variable presented the linearity of the data (Figures 7.13, 7.14, and 7.15). The plot of each WRU's Cook's Distance value also demonstrates that no WRUs had potentially excessive influence on the performance of the model (Figure 7.16).

Figure 7.13 Residuals/fit for non-tidal fill.

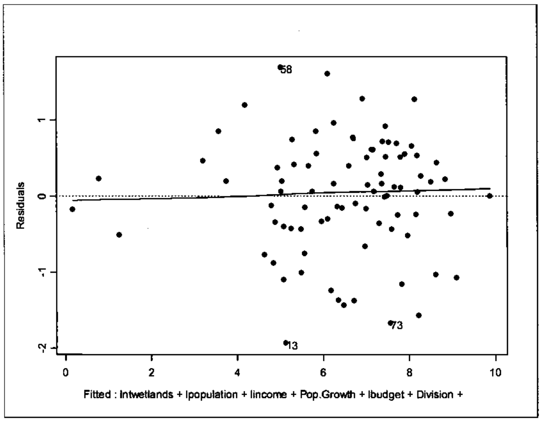


Figure 7.14 Normal QQ for non-tidal fill.

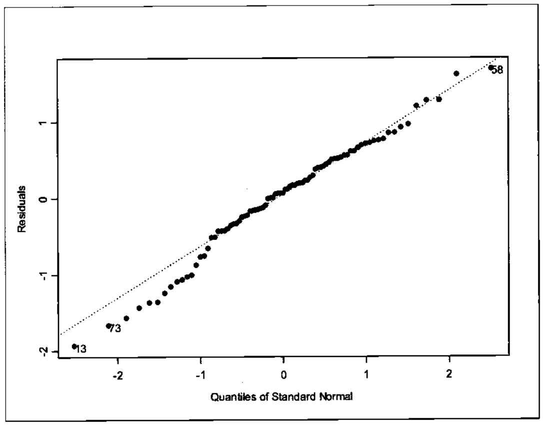


Figure 7.15 Response/fit for non-tidal fill.

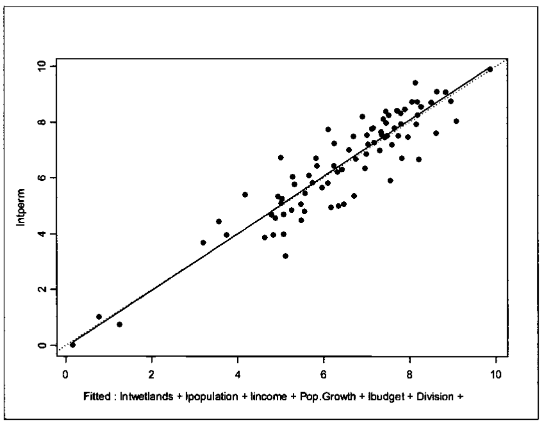
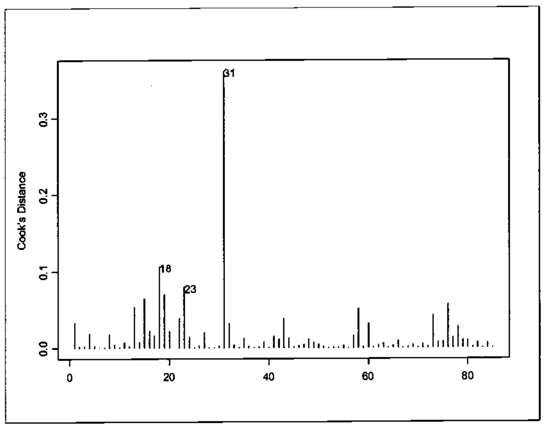


Figure 7.16 Cook's dist. for non-tidal fill.



Furthermore, even with two WRUs excluded from the data, this model generated an AIC value of 67.7013 on the scale of 0.67701. This statistic suggests the model may largely include terms that describe this subcategory of wetland fill fairly well. A review of the analysis of variance table for each term supports this suggestion (Table 7.9). The p-values for each of the terms demonstrates that only the income variable, when it is not a part of the interaction with population growth rates, continues to demonstrate inconclusive evidence regarding its relationship to the response variable. The evidence for the relationships with all of the other variables, on the other hand, remains very strong.

Table 7.9 Analysis of variance table for non-tidal wetland fill linear regression.

Response: lntperm

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lntwetlands	1	179.7051	179.7051	265.4380	0.0000000
lpopulation	1	20.2545	20.2545	29.9174	0.0000007
lincome	1	1.1966	1.1966	1.7675	0.1880115
Pop.Growth	1	7.1503	7.1503	10.5616	0.0017761
lbudget	1	11.1477	11.1477	16.4660	0.0001271
Division	7	30.5223	4.3603	6.4405	0.0000073
lntwetlands:lpopulation	1	5.1254	5.1254	7.5706	0.0075476
lincome:Pop.Growth	1	4.4031	4.4031	6.5036	0.0129562
Residuals	70	47.3909	0.6770		

*Terms added sequentially (first to last)

In an effort to apply the model to amounts of tidal wetland fill permitted within WRUs, it was once again slightly modified. In this analysis the measure for the total amount of wetland abundance was substituted with only a measure for the amount of tidal wetland abundance in each WRU. Unlike the non-tidal wetland modification, this modification results in a significant reduction in the number of WRUs used in the study. Only 40 WRUs contain any tidal wetlands, and of those, only 31 have any recorded permitted wetland fill in those tidal wetlands.

With this large number of WRUs removed, the model performs in a way as may be expected. Although the model provides convincing evidence that it still adequately explains 77.64% of the variation, this is also the lowest R-squared value it has produced with a residual standard error of 1.507 on 16 degrees of freedom (p-value = 0.005019; f-statistic = 3.969 on 14 and 16 degrees of freedom). It also demonstrates the least amount of accuracy with a significantly larger residual standard error of 1.507 on 16 degrees of freedom (Table 7.10).

While the graphical diagnostic tools suggest that the data are demonstrating all the necessary characteristics of a multiple linear regression model, and therefore, that this model adequately fits the data, it is the worst-fit application of the model against any of the subcategories of response variables (Figures 7.17 - 7.20). This relatively poorer fit may primarily be due to the small population size used in the analysis, or it may be due to some unaccounted for condition that only affects the amount of filled tidal wetlands.

Table 7.10 Linear regression results for tidal permitted wetland fill.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-5.1031	61.7172	-0.0827	0.9351
ltidalwetlands	2.0985	1.9020	1.1034	0.2862
lpopulation	2.0053	1.7511	1.1452	0.2690
lincome	-2.4552	5.8481	-0.4198	0.6802
Pop.Growth	-707.1743	628.5238	-1.1251	0.2771
lbudget	0.0099	0.3849	0.0258	0.9798
Division1	-0.9781	0.9787	-0.9995	0.3324
Division2	-1.1411	0.5067	-2.2521	0.0387
Division3	0.1040	0.4071	0.2556	0.8015
Division4	0.0763	0.2198	0.3472	0.7330
Division5	-0.1911	0.2338	-0.8173	0.4257
Division6	0.2956	0.2182	1.3543	0.1944
Division7	-0.3404	0.1921	-1.7717	0.0955
ltidalwetlands:lpopulation	-0.0953	0.1294	-0.7368	0.4719
lincome:Pop.Growth	64.3306	58.0418	1.1083	0.2841

```
Residual standard error: 1.507 on 16 degrees of freedom
Multiple R-Squared: 0.7764
F-statistic: 3.969 on 14 and 16 degrees of freedom, the p-value is 0.005019
56 observations deleted due to missing values
```

Figure 7.17 Residuals/fit for tidal fill.

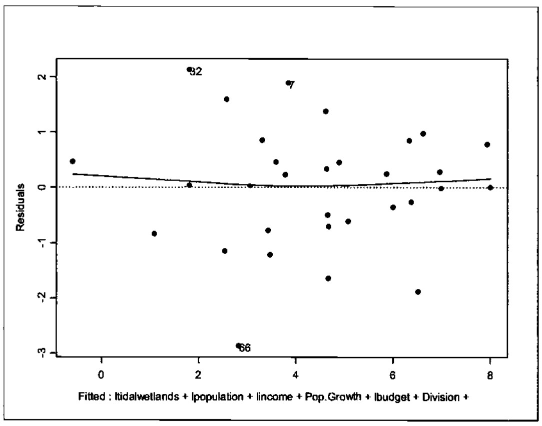
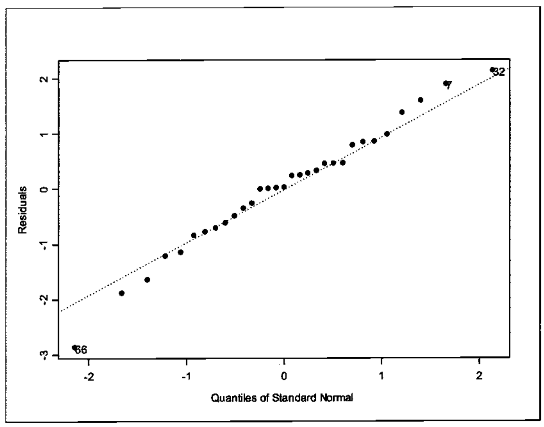


Figure 7.18 Normal QQ for tidal fill.



Furthermore, this scenario generates a very poor AIC value of 104.45339 on the scale of 2.27247, which suggests that several of the terms may not adequately describe the tidal wetland fill data. In order to gain additional understanding of the model's poor performance, the Analysis of Variance Table for each of the variables included in the model reveals that there is only conclusive evidence that the abundance of tidal wetlands (p-value < 0.0001), and the size of the population (p-value = 0.0164), are still significantly related to the response variable. At the same time, the rest of the variables produce no evidence of any such relationships (Table 7.11). The lack of evidence for any of the additional variables suggests there may be plenty of opportunity for the construction of a more sensitive permitted tidal wetland fill model with new terms not yet explored in this study.

Figure 7.19 Response/fit for tidal fill.

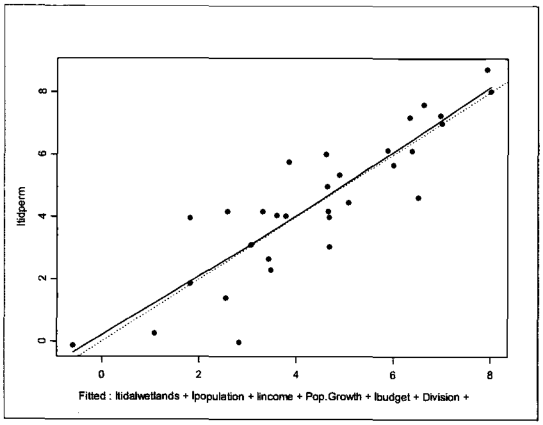


Figure 7.20 Cook's dist. for tidal fill.

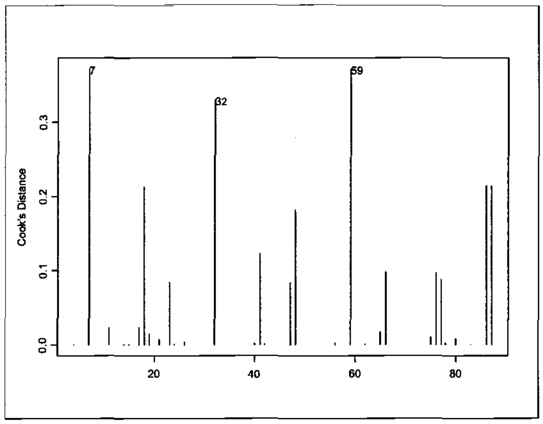


Table 7.11 Analysis of variance table for tidal wetland fill linear regression.

Response: ltidperm

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
tidalwetlands	1	83.28553	83.28553	36.64967	0.0000167
lpopulation	1	16.33199	16.33199	7.18687	0.0164030
lincome	1	0.42604	0.42604	0.18748	0.6708053
Pop.Growth	1	0.11054	0.11054	0.04864	0.8282317
lbudget	1	1.08085	1.08085	0.47563	0.5002911
Division	7	21.42883	3.06126	1.34710	0.2921888
ltidalwetlands:lpopulation	1	0.82634	0.82634	0.36363	0.5549506
lincome:Pop.Growth	1	2.79160	2.79160	1.22844	0.2840942
Residuals	16	36.35963	2.27248		

*Terms added sequentially (first to last)

<u>*Multivariate Verification of Permitted Wetland Fill Model*</u>

Considering that the values for each of the four subcategories for the amounts of permitted wetland fill are all subgroups of the total amount of permitted wetland fill, a correlation analysis reveals that the coefficients for all four categories of data are strongly correlated, >|60%| with the coefficients for the total amount of wetland fill and with one another (Table 7.12). Because the values for each of these measures are subcategories of the same program outcome, they can be analyzed together as though a set of replicate measures for a single class of data.

Table 7.12 Correlation analysis of permitted wetland fill categories.

	lntperm	ltidperm	lgenperm	lstanperm	ltotpermit
lntperm	1.0000000				
ltidperm	0.6602013	1.0000000			
lgenperm	0.9860569	0.6370713	1.0000000		
lstanperm	0.9722634	0.7483536	0.9354956	1.0000000	
ltotpermit	0.9961008	0.7090490	0.9811071	0.9833914	1.0000000

A multivariate analysis of variance for all five terms, however, could not ultimately be constructed because of the adjustments necessary in the model to represent the landscape variations between the non-tidal and tidal wetlands. The analysis, therefore, only bound the three measures of permitted wetland fill together that were not determined by wetland type, and evaluated the evidence that each of the terms of the model held relationships with the entire group of responses (Table 7.13).

Table 7.13 Multivariate analysis of variance table for all wetland fill types.

	Df	Pillai Trace	approx. F	num df	den df	P-value
lwetlands	1	0.8009	91.2033	3	68	<0.0001
lpopulation	1	0.2627	8.0747	3	68	0.0001
lincome	1	0.0319	0.7469	3	68	0.5279
Pop.Growth	1	0.1416	3.7381	3	68	0.0151
lbudget	1	0.0691	1.682	3	68	0.1791
Division	7	0.9041	4.3137	21	210	<0.0001
lwetlands:lpopulation	1	0.0898	2.2375	3	68	0.0917
lincome:Pop.Growth	1	0.2200	6.3925	3	68	0.0007
Residuals	70					

The results indicate that, as a whole, only the individual measure for resident income, the measure of the USACE's budget, and the term for the interaction between amount of wetlands and the size of the population produced evidence of significance that was sufficiently weak that no conclusive relationship to this group of response variables could be determined (p-value = 0.5279, p-value = 0.1791, and p-value = 0.0917 respectively). These results not only confirm the significance of these specific variables they also verify the robustness of this model. In addition to the univariate analysis suggesting the developed model adequately describes the total amount of wetland fill permitted in WRUs, this multivariate analysis suggests the model also adequately describes most of the measures for this entire class of program outcome.

Total Number of Wetland Permits Issued

The application of this model may not be completely limited to only describing the primary program outcome of the amounts of permitted wetland fill. Previous analysis demonstrated a strong relationship between the amount of permitted wetland fill and the secondary program outcome of the total number of permits issued in WRUs. This suggests that although this model was developed in order to describe the amount of total permitted wetland fill, it may also be used to describe the total number of permits issued in WRUs.

The application of this model may, however, require one modification. While all the variables currently included in the model were previously demonstrated to have a direct relationship with the total amount of wetland fill, one additional variable was also shown to have a potential relationship with the total number of permits that demonstrated no such relationship with the total amount of permitted wetland fill. The indicator variable for the presence of a CZM program may also need to be included in this model in order to improve its accuracy.

Despite the number of issued permits being strongly related to the amount of wetland fill permitted in WRUs, this model does not describe the total number of permits equally as well. The model does fit the majority of the data, but it only describes 76.06 % of the variation with a residual standard error of 0.8451 on 72 degrees of freedom (p-value < 0.0001; F-statistic = 16.34 on 14 and 72 degrees of freedom).

This amount is considerably less than it explains in the amount of total permitted wetland fill (Table 7.14).

Table 7.14 Linear regression results for total no. of wetland fill permits.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-8.0167	11.4636	-0.6993	0.4866
lwetlands	1.8932	1.0926	1.7328	0.0874
lpopulation	0.7866	0.4194	1.8754	0.0648
lincome	-0.4852	1.0732	-0.4521	0.6525
Pop.Growth	-4.3337	74.8469	-0.0579	0.9540
lbudget	0.3418	0.1487	2.2982	0.0245
Division1	-0.1893	0.1555	-1.2173	0.2275
Division2	0.1098	0.1088	1.0095	0.3161
Division3	0.0905	0.0766	1.1812	0.2414
Division4	0.1765	0.0975	1.8111	0.0743
Division5	0.0058	0.0605	0.0957	0.9240
Division6	-0.0477	0.0506	-0.9432	0.3487
Division7	-0.1270	0.0908	-1.3981	0.1664
lwetlands:lpopulation	-0.0856	0.0771	-1.1096	0.2708
lincome:Pop.Growth	0.2217	6.9513	0.0319	0.9746

```
Residual standard error: 0.8451 on 72 degrees of freedom
Multiple R-Squared: 0.7606
F-statistic: 16.34 on 14 and 72 degrees of freedom, the p-value < 0.0001
```

Despite the much lower explanatory power, the model does still adequately describe the data. Furthermore, the graphical diagnostic tools confirm that the data are still meeting all the necessary assumptions of a multiple linear regression model (Figures 7.21-7.24).

Figure 7.21 Residuals/fit for total no. of permits issued.

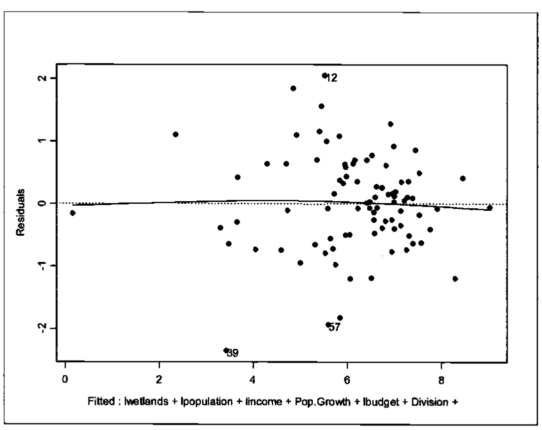


Figure 7.22 Normal QQ for total no. of permits issued.

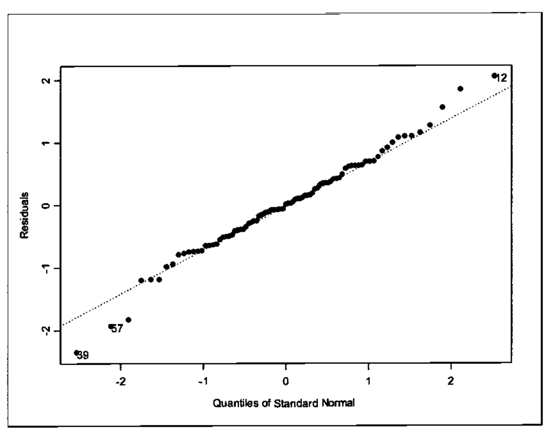


Figure 7.23 Response/fit for total no. of permits issued.

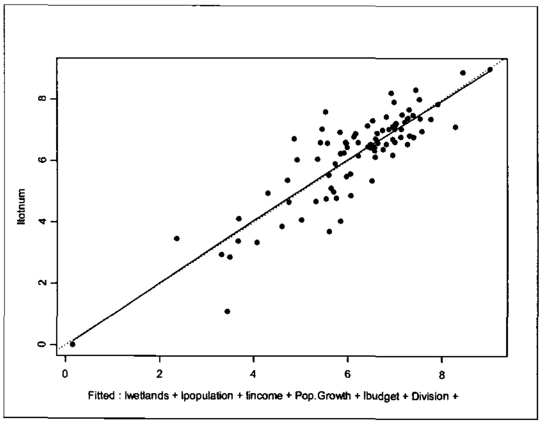
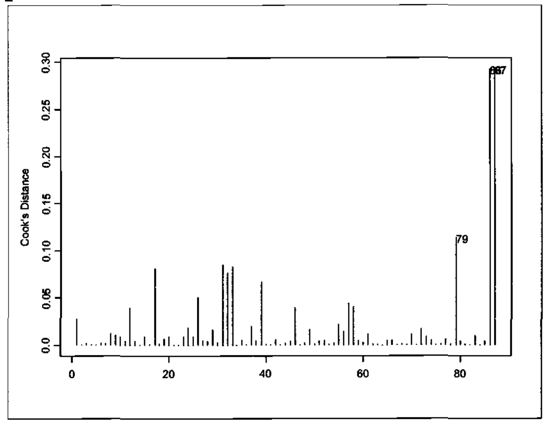


Figure 7.24 Cook's dist. for total no. of permits issued.



The AIC value of 72.4814 on the scale of 0.71413, however, suggests that several of the terms may not adequately describe the total number of permits issued. Furthermore, an investigation of the analysis of variance table for the independent variables in the model demonstrates that only the measures of wetland abundance and total population demonstrate any evidence of significant relationship with that program outcome (p-values both <0.0001). The model no longer produces evidence that any of the other variables are significantly contributing to the fit of the model (Table 7.15).

Table 7.15 Analysis of variance table total no. of permits linear regression.

Response: ltotnum

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	107.9565	107.9565	151.1718	0.0000000
lpopulation	1	42.9338	42.9338	60.1203	0.0000000
lincome	1	1.5860	1.5860	2.2209	0.1405232
Pop.Growth	1	0.4135	0.4135	0.5790	0.4491789
lbudget	1	2.8007	2.8007	3.9219	0.0514828
Division	7	6.6689	0.9527	1.3341	0.2470135
lwetlands:lpopulation	1	1.0352	1.0352	1.4495	0.2325450
lincome:Pop.Growth	1	0.0007	0.0007	0.0010	0.9746467
Residuals	72	51.4175	0.7141		

*Terms added sequentially (first to last)

These results suggest that the total number of permits issued in WRUs may be further influenced by the replacement of some of these variables as well as the inclusion of an additional variable or set of variables that have not been discussed in this study. The fit of this model is not, however, significantly improved upon by the addition of the CZM indicator variable, as suggested by the preliminary analysis (p-value = 0.8567, extra sum of squares f-test). There is, therefore, a considerable amount of opportunity for future studies into characteristics that influence the number of issued permits.

Multivariate Verification of Permit Activity Model

Considering that the values for recorded the amount of permitted wetland fill and the number of issued permits are both measures of different outcomes for the same program, a correlation analysis reveals that the coefficients for these summary measures of both program outcomes are strongly correlated >|60%| with one another (Table 7.16). Because of this strong correlation, it is possible that the univariate analysis of the total number of permits issued, may underestimate the significance of some of the model's variables.

Table 7.16 Correlation analysis between permit no. and permitted fill amounts.

	ltotpermit	ltotnum
ltotpermit	1.0000000	
ltotnum	0.7954733	1.00000000

With both of the classes of response variables so strongly correlated with one another, a multivariate analysis of variance both terms was constructed. This allows the model to consider both the number permits issued and the amount of wetland fill permitted to be co-measures of a value for an overall measure of wetland permit activity. The analysis bound the two program outcome summary measures together, and evaluated the evidence that each of the terms of the model held relationships with the entire group of responses (Table 7.17).

The results indicate that when program outcomes are assessed as a whole, only the measure for resident incomes by itself produced evidence of significance that was sufficiently weak that no conclusive relationship to the combined program outcomes could be determined (p-value = 0.1686). These results not only confirm the significance of each of the specific variables in the model to the combined measure of wetland permit activity in WRUs, they also provide additional evidence supporting the robustness of the model to broader measures of wetland permit activity.

Table 7.17 Multivariate analysis of variance table for wetland permit activity.

	Df	Pillai Trace	approx. F	num df	den df	P-value
lwetlands	1	0.8454	194.1264	2	71	<0.0001
lpopulation	1	0.4841	33.3064	2	71	<0.0001
lincome	1	0.0489	1.8255	2	71	0.1686
Pop.Growth	1	0.1768	7.6222	2	71	0.0010
lbudget	1	0.0797	3.0726	2	71	0.0525
Division	7	0.5554	3.9541	14	144	<0.0001
lwetlands:lpopulation	1	0.0932	3.6469	2	71	0.0311
lincome:Pop.Growth	1	0.1059	4.2042	2	71	0.0188
Residuals	72					

<u>*Numbers of General and Standard Actions*</u>

The same general relationship demonstrated with the total number of permits was also demonstrated individually by both subcategories of permit types. For each measure respectively, the model produces R-squared values of 0.7357 with a residual standard error of 0.9167 on 72 degrees of freedom for general permits; and 0.6719 with a residual standard error of 0.8244 on 70 degrees of freedom for standard permits (P-values both < 0.0001). This suggests that for each measure, the model demonstrates that it is relatively equally well fit to both measures. However, it suggests that in both cases the model describes neither the number of general permits, nor the number of standard permits as well as it does the total number of permits (Tables 7.18 and 7.19). This suggests that both actions that require standard and general permits are affected similarly by the variables included in the model.

Table 7.18 Linear regression results for no. of general wetland fill permits.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-7.1029	12.4348	-0.5712	0.5696
lwetlands	1.7577	1.1851	1.4831	0.1424
lpopulation	0.7441	0.4550	1.6355	0.1063
lincome	-0.5325	1.1641	-0.4574	0.6487
Pop.Growth	-3.4517	81.1879	-0.0425	0.9662
lbudget	0.3520	0.1613	2.1819	0.0324
Division1	-0.2034	0.1687	-1.2054	0.2320
Division2	0.1244	0.1180	1.0541	0.2954
Division3	0.1055	0.0831	1.2703	0.2081
Division4	0.1792	0.1057	1.6950	0.0944
Division5	0.0164	0.0656	0.2501	0.8032
Division6	-0.0500	0.0549	-0.9110	0.3653
Division7	-0.1344	0.0985	-1.3637	0.1769
lwetlands:lpopulation	-0.0760	0.0836	-0.9091	0.3663
lincome:Pop.Growth	0.1256	7.5402	0.0167	0.9868

```
Residual standard error: 0.9167 on 72 degrees of freedom
Multiple R-Squared: 0.7357
F-statistic: 14.32 on 14 and 72 degrees of freedom, the p-value is 1.332e-015
```

Table 7.19 Linear regression results for no. of standard wetland fill permits.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-3.2426	13.7464	-0.2359	0.8142
lwetlands	2.1147	1.7729	1.1928	0.2370
lpopulation	0.9279	0.7232	1.2830	0.2037
lincome	-1.3650	1.0790	-1.2651	0.2100
Pop.Growth	-129.0735	80.0924	-1.6116	0.1116
lbudget	0.3557	0.1452	2.4507	0.0168
Division1	-0.0131	0.1579	-0.0831	0.9340
Division2	0.0586	0.1062	0.5517	0.5829
Division3	-0.0679	0.0756	-0.8976	0.3725
Division4	0.1376	0.0964	1.4277	0.1578
Division5	-0.0993	0.0604	-1.6453	0.1044
Division6	-0.0079	0.0499	-0.1591	0.8740
Division7	-0.0082	0.0891	-0.0917	0.9272
lwetlands:lpopulation	-0.1104	0.1255	-0.8796	0.3821
lincome:Pop.Growth	11.9231	7.4262	1.6056	0.1129

```
Residual standard error: 0.8244 on 70 degrees of freedom
Multiple R-Squared: 0.6719
F-statistic: 10.24 on 14 and 70 degrees of freedom, the p-value is 5.171e-012
2 observations deleted due to missing values
```

Furthermore, the graphical diagnostic tools demonstrate that both of these models continue to meet the assumptions of a multiple regression model. The diagnostic tools for the number of general permits are presented in Figures 7.25-7.28. In addition, the diagnostic tools for the number of standard permits are presented in Figures 7.29-7.32.

Figure 7.25 Residuals/fit for no. of general permits issued.

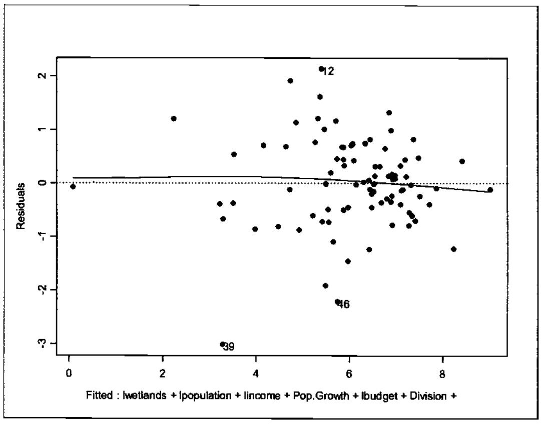


Figure 7.26 Normal QQ for no. of general permits issued.

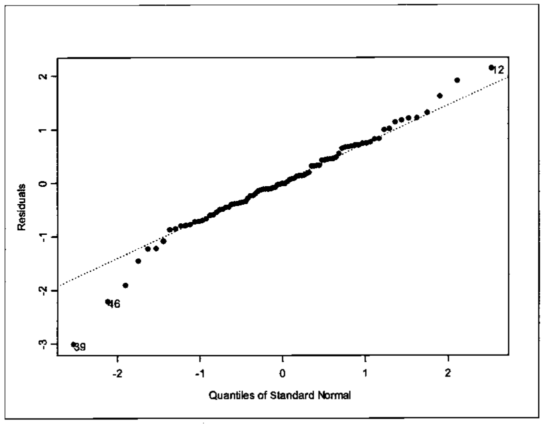


Figure 7.27 Response/fit for no. of general permits issued.

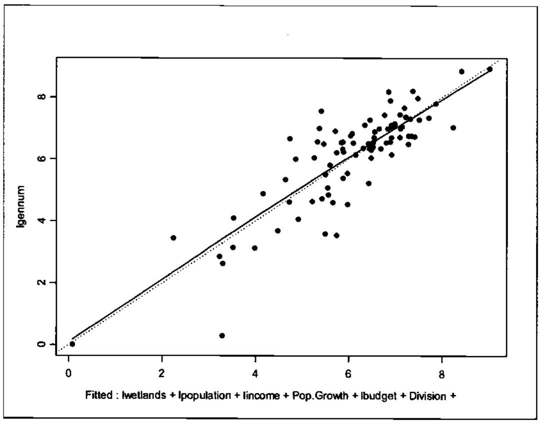
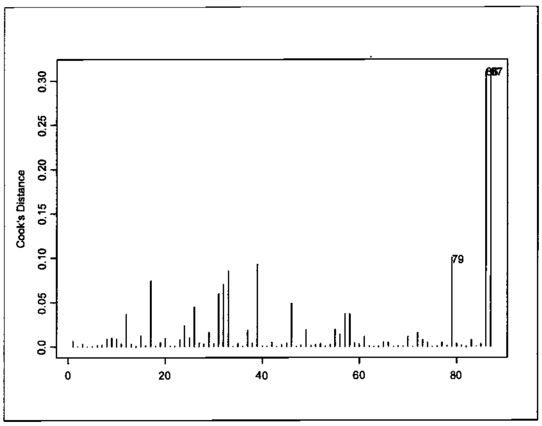


Figure 7.28 Cook's dist. for no. of general permits issued.



As with the total number of permits, the model produces AIC values that suggest many of the terms included in these models may not adequately describe either the number of general or standard permits issued (AIC of 85.7064 on the scale of 0.84026 for the number of general permits, and AIC of 67.9601 on the scale of 0.67960 for the number of standard permits). Furthermore, an investigation of the analysis of variance table for each independent term suggests that both wetland abundance and total population continue to demonstrate conclusive evidence of relationships with the response variables (p-values of both < 0.0001; analysis of variance F-statistic).

Figure 7.29 Residuals/fit for no. of standard permits issued.

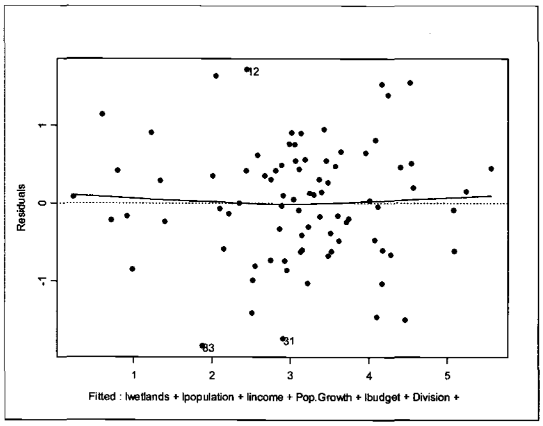


Figure 7.30 Normal QQ for no. of standard permits issued.

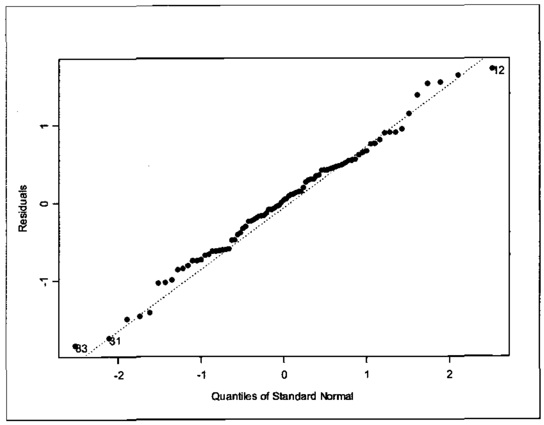


Figure 7.31 Response/fit for no. of standard permits issued.

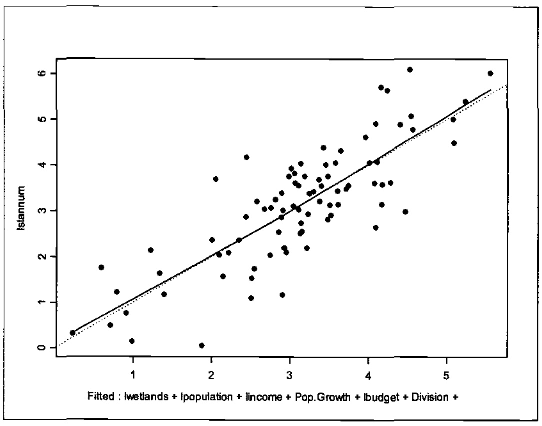
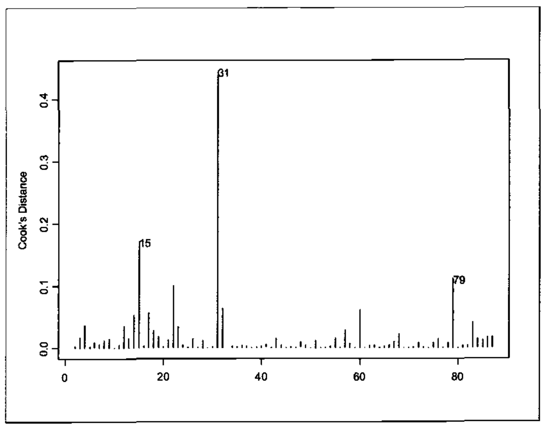


Figure 7.32 Cook's dist. for no. of standard permits issued.



In addition, the evidence that the USACE budget may still be related to the response variables of both models is greatly reduced, but it is still suggestive for general permits (p-value = 0.0657) and strong for standard permits (p-value = 0.0324). For all of the other variables, however the analysis provides no evidence that they continue to show relationships with the response variables. Therefore, as with the total number of wetland permits, these two measures may also be better described by future modeling efforts that incorporate variables that have not yet been discussed in this study (Tables 7.20 and 7.21).

Table 7.20 Analysis of variance table for no. of general permits linear regression.

Response: lgennum

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	109.4335	109.4335	130.2379	0.0000000
lpopulation	1	45.2250	45.2250	53.8227	0.0000000
lincome	1	1.7283	1.7283	2.0568	0.1558523
Pop.Growth	1	0.4131	0.4131	0.4917	0.4854380
lbudget	1	2.9340	2.9340	3.4918	0.0657423
Division	7	7.8835	1.1262	1.3403	0.2441996
lwetlands:lpopulation	1	0.8247	0.8247	0.9815	0.3251474
lincome:Pop.Growth	1	0.0002	0.0002	0.0003	0.9867584
Residuals	72	60.4986	0.8403		

*Terms added sequentially (first to last)

Table 7.21 Analysis of variance table for no. of standard permits linear regression.

Response: lstannum

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	64.98402	64.98402	95.62079	0.0000000
lpopulation	1	22.56918	22.56918	33.20944	0.0000002
lincome	1	0.32427	0.32427	0.47714	0.4920036
Pop.Growth	1	1.08972	1.08972	1.60347	0.2096105
lbudget	1	3.23575	3.23575	4.76125	0.0324662
Division	7	3.16755	0.45251	0.66584	0.7000516
lwetlands:lpopulation	1	0.29377	0.29377	0.43227	0.5130343
lincome:Pop.Growth	1	1.75188	1.75188	2.57780	0.1128743
Residuals	70	47.57210	0.67960		

*Terms added sequentially (first to last)

Multivariate Verification of Number of Permits Issued Model

Considering that the values for both of the subcategories for the amounts of permitted wetland fill are all subgroups of the total number of permits issued in WRUs, a correlation analysis reveals that the coefficients for both categories of data are strongly correlated, >|60%| with the coefficients for the total number of issued permits and with one another (Table 7.22). Because the values for each of these measures are subcategories of the same program outcome they can be analyzed together as though a set of replicate measures for a single class of data.

Table 7.22 Correlation analysis of no. of permit categories.

	ltotnum	lgennum	lstannum
ltotnum	1.00000000	0.99861599	0.8452869
lgennum	0.99861599	1.00000000	0.8187935
lstannum	0.84528692	0.81879348	1.0000000

With both of the subcategories of response variables so strongly correlated with one another, a multivariate analysis of variance for all three terms was constructed. The analysis bound the three measures of permitted wetland fill together, and evaluated the evidence that each of the terms of the model held relationships with the entire group of responses (Table 7.23). The results indicate that, as a whole, only the measures for the amounts of wetlands present, and the size of the resident population have conclusive evidence of their relationship to all of the classes of wetland fill (p-value both < 0.0001).

The remainder of the terms produced evidence of significance that was sufficiently weak that no conclusive relationship to this group of response variables could be determined. These results not only confirm the significance of these specific variables to each of the measures for the number of issued permits in WRUs, they also provide additional evidence to suggest that the developed model may include a number of excess terms that do not necessarily help explain this entire class of program outcomes.

Table 7.23 Multivariate analysis of variance table for numbers of all permit types.

	Df	Pillai Trace	approx. F	num df	den df	P-value
lwetlands	1	0.6786	47.8605	3	68	<0.0001
lpopulation	1	0.4447	18.1503	3	68	<0.0001
lincome	1	0.0285	0.6661	3	68	0.5757
Pop.Growth	1	0.0332	0.7788	3	68	0.5099
lbudget	1	0.0802	1.9773	3	68	0.1256
Division	7	0.2313	0.8353	21	210	0.6743
lwetlands:lpopulation	1	0.0499	1.1906	3	68	0.3199
lincome:Pop.Growth	1	0.0427	1.0100	3	68	0.3938
Residuals	70					

Permit and Mitigation Ratios

The preliminary analyses of each of the independent variables included in the model for the amount of permitted wetland fill produced no evidence of any linear relationships between any of them and either of the permit or mitigation ratios of each WRU. As a result, there is no evidence to suggest the model constructed to describe the amount of permitted wetland fill may be used to describe either measures for the permit ratios or mitigation ratios. Before this lack of fit could be tested, however, the Memphis-Illinois WRU was excluded from the analysis, because it was not possible to estimate the permit or mitigation ratios for a WRU in which no actual wetland fill was recorded. With Memphis-Illinois removed, the hypothesized lack of fit of this model to either of these secondary program outcomes was confirmed by all of the traditional analytical methods.

The poor response of both of these variables against the regression was demonstrated by low R-squared values for each. An R-squared value of 0.2572 with a standard error of 0.1637 on 71 degrees of freedom was produced by the model of permit ratios (Table 7.24). Likewise an R-squared value of 0.4515 with a standard error of 0.5176 on 71 degrees of freedom was produced by the model for mitigation ratios (Table 7.25). Both of these estimates have respective p-values = 0.0633 and < 0.0001 from f-statistics of 1.756 and 4.174 on 14 and 71 degrees of freedom each.

Table 7.24 Linear regression results for permit ratio.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	2.9495	2.6169	1.1271	0.2635
lwetlands	0.2941	0.2853	1.0307	0.3062
lpopulation	0.1053	0.1127	0.9350	0.3529
lincome	-0.3287	0.2096	-1.5684	0.1212
Pop.Growth	-41.2518	15.6133	-2.6421	0.0101
lbudget	-0.0237	0.0288	-0.8211	0.4144
Division1	-0.0355	0.0302	-1.1763	0.2434
Division2	-0.0267	0.0211	-1.2667	0.2094
Division3	0.0347	0.0150	2.3142	0.0236
Division4	0.0175	0.0189	0.9261	0.3575
Division5	-0.0021	0.0120	-0.1796	0.8580
Division6	0.0145	0.0098	1.4696	0.1461
Division7	-0.0124	0.0176	-0.7013	0.4854
lwetlands:lpopulation	-0.0178	0.0201	-0.8848	0.3792
lincome:Pop.Growth	3.8389	1.4477	2.6517	0.0099

```
Residual standard error: 0.1637 on 71 degrees of freedom
Multiple R-Squared: 0.2572
F-statistic: 1.756 on 14 and 71 degrees of freedom, the p-value is 0.06329
1 observation deleted due to missing values
```

Table 7.25 Linear regression results for log mit. ratio.

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-4.6216	8.2736	-0.5586	0.5782
lwetlands	-0.2682	0.9020	-0.2974	0.7671
lpopulation	-0.1418	0.3562	-0.3982	0.6917
lincome	0.5433	0.6627	0.8198	0.4151
Pop.Growth	54.4517	49.3623	1.1031	0.2737
lbudget	0.0986	0.0911	1.0818	0.2830
Division1	-0.0294	0.0955	-0.3074	0.7595
Division2	-0.1585	0.0667	-2.3772	0.0201
Division3	-0.0518	0.0474	-1.0932	0.2780
Division4	0.0526	0.0598	0.8793	0.3822
Division5	-0.0356	0.0378	-0.9397	0.3505
Division6	0.0530	0.0311	1.7032	0.0929
Division7	-0.3018	0.0557	-5.4166	0.0000
lwetlands:lpopulation	0.0140	0.0637	0.2201	0.8264
lincome:Pop.Growth	-4.9842	4.5770	-1.0890	0.2798

```
Residual standard error: 0.5176 on 71 degrees of freedom
Multiple R-Squared: 0.4515
F-statistic: 4.174 on 14 and 71 degrees of freedom, the p-value is 0.00002803
1 observation deleted due to missing values
```

With the model only explaining approximately one quarter of the variance in the permit ratio data and approximately one half of the variance in the mitigation ratio data, neither variable appears to demonstrate strong responses to the regression model. The graphical diagnostic tools also illustrate that the data do not meet the basic assumptions of a linear regression (Figures 7.33-7.36).

Figure 7.33 Residuals/fit for permit ratio.

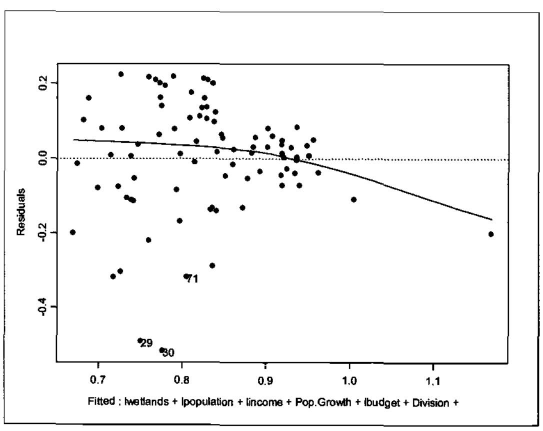


Figure 7.34 Normal QQ for permit ratios.

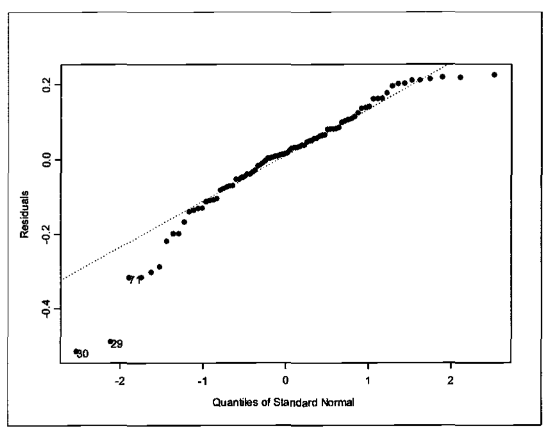


Figure 7.35 Response/fit for permit ratio.

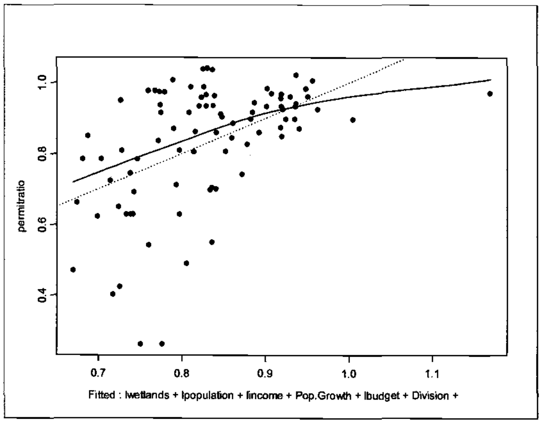


Figure 7.36 Cook's dist. for permit ratio.

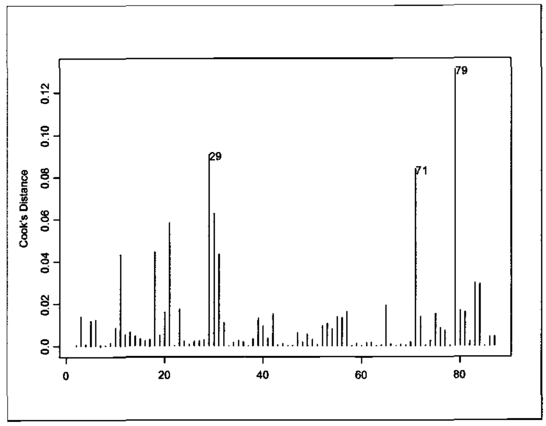


Figure 7.37 Residuals/fit for log mit. ratio.

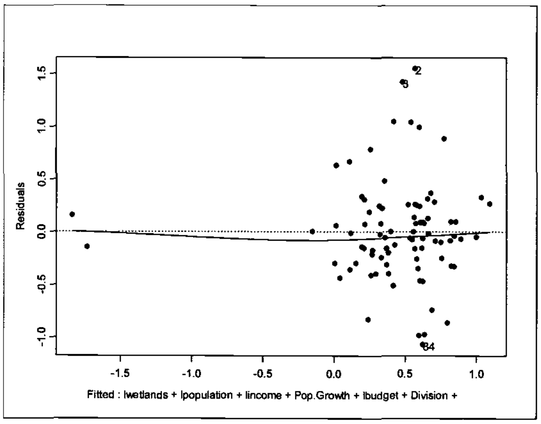


Figure 7.38 Normal QQ for log mit. ratio.

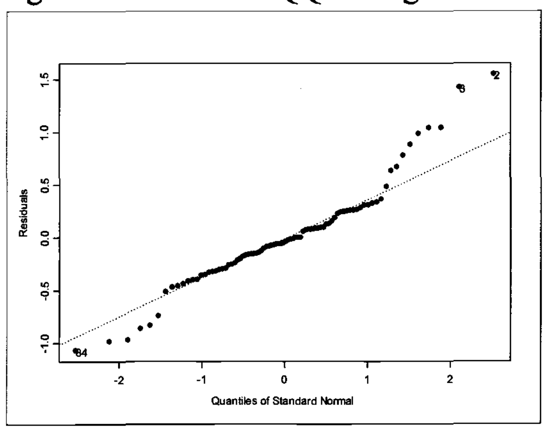


Figure 7.39 Response/fit for log mit. ratio.

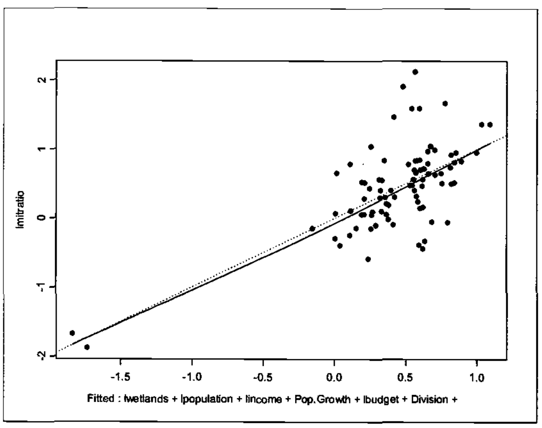
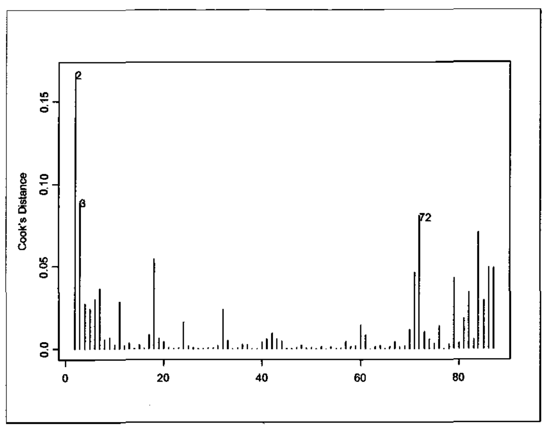


Figure 7.40 Cook's dist. for log mit. ratio.



The inability of the terms included in these models to adequately describe both the permit and the mitigation ratios of WRUs is further supported by each application's respective high AIC values. The AIC of 2.707 on a scale of 0.02679 for the permit ratio data and the AIC value of 27.054 on a scale of 0.26788 for the mitigation ratio data both suggest that the included variables may not significantly contribute to the fit of the model.

The poor fit of many of the variables is confirmed by both measures' respective analysis of variance tables (Tables 7.26 and 7.27). In the case of permit ratios, only the term describing the interaction between income and population growth rates produces evidence that it is significantly related to the response variable (p-value = 0.0098; analysis of variance f-statistic). In the case of mitigation ratios, only the categorical variable identifying specific regulatory divisions and the individual income variables produce evidence that they are significantly related to the response variable (p-value < 0.0001 and p-value = 0.0004; analysis of variance f-statistics, respectively). In neither case, do the variables that have contributed most to the descriptive power of the other models demonstrate any significant contribution to these models.

This overall lack of fit suggests that the conditions that determine the permit ratios or mitigation ratios of permits issued within WRUs may be determined by an entirely different set of factors than those that determine the volume of permit activity. Permit and mitigation ratios are, therefore, a clearly identified area where future research into factors that affect USACE wetland regulatory program outcomes may be conducted. This is also a place where future research may be continued in determining the type of intergovernmental relationships that are present between the state and national wetland regulatory agencies. Although preliminary analysis demonstrated no conclusive evidence of direct relationships between these ratios and the type of state wetland regulatory program present, the data were suggestive that some such relationships may exist. It is possible, therefore, that more conclusive evidence for this relationship could still be discovered here if the appropriate variables were described that do establish the permit and mitigation ratios of permits. The weakness of the developed model's ability to adequately describe either of these summary measures, however, suggests that additional investigation into the four different subcategories of permit and mitigation ratios for intergovernmental relationships with this tool would be equally as fruitless.

Table 7.26 Analysis of variance table for total permit ratio linear regression.

Response: permitratio

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	0.029287	0.0292873	1.092875	0.2993812
lpopulation	1	0.011197	0.0111968	0.417814	0.5201137
lincome	1	0.023818	0.0238183	0.888794	0.3490014
Pop.Growth	1	0.056113	0.0561128	2.093886	0.1522904
lbudget	1	0.012398	0.0123981	0.462641	0.4986041
Division	7	0.321096	0.0458709	1.711702	0.1200532
lwetlands:lpopulation	1	0.016452	0.0164521	0.613920	0.4359217
lincome:Pop.Growth	1	0.188430	0.1884301	7.031390	0.0098715
Residuals	71	1.902688	0.0267984		

*Terms added sequentially (first to last)

Table 7.27 Analysis of variance table for total log mit. ratio linear regression.

Response: lmitratio

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)*
lwetlands	1	0.01790	0.017901	0.06683	0.7967613
lpopulation	1	0.00626	0.006261	0.02337	0.8789248
lincome	1	3.64156	3.641558	13.59491	0.0004403
Pop.Growth	1	0.69880	0.698800	2.60881	0.1107072
lbudget	1	0.11775	0.117749	0.43959	0.5094671
Division	7	10.84586	1.549409	5.78436	0.0000252
lwetlands:lpopulation	1	0.00852	0.008523	0.03182	0.8589341
lincome:Pop.Growth	1	0.31765	0.317645	1.18586	0.2798496
Residuals	71	19.01819	0.267862		

*Terms added sequentially (first to last)

Considering that the values for neither the permit nor the mitigation ratios issued in WRUs respond too well to the multiple regression model, a test was performed to determine if permit and mitigation ratios should, actually be combined with one another or measures for other program outcomes to form a single measure of permit activity. A correlation analysis, however, revealed that the coefficients of neither measure are strongly correlated > |60%| with the coefficients for each other or any of the summary or subcategories of other program outcomes (Table 7.28). Without evidence of a significant correlation, a multivariate analysis is not an appropriate analytical tool. Therefore, measures for both permit and mitigation ratios continue to only be evaluated as separate program outcomes. The application of the model to these measures, therefore, ceases with this level of analysis.

Table 7.28 Correlation of analysis of permit and log mit. ratio.

	lmitratio	permitratio
lmitratio	1.0000000	
permitratio	0.2604712	1.00000000
lntperm	0.3829004	0.20876688
ltidperm	0.3436543	0.14120550
lgenperm	0.3990325	0.19290560
lstanperm	0.4258124	0.23236126
ltotpermit	0.3987128	0.21993210
ltotnum	0.3283730	0.09146353
lgennum	0.3214933	0.07588998
lstannum	0.3112219	0.27445401

Intergovernmental Relations Variable Evaluation

The multiple linear regression model developed to describe the amount of wetland fill that has been permitted in Wetland Regulatory Units (WRUs), does a sufficient job of describing 86.69% of the variation in the data. This model accounts for both bottom-up and top-down conditions that potentially determine the amount of permit activity in WRUs. The question of primary interest to this study, however, still remains to be answered. Can a significant portion of the remaining variation in the data be attributed to differences in the types of state wetland regulatory programs that are present?

Preliminary analyses of each of the individual variables included in the model produced no conclusive evidence that measures of any of these characteristics were significantly different between groups of WRUs that are subjected to different types of state wetland regulatory programs. Likewise, a direct analysis also produced no evidence of such a relationship in the amount of permitted wetland fill. A relationship between the type of state program and this regulatory program outcome may still exist, however, but it may be obscured by the other relationships that exist between this variable and all of the other independent variables included in this model. Because this model accounts for all of these additional relationships, it may be the tool necessary to reveal the evidence of this potential relationship.

Three types of state wetland regulatory programs exist in the United States. States can choose to let the USACE make all of the major regulatory decisions concerning wetlands within their territories, which by default establishes no state wetland regulatory program. States may also choose, instead, to assert some control over the way wetlands are regulated. In order to accomplish this goal, states may choose to exploit Section 401 water quality certification requirements in the Federal Clean Water Act in order to set some conditions on the types of wetland fill activities that the USACE permits to occur. States may also choose to author their own wetland regulatory statutes with separate standards and review processes for wetland fill activities that are intended to be completely autonomous from the USACE's wetland regulatory program.

It is this last type of state wetland regulatory program that is of central interest to this study. Should the national wetland regulatory program behave significantly differently in WRUs subject to statute-based state wetland regulatory programs, than it does in other WRUs it may provide evidence to suggest that the overlapping-authority model of intergovernmental relations describes the relationship between state and national wetland regulatory agencies. Should this subgroup of WRUs not perform significantly different than other WRUs no evidence will be produced to suggest the separated-authority model of intergovernmental relations does not adequately describe the relationships between these two agencies.

Differences in Total Amount of Wetland Fill

In order to test for the presence of any significant differences between groups of WRUs subjected to different types of state wetland regulatory programs, a categorical variable was added to the multiple linear regression model. This variable classifies each of the 87 WRUs into one of three categories based upon the type of state wetland regulatory program that is present. This grouping creates categories with unequal numbers of WRUs. Twenty-three WRUs are subjected to statute-based state wetland regulatory programs, 39 are subjected Section 401 programs, while the remaining 25 are subjected to no active state wetland regulatory program. This unequal distribution of WRUs does not require further adjustment to the model, however, because multiple regression analysis is robust to comparing populations with different numbers of individuals.

With this categorical variable included, the model proposes the existence of different mean responses for three groups of WRUs, each responding in similar ways to the same sets of independent variables. If the mean amount of wetland fill permitted in the WRUs of any one of the groups truly is significantly different from any of the others groups, the categorical variable should contribute significantly to the accuracy of the model, and suggest the inclusion of that variable into the model. With the categorical variable added to the model, the analysis was again conducted. The model does not, however, produce any evidence that the addition of this variable improves the fit of the model and therefore there is no evidence of any significant difference between the groups (p-value = 0.7321; extra sum of squares f-test).

Differences in General and Standard Actions

Model testing demonstrated the ability of this model to describe relatively similar amounts of variances within subcategories of the response variable that are based upon permit type. It describes 82.83% of the amount of wetland fill permitted through general actions and 80.75% of the amount of wetland fill permitted through standard actions. In order to determine if any significant difference exists between groups of WRUs subjected to different types of state wetland regulatory programs in either of the subcategories of permitted wetland fill, two additional analyses were conducted.

In each analysis, the amount of total wetland fill permitted was substituted with either the amount of fill permitted through general actions or through standard actions. The state program type categorical variable was then added to the model and the significance of that addition was evaluated. In neither case, however, did the inclusion of the state program categorical variable improve the fit of the model. The analysis of adding the variable to the model for the amount of wetland fill permitted through general actions produced a p-value of 0.4201 from an extra sum of squares f-test. Adding the same variable to the model for the amount of wetland fill permitted through standard actions produced a p-value of 0.8786 from an extra sum of squares f-test. These results suggest there is no evidence in either case of any significant difference between the different types of state program types in place. Therefore, if differences in the amount of permitted wetland fill do exist between state program types, it is not a difference that is dependent upon permit type.

Differences in Non-Tidal and Tidal Wetland Fill

Model testing also demonstrated this model's ability describe considerably different amounts of variances within subcategories of the response variable that are based upon wetland type. It describes 84.56% of the amount of wetland fill permitted in non-tidal wetlands, and 77.64% of the amount of wetland fill permitted in tidal wetlands. In order to determine if any significant difference exists between groups of WRUs subjected to different types of state wetland regulatory programs in either of these subcategories of permitted wetland fill, two additional analyses were conducted.

In each analysis, the amount of total wetland fill permitted was substituted with either the amount of fill permitted in non-tidal wetlands or in tidal wetlands. In addition, estimates for the total amounts of wetlands in the WRUs were substituted for estimates for the total amounts of non-tidal or tidal wetlands respectively. The state program type categorical variable was then added to the model and the significance of that addition was evaluated. Previous analysis of variance investigations into the amount of non-tidal fill produced no evidence that the addition of this variable would be significant. The analysis did, however, produce inconclusive evidence that suggested the addition of this variable may be significant to the model for permitted tidal wetland fill. In neither case, however, did the inclusion of the state program type categorical variable improve the fit of the model. The analysis of adding the variable to the model for the amount of permitted non-tidal wetland fill produced a p-value of 0.2861 from an extra sum of squares f-test. Adding the same variable to the more poorly fit model for the amount of permitted tidal wetland fill produced a p-value of 0.9991 from an extra sum of squares f-test. These results suggest there is no evidence in either case of any significant difference between the different types of state program types in place.

Differences in Total Numbers of Permits

Prior model testing demonstrated that the model does not fit this program outcome as well as it does the amount of permitted wetland fill, but it does still describe 76.06% of the variance in the WRUs. This allows for an analysis of how the number of issued permits may be related to the type of state wetland regulatory program present in WRUs. Although the results of prior analysis of variance tests of this program outcome produced no evidence of a relationship between program type and the total number of issued permits, the analysis of the inclusion of this variable in to the multiple regression model for total number of issued permits, produces strong evidence that a description of the type of state wetland regulatory program significantly improves the fit of the model (p-value = 0.0465; extra sum of squares f-test). This means that there is strong evidence of a significant difference between the mean numbers of standard permits issued in groups of WRUs subject to different types of state programs.

Because S-plus software arbitrarily assigns identifiers to factor levels in categorical variables that are added to a multiple linear regression model, additional analysis was required to determine specifically how different each of the groups are from one another, and which of the three categories of state program types were significantly different from the others. In order to identify which of the specific types of state wetland regulatory programs differ significantly from one another; the categorical variable for program type was replaced in the model with two indicator variables.

One variable indicated the presence of statute-based wetland regulatory programs. The other variable indicated the presence of Section 401 regulatory programs. These two indicator variables allow for S-plus to test for significant differences between the medians each of these two groups of WRUs and the group of WRUs subjected to no active state wetland regulatory program. Subsequently replacing the indicator variable for Section 401 programs with an indicator variable for the presence of no active state program also allows S-plus to conduct a follow-up analysis that can suggest any significant differences between the group subjected to statute-based programs and the group of WRUs subjected to Section 401 programs. The analysis for the total number of issued permits was then re-run producing the same overall results of significance of a difference between the medians of the groups. Specific results, however, can now be interpreted regarding both of the individual indicator terms.

With the inclusion of the indicator variables for both the groups of WRUs subject to statute-based programs and Section 401 programs, the model produced inconclusive evidence that the median total number of permits issued in statute-based WRUs is 28.33% higher than in those WRUs with no state program (standard error = 16.81%, p-value = 0.1129; t-statistic = 1.6054). The model provides strong evidence, on the other hand, that those WRUs subject to the Section 401 programs issue approximately 33.12% more total permits than those subject to no state program (standard error = 12.23% and p-value =0.0161; t-statistic = 2.4660). In addition, however, the model also produces no evidence of any meaningful difference between the median total number of permits in those WRUs subject to statute-based programs and those subject to Section 401 programs (p-value =0.8040; t-statistic = 0.2491).

Differences in Numbers of General and Standard Actions

During model testing, this model demonstrated the ability to describe relatively equal amounts of variance within each subcategory of the number of issued permits determined by permit type. It describes 73.57% of the number of permits issued through general actions and 67.19% of the number of permits issued through standard actions. In order to determine if any significant difference in either of the subcategories of wetland fill permits can be described by grouping together WRUs subjected to different types of state wetland regulatory programs, two additional analyses were conducted.

In each analysis, the total number of issued permits was substituted with either the number of permits issued through general actions or through standard actions. The state program type categorical variable was then added to the model and the improvement of that model's fit due to that addition was evaluated. In the case of the number of general permits issued, the analysis of adding the variable to the model for the number of general action permits issued produced a p-value of 0.0494 from an extra sum of squares f-test. This result produces strong evidence to suggest the median numbers of issued general permits are different in groups of WRUs determined by the type of state program that is present.

The indicator variables for the statute-based and Section 401 programs were then substituted for the program categorical variable in the model for the number of general permits issued. The model was re-run and produced inconclusive evidence that the median number of general action permits issued in statute-based WRUs was 28.78 % higher than in those WRUs with no state program (standard error = 18.38% p-value = 0.1383; t-statistic = 1.4995). The model provides strong evidence, on the other hand, that those WRUs subject to the Section 401 programs issue approximately 33.36% more general permits than those subject to no state program (standard error = 13.42% and p-value =0.0162; t-statistic = 2.4639). In addition, the model also produces no evidence of any meaningful difference between the median number of general permits in those WRUs subject to statute-based programs and those subject to Section 401 programs (p-value =0.7206; t-statistic = 0.3591).

Adding the categorical state program variable to the model for the number of wetland fill permits issued through standard actions also produced results that suggest that a possible relationship may exist. An extra sum of squares f-test for the inclusion of this variable produced a p-value of 0.0217. This result suggests that there is strong evidence that the fit of the linear regression model is improved by the inclusion of this categorical variable. This, in turn, argues there is strong evidence of a significant difference between the mean numbers of standard permits issued in groups of WRUs subject to different types of state programs. It also supports results of the prior analysis of variance test of the relationship between this program outcome and the type of state program present.

The indicator variables for the statute-based and Section 401 programs were then substituted for the program categorical variable in the model for the number of standard permits issued. The model was re-run and produced strong evidence that the median number of standard permits issued in WRUs subject to statute-based programs were 35.57% higher than the median number of standard permits issued in WRUs with no state program (standard error = 16.52% and p-value = 0.0505; t-statistic = 1.9908). Furthermore, the model provides convincing evidence, that those WRUs subject to the Section 401 programs issue approximately 36.63% more standard permits than those subject to no state program (standard error = 12.13% and p-value =0.0082; t-statistic = 2.7257). The model did not, however, produce any evidence of any difference between the median number of standard permits issued in those WRUs subject to statute-based programs and those subject to Section 401 programs (p-value =0.9565; t-statistic = 0.0547).

Permit and Mitigation Ratios

Because none of the individual analyses of any of the independent variables discussed in this study seem to be directly related to the permit ratios or the mitigation ratios of WRUs, and the regression model described such small amounts of variation for both measures, no sophisticated multiple linear regression model was developed in order to help explain the differences in these program outcomes. Therefore, no additional tests for between-group variations in these variables can be conducted outside of the initial sets of Analyses of Variance that only produced inconclusive evidence suggesting some possible differences in these specific program outcomes may exist. Because these analyses did not produce any conclusive evidence of significant differences between state program types in either of these program outcomes, however, the separated-authority model hypothesis that state program types do not affect any of the subcategories of permit or mitigation ratios cannot be refuted. With a larger data set and more precise data, however, an opportunity exists to develop a more appropriate model that accurately and adequately describes these two program outcomes and possibly answers questions regarding the types of intergovernmental relationships that govern the national government's wetland regulatory program.

Conclusion

The development of this multiple regression model represents a first effort to conduct a nationwide analysis of factors affecting permitted wetland fill and devising an explanatory model from those factors. It also marks a first attempt to systematically evaluate the outcomes of the wetland regulatory program, particularly as used in an effort to describe the type of intergovernmental relations model that most accurately describes the way the national wetland regulatory program is implemented.

There are potentially many permitted wetland fill models such that could be developed. This particular model, however, successfully describes a significant amount of the permitted wetland fill that has occurred in the United States with reasonable accuracy. Furthermore, as a whole, the model has demonstrated sufficient robustness that it is not just restricted to the description of amounts of permitted wetland fill. The model can also be applied to other wetland regulatory program outcomes.

Throughout the process of the model's development, tests have demonstrated varying levels of evidence supporting the inclusion of several of the terms in regression models for each of the different categories and subcategories of the primary program outcomes. As a result, the amount of confidence in the ability of these terms to consistently describe various amounts of permitted wetland fill is not high. The three independent variables for which there is consistently the strongest evidence, however, are; the amount of wetlands locally available, the size of the resident population, and the identity of the division to which USACE districts report. Furthermore, model testing produced evidence of similar relationships, for at least the first two of these terms, to the various measures of the number of permits issued.

Analyses have also identified limitations of the model by indicating those program outcomes for which the inclusion of some additional or different variables may be necessary in order to better describe their variance through this modeling effort. In particular, future research may be useful to identify additional terms that could better explain the amount of permitted fill in tidal wetlands. Likewise, an additional set of terms are most likely necessary for models that adequately describe the variance in the permit and mitigation ratios of all types of permits issued in WRUs. As this study uses the program outcome of the total amount of permitted wetland fill as its primary response variable, however, sufficient evidence has been provided to suggest this model may potentially be useful in determining the type of intergovernmental relationship structure that may exist between state and national wetland regulatory agencies.

If conclusive evidence of a relationship could be found between the amount of permitted wetland fill and the type of state program present within WRUs, it would suggest that the separated-authority model of intergovernmental relations does not adequately describe the relationships that govern the national wetland regulatory program. No such evidence, however, was produced by any of the multiple linear regression analyses of the various measures of permitted wetland fill that were conducted. Therefore, without additional analysis of a differently constructed model, the separated-authority model of intergovernmental relations cannot be rejected as being appropriately applied to the issue of wetland regulations. It can also, therefore, not be suggested that the overlapping-authority model may provide a possible alternative description of the relationships that exist between state and national wetland regulators.

When the model was applied to the total number of permits issued in WRUs , however, it produced strong evidence for the significance of relationships with the type of state wetland regulatory program present. When the numbers of issued permits were sorted by permit type, evidence of a relationship with state program type was again considered significant and strong evidence was produced that both the number of general and standard permits issued in WRUs were partially dependent upon the type of state wetland regulatory program to which they were subject.

In addition, for all three measures of the number of issued permits, there was no evidence that the number of permits issued differed significantly between those WRUs subject to Section 401 programs and those subject to statute-based programs. There was strong evidence, however, that the fewest number of permits issued in each category were consistently located in those WRUs subject to no state program.

This evidence supporting separate measures of the number of permits issued between these three groups is the only evidence produced by the regression model that the separated-authority model of intergovernmental relations may not adequately describe the type of relationships that exist between national and state government wetland regulatory programs. It is also, therefore, the only result that suggests the overlapping-authority model of intergovernmental relations may better describe the circumstances present in the national wetland regulatory program.

Ultimately, a single model may not, in fact, be best suited to describe all of the different outcomes of the national wetland regulatory program. Because they are different measures of fundamentally different aspects of the same regulatory program, differently constructed models may be necessary in order to best describe each program outcome. Model construction is, however, limited by the data that is available to the researcher, and the abundance of the resources necessary to obtain them.

The groundwork for the development of this particular model was laid over ten years ago when phone surveys with state wetland regulatory program administrators revealed the sorting of state program types into the three groups analyzed by this study. Since that time all of the data for the variables included in these models have been painstakingly collected, recorded, analyzed, refined, and published by an army of technical experts with congressionally allocated resources from a whole suite of federal agencies that range from the U.S. Census Bureau, to the U.S. Geologic Survey, and the U.S. Army Corps of Engineers.

The ability to analyze these collected data are the result over two years of time spent manually clipping and re-aggregating digital data from many national datasets developed for analyses on other scales. Considerable resources were expended by making personal contacts through letters, emails, and phone conversations with top resource administrators throughout the country who steward these national datasets, as well as with USACE headquarters and every one of the regulatory branch chiefs and district commanders in all 38 USACE districts. Much additional time was spent by consulting with national wetland management experts and USACE officials, in order to develop comparable datasets and design meaningful variables that could come from these data. Therefore, the next steps to developing more robust models and conducting better analyses are much more complicated than just identifying additional or more accurate variables for inclusion. The data for these variables may be very difficult to acquire and manipulate or even be altogether unattainable.

SIGNIFICANCE OF STATE WETLAND REGULATORY PROGRAMS

Introduction

The following two-step logistic regression analysis was designed with two purposes in mind. The primary intent of this analysis was to more closely examine the potential similarities and differences between statute-based and Section 401 programs that were suggested by the results of the multiple linear regression analysis. In the process, this analysis provides additional evidence supporting the results of the multiple linear regression analysis that suggest the separated-authority model of intergovernmental relations may be inadequate to describe the relationship that exists between state and national wetland regulatory programs.

Since the results of the multiple linear regression analyses produced varying amounts of evidence that the type of state wetland regulatory program present was a significant determinant for each of the different measures of the national wetland regulatory program outcomes, these results are strengthened by verification from an additional analytical tool. For that reason, the first step of this logistic regression analysis was developed. This step was designed to confirm that, for certain program outcomes, the national wetland regulatory program performs differently in areas subject to state wetland regulatory programs than it does in areas without active state wetland regulatory programs.

With confirmation from the first step of this analysis that certain program outcomes demonstrate relationships with the existence of state wetland regulatory programs; the second step of the analysis is capable of producing meaningful results for those same measures. This step was designed with the expressed purpose of determining if there is any evidence that statute-based state wetland regulatory programs results in significantly stronger or weaker protections of wetland resources by the USACE than Section 401 programs.

The results of the extra sum of squares f-tests on the multiple linear regression model for permitted wetland loss produced no evidence that any relationships exist between measures for the amount of wetland loss permitted in Wetland Regulatory Units (WRUs) by the US Army Corps of Engineers (USACE) and the type of state wetland regulatory program that is present. When this same model was applied to measures for the number of permits issued in WRUs, however, strong evidence was produced suggesting that this program outcome may be related to the type of state wetland regulatory program present.

These results further suggested, however, that what mattered most was that a state had taken the initiative to establish some kind of wetland regulatory program, regardless of weather it was statute-based or built around the Section 401 certification process. In addition, because many of the basic variables included in the model did not meet the basic assumptions for a linear regression analysis against either the permit or mitigation ratios in WRUs, no additional insights into the potential relationships between these values and types of state wetland regulatory programs were produced.

Because no conclusive evidence was produced by the linear regression analysis suggesting that any of the program outcomes varied specifically and solely in relation to the presence of statute-based state wetland regulatory programs, additional analysis is necessary in order to distinguish any differences between statute-based and Section 401 programs. In order to more fully explore potential differences between WRUs subject to different types of state wetland regulatory programs, a two stage logistic regression analysis was conducted on each of the USACE's wetland regulatory program outcomes. This analysis takes into account all of the potential influences of both the bottom-up and top-down conditions described by the multiple linear regression model. The measures for each of the outcomes of the national wetland regulatory program were then individually added to the model and tested for evidence that their values were significantly related to the type of state program that is present, after accounting for these various background conditions.

These tests were conducted in two steps. Evidence was first sought that the values for each of the program outcomes were significantly different in the group of WRUs subject to either type of active state wetland regulatory programs (statute-based and Section 401), and the group subject to no active state wetland regulatory program. Those WRUs without an active state wetland regulatory program were then excluded from the second step of the analysis. In this step, evidence was sought that the values for each of the program outcomes were significantly different in the group of WRUs subject to statute-based state wetland regulatory programs and those subject to Section 401 programs.

Step One Analysis

This logistic regression analysis is designed to measure the potential amount of change in the odds that a WRU is subject to no active state wetland regulatory program that is the result of changes in each of the individual program outcomes. In order to calculate this measure, a preliminary model containing all of the potentially confounding variables developed for the multiple linear regression analysis was first constructed. The creation of this model allows for future measures of any potential differences that are the result of program outcomes to be free of influence from the influences of these identified conditions. The response variable for this model was an indicator variable identifying those WRUs subject to no active state wetland regulatory program. This structure, therefore, groups WRUs subject to either type of active state regulatory program together. Table 8.1 presents the coefficients of the terms produced by the results of this preliminary model as well as a measures of the amount of deviance the model describes.

Amount of Permitted Wetland Fill

With the preliminary model constructed, the term measuring the total amount of permitted wetland fill was added. The total residual deviance after the inclusion of this variable was reported along with its estimated coefficient, associated standard error and the results of a t-test for the term's significance (Table 8.2). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that differences in the measure for the total amount of permitted wetland fill significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.2884).

Table 8.1 Preliminary model for "no program".

	Value	Std. Error	t value
(Intercept)	13.79912896	39.3708825	0.3504907
lwetlands	-6.17415643	4.4687957	-1.3816153
lpopulation	-2.31688459	1.7703366	-1.3087254
lincome	1.34871335	3.1858647	0.4233429
Pop.Growth	-147.67138016	227.8400357	-0.6481362
lbudget	0.26136305	0.4485840	0.5826402
Division1	-0.61591517	0.4658707	-1.3220733
Division2	-0.09207202	0.3491069	-0.2637359
Division3	0.07342207	0.2417288	0.3037373
Division4	-0.57982662	0.3096234	-1.8726832
Division5	-0.03642371	0.1780025	-0.2046247
Division6	0.13283748	0.1536940	0.8642985
Division7	-0.15441887	0.2364709	-0.6530142
lwetlands:lpopulation	0.45998540	0.3242729	1.4185132
lincome:Pop.Growth	13.38241554	21.1357568	0.6331647

Null Deviance: 104.3596 on 86 degrees of freedom
Residual Deviance: 83.98372 on 72 degrees of freedom

Analysis of Deviance Table*
Response: XNone

	Df	Deviance	Res.Df	Res. Deviance
NULL			86	104.3596
lwetlands	1	0.670004	85	103.6896
lpopulation	1	1.989257	84	101.7003
lincome	1	1.023516	83	100.6768
Pop.Growth	1	4.871050	82	95.8057
lbudget	1	0.628276	81	95.1775
Division	7	6.732582	74	88.4449
lwetlands:lpopulation	1	4.047389	73	84.3975
lincome:Pop.Growth	1	0.413766	72	83.9837

*Terms added sequentially (first to last)

In addition to the analysis of the total amount of permitted wetland fill, analyses of each of the four subcategories of permitted wetland fill were also conducted, and their results recorded in Table 8.2. The first subcategory of permit to be evaluated was the amount of wetland fill permitted through general actions. Results from adding this term to the preliminary model also suggested that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for the amount of wetland fill permitted through general actions may change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.1426). Similar results were also produced when the term measuring the amount of wetland fill permitted through standard actions was added to the preliminary model (p-value = 0.3256).

Table 8.2 Logistic regression results for categories of log amounts of wetland fill.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total Fill	-0.4221659	0.3947064	-1.0695694	82.81526	71	0.2884
Gen. Fill	-0.5392567	0.3637537	-1.4824777	81.63865	71	0.1426
Stan. Fill	-0.3836673	0.3875010	-0.9901067	76.00374	69	0.3256
N.T. Fill	-0.6949791	0.4057526	-1.7128151	77.47912	69	0.0912
Tid. Fill	0.1799842	0.1577550	1.1409094	39.13513	31	0.2626

In order to conduct a regression on the amount of permitted non-tidal wetland fill only, however, the preliminary model was adjusted in order to only describe the amount of non-tidal wetlands within each WRU. Only then was the term measuring the amount of wetland fill permitted in non-tidal wetlands added to the preliminary model. With this modification, these results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is suggestive but not conclusive evidence that increases in the measure for the amount of wetland fill permitted in non-tidal wetlands may decrease the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.0912).

In order to conduct a regression on the amount of permitted tidal wetland fill only, the preliminary model was again adjusted. This time, the adjustment permitted the model to only describe the amount of tidal wetlands within each WRU (Table 8.3). In this case, however, the results confirm the suggestion from the linear regression analysis, that the terms included in this analysis do not adequately describe the amount of wetland fill in tidal wetlands. The evidence of this model's lack of fit are produced both by the uncharacteristically small t-values for each of the coefficients included in the model, while at the same time all of the deviance is described before all of the variables are accounted for in the model.

Table. 8.3 *Preliminary tidal model for "no program".*

	Value	Std. Error	t value
(Intercept)	-21565.02672	23828855.54	-9.049963e-004
ltidalwetlands	-189.47225	1344188.55	-1.409566e-004
lpopulation	-253.14211	1020934.54	-2.479514e-004
lincome	2218.55447	1599147.52	1.387336e-003
Pop.Growth	164275.05363	417464703.80	3.935065e-004
lbudget	77.00812	99967.83	7.703290e-004
Division1	-142.21759	334048.15	-4.257398e-004
Division2	-37.67354	61881.56	-6.088008e-004
Division3	-60.00730	73434.87	-8.171500e-004
Division4	-76.07270	184724.05	-4.118181e-004
Division5	19.18835	50055.72	3.833398e-004
Division6	-5.93501	176093.31	-3.370378e-005
Division7	-35.80523	5931844.28	-6.036104e-006
ltidalwetlands:lpopulation	13.75794	92705.81	1.484043e-004
lincome:Pop.Growth	-15093.87733	38040189.97	-3.967876e-004

Null Deviance: 48.86914 on 39 degrees of freedom
Residual Deviance: 0 on 25 degrees of freedom
*47 observations deleted due to missing values

Analysis of Deviance Table*
Response: XNone

	Df	Deviance	Res.Df	Res. Deviance
NULL			39	48.86914
ltidalwetlands	1	1.56931	38	47.29984
lpopulation	1	6.31041	37	40.98942
lincome	1	11.47472	36	29.51470
Pop.Growth	1	0.15114	35	29.36356
lbudget	1	0.27212	34	29.09144
Division	7	16.94921	27	12.14223
ltidalwetlands:lpopulation	1	12.14223	26	0.00000
lincome:Pop.Growth	1	0.00000	25	0.00000

*Terms added sequentially (first to last)

As a result, no conclusions regarding the distribution of tidal wetland fill can be made with this model. Only a simple logistic regression analysis, with the amount of tidal wetland fill as the only independent variable, could produce viable results. Even this simple test, however, produced no evidence that changes in the measure for the amount of permitted tidal wetland fill may change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.2626).

Number of Wetland Fill Permits Issued

With the step one analysis for the amount of permitted wetland fill complete, the investigation shifts towards the number of permits issued in each WRU. This analysis began with the term measuring the total number of wetland fill permits issued being added to the preliminary model (Table 8.4). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is still strong evidence that increases in the measure for the total number of wetland fill permits issued significantly decrease the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.0137).

Table 8.4 Logistic regression results for categories of log no. of permits issued.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total No.Permits	-1.0954048	0.4331363	-2.5290070	75.97400	71	0.0137
Gen. No.Permits	-1.0042450	0.4097675	-2.4507681	76.24636	71	0.0167
Stan. No.Permits	-1.6325839	0.5323622	-3.0666790	64.68909	69	0.0031

In addition to the analysis for the total number of permits issued, analyses were also conducted for the measures of both subcategories of the number of permits issued and their results were also recorded in Table 8.4. When the term measuring the number of wetland fill permits issued through general actions was added to the preliminary model, the results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is still strong evidence that increases in the measure for the number of general wetland fill permits issued significantly decrease the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.0167). Likewise, adding the term measuring the number of wetland fill permits issued through standard actions to the preliminary model produced similar results (p-value = 0.0031).

Permit Ratios

With the step one analysis for the number of wetland fill permits issued complete, the investigation shifts towards the last two program outcomes; permit and mitigation ratios of the issued permits. These analyses began with the term measuring the total permit ratios being added to the preliminary model (Table 8.5). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios issued significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.6949).

Table 8.5 Logistic regression results for categories of permit ratios.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total P.Ratio	-0.7280241	1.8483910	-0.3938690	83.78982	70	0.6949
Gen. P.Ratio	-1.7425655	1.6523365	-1.0546069	82.66891	70	0.2952
Stan. P.Ratio	1.1652549	1.6070355	0.7250959	76.39230	69	0.4708
N.T. P.Ratio	-1.8291542	2.1058580	-0.8686028	79.78029	68	0.3881
Tid. P.Ratio	0.4780052	1.3957270	0.3424755	39.62759	30	0.7344

In addition to the analysis of the total permit ratios, analyses of each of the four subcategories of permit ratios were also conducted, and their results were also recorded in Table 8.5. The first subcategory to be evaluated was the permit ratios of general actions. The results from adding the term measuring the permit ratios for general actions to the preliminary model suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios for general actions significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.2952). Similar results were also produced for the term measuring the permit ratios for standard actions (p-value = 0.4708).

As with the measure for the term describing the amount of wetland fill permitted in non-tidal wetlands, the term measuring the permit ratios for non-tidal wetlands was then added to the preliminary model for non-tidal wetlands. These results again suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios for non-tidal wetlands significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.3881).

Likewise, because the preliminary model for tidal wetlands is not statistically relevant, a simple logistic regression with tidal permit ratios as the only independent variable was constructed. These results, however, still suggest that there is no evidence that changes in the measure for permit ratios for tidal wetlands significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.7344).

Mitigation Ratios

This analysis began with the term measuring the log total mitigation ratios being added to the preliminary model (Table 8.6). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for mitigation ratios issued may change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.1595).

Table 8.6 Logistic regression results for categories of log mit. ratios.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total M.Ratio	0.9217627	0.6482373	1.4219526	81.66076	70	0.1595
Gen. M.Ratio	0.1409740	0.2427953	0.5806287	83.61155	70	0.5634
Stan. M.Ratio	-0.7282321	0.8709205	-0.8361637	76.29354	69	0.4059
N.T. M.Ratio	0.8953583	0.6453473	1.3874053	78.42078	68	0.1698
Tid. M.Ratio	-0.1997504	0.4306685	-0.4638147	33.94005	27	0.6465

Analyses were then also conducted for all four of the subcategories of mitigation ratios and their results were also recorded in Table 8.6. The results from adding the term measuring the mitigation ratios for general actions to the preliminary model suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for mitigation ratios for general actions significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.5634). Similar results were also produced from the analysis of the term measuring the mitigation ratios for standard actions was then added to the preliminary model (p-value = 0.4059).

As in the previous analyses, the term measuring the mitigation ratios for non-tidal wetlands was then added to the preliminary model for non-tidal wetlands and the results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for mitigation ratios for non-tidal wetlands may change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.1698).

Furthermore, because the preliminary model for tidal wetlands remains statistically irrelevant, a simple logistic regression with tidal mitigation ratios as the only independent variable was constructed. These results, however, still suggest that there is no evidence that changes in the measure for mitigation ratios for tidal wetlands significantly change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.6465).

Step Two Analysis

With step one of the analysis complete, it was possible to conduct step two on the subset of WRUs subject only to either statute-based or Section 401 programs. The first step of the analysis identified potential differences in program outcomes between those WRUs subject to any type of active state wetland regulatory program and those subject to no active state wetland regulatory program. This second step in the analysis allows measurement of the potential amount of change in the odds that a WRU is subject to a statute-based state wetland regulatory program that is the result of changes in each of the individual program outcomes.

As in step-one, in order to calculate this measure, a preliminary model containing all of the potentially confounding variables developed for the multiple linear regression analysis was first constructed. The creation of this model allows for future measures of any potential differences that are the result of program outcomes to be free of influence from the influences of these identified conditions. The response variable for this model, however, was an indicator variable identifying those WRUs subject to statute-based state wetland regulatory program. Table 8.7 presents the coefficients of the terms produced by the results of this preliminary model as well as a measures of the amount of deviance the model describes.

Table 8.7 Preliminary model for "statute-based" programs.

	Value	Std. Error	t value
(Intercept)	-182.03446982	120.4775060	-1.51094155
lwetlands	-0.54291039	13.8918312	-0.03908127
lpopulation	-2.61911912	5.6697632	-0.46194506
lincome	18.15994145	12.8784822	1.41009951
Pop.Growth	-486.04312368	769.8859348	-0.63131836
lbudget	0.08914113	0.9306073	0.09578813
Division1	0.12955539	0.7346866	0.17634104
Division2	0.05084550	0.6314200	0.08052564
Division3	-0.64060240	0.4025991	-1.59116691
Division4	-4.53139645	19.9925431	-0.22665433
Division5	1.08036047	3.3847401	0.31918565
Division6	-1.43235645	4.9552038	-0.28906106
Division7	-0.22652359	5.4233806	-0.04176797
lwetlands:lpopulation	0.26390333	0.9449492	0.27927778
lincome:Pop.Growth	43.38206114	71.5714623	0.60613630

Null Deviance: 81.77412 on 61 degrees of freedom
Residual Deviance: 32.03174 on 47 degrees of freedom

Analysis of Deviance Table*
Response: XStatute

	Df	Deviance	Res.Df	Res. Deviance
NULL			61	81.77412
lwetlands	1	0.49463	60	81.27949
lpopulation	1	0.19117	59	81.08832
lincome	1	14.95801	58	66.13031
Pop.Growth	1	8.45373	57	57.67658
lbudget	1	0.80496	56	56.87161
Division	7	24.04342	49	32.82820
lwetlands:lpopulation	1	0.43588	48	32.39231
lincome:Pop.Growth	1	0.36057	47	32.03174

*Terms added sequentially (first to last)

Amount of Permitted Wetland Fill

With the preliminary model constructed, the term measuring the total amount of permitted wetland fill was added. The total residual deviance after the inclusion of this variable was reported along with its estimated coefficient, associated standard error and the results of a t-test for the term's significance (Table 8.8). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that differences in the measure for the total amount of permitted wetland fill significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.6733).

Table 8.8 Logistic regression results for categories of log amount of wetland fill.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total Fill	-0.3832139	0.9030397	-0.4243599	31.84405	46	0.6733
Gen. Fill	-1.4742807	1.1352216	-1.2986722	29.59146	46	0.2005
Stan. Fill	1.1769478	0.8339328	1.4113220	29.67275	45	0.1650
N.T. Fill	0.8492675	1.0254536	-0.8281871	28.56179	45	0.4119
Tid. Fill	-0.4257315	0.2358432	-1.8051470	27.26381	21	0.0854

In addition to the analysis of the total amount of permitted wetland fill, analyses of each of the four subcategories of permitted wetland fill were also conducted, and their results recorded in Table 8.8. The first subcategory of permit to be evaluated was the amount of wetland fill permitted through general actions. Results from adding this term to the preliminary model also suggested that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for the amount of wetland fill permitted through general actions may change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.2005). Similar results were also produced when the term measuring the amount of wetland fill permitted through standard actions was added to the preliminary model (p-value = 0.1650).

As in step one of the analysis, in order to conduct a regression on the amount of permitted non-tidal wetland fill only, the preliminary model was again adjusted so that it only included an estimate for the amount of non-tidal wetlands within each WRU. The term measuring the amount of wetland fill permitted in non-tidal wetlands was then added to the preliminary model. Even after these adjustments, however, these results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for the amount of wetland fill permitted through standard actions may decrease the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.4119).

Because the preliminary model for tidal wetlands remains statistically irrelevant in this step of the analysis, a simple logistic regression with the amount of permitted tidal wetland fill as the only independent variable was constructed. Ultimately, this test produced suggestive, but not conclusive evidence that increases in the measure for the amount of permitted tidal wetland fill may decrease the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.0854).

<u>*Number of Wetland Fill Permits Issued*</u>

With the step two analysis for the amount of permitted wetland fill complete, the investigation shifts towards the number of permits issued in each WRU. This analysis began with the term measuring the total number of wetland fill permits issued being added to the preliminary model (Table 8.9). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is suggestive, but not conclusive evidence that increases in the measure for the total number of wetland fill permits issued may decrease the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.1036).

Table 8.9 Logistic regression results for categories of log no. of permits issued.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total No.Permits	-1.5422013	0.9286398	-1.6607099	28.31482	46	0.1036
Gen. No.Permits	-1.3135634	0.8115334	-1.6186191	28.65349	46	0.1124
Stan. No.Permits	0.0005050	0.8246476	0.0006124	32.03075	45	0.9995

Both subcategories of the number of wetland fill permits issued were also analyzed and their results included in Table 8.9. The results from adding the measure of the number of permits issued through general actions to the preliminary model, suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for the number of general wetland fill permits issued significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.1124). Likewise, results for the term measuring the number of wetland fill permits issued through standard actions produced similar results (p-value = 0.9995).

Permit Ratios

With the step one analysis for the number of wetland fill permits issued complete, the investigation shifts towards the last two program outcomes; the permit and mitigation ratios of the issued permits. This analysis began with the term measuring the total permit ratios being added to the preliminary model (Table 8.10). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios issued significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.9785).

Table 8.10 Logistic regression results for categories of permit ratio measures.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total P.Ratio	0.4252540	0.0015707	0.0270739	32.03076	46	0.9785
Gen. P.Ratio	0.5372721	2.3606963	0.2275905	31.17365	45	0.8210
Stan. P.Ratio	-0.1225552	2.7321328	-0.0448570	31.22363	45	0.9644
N.T. P.Ratio	0.6786682	2.4646277	0.2753634	28.45429	44	0.7843
Tid. P.Ratio	-5.4349900	3.1025130	-1.7518020	26.66409	20	0.0951

All four subcategories of permit ratios were also analyzed and their results were also recorded in table 8.10. The results from adding the term measuring the permit ratios for general actions suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios for general actions significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.8210). Likewise, the term measuring the permit ratios for standard actions produced similar results (p-value = 0.9644).

As with similar measures, the term measuring the permit ratios for non-tidal wetlands was added to the preliminary model for non-tidal wetlands. These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for permit ratios for non-tidal wetlands significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.7843).

Because the preliminary model for tidal wetlands is not statistically relevant, a simple logistic regression with tidal permit ratios as the only independent variable was constructed for this measure. These results, suggest that there is suggestive but not inconclusive evidence that changes in the measure for permit ratios for tidal wetlands significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.0951).

Mitigation Ratios

This final set of analyses began with the term measuring the log total mitigation ratios being added to the preliminary model (Table 8.11). These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no evidence that changes in the measure for mitigation ratios issued may change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.9781).

Table 8.11 Logistic regression results for categories of log mit. ratio measures.

	Value	Std. Error	t value	Res. Dev.	Df	p value
Total M.Ratio	0.0000442	0.0016007	0.0276329	32.03071	46	0.9781
Gen. M.Ratio	1.1211176	0.7656356	1.4642967	28.25216	45	0.1501
Stan. M.Ratio	-2.7327724	1.6862829	-1.6205896	27.72494	45	0.1121
N.T. M.Ratio	1.9881493	1.4339514	1.3864830	26.05583	44	0.1726
Tid. M.Ratio	0.0824911	0.4226488	0.1951763	29.02636	19	0.8473

All four subcategories of mitigation ratios were also analyzed and their results were also recorded in table 8.11. The results from adding the term measuring the mitigation ratios for general actions to the preliminary model suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for mitigation ratios for general actions significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.1501). Similar results were also produced for the term measuring the mitigation ratios for standard actions (p-value = 0.1121).

As before, the term measuring the mitigation ratios for non-tidal wetlands was added to the preliminary model for non-tidal wetlands. Even after making the adjustments, however, These results suggest that after accounting for all of the top-down and bottom-up characteristics of each WRU, there is no conclusive evidence that changes in the measure for mitigation ratios for non-tidal wetlands may change the odds that a WRU is subject to no active state wetland regulatory program (p-value = 0.1726).

In addition, because the preliminary model for tidal wetlands is still statistically irrelevant, a simple logistic regression with tidal mitigation ratios as the only independent variable was constructed. These results, however, still suggest that there is no evidence that changes in the measure for mitigation ratios for tidal wetlands significantly change the odds that a WRU is subject to a statute-based state wetland regulatory program (p-value = 0.8473).

Conclusion

This two step logistic regression analysis was constructed to accomplish two tasks. The first step of the analysis was designed to confirm for which, if any, program outcomes the measures were significantly different in WRUs subject to no active state program from those subject to either type of active state wetland regulatory program. The second step was designed to identify which outcome measures were significantly different in those WRUs subject to statue-based programs from those subject to Section 401 programs. Both steps, however, included the terms identified from the multiple linear regression analysis as demonstrating strong linear relationships with the various measures of the program outcomes in order to account for the added variance these differences in conditions can cause.

The results of the step one analysis produced no conclusive evidence that any of the measures for the amount of wetland fill permitted in WRUs was significantly different between those areas where states have made the effort to establish an active wetland regulatory program, and those areas without active state programs. Only the measure for non-tidal wetlands even suggested any potential relationship with the existence of state wetland regulatory programs. The analysis produced inconclusive evidence that those WRUs subject to some form of active state wetland regulatory program may also tend to permit greater amounts of fill in non-tidal wetlands than those subject to no active state wetland regulatory programs. This suggestion may have potential relevancy, but additional research is necessary in order to support the claim. It may, however, be necessary to conduct an analysis specifically on this measure with a larger number of cases, or with more precise data in order to confirm these potential relationships.

The most convincing evidence of difference between these two groups of WRUs, however, was found in the analysis of the number of permits issued. In all three measures of this program outcome; the total number of permits, and the two subcategories based upon the type of permit issued, strong evidence was produced suggesting that the USACE approves a significantly higher number of permits in those WRUs subject to either type of active state wetland regulatory programs than it does in those not subject to state programs. This suggests, that regardless of the source of a state's authorization, the number of permits issued is significantly higher in WRUs where there is some form of an active state wetland regulatory program than it is in WRUs where there are not state programs, even after accounting for all of the other differences in bottom-up drivers such as landscape and socioeconomic conditions, and top-down drivers of USACE administrative resources.

The results from these analyses of the three measures for the number of permits issued turn out to be the only program outcomes, however, that demonstrate any conclusive evidence of differences between groups of WRUs based upon the existence of active state wetland regulatory programs. Like the analyses on the amounts of permitted wetland fill, the analyses on the measures of both permit and mitigation ratios also produced no conclusive evidence of any differences between the groups of WRUs with active state programs and those without any active state program.

These results mean that for any measure of wetland protection that can be produced from the USACE's regulatory records, other than the number of permits issued, there is no conclusive evidence that the presence of active state wetland regulatory programs alone demonstrate any potential affect on the national wetland regulatory program. This suggests that decision-making processes within USACE districts regarding the total amounts of wetland fill to approve, or the permit and mitigation ratio conditions that districts place upon approved permits may actually be made without the input from state wetland regulatory programs as they are designed. However, the fact that the number of permits issued is directly influenced by the presence of state wetland regulatory programs, suggests that even with these clearly defined roles, the overlapping-authority model may be applicable to these circumstances.

Regardless, the results mean that USACE districts that overlap at least in part with states having active wetland regulatory programs, must prepare for larger workloads due to both greater numbers of general permits to process and higher numbers of time-intensive standard permits to review. The fact that these greater numbers of permits are issued, but greater amounts of wetland fill are not approved, however, introduces some speculation about the source and nature of these additional permits. If some of the excess permits are the result of extra policing activities carried out by state wetland regulatory program agents, it is possible that many of the general permits are actually after-the-fact permits that may include underestimated or missing acreage amounts when they are entered into the USACE's wetland impact tracking database. If, on the other hand, applicants are submitting their USACE permits after they have received their state permits, and the state has lower permit thresholds than the USACE, it is possible that the increased number of standard permits might not result in higher amounts of permitted wetland fill because while the number of permits increases, the size of the impacts for each permit decreases. In either case, it remains evident that the USACE wetland regulatory program is not functioning in a vacuum apart from state wetland regulatory programs, and USACE district regulatory chiefs should be concerned with changes state wetland managers propose to make to their programs.

The results from the second step of the analysis were far less conclusive than those of the first step. These results suggest that WRUs subject to statute-based programs and those subject to section 401 programs produce very similar program outcomes after accounting for the various differences between them in landscape, socioeconomic, and administrative resource measures. This step of the analysis found no conclusive evidence of any differences in any of the measures for the amount of wetland fill permitted, that may be attributed to the source of a state's wetland regulatory program authority. Likewise, the analysis produced no conclusive evidence of any differences in the total numbers of permits issued, either in total, or in either of the subcategories based on permit type. Furthermore, similar results were produced for measures of the permit and mitigation ratios of each WRU. The results did, however, provide some suggestive, although inconclusive, evidence that both the measures for the amount of wetland fill permitted in tidal wetlands, and the permit ratios of those tidal wetland fills may tend to be lower in WRUs subject to statute-based state wetland regulatory programs than in those subject to Section 401 programs.

Only for the measure of the amount of permitted tidal wetland fill did the results suggest a potential relationship to the type of state wetland regulatory program that was present. The analysis produced inconclusive results suggesting that the USACE may tend to permit fewer acres of fill in tidal wetlands in those WRUs subject to statute-based programs than in those subject to Section 401 programs. These results, therefore, provide an opportunity for additional research into the potential relationships between statute-based wetland regulatory programs and tidal wetland protection efforts. It is possible that with a larger number of cases, or with different and more precise data stronger evidence may be produced to suggest that statute-based state wetland regulatory programs influence USACE permit decisions regarding wetland fill activity in tidal wetlands more than those programs with Section-401 programs or no active state programs at all.

The results of this two step analysis provide evidence to suggest that the separated-authority model of intergovernmental relations may be inadequate to describe the relationship that exists between state and national wetland regulatory programs. Some of the program outcomes of a USACE district issues seems to be directly related to whether or not a related state has created its own wetland regulatory program. There is no evidence, however, that the source of authorization for a state's wetland regulatory program is likewise related to these same outcomes. This additional evidence suggests that the relationship between the outcomes of the USACE regulatory program and statute-based state wetland regulatory programs is essentially the same as the relationship it has with Section 401 based programs. Therefore, it may be concluded that statute-based state wetland regulatory programs do not occupy a completely separate sphere of influence from the USACE wetland regulatory program; furthermore there is no evidence that the sphere of influence of these statute-based programs is neither any greater nor any lesser than that of Section 401 based programs. Therefore, since these programs obviously do not meet the assumptions of either the separated-authority or the inclusive-authority model, these results open the door for future analyses to specifically produce confirming evidence for the applicability of the overlapping-authority model.

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Three different general models of intergovernmental relations have been used over the years to describe the relationships that exist between state and national levels of government in the United States (Wright, 1978). The most widely and currently accepted of these is the overlapping-authority model (Reagan, 1972). According to this model, agents of both state and national levels of government are so intertwined through the administration of their respective programs that one level of government cannot help but influence the performance of the other. Sometimes these relationships are intentionally designed, while other times they are not.

There are also many contemporary examples of relationships between state and national programs that reflect the inclusive-authority model of intergovernmental relations (Scheberle, 1998). State-level agents engaged in these types of relationships provide many of the government services for the citizenry both on behalf of and out of coercion by the national government. These programs began to proliferate in the United States during the new deal era in the form of various national government mandates and have increased over the years in the form of funding dependent performance standards.

The final form of state-national government relationship follows the separated-authority model of intergovernmental relations. According to this model, agents of state and national levels of government administer programs that are not only completely independent from one another for the source of their authority, but also their program outcomes. Historically, scholars have described the state and national levels of government in the United States to have completely separate spheres of influence upon their citizenry and lauded the existence of this relationship to be a unique characteristic of American federalism (Bryce, 1891). Current theory, however, suggests this relationship is not likely to exist anywhere within the United States.

Furthermore, some modern scholars argue that not only are separated-authority relationships gone forever, but that these types of relationships may have never truly existed in the first place (Elazar, 1966 and Grodzins, 1966).

Only within those national government programs administered through congressional assertion of authority in the interstate commerce clause of the constitution, do scholars suggest any evidence of the existence of separated-authority relationships may be found (Wright, 1978). It is, therefore, within this subset of national government programs that this study resides. Section 404 of the federal clean water act establishes a national wetlands regulatory program on the basis that the filling of these resources can affect the navigability of the nation's waterways and therefore potentially affect interstate commerce. In addition, because of a variety of other reasons, several state legislatures have passed their own statutes establishing state-level wetland regulatory programs (Want, 1990).

Under these circumstances, both national and state government agents assert sovereign authority over the ability to grant permission to affect the same resource. The national wetland regulatory program, however, makes no reference to decisions of approval made by statute-based programs as a basis for its decision-making regarding permissible activity in either its authorized language, or in its administrative rules. Likewise, statute-based state wetland regulations do not predicate state approval for wetland fill projects upon the receipt of a national wetland regulatory program permits. These conditions create an ideal laboratory in which to test for evidence that state and national wetland regulatory agents exhibit a separated-authority relationship with one another.

Intergovernmental Relationships

If a separated-authority relationship truly existed, an analysis of the measures for the outcomes of the national wetland regulatory program should not produce evidence that there is variance within these measures that can be described by the type of state wetland regulatory program that is present. Because of historical emphasis placed on measuring wetland loss in the United States, this study focused on the measure for the total amount of wetland fill permitted by the USACE. The central hypothesis of this investigation, therefore, was that this measure should not vary by different state program types, and the results produced no evidence that this particular hypothesis should be rejected (p-value = 0.7321; extra sum of squares f-test).

The study did, however, produce strong evidence that relationships between state program types and at least the measure for the total number of permits issued by the national wetland regulatory program do exist (p-value = 0.0465; extra sum of squares f-test). These alternative results suggest that measures for the amount of permitted wetland fill may not be sensitive enough to detect real differences in the types of relationships that exist between the USACE and state wetland regulators who have different sources of authorization for their programs. Furthermore, they suggest that, overall, the separated-authority model inadequately describes the relationships between state and national wetland regulatory programs and that the overlapping-authority model may potentially be a plausible alternative description of these relationships.

This conclusion was made possible chiefly because some states have chosen not to establish any form of active state wetland regulatory program. This means, that although in accordance with Section 401 of the Clean Water Act, these states may have some water quality standards with which all national government approved projects must comply, they have chosen not to create special water quality standards that are specific to wetlands, and allow all of the decisions regarding permit conditions and compliance tracking to lie with the USACE.

These states' decisions to not exercise their sovereign jurisdictions over wetlands creates a condition where the national government is free to administer its wetland regulatory authority completely unfettered by potential relationships with state government level agents. If the separated-authority model of intergovernmental relations adequately described the relationships between state and national government wetland regulatory agents, outcome measures of the national wetland regulatory program would be expected to be similar between those regions of the country with statute-based or Section 401 state wetland regulatory programs and those with no active state programs. The results, however, produced strong evidence that the numbers of permits issued in areas with no active state wetland are lower than in areas subject to either other type of state wetland regulatory program (p-value = 0.0137; logistic regression).

These results are further enhanced by the fact that there are also several states that have chosen to develop active state wetland regulatory programs under authorities granted them through Section 401 of the Federal Clean Water Act. This piece of legislation requires, among other things, that all federally permitted projects must comply with state-established water quality standards. The states that belong to this group of wetland regulators have created fully-developed state programs through the establishment of special water quality standards that are specific to wetlands. They have, as a result, created conditions wetland fill projects receiving water quality certification that include everything from impact size limits, to mitigation requirements (Taylor and Abderhalden, 1997). These conditions ultimately establish the states' vested interest in assisting the USACE in the approval, tracking, and monitoring of wetland fill permit activities.

Because the scope of these states' ability to regulate wetland fill activities is completely limited to those activities requiring national government permits, and does not extend beyond those permits, it would be expected that the outcomes of the national wetland regulatory program would be directly related to the existence of Section 401 state wetland regulatory programs. Since the results do suggest that some national wetland regulatory program outcomes are found to vary in relationship to the existence of Section 401 programs, it supports the assumption that these program outcome data are sensitive enough to detect these inherent relationships (p-value = 0.0465). Furthermore, these results also suggests that these same program outcome data are also adequately sensitive enough that the similar relationships the study identified between statute-based state wetland regulatory programs are valid.

In addition, the lack of evidence from all of the analyses of the program outcomes that there is any difference in the relationships between both Section 401 and statute-based state wetland regulatory programs and the national wetland regulatory program also provide additional evidence to suggest that the separated-authority model may truly be inadequate to describe the relationship between the national government wetland regulatory program and statute-based state wetland regulatory programs.

Program Outcome Measures

These analyses were only possible because valid program outcomes were identified for the national wetland regulatory program. Measures were solicited by the USACE for four different program outcomes; acres of wetland fill permitted, numbers of permits issued, permit ratios of approved fill activities as well as their mitigation ratios. These data were further distinguished into subcategories both by permit type, and by wetland type.

Data for each these outcome measures were provided at the WRU scale for several USACE districts. There were a few USACE districts, however, that were not able to produce the data at any lower scale, but they provided estimated distributions of the various program outcomes that were used to calculate WRU-based total estimates. Tests for consistency between the estimated distribution amounts and documented distributions suggested that estimated WRU amounts of permitted fill may be consistently lower than documented WRU amounts of permitted fill (p-value = 0.0101; two-sample t-test). It could not, however, be concluded that this difference was the result of any systematic underestimation on the part of USACE district administrators. The nature of the data suggested instead, that USACE districts that did not have the resources available to document their district-wide totals on the WRU scale also had initially lower amounts of permitted wetland fill.

Initial analyses of each of the individual program outcomes produced no conclusive evidence that there were any inherently significant differences in the measures for any of these variables between WRUs that were grouped by state wetland regulatory program type. The results did, however, suggest that total and non-tidal permit ratios may tend to be lower in WRUs subject to statute-based WRUs than in other WRUs (p-values = 0.1910 and 0.1635; analysis of variance f-tests, respectively). Furthermore, there is also evidence that suggests measures for the acres of permitted tidal fill and the tidal permit ratios may tend to be higher in WRUs subject to Section 401 programs (p-values = 0.0907 and 0.5628; analysis of variance f-tests, respectively). There were also results that suggested overall tidal mitigation ratios may tend to be lower than non-tidal mitigation ratios (p-values = 0.1095; analysis of variance f-test).

The evidence for all of these possible tendencies, however, was not strong enough to be conclusive. In addition, the existence of some potentially confounding conditions was suggested by the natural long-tailed distributions of some of the data for WRUs that are also similar in other characteristics, such as wetland abundance or high population levels. Because of these potential biases in the data, these results suggested that simple analysis of variance tests alone may not be sophisticated or powerful enough to detect real or meaningful potential differences between WRUs in any of these measures of the national wetland regulatory program's outcomes. It was for these reasons that the multiple linear regression and logistic regression analyses were developed.

There is also opportunity for the exploratory analysis of differences in program outcomes between WRUs well beyond the scope of this study. Future discussions of variations between WRUs should not be limited only to regulatory program outcomes such as permit ratios and acres of fill. Potential investigations could incorporate more qualitative comparisons and contrasts between WRUs. Most ripe would likely be an analysis of differences in the complexity and stringency of regional conditions for specific nationwide permits. Measures of USACE staff interaction with staff from different states within their district could also be revealing. As could permit review times, and comparisons of complexity and stringency of state water quality standards or state wetland regulatory statutes. These investigations would be very resource-intensive, however. They would require the development of an entirely new dataset, and may involve either intensive interview or survey techniques. They may also require securing phone logs or staff schedules and meeting minutes.

Independent Variables

In order to account for the various conditions in WRUs that may be confounding the results of simple analyses on the various program outcome measures, additional data was collected for several landscape and socioeconomic characteristics. Since no previous study has been conducted on the WRU scale, all of these additional datasets needed to be constructed from data collected at other scales.

The process of assembling this dataset in a manner that insured comparability of all of the different measures required both a considerable amount of resources and time. In the end, however, this collection effort has created a flexible digital atlas of WRU characteristics that can be easily manipulated to meaningful results for both state and USACE wetland regulators alike. In addition, this dataset has potential applications beyond describing potential types of intergovernmental relationships. It is suspected that not only would potential permit applicants within a given WRU be interested in knowing how their projects may be treated differently in other parts of the country, but that government streamlining and environmental justice advocates alike may also take interest in a dataset capable of demonstrating both differences and similarities in the program outcomes for WRUs that share similarities in other characteristics.

Furthermore, when these independent variables were evaluated for their applicability to the current study, it was the first time any evidence was produced in the literature that any of these variables demonstrate a linear relationship with measures for the activity level of the national wetland regulatory program. In every case, each of the different measures for both the amount of permitted wetland fill and the number of permits issued demonstrated strong evidence of linear relationships with the size of the administered area; the amount of wetlands present; the size of the resident population as well as the income of the population; and population growth rates (p-values, 0.0001). Likewise, similar relationships were also demonstrated to exist between USACE funding and staffing levels and the measures for the various program outcomes (p-values < 0.0001). All of these are characteristics that wetland regulators have long suggested determine the levels of their workloads, but are also characteristics for which no known previous study has produced evidence supporting these claims. This investigation, however, has finally produced such evidence.

Strong evidence of two interaction terms was also produced by this investigation. The interaction between wetland abundance and population abundance suggests that there may be a very strong spatial component to this analysis that has not yet been discussed. This suggestion is further supported by the findings that none of the measures for wetland density, population density, or the interaction between the two produced any evidence of a relationship with the various program outcomes. Since relative densities are not what seem to drive the interaction, it is likely that it may be the result of co-location. Future research should, therefore, focus on conducting a spatial analysis on the proximity of population centers to wetlands, and determine if it is the relative location of high amounts of wetlands in areas of high populations that is being described by this interaction term. As coastal areas are both hotspots for high populations and wetland concentrations an analysis focused within those regions may provide the best starting point for such an analysis.

Furthermore, the interaction between income and population growth rates supports findings from past urban growth studies that predict that growing areas where residents have the resources necessary, will result in the conversion of marginal lands (Cadwallader, 1996). As wetlands are traditionally marginally developed lands the theory appears to be supported by these findings. There may also be some additional characteristic that may partially overlap with both of these variables that may also need to be explored by future analyses. Characteristics such as location desirability, property values, climate comfort indices, perceived school district quality, or some other measures of livability should be considered for future analyses of wetland regulatory program outcomes. Many of these future analyses, however would likely require smaller scales of resolution in order to produce viable results. These analyses may, therefore, be illuminated through the application of some intensive comparative case-study methods to some target locations.

Closer investigations into the distribution of each the variables that were included in the present analysis, produced interesting insights into some of the characteristics that are shared by WRUs that are subject to the same type of state wetland regulatory program. It is interesting that the variables demonstrating some of the strongest relationships with amounts of permitted wetland loss: total wetlands, total population, USACE budget and staff size, demonstrate no evidence of varying with the type of state wetland regulatory program. This suggests that for the most significant variables, the playing field is relatively level between state program types.

It is of most interest, however, that there is strong evidence that WRUs subject to statute-based state programs not only have higher wetland densities, but also wealthier and more densely distributed populations. These findings seem to support, at least in part, the findings of other studies that wealthier populations are more likely to adopt pro-environmental regulations, and that more urban regions of the country also tend to be more likely to adopt similar laws (Steel and Lovrich, 2000).

The consistency between the findings of this study's analysis of socioeconomic conditions and those of previous studies opens this dataset up to an entire line of additional questioning. There is undoubtedly a long list of potential characteristics for which relationships with the outcomes of the USACE's wetland regulatory program could be checked. Future analyses may, however, focus on relationships with other characteristics that have been discussed in the literature as having strong relationships with the adoption of environmental programs like levels of education attainment, political party affiliation, or regional value systems. The easiest of these to obtain and consolidate to the WRU level may be education levels, as the aggregation protocol may follow the same path already taken by other variables obtained for this study from the US Census Bureau. Predominant party affiliation may be the next easiest variable to incorporate, by consolidating county-based election returns, whereas regional values may require the collection of new survey data, or acquiring access to proprietary data collected for other private research purposes.

Likewise, measures for the abundance of several other landuse types, may also be valid variables to include in more refined, future, models for wetland program outcomes. Considering that federal wetland managers do not agree on which type of land use most wetland fill activity has resulted in, correlations could be made by future investigations between wetland fill rates and the presence of varying levels of different land use types. These results could shed additional light not only onto the nature of the wetland regulatory program, but more generally on land use development in the United States. These estimates for other land use types such as agricultural or developed lands could become a very time consuming process, as generating the WRU scale estimates for just the wetland data alone required computing assistance from the US Environmental Protection Agency's Western Ecology Division.

Permitted Wetland Fill Model Construction

In order to arrive at any conclusions about the relationships between state wetland regulatory program type and any of the program outcomes, a multiple linear regression model was created to account for the most relevant independent variables that have been identified. As the total amount of permitted wetland loss was the program outcome around which this study was centrally designed, model selection focused on including those variables that best described this program outcome.

While the developed model itself revealed many interesting aspects of the performance of the national wetland regulatory program, the process of constructing the model has also illuminated several significant circumstances that surround the program. Most significantly, it demonstrates the potential for the national wetland regulatory program to be influenced by both bottom-up variables such as landscape conditions and population characteristics, and top-down variables such as USACE budget and divisional oversight. It also demonstrates the limitations of these potential influences, as not all of them that were determined to be influential affect the regulatory program equally.

In addition, much was revealed by the variables that were excluded from being included in the model, the size of a WRU only affects its performance as far as it helps establish the amount of wetlands, population, and administrative resources allocated to it. Size, separate from these conditions, does not significantly describe variances in the amounts of permitted wetland fill in WRUs. In addition, the presence of coastal zone management programs may increase the number of permits issued in WRUs, but that amount of increase is relatively insignificant when compared to all the other variables that can influence this variable, and its presence has no influence on the total amount of wetland fill that gets permitted through the USACE's wetland regulatory program. Furthermore, measures for the budgets allocated to WRUs completely account for the number of staff allocated to those WRUs, and are capable of also describing more making it a more valuable variable to describe differences in the USACE's regulatory program outcomes.

The power of this model resides in its ability to describe 86.69% of the differences in the amounts of wetland fill permitted in WRUs (p-value = 0.0001; f-statistic). The model's application to other program outcomes, however, also revealed additional insights. This model can also reliably describe 76.06% of the number of permits issued in WRUs (p-value < 0.0001; f-statitstic). There is still, however, considerable room in the remaining unexplained variation in this program outcome for future research to help explain what else may be influencing the numbers of permits that get issued.

On the other hand, this model does not have the ability to adequately describe much of the variability in the permit ratios or mitigation ratios of permits issued in WRUs (R-squared values of 0.2572 and 0.4515, respectively). It appears, from all measures, that none of the variables that have been discussed in this study have the ability to influence whatever internal decision-making processes the USACE uses to establish these approval conditions. This lack of this model to adequately describe the variation in the permit and mitigation ratios makes these variables prime for future investigations into the performance of the national wetland regulatory program and ultimately also for future investigations into the forms of intergovernmental relationships that are present.

In order to pursue more conclusive alternative analyses of these program outcomes, it may be necessary for future analyses to develop a model that incorporates a different set of variables. One such potential variable may be the presence of mitigation banks. It is possible that permit and mitigation ratios could demonstrate linear relationships with the relative abundance of local mitigation banks. Because mitigation banks are held by private developers information regarding their locations and sizes are not universally well publicized. Since all banks must be approved by the USACE before credits may be sold from them, however, the sought-after data may be acquired by contacting each of the 38 USACE districts individually. It may also be that future qualitative analyses into the regional conditions published for permits by each USACE district may be more productive in providing meaningful insight into differences in permit and mitigation ratios.

While this model does fit some measures for the total amount of permitted wetland fill well, it is not a panacea for describing all wetland regulatory program outcomes. In fact, no single model may be able to describe all of the different outcomes of the national wetland regulatory program. Ultimately, differently constructed models may be necessary in order to best describe each program outcome. As this study is primarily focused on the total amount of permitted wetland fill, however, sufficient evidence has been provided to suggest this model is useful in determining the type of intergovernmental relationship structure that may exist between state and national wetland regulatory agencies.

Evidence for opportunities to better refine this model abounds, however. For instance, the amount of variation that remains to be explained by divisional grouping in a multiple linear regression model. Even after accounting for the variations in the measures of physical and socioeconomic conditions that exist, two possible circumstances may still prevail. The persisting relationships may indicate that the variation still explained by this variable could legitimately be due to the top-down influence of division office oversight. It is also possible; however, that some of this remaining relationship may be due to other bottom-up landscape or socioeconomic characteristics that may be accounted for when measures for these other conditions are included in a future linear regression model.

Some of these potential underlying characteristics of WRUs that remain to be addressed may include differences in the age structures of the resident populations, the distribution of landscape characteristics that affect construction suitability such as slope, or the predominance of certain social values or educational levels. In order to actually isolate the potential influence of any of these characteristics, a finer scale of resolution than was used in this study for all the variables involved in a multiple regression model may be necessary in order to achieve meaningful measures for these characteristics.

Significance of State Programs

In order to produce more conclusive and discrete results concerning variance in the program outcomes of WRUs subject to different types of state wetland regulatory programs, the variables identified in the selection of the multiple linear regression analysis were applied to a logistic regression model. This model provided the expected additional evidence supporting the same results of the linear regression model.

The logistic regression model also provided additional clarity regarding the differences between state program types in the number of permits that are issued. It produced strong evidence that significantly fewer numbers of permits are issued in WRUs subject to no type of active state wetland regulatory program than in those WRUs subject to either type of active state wetland regulatory program (p-value = 0.0167). Furthermore, it demonstrated no conclusive evidence that those WRUs subject to statute-based state wetland regulatory programs issued a significantly different number of permits than those subject to Section 401 programs (p-value = 0.1036).

The fact that both the linear and logistic regression analyses produced strong evidence that there is a relationship between the measure for the number of permits issued and the existence of a state wetland regulatory program opens the door for additional commentary concerning the direction in which these state programs may potentially influence the USACE wetland regulatory program.

Based upon the evidence produced by investigations into differences in the management of state and national forests, it might be assumed that state wetland regulatory programs, like forestry management programs, are more easily influenced by development interests than are national government programs (Koontz, 2002). As a result, it might be argued that a higher number of issued permits could be considered evidence that state programs, regardless of their source of authorization, are being used as vehicles by which these interests are able to increase the amount of wetland fill activity that is permitted by the USACE in these areas.

The increased number of permits could, however, also be considered as evidence that state wetland regulatory programs are functioning as deterrents to illegal fill activities. As a result of these areas employing an additional set of state-level wetland regulatory personnel, it may also be likely that the increased number of permits is the result of increased awareness by potential applicants that permits are necessary, and that there is perceived increased likelihood of being caught for not applying for them.

Therefore, the increased number of issued permits alone does not, necessarily, suggest that active state wetland regulatory programs are resulting in the better or worse protection of wetlands. In fact, it only serves to suggest that the existence of state programs, regardless of their source of authorization, increases the workload of the USACE.

In order to gain a better understanding of whether these state programs may be resulting in better or worse protections of wetlands by the national government, the total amount of permitted wetland fill must also be considered. When this variable is also considered, the reality of the situation becomes more clearly defined. The fact that the national government is permitting the same relative amount of wetland fill in WRUs, after accounting for various other conditions, regardless of state wetland regulatory efforts, suggests that there would not be a statistically significant increase in the amount of wetlands lost through the national wetland regulatory program in these areas if no state wetland regulatory programs were present (p-value = 0.2884). The only potential difference that may occur would likely be that fewer permits would be issued by the national government in these WRUs while the rate of the amount of wetland fill permitted remained unchanged. These results allow the conclusion to be made that state wetland regulatory programs are having no affect on the amount of wetland fill that the USACE permits, and therefore are not vehicles by which development interests are able to increase the amount of wetland fill that gets permitted.

Furthermore, states with wetland regulatory programs may not necessarily be less effective at reducing the amount of wetland fill that is permitted in WRUs or otherwise protecting wetlands. Just because there is no conclusive evidence that statue-based and Section 401 programs significantly reduce the amount of wetlands that the USACE approves for fill (p-value = 0.2884), does not mean that these programs do not ultimately result in a reduction in the amount of change that actually occurs in the landscape. The timing of permit approvals may be very instrumental in affecting this program outcome measure. Many permit applicants may actually be seeking and receiving USACE approval for wetland fill in projects that may be later denied or modified by state wetland regulatory programs during the state's permit review process. In these circumstances, permit applicants would have to adhere to the state's more stringent set of conditions in order to insure minimal compliance with both their national and state wetland fill permits. As a result, less impact on the landscape may actually occur in those WRUs with state wetland regulatory programs than in those WRUs without them.

Because the USACE national permit database does not track "as-built" specifications of issued permits, these reductions cannot be measured from values in this database. A study documenting both the order in which permit applicants submit their permits for state and USACE approval as well as differences in the amounts of fill that are approved by each agency for the same project could provide conclusive evidence on this topic. Any future analysis into how state programs may modify the scope of potential landscape changes approved by the USACE, however, may require project-by-project comparisons of the amount of fill permitted in both state and USACE databases and would therefore be potentially very costly and very time-consuming.

Furthermore, it is entirely possible that state government wetland regulatory programs may significantly reduce absolute wetland loss rates in areas under their jurisdiction. This study used measures of the amount of wetland fill that was permitted by the USACE only to focus attention on the types of relationships that may potentially exist between state and national wetland regulatory agencies. This study did not concentrate on measures of actual changes in the landscape. A comparison of actual landscape changes resulting from both national and state wetland regulatory programs should, however, become the domain of future research projects. In addition, some of these projects may ultimately be built upon the framework of intergovernmental relations revealed here and may further increase our understanding of the types of relationships that govern national and state wetland regulatory programs.

In addition to these results from full logistic regression analyses, simple logistic regression conducted on tidal wetlands also suggested that this class of wetlands may tend to be better protected through the USACE wetland regulatory program in states that also have statute-based state wetland regulatory programs (p-value = 0.0854). Furthermore, while a potential relationship between state program types and both tidal wetland permit ratios and the total amounts of fill permitted in tidal wetlands was not revealed by the multiple linear regression model, simple analysis of variance tests provided inconclusive evidence suggesting that prior to taking into account any other characteristics, tidal wetlands may tend to be more poorly protected through the USACE wetland regulatory program in states that have section 401 programs (p-values = 0.0907 and 0.5628; analysis of variance f-test). Since both of these types of simple analyses demonstrated potential relationships, while neither the full logistic nor the full multiple linear regression models were particularly well fit to describe tidal wetland program outcomes, there remains considerable opportunity for future research to better describe those conditions that are specific to tidal wetlands that describe the variation in the amounts of permitted wetland fill that occurs within them.

Establishment of Wetland Regulatory Units

Constructing a model that was capable of producing these results involved describing the potential interaction between individual states and individual USACE districts. Because of the USACE's mandate to construct water management systems for civil purposes such as flood control and navigation, district boundaries were drawn in a manner that mainly approximates large watershed boundaries. These civil boundaries provide most USACE districts with sole authority within entire specific river drainages, allowing them to manage these flood control and navigation projects without the additional administrative burden of having to coordinate most actions with other USACE districts.

In many cases, these USACE district civil boundaries do not match state boundaries. As a result, several USACE districts also have potential regulatory authority in multiple states, and likewise several states may fall under the regulatory authority of multiple USACE districts. This overlap creates a distinct boundary that has some of the most real and profound consequences for potential wetland permit applicants. As a result of these overlapping jurisdictions, applicants may be subjected to different combinations of state and USACE requirements than other similar projects within either the same USACE district or state.

As a result of the increased complexity added to the wetland regulatory landscape by the existence of these multi-state districts and multi-district states, any joint analysis of state and national wetland regulatory programs that does not address the existence of these divisions would demonstrate a lack of understanding about the significance of two fundamental questions facing all potential permit applicants. Who do they need to talk to, and what do they have to do in order to get a permit? The answers to both of these questions can depend on both what state and what district the applicant's project is located, and can potentially result in varying amounts of impacts to the wetland resources.

As a result, while the USACE may have found that watershed-based boundaries are useful for establishing management areas for civil projects, it appears that they have concluded that state political boundaries better serve their wetland regulatory efforts. Therefore, many formal and informal agreements between USACE districts and state regulatory agencies have been made over the years to reduce both the number of states within a single USACE district's regulatory jurisdiction, and the number of USACE districts with regulatory authority within a single state. Consequently, the number of single district states is four times higher and the number of single state districts is two and a half times higher than would be created by civil boundaries alone.

A new unit of analysis, therefore, was developed for this study that describes unique geographic units that take into account both the identity of the single USACE district and the single state that share jurisdiction within that area. This allows regions within a single USACE district that may be subject to different types of state wetland regulatory programs to be analyzed separate from one another, and grouped with other regions with similar types of state programs. As a result, this analysis also allows regions within a single USACE district that have potentially different intergovernmental relationships with state wetland regulatory programs to be separated from one another and grouped with other regions that have potential similar types of relationships.

The new unit of analysis that is introduced into the literature for the first time by this study is identified as WRUs. While evaluating the viability of using WRUs as the unit of analysis for this study, it was discovered that not only was the use of WRUs necessary in order to conduct an adequate analysis, but that there was considerable evidence that their existence had long been recognized both by state and USACE regulators.

If USACE districts genuinely operated within a separate sphere of influence from statute-based state wetland regulatory programs, USACE regulators would seem to have little incentive to eliminate the number of WRUs within their jurisdiction. Furthermore, only if their programs were affected in some way, would statute-based state wetland regulators seem to have incentive to seek to reduce the numbers and impacts of WRUs within their boundaries. Convincing evidence was produced, however, that significant action has been taken over the years by regulators to reduce the number of potential WRUs across the United States by 42.8% ($p\text{-value} < 0.0001$; two sample t-test). This reduction has taken the form of USACE districts establishing regulatory boundaries that are separate from their civil works boundaries. Likewise efforts have also been made to reduce the potential differences that exist between those WRUs that remain within a single state or a single USACE district. Therefore, the difference between the number of potential WRUs and the actual WRUs that exist suggests that the separated-authority model would not adequately describe any of the potential relationships between the USACE and any of the different types of state wetland regulatory programs.

The WRU concept lends itself to being supported by additional studies. In the future, several individual investigations into the program outcomes of state wetland regulatory programs should be conducted. For those states consisting of multiple WRUs, between group variations in the various program outcomes that are chosen should be evaluated for the different constituent units. For those states containing only one WRU, measures for their program outcomes could be grouped with similar measures from other WRUs subject to similar types of state wetland regulatory programs and comparisons between the different groups of states could be made.

Conclusion

Historical intergovernmental relations scholars championed the idea that what made American federalism unique was the existence of separate spheres of influence between state and nation government agents. Modern scholars have come to doubt the relevancy of this model to the nation's current governmental infrastructure. The prevailing theory is that there is a new federalism in the United States that involves state and national government agents working so closely together that the walls dividing their actions have virtually dissolved.

This particular investigation into the relationships between state and national government agents was not designed to produce any evidence confirming the validity of the prevailing overlapping-authority model. It does, however, contribute some additional evidence to the debate that favors the view of these new federalists. According to the results of this investigation, there is both conclusive and suggestive evidence that the separated-authority model should be rejected. It is evident from the measures of some of the USACE's regulatory program outcomes, the overlapping-authority model, does not adequately describe the relationships that develop between state and national government wetland regulatory agents as a result of statute-based state wetland regulations. Traditional American federalism may indeed be dead, for if the separated-authority model does still describe any intergovernmental relationships between state and national governments in the United States, evidence of its applicability will have to be found someplace other than in the nation's wetland regulatory efforts, as state programs do not demonstrate that they occupy a truly separate sphere of influence from the national government.

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APPENDICES

APPENDIX A: ADMINISTRATIVE RESOURCE VARIABLE EVALUATION

Introduction

Wetland Regulatory Units (WRUs) vary from one another in a number of ways. Some characteristics in which they differ are outside of the US Army Corps of Engineer's USACE's control. Each WRU represents the USACE's jurisdiction over unique local geographies, economies, and populations. The USACE does not determine the quantity or quality of these characteristics of WRUs, however, each of these conditions can be considered bottom-up drivers of wetland permit applications because of their direct linear relationships with the national wetland regulatory program's outcomes.

Other WRU characteristics, however, are the result of administrative priorities and structuring decisions internal to the USACE. Since the USACE is a centralized bureaucracy, the size of the staffs and budgets allocated to the regulatory branches of each district reflect operational priorities of USACE headquarters. Likewise, the regionally-based hierarchy of oversight through which all USACE districts must be accountable is a product of the organizational needs of this large agency. The USACE directly determines the quantity and quality of these characteristics of WRUs, which may be considered top-down drivers of wetland permit applications because of their potential linear relationships with the national wetland regulatory program's outcomes.

This study seeks evidence of relationships between the wetland regulatory program's outcomes and quantifiable measures of staff size and budget, as well as the clearly identifiable sources of regional oversight. These characteristics are being evaluated in an effort to account for variations in program outcomes that may be the result of differences in the resources available for use by USACE districts in the administration of the national wetland regulatory program. Adding the component of these top-down drivers of wetland permit applications may ultimately help produce more robust multiple regression models of all permit program outcomes.

Budget

USACE headquarters allocates budgets to be spent at the digression of the regulatory branch chiefs in each USACE district. Each of these districts uses these budgets to implement the wetland regulatory program throughout the WRUs under its jurisdiction. Through this process WRUs do not receive equal budgets. In fact, while the distribution of WRU budgets is relatively normal, there is a long-tail of WRUs with relatively high budgets. The WRUs that make-up this tail include Jacksonville-Florida, Alaska-Alaska, New Orleans-Louisiana, and Norfolk-Virginia (Figure A.1).

Figure A.1 Budget.

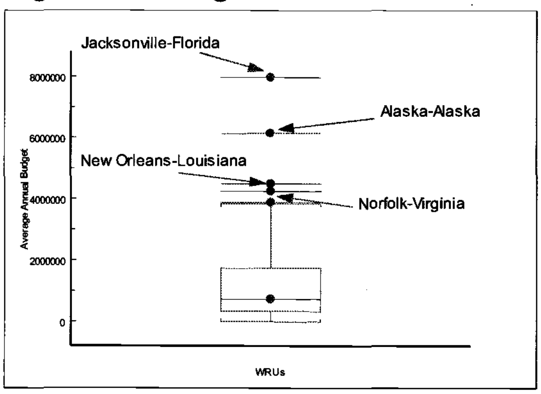


Figure A.2 Budget/program type.

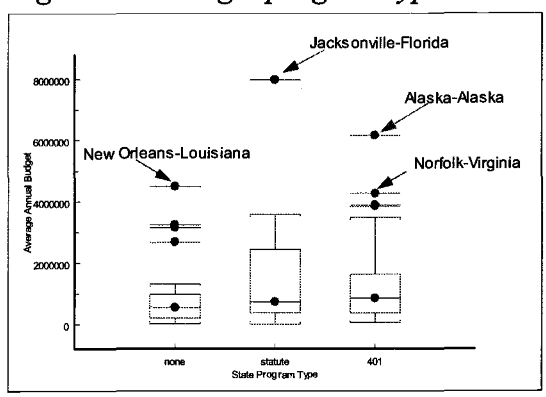


Figure A.3 Log budget.

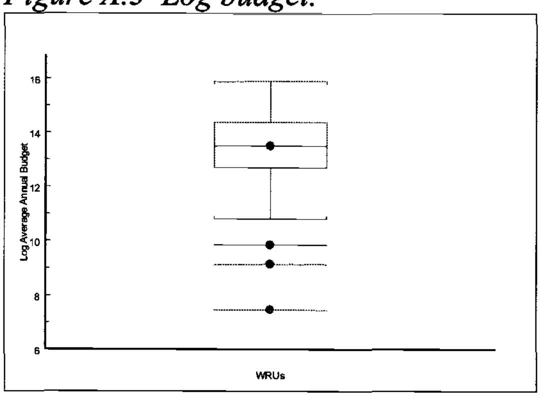
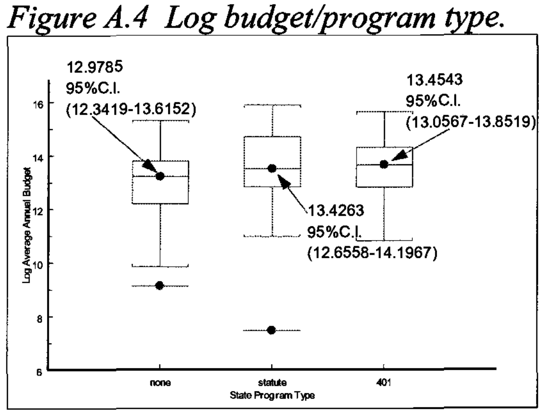


Figure A.4 Log budget/program type.



This non-normal distribution makes it difficult to establish how relatively constant the variance is between groups of WRUs that are determined by state wetland regulatory program type (Figure A.2). When evaluated on the log-scale, however, the whole population of WRUs demonstrates both a normal distribution of budgets as well as a constant variation of those budgets within WRUs grouped by state program type (Figures A.3 and A.4).

An analysis of WRU budgets produces overwhelming evidence of a strong relationship between this characteristic and the total amount of wetland fill permitted within WRUs (p-value < 0.0001; simple linear regression on the log scale). Overwhelming evidence is also produced of a similar relationship against the average number of permits issued each year (p-value < 0.0001; simple linear regression on the log scale). Figures A.5 and A.6 demonstrate the linearity of the response with both of these measures. These results may suggest that the amount of permits that can processed within a WRU may be constrained by the budget of that WRU, as higher budgets are necessary to acquire sufficient staff and equipment to conduct permit reviews and approvals. There should, however, be a limit to the amount of potential permit activity that may be requested in a WRU. Therefore, it may also suggest that the budgets of WRUs increase according to the amount of permit activity present in WRUs. A qualitative investigation of the decision-making behind USACE budget allocations would be necessary to determine the direction of these potentially causal relationships.

Figure A.5 Log budget/ log wetland fill.

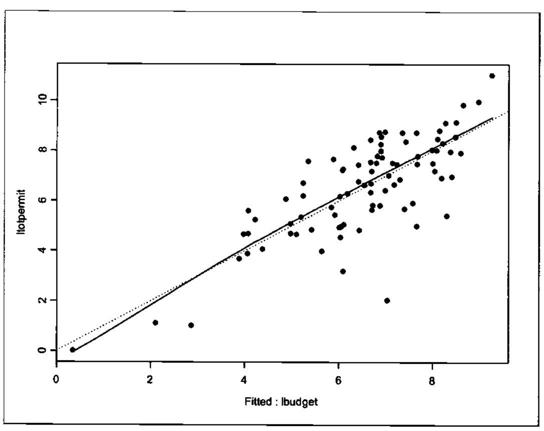
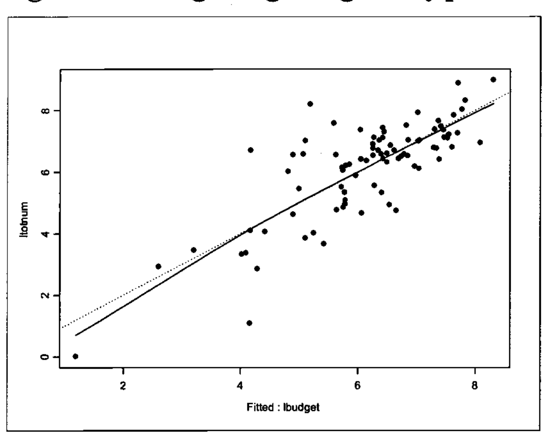


Figure A.6 Log budget/log no. of permits.



Despite evidence of strong relationships between WRU budget size and measures of the quantity of permit activity, there is no evidence of any similar relationships with the permit ratios or the log of the mitigation ratios for permits issued in WRUs (p-values of 0.7581 and 0.8551 respectively; simple linear regressions). Figures A.7 and A.8 demonstrate the lack of linearity with both of these measures. These results suggest that the amount of resources available does not seem to systematically constrain the levels of restrictions the USACE places upon the permits it issues.

Figure A.7 Log budget/permit ratio.

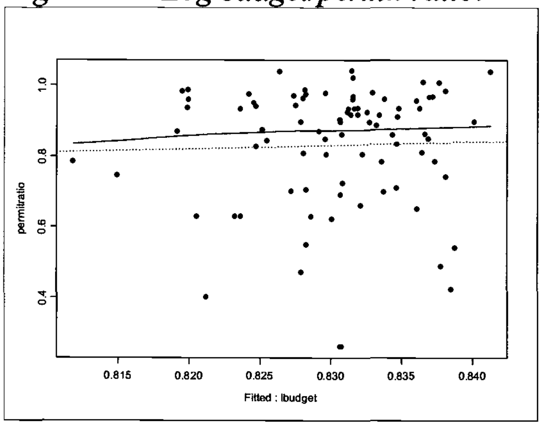
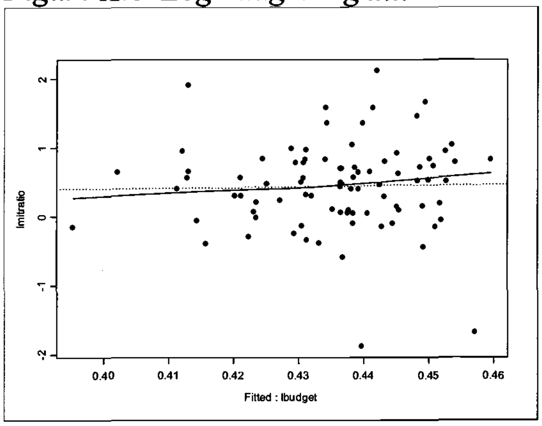


Figure A.8 Log budget/log mit. ratio.



Despite the lack of evidence that linear relationships exist between the budgets of WRUs and either of the measures for permit or mitigation ratios, the strength of the evidence that linear relationships do exist with both measures of permit activity suggest that further analysis of this independent variable is warranted. A comparison between the median budgets of WRUs grouped by program type produced no evidence of any significant differences (p-value = 0.4174; analysis of variance f-test on the log scale). This suggests that USACE districts have relatively equal financial resources to implement the national wetland permit program in WRUs regardless of the type of state programs that are in place in those WRUs. A closer inspection of the amount of overlap between the confidence intervals of the estimated medians, however, suggests those WRUs subject to Section 401 programs may tend to have higher budgets than those subject to no state program, but the relatively small population size, and high variance requires the collection of different or more precise budget measures in order to produce more conclusive evidence of this potential difference.

Staff Size

Another administrative resource characteristic of WRUs that is closely related to their average annual budget is their average annual staff size (correlation coefficient = 0.9375). Measures of staff size can, however, tell a slightly different story than measures of budget. While an increase in budget is generally related to an increase in staff size, variances in cost of living adjustments to salary levels may, in part, cause a lessening in this relationship a slight amount. Furthermore, while the majority of the USACE's regulatory budget is dedicated to staff salaries, some budget amounts are dedicated to other uses that may vary between WRUs. Some of these uses include the professional development of staff, the purchase and depreciation of vehicles and other equipment, and differences in office-space lease agreements. Therefore, as the budgets of WRUs may indicate the total amount of resources available to be applied across the entire regulatory program; staff size indicates specifically the amount of personnel available to issue permits.

As with the average annual budget, an analysis of WRU staff sizes reveals the need to transform the data onto the log scale in order to demonstrate both characteristics of normal distribution and constant variance. There is, again, a long-tail of WRUs with relatively large USACE staffs. As before, the WRUs that make-up this tail include Jacksonville-Florida, Alaska-Alaska, New Orleans-Louisiana, and Norfolk-Virginia (Figure A.9). This non-normal distribution makes it difficult to establish how relatively constant the variance is between groups of WRUs that are determined by state wetland regulatory program type (Figure A.10). When evaluated on the log-scale, however, the whole population of WRUs demonstrates both a normal distribution of staff size as well as a constant variation of those staffs within WRUs grouped by state program type (Figures A.11 and A.12).

Figure A.9 Staff size.

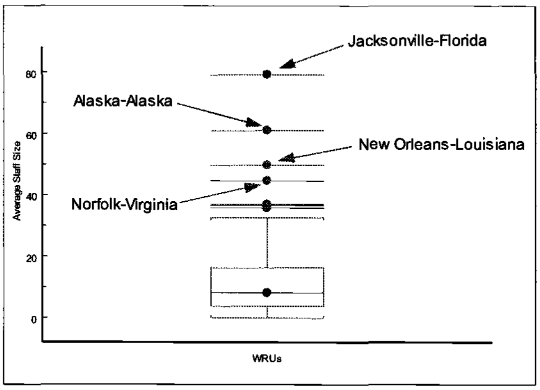


Figure A.10 Staff size/program type.

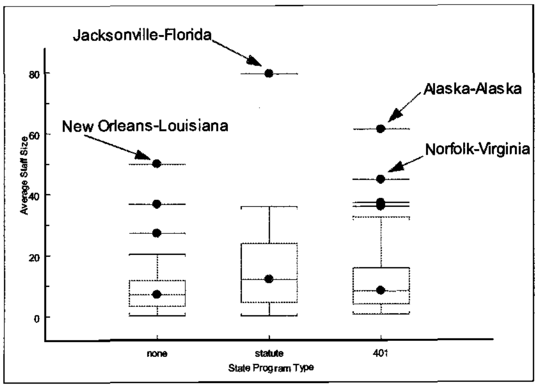


Figure A.11 Log staff size.

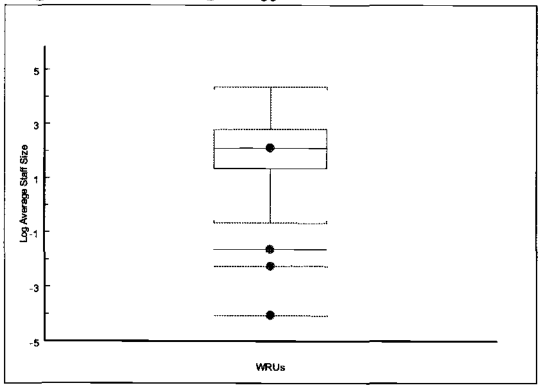
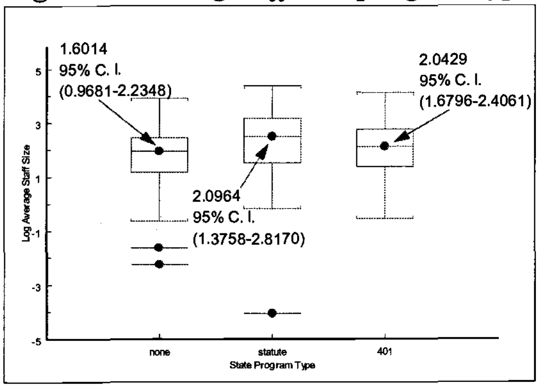


Figure A.12 Log staff size/program type.



An analysis of this variable produces overwhelming evidence of a strong relationship between this characteristic and the total amount of wetland fill permitted within WRUs (p-value < 0.0001; simple linear regression on the log scale). Overwhelming evidence is also produced of a similar relationship against the average number of permits issued each year (p-value < 0.0001; simple linear regression on the log scale). Figures A.13 and A.14 demonstrate the linearity of the response against both of these measures. These results may suggest that the amount of permits that can be processed within a WRU may be constrained by the number of staff members. As there must be limits to the amount of potential permit activity that may be requested in a WRU. Therefore, it may also suggest that the number of staff increases according to the amount of permit activity present in WRUs. As with the budget variable, a qualitative investigation of the decision-making behind USACE budget allocations would be necessary to determine the direction of these potentially causal relationships.

Figure A.13 Log staff size/log wetland fill.

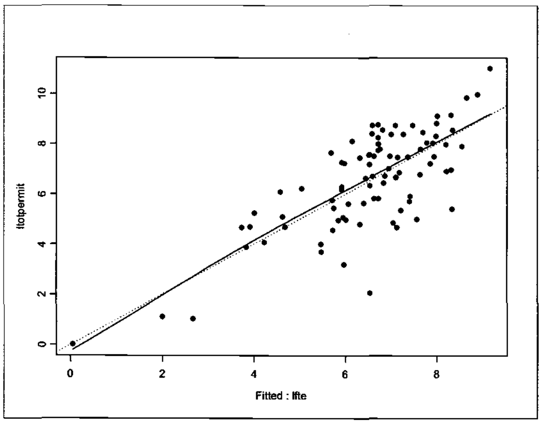
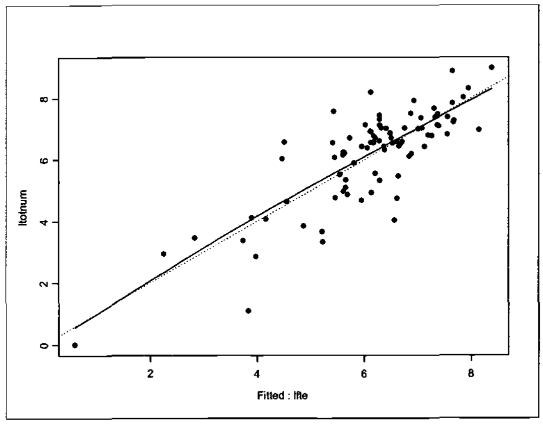


Figure A.14 Log staff size/log no. of permits.



Despite evidence of strong relationships between WRU staff size and measures of the quantity of permit activity, there is no evidence of any similar relationships with the permit ratios or the log of mitigation ratios of permits issued in WRUs (p-values of 0.4148 and 0.8746 respectively; simple linear regressions). Figures A.15 and A.16 demonstrate lack of linearity of the response against both of these measures. This suggests that the amount of resources available does not seem to systematically constrain the levels of restrictions the USACE places upon the permits it issues.

Figure A.15 Log staff size/permit ratio.

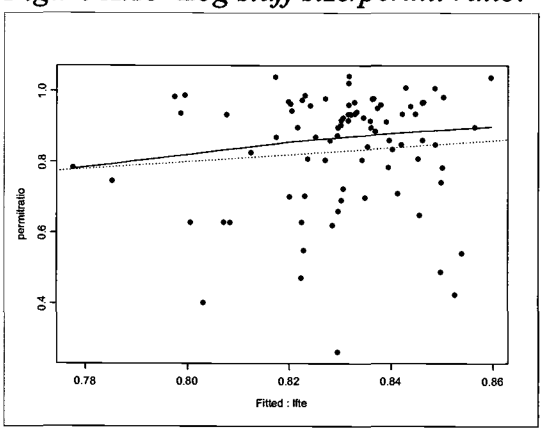
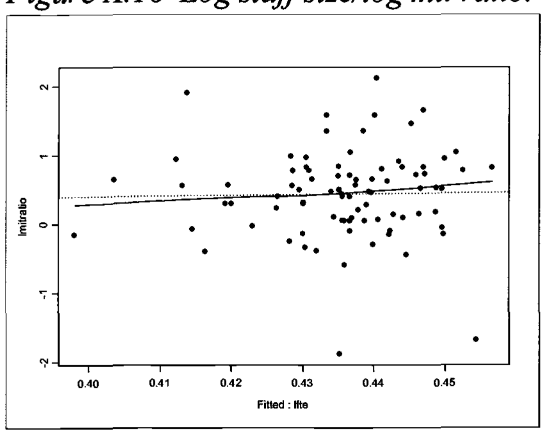


Figure A.16 Log staff size/log mit ratio.



Despite the lack of evidence that linear relationships exist between WRU staff size and either of the measures for permit or mitigation ratios, the strength of the evidence that linear relationships do exist with both measures of permit activity suggest that further analysis of this independent variable is warranted. A comparison between the median staff sizes of WRUs grouped by program type produced no evidence of any significant differences (p-value = 0.3819; analysis of variance f-test on the log scale). This suggests that the number of staff members available to implement the national wetland permit program in WRUs does not vary depending upon the type of state programs that are in place in those WRUs. A closer inspection of the amount of overlap between the confidence intervals of the estimated medians, however, suggests those WRUs subject to Section 401 programs may tend to have larger staffs than those subject to no state program, but the relatively small population size, and high variance requires the collection of different or more precise staffing measures in order to produce more conclusive evidence of this potential difference.

Since both the staff and the budget size of WRUs directly relate to the amount of wetland fill permitted and the number of wetland fill permits issued, a multiple regression model for those two program outcomes may be enriched from the inclusion of both variables. This may be especially true considering it appears the two variables contribute somewhat different descriptions of administrative resources available to wetland regulators. The slightness of the differences between the two variables, however, may be overcome by the overall similarities between them. Since both measures are so highly correlated to one another, the inclusion of both variables raise issues of multicollinearity and may ultimately be considered redundant and unnecessary in a rich multiple regression model. Regardless, neither variable appears to have sufficient evidence to support their inclusion in models for permit or mitigation ratios.

A regression of the measure for staff size against the measure for budget size demonstrates evidence of a potential anomaly in the assumed simple linear relationship between staff and budget sizes (Table A.1). There is overwhelming evidence that subgroup of WRUs exists for within the linear relationship between staff size and budget (p-value <0.0001; linear regression on the log scale). There appears to be fundamental and consistent difference in the size of the budgets relative to the size of the staffs for all of the WRUs under the authority of the Huntington, Philadelphia, and Mobile USACE districts (Figure A.17). These districts still appear, however, to have both staff sizes and annual budgets that are within the normal distribution of the rest of the USACE districts. Furthermore, the size of the staff continues to vary linearly along the same slope with the size of their budgets (Table A.1).

Figure A.17 Log staff size/log budget.

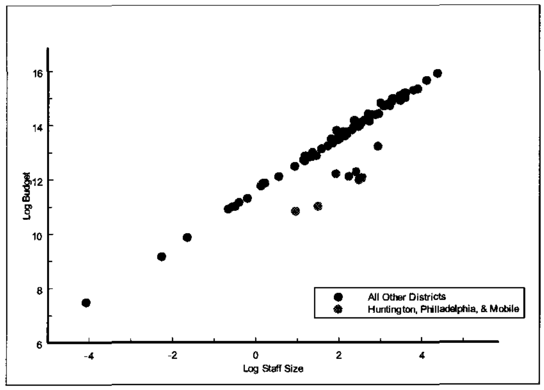


Table A.1 Linear regression results log budget/log staff size.

	(Standardized) (Coeff.)	Value	Std. Error	t value	Pr(>|t|)
(Intercept)		10.6694	0.0303	351.7597	0.0000
lfte	-0.6425	1.0046	0.0096	104.1691	0.0000
payoutlier	-0.6542	-0.8598	0.0233	-36.9530	0.0000

Residual standard error: 0.1253 on 84 degrees of freedom
Multiple R-Squared: 0.993
F-statistic: 5944 on 2 and 84 degrees of freedom, the p-value is < 0.0001

Analysis of Variance Table*
Response: lbudget

	Df	Sum of Sq	Mean Sq	F Value	Pr(F)
lfte	1	165.1881	165.1881	10522.59	0
payoutlier	1	21.4366	21.4366	1365.52	0
Residuals	84	1.3187	0.0157		

*Terms added sequentially (first to last)

These results, therefore, suggest that within this group of WRUs the median budget of the USACE's regulatory program is 42.32% smaller than it is for WRUs with similar staff sizes. This difference may be the result of a lack of lack of funds for unidentified special projects within the regulatory program, or other major differences in overhead costs, or it may indicate that the median salary is consistently lower for the pool of USACE staff within these three districts.

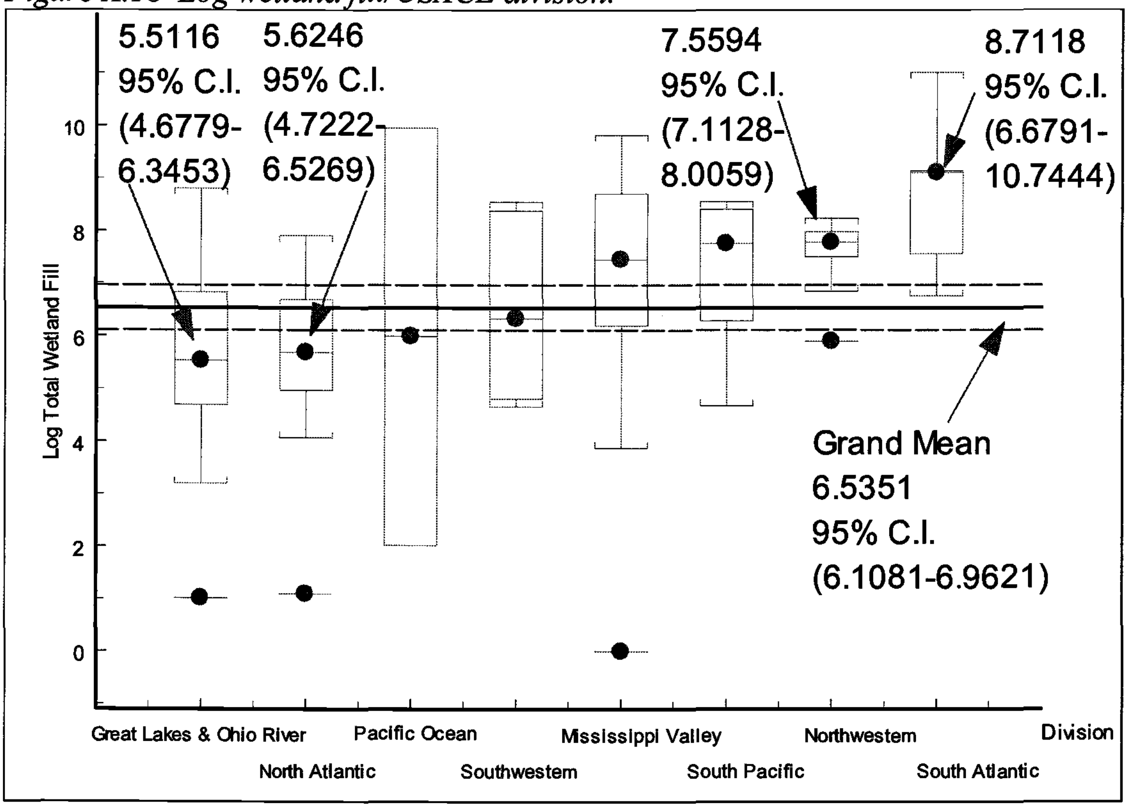
Divisional Oversight

Both staff and budget size are measures of resources that USACE headquarters allocates directly to USACE districts. Decisions about how to use these resources are decentralized and left to be made by individual districts. One other administrative resource that may influence some of the outcomes of the USACE wetland regulatory program and that is not under the authority of districts is the oversight they receive from division offices.

The USACE is a very hierarchical organization, and as such each USACE district reports directly to a Division office. There are eight USACE Division offices in the United States. On average, each division supervises the performance of 4.75 districts. The command-and-control, rank-and-file nature of the army leads to a consolidation of decision-making power over these districts within the USACE at the Division level. Division commanders, therefore, have the ability to set performance standards and priorities for USACE district regulatory programs. The consistent oversight by these Division commanders, therefore, may have the direct result of creating groups of districts that perform their roles as regulators in a very similar fashion to one another. As a result, the groups of districts within a single Division may produce program outcomes that are more similar to each other than the rest of the districts in the USACE.

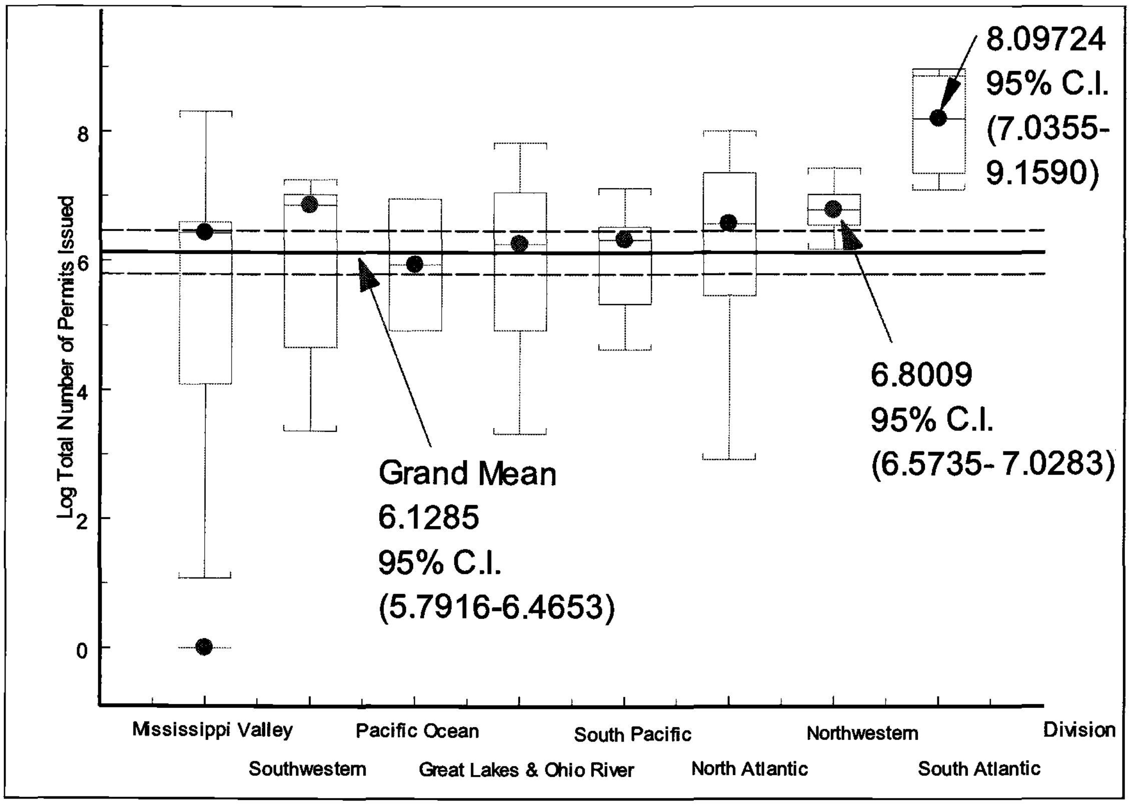
An analysis of the amount of wetland fill permitted in WRUs revealed that when grouped by the appropriate USACE Division offices of oversight, there is convincing evidence of significant variations between the median values of these groups (p-value = 0.0041; analysis of variance f-test on the log scale). A closer inspection of the confidence intervals for each estimated median suggests that specifically WRUs subject to the South Atlantic and the Northwestern Divisions both may tend to permit higher amounts of wetland fill than the national average, while the North Atlantic and Mississippi Valley, and the Great Lakes & Ohio River Divisions may tend to permit lower amounts of wetland fill than the nation average (Figure A.18).

Figure A.18 Log wetland fill/USACE division.



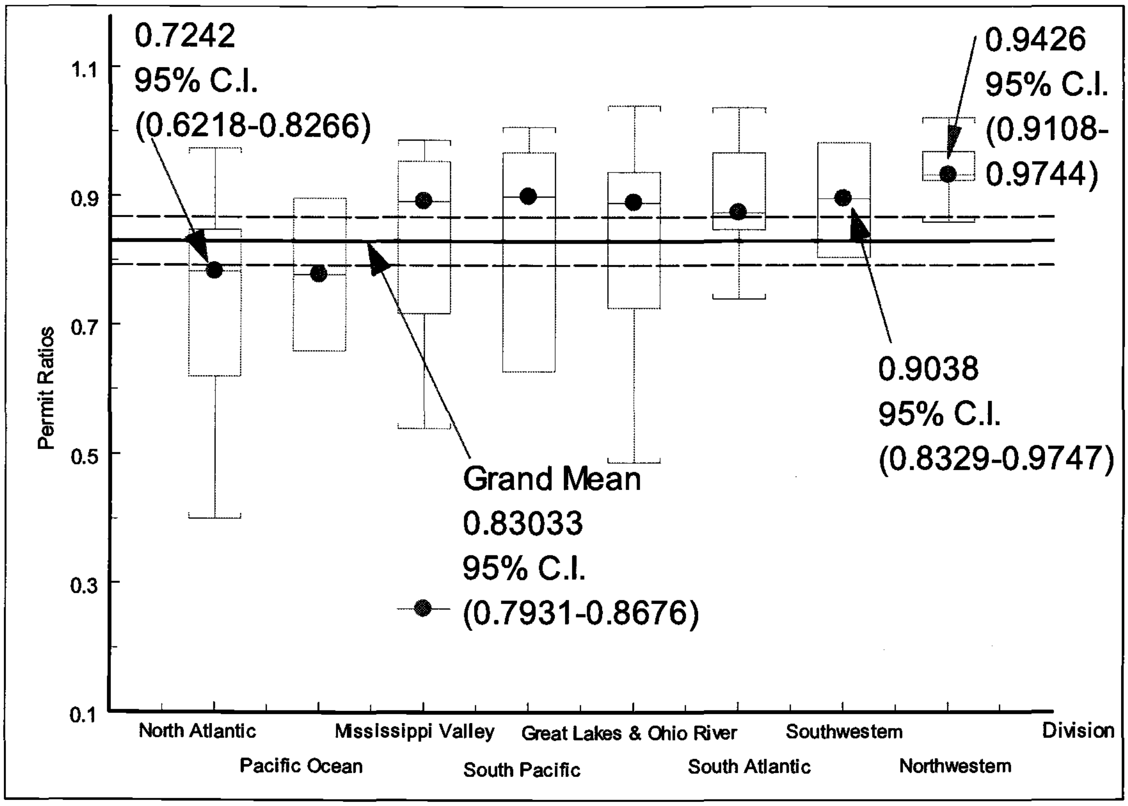
When similar analysis was conducted on the number of permits issued, the median values were more closely grouped and as a result, the evidence that there were significant differences between the divisions was less conclusive (p-value = 0.0554; analysis of variance f-test on the log scale). A closer inspection of the confidence intervals for each estimated median suggests that specifically WRUs subject to the South Atlantic and the Northwestern Divisions both may tend to permit higher numbers of permits than the national average, while the remaining Divisions may tend to permit numbers of permits closer to the nation average (Figure A.19).

Figure A.19 Log no. of permits/USACE division.



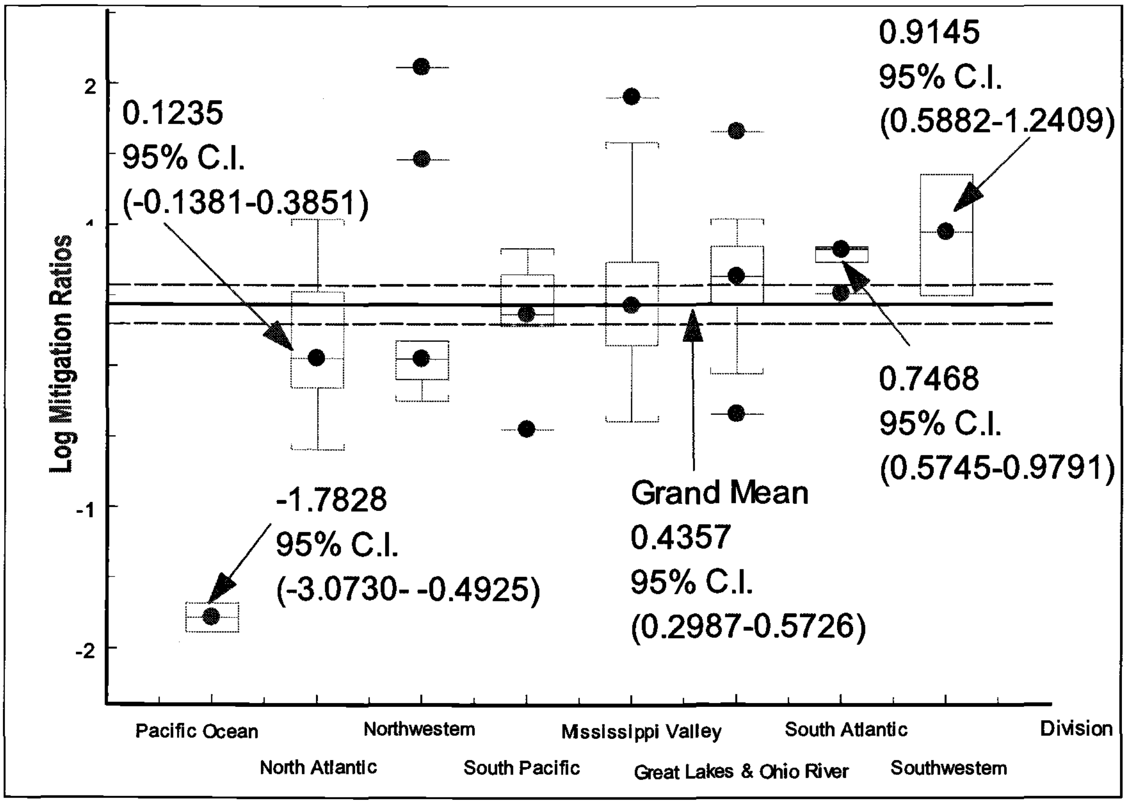
Similar results were produced from an analysis of permit ratios in each WRU. In the case of this program outcome, the evidence for differences based upon divisional oversight remained largely inconclusive (p-value = 0.0563 ; analysis of variance f-test). Closer inspection of the confidence intervals for each estimated median suggests that specifically WRUs subject to the Southwestern and the Northwestern Divisions both may tend to have higher permit ratios than the national average, while the North Atlantic Division may tend to approve lower numbers of permit requests than the nation average (Figure A.20).

Figure A.20 Permit ratio/USACE division.



In the case of the log of mitigation ratios, however, the data was more widely distributed, as a result the evidence for differences based upon divisional oversight was overwhelming (p-value < 0.0001; analysis of variance f-test). Closer inspection of the confidence intervals for each estimated median suggests that specifically WRUs subject to the South Atlantic and the Southwestern Divisions both may tend to have higher mitigation ratios than the national average, while the North Atlantic Division may tend to require slightly lower mitigation ratios of projects and the Pacific Ocean Division requires lower mitigation ratios than the nation average (Figure A.21).

Figure A. 21 Log mit. ratio/USACE division.



Although there is strong evidence to suggest some kind of a direct relationship with division boundaries exists, with the total acres of wetland fill permitted in WRUs, a clear interpretation of this relationship is not as easily obtained as intended. One potentially complicating characteristic of USACE divisional oversight, is that division boundaries also delineate physically unique regions of the country. This coinciding organization has the effect of simultaneously grouping WRUs into physically and administratively unique regions. Ultimately, this means that it becomes difficult to separate the potential influences of similar physical geographies from the potential influences of divisional oversight. However, if these differences are completely based in the physical attributes of the divisions alone, this variation may be accounted for by other independent variables describing specific physical characteristics in multiple regression models for program outcomes.

Another complication arises because each program outcome has demonstrated its own pattern of response among Divisions. There does seem to be some suggestion that at least the Southeastern Division seems to consistently have higher than normal responses in the program outcomes no other Divisions seem to demonstrate similar patterns. These results, therefore, suggest that divisional oversight does not seem to overwhelmingly and consistently dictate all program outcomes of the USACE's wetland regulatory program, but that there does seem to be some significant variation that this term is capable of describing.

Conclusions

From the above analysis there appears to be sufficient evidence to suggest that not all of the factors capable of determining the various measures for amounts of wetland fill activity are bottom-up in nature. At least three top-down administrative influences also appear to be sufficiently related to wetland permit program outcomes to warrant their consideration for inclusion into a multiple regression model of permit activity. Both the budget and staff sizes allocated to WRUs seem to have strong direct relationships to the amount of wetland fill permitted and the number of wetland fill permits issued, as well as to each other. Because they are closely correlated to one another, they both may not ultimately be included in a final regression model for these two program outcomes, but the merits of each should be heavily considered during variable selection.

Furthermore, divisional oversight is intended to represent a top-down administrative resource, and as such there is strong evidence of its importance in estimating total amounts of wetland fill permitted in WRUs. The meaning of this relationship, however, may be sufficiently confounded by regional landscape variations to warrant careful scrutiny before it can be properly interpreted and included in any multiple regression models for wetland permit program outcomes.

Not all three of these administrative resource variables must be included into a model in order to capture the essence of the potential influence that top-down influences can have on the performance of national wetland regulatory efforts. The inclusion of any of these variables opens the door for future research into the scope of this class of variables. It also helps to present a picture of the national wetland permit program that acknowledges how wetland fill permit activity in the United States is not only determined by the downstream flow of projects demanded by a population of potential applicants and landscape that supports them, but that is also restricted by the resources provided to the regulators as they carry out their responsibilities.

APPENDIX B: SOCIOECONOMIC VARIABLE EVALUATION

Introduction

The analyses of four socioeconomic conditions that are commonly discussed among regulatory professionals as driving forces behind their workloads are the focus of this section. During this investigator's tenure as a state wetland administrator, many conversations were held with USACE regulators regarding the root causes of wetland fill activities and factors that increase USACE permit workload. These conversations were often conducted in the context of efforts to establish statewide consistency in the administration of USACE wetland regulations across district boundaries. These efforts created the opportunity for administrators of both largely rural and highly urban districts to communicate with one another and their state counterparts what limitations each perceived that their programs faced.

In addition to landscape conditions discussed in Appendix C, four bottom-up socioeconomic conditions were routinely identified as major factors influencing a district's permit outcomes. These conditions are the total population of an area, population density, population growth rates, and median family incomes. Throughout the development of this study, wetland resource professionals from whom the investigator received technical assistance echoed the opinions of these regulators and continued to suggest the appropriateness of including these variables, as well as those described in Appendix C, into a model describing permitted wetland loss.

As there is no documentation in the literature of previous efforts to identify these or any other socioeconomic characteristics that directly affect the outcomes of wetland regulatory programs, it is possible that no evidence may be produced from an analysis that any of these characteristics are systematically related to any of the wetland regulatory program outcomes. Conversely, it is also possible that program outcomes are influenced by socioeconomic variables not considered here. Absent direct academic documentation, several indirect and associated references were discussed in the literature review that, at least, support testing the perceptions of regulatory community. Should evidence be produced supporting the inclusion of these variables, future studies may have a cornerstone from which they can conducted in order to identify additional potentially relevant socioeconomic conditions.

Total Population

As of the 2000 census, the total population of the United States was not equally distributed among all WRUs. The natural distribution of the populations of WRUs demonstrates that most WRUs have populations of a similar scale; however there is a long-tail of WRUs in the direction of greater population (Figure B.1). The Los Angeles-California, Jacksonville-Florida, New York-New York, Fort Worth-Texas, and Detroit Michigan WRUs have relatively high total populations. A transformation onto the log scale reduces this long-tailed tendency (Figure B.2). There is, however, some mild inequality in the variance between the groups when they are grouped by state wetland regulatory program type (Figure B.3).

Figure B.1 WRU pop.

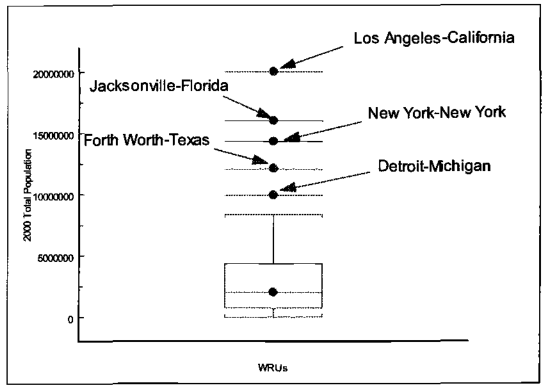


Figure B.2 Log pop.

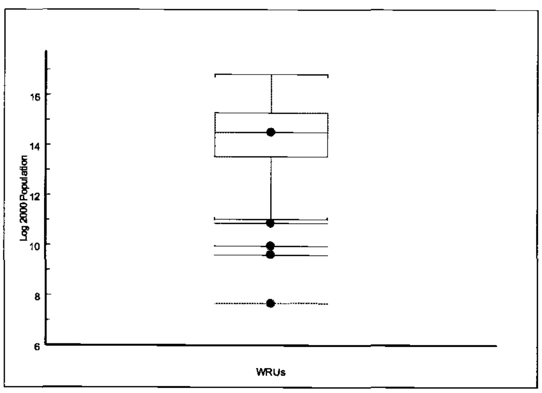
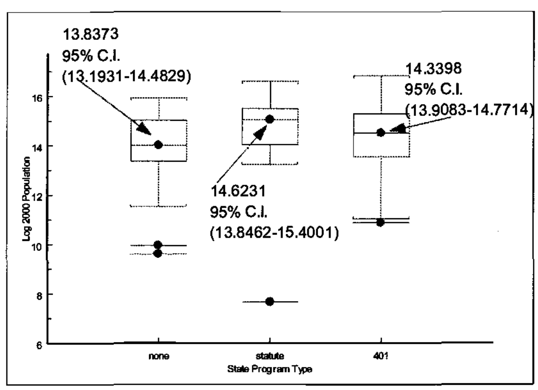


Figure B.3 Log pop ./program type.



A comparison between the medians of WRUs grouped by state program type, however, provides no conclusive evidence of any significant variation from one another (p-value = 0.1987; analysis of variance f-test on the log scale). Additional investigation into the amount of overlap between the confidence intervals for the estimated medians does suggest, however, that WRUs with no state program may tend to have lower populations than other WRUs. The collection of more precise data would be necessary in order to produce more conclusive evidence of this potential difference.

Regardless of the lack of any conclusive evidence of a relationship with the type of state program, this variable has relevancy for other reasons. As demonstrated in Figure B.4, total population does, in fact, demonstrate overwhelming evidence of a strong linear relationship with the amount of permitted wetland fill (p-value < 0.0001; simple linear regression on the log scale). A similar response is found in Figure B.5 between total population and the secondary program outcome of the number of issued permits as well (p-value < 0.0001; simple linear regression on the log scale). An expression of the potential relationships between the size of the population and both the amount of permitted wetland fill and the number of issued permits may, therefore, enrich regression models for both of those program outcomes.

Figure B.4 Log pop./total fill.

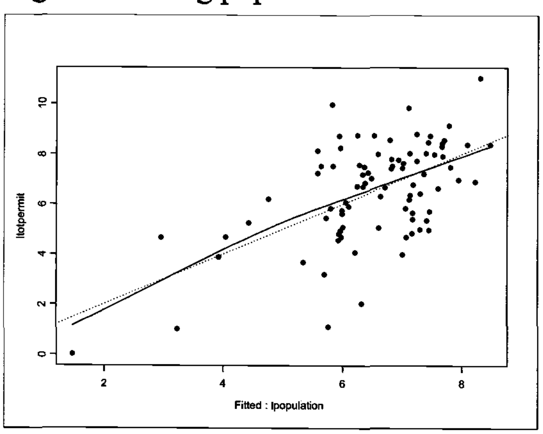
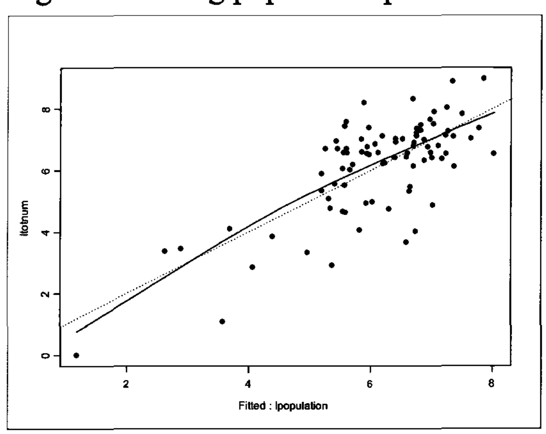


Figure B. 5 Log pop./no. of permits.



On the other hand, the permit ratios and mitigation ratios for wetland fill permits are supposed to be products of a decision-making processes that is not influenced by the volume of permits or the amount of fill processed by the district. These approval conditions are supposed to be developed in accordance with the nature of the resource being impacted. Regression models for these two program outcomes therefore do not demonstrate any evidence of a relationship with total population (Figures B.6 and B.7). With a p-values of 0.8758 and 0.8443 respectively, unless total population strongly interacts with other independent variables, it would not be chosen to be included in a regression model for either permit ratios or mitigation ratios.

Figure B.6 Log pop./permit ratio.

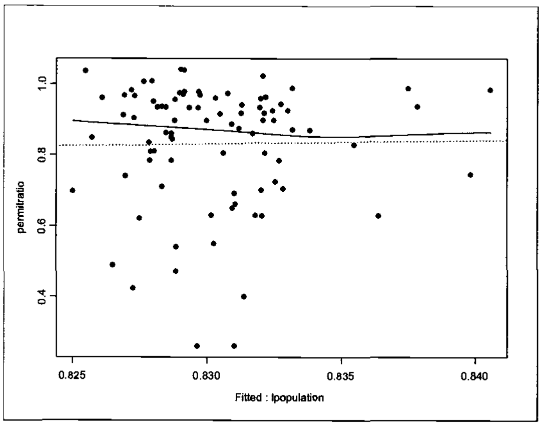
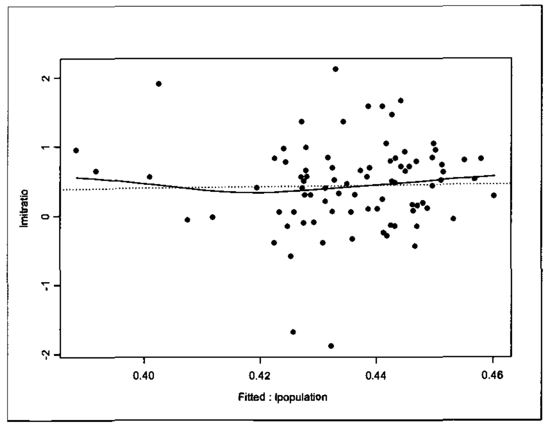


Figure B.7 Log pop./log mit. ratio.



<u>Population Density</u>

In addition to the total population of a given area, the density of that population may also demonstrate a relationship with the amount of permitted wetland fill. Due to inequalities in size, some WRUs may exhibit very large populations simply because they cover a large area, whereas others may have extraordinarily large populations for their size. Conventional thinking suggests that higher population densities can increase development pressures that in-turn may increase the amount of requests for permitted wetland fill.

As with total population, population density is also not uniform across all WRUs. The distribution of WRU population density is both long-tailed and highly skewed by a few relatively densely populated areas (Figure B.8). Specifically, the Baltimore-

Washington D.C., New York-New Jersey, and Chicago-Illinois WRUs are exceptionally densely populated areas. When transformed onto the log scale, however, population density across all WRUs demonstrates a more normal distribution (Figure B.9).

Figure B.8 Pop. density.

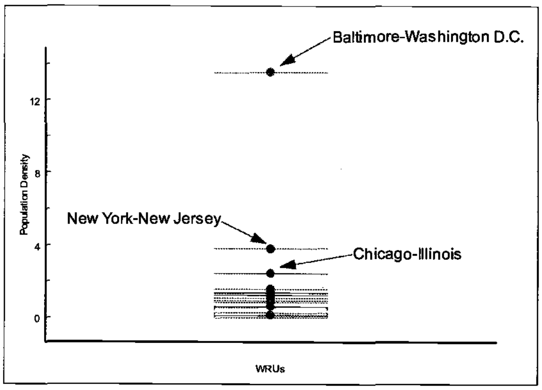
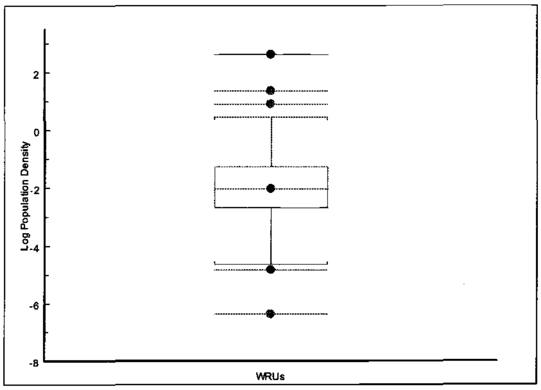


Figure .9 Log pop. density.



As expected, population density also exhibits strong evidence of a linear relationship with the amount of permitted wetland fill (p-value = 0.0368; linear regression on the log scale). This relationship is not, however, as strong as the one exhibited by the total population. This may be due, in part, to a confounding influence of the size of the WRU that is not taken into account by the total population estimate that may over inflate the strength of its relationship. In addition, unlike total population, there is no evidence of a relationship with the number of permits issued (p-value = 0.9858; simple linear regression). Figures B.10 and B.11 illustrate both of these relationships.

Given that the measure for total population did not demonstrate evidence of a regression against the permit or mitigation ratios of each WRU, additional tests for the same relationship with population density, produced similar results (Figures B.12 and B.13). With no conclusive evidence of a linear relationship produced by p-values of 0.0540 and 0.9672 respectively, unless population density can also be demonstrated to strongly interact with other independent variables, it would not be chosen to be included in a regression model for either permit ratios or mitigation ratios.

Figure B.10 Log pop. density/log wetland fill.

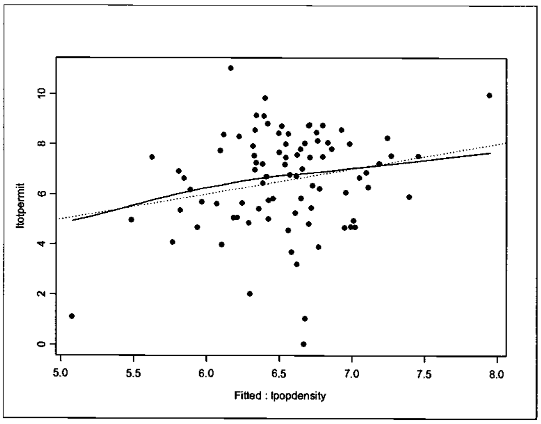


Figure B.11 Log pop density/log no. of. permits.

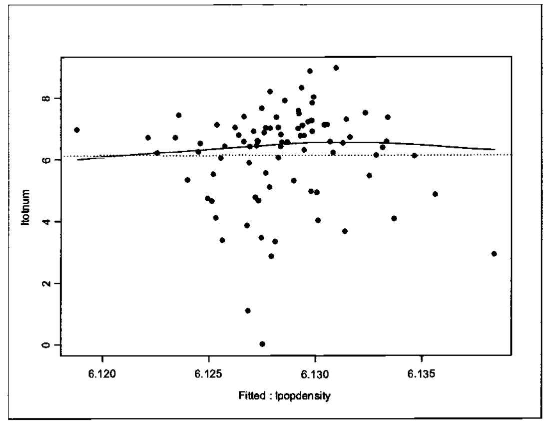


Figure B.12 Log pop.density/permit ratio.

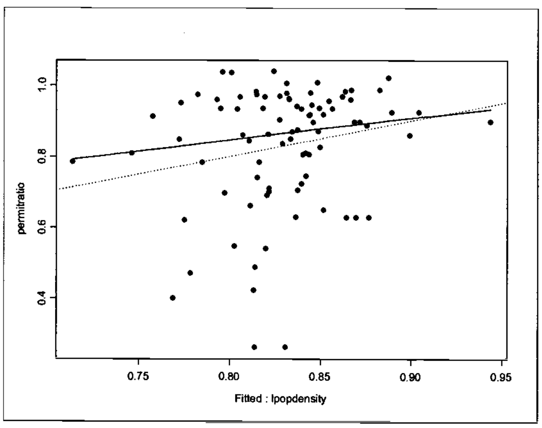
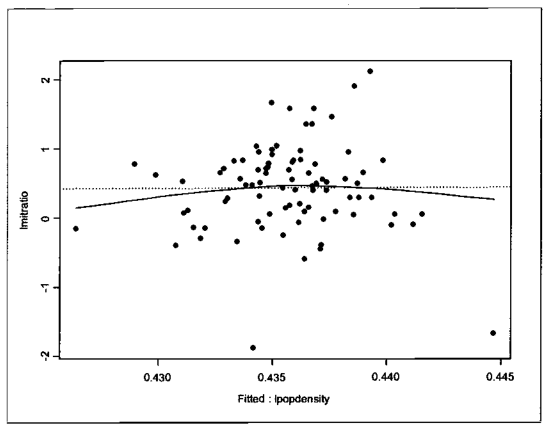
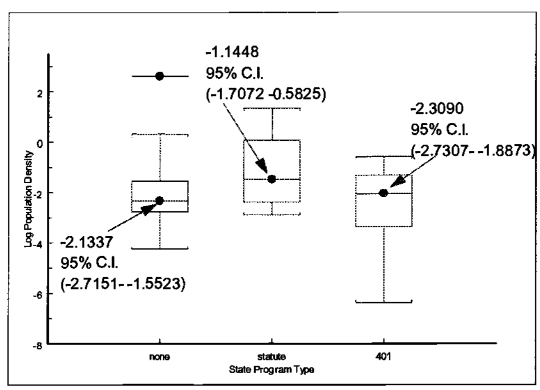


Figure B.13 Log pop.density/log mit ratio.



Interestingly, however, there is convincing evidence to suggest that when sorted by state program type, there is a significant difference between the groups (p-value = 0.0042 ; analysis of variance f-test). A closer investigation of the confidence intervals for the estimated medians suggest that as group, WRUs with statute-based state wetland regulations are more

Figure B.14 Log pop.density/program. type.

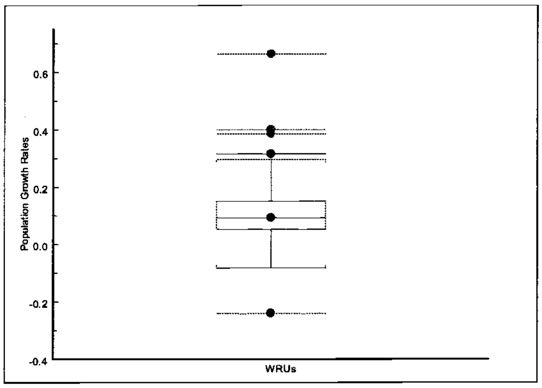


densely populated than those subject to either Section 401 water quality certification programs, no active state program (Figure B.14). This suggests that more urban areas may be more likely to have drafted their own wetlands protection legislation than to become engaged in Section 401 programs or to develop no program.

Population Growth Rates

Population growth is a characteristic of an area that is separate from the conditions described by the size and density of the population. The growth rate of an area can describe how changes in the landscape may be increasing or decreasing over time as pressures to develop land may increase or decrease along with population changes.

Figure B.15 WRU pop. growth.



Unlike previous population measures, the population growth rates of WRUs are fairly normally distributed across the entire nation (Figure B.15). There are WRUs that have gained populations over the last decade while others have lost them. Due to the relatively coarse levels of geographic resolution used in this study, however, no WRUs experience drastically large population growth rates as may be experienced on more local scales. In order to garner the full power of a population growth measure into a more sophisticated model, therefore, it may be necessary to develop a more sensitive measure of population growth.

As with the previous measures, there is convincing evidence that the amount of wetland fill permitted has a linear relationship with the growth rate of an area (p-value = 0.0002; simple linear regression). At the same time, there is also strong evidence of a similar relationship between the number of wetland fill permits issued and the growth rate of an area (p-value = 0.0304; simple linear regression). These results suggest the potential viability of this variable's inclusion in both a multiple regression model for permitted wetland loss and for the number of issued permits (Figures B.16 and B.17).

Figure B.16 Pop. growth/log wetland fill.

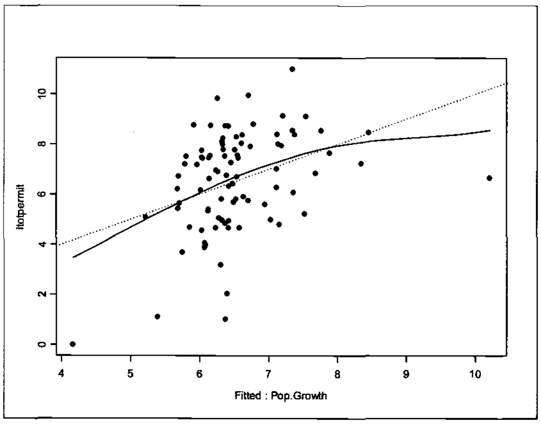
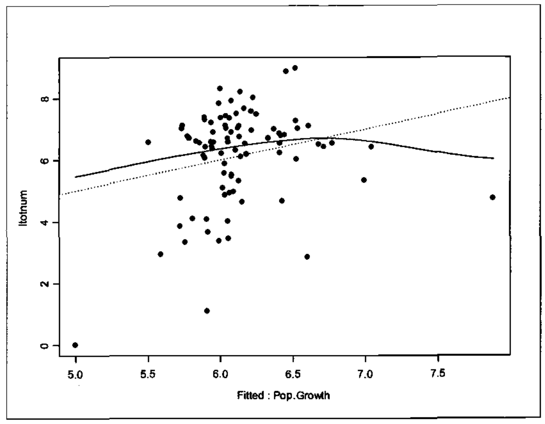


Figure B.17 Pop. growth/log no. permits.



Regressions were also constructed between population growth rates and both permit and mitigation ratios. These analyses did not, however, demonstrate any conclusive evidence of a relationship between these program outcomes and population growth (Figures B.18 and B.19). With a p-values of 0.1950 and 0.3330 respectively, unless population growth strongly interacts with other independent variables, it would not be chosen to be included in a regression model for either permit ratios or mitigation ratios.

Figure B.18 Pop growth/permit ratio.

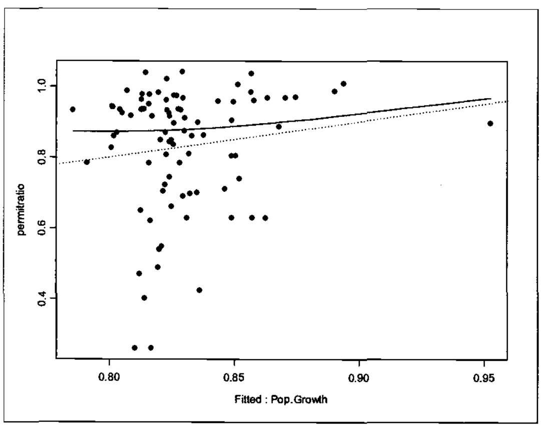
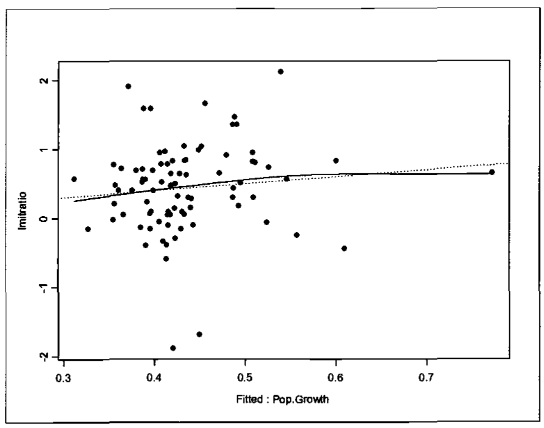
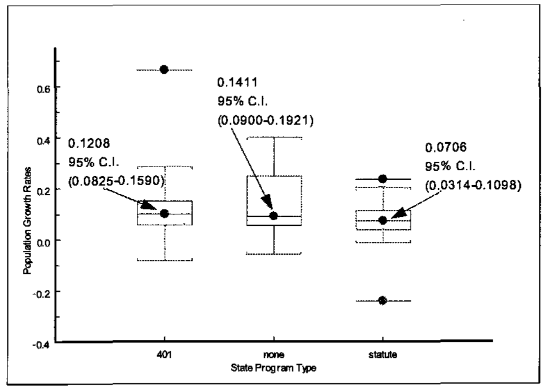


Figure B.19 Pop growth/log mit. ratio.



Because of its potential inclusion in a permitted wetland fill model, a comparison of the mean growth rates for WRUs grouped by state wetland program type was conducted (Figure B.20). This comparison, demonstrates the relatively equal variance between the groups. A comparison between the means of these three groups, consequently, only produced suggestive, but inconclusive evidence of any differences between them (p-value = 0.0909; analysis of variance f-test). A closer investigation of the amount of overlap between the confidence intervals for the three estimated means, however, suggests that WRUs subject to statute-based programs may tend to demonstrate lower population growth rates than WRUs subject to other state program types.

Figure B.20 Pop. growth/program type.



Median Family Income

Median annual family income is the only socioeconomic characteristic of WRUs included in this study that is not population-based. The previous set of socioeconomic variables only present relationships between program outcomes and quantities of citizens. The median annual family income is the only variable that attempts to describe the condition of the potential applicant pool. While some WRUs have greater median annual family incomes than others, as a group, they demonstrate a naturally-occurring normal distribution (Figure B. 21). They do not, however, demonstrate a constant variance when grouped by type of state wetland regulatory program (Figure B. 22). As a result, a log transformation was conducted in order to standardize the variance between the groups (Figure B.23).

Figure B.21 Income.

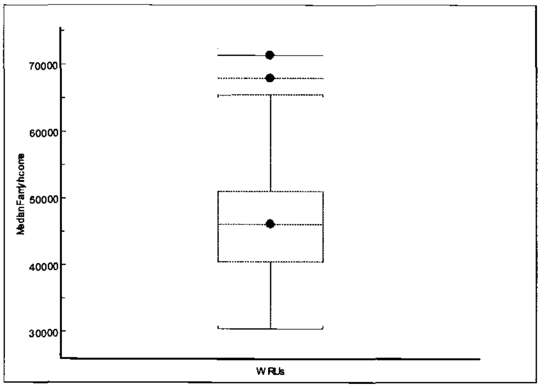


Figure B. 22 Income/program type.

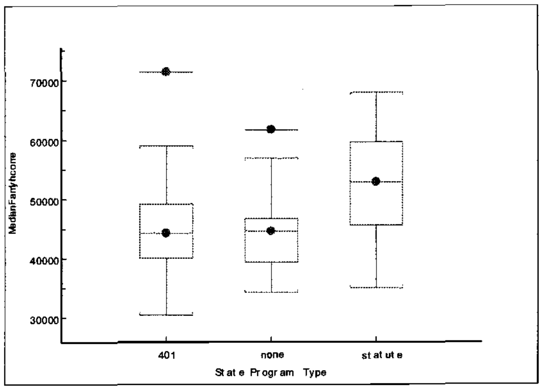
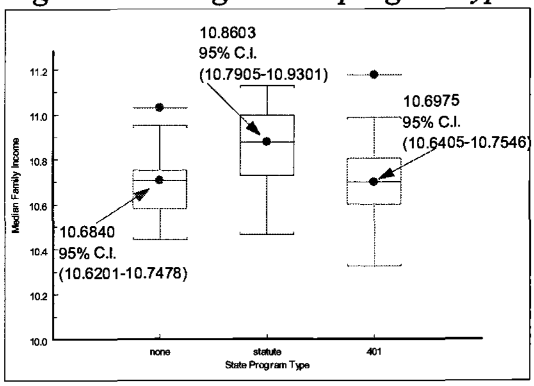


Figure B.23 Log income/program type.



When grouped by state wetland regulatory program type, there is also convincing evidence of considerable variances between the mean values for the different groups (p-value = 0.0004; analysis of variance f-test). A comparison of the amount of overlap between the confidence intervals for the estimated median values suggest that those WRUs with statute-based state wetland programs have significantly higher median income levels than those of than the median annual family incomes of WRUs subject to either of the other types of state wetland regulatory programs.

Ultimately, there is strong evidence to suggest that the total amount of wetland fill increases directly with median annual family income (p-value = 0.0295; simple linear regression). In addition, there is convincing evidence suggesting that the number of permits the USACE issues in WRUs increases as the median annual family income in those WRUs increases (p-value = 0.0030; simple linear regression). Figures B24 and B.25 illustrate these relationships.

Figure B.24 Log income/log wetland fill.

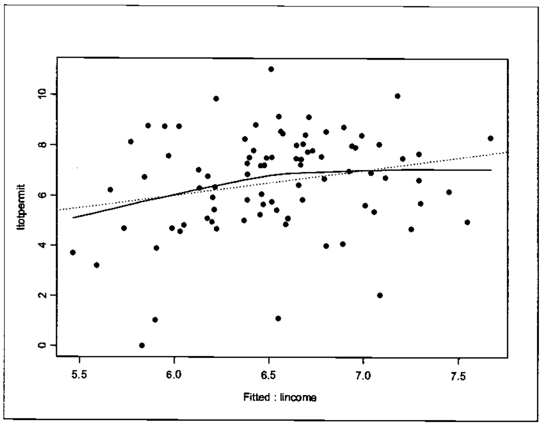
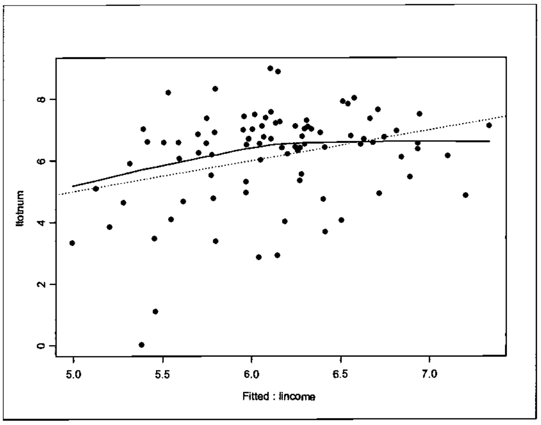
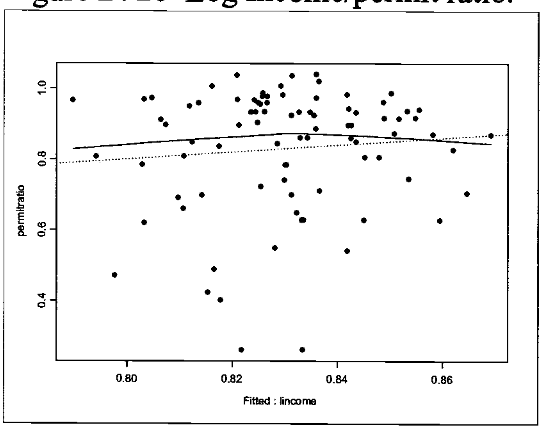


Figure B.25 Log income/log no. permits.

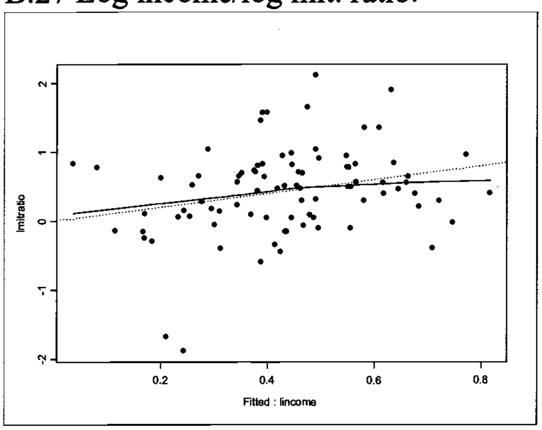


Furthermore, no conclusive evidence exists to suggest that permit ratios are similarly related with median family income, while there is strong evidence that mitigation ratios might be related to family income (p-values of 0.3772 and 0.0169 respectively; simple linear regressions). Figures B. 26 and B. 27 illustrate these relationships. These results suggest that the USACE may issue more permits in wealthier WRUs than others, and that those permits ultimately result in a greater amount of impact upon the resource. However, quantitative limitations placed upon the approval of these permits are not systematically relaxed in a way that demonstrates preference for wealthier WRUs. In fact, wealthier WRUs are actually subjected to higher mitigation ratios than other WRUs. In any case, a model the various outcomes of the national wetland regulatory program would likely be improved by the inclusion of an income variable.

Figure B. 26 Log Income/permit ratio.



B.27 Log income/log mit. ratio.



Conclusions

The amount of wetland fill permitted in WRUs is very responsive to population changes. Permitted wetland fill amounts are not just related to increases in total populations either. In each case, permitted wetland fill amounts increase systematically as population size, population density, and population growth rates increase. This suggests that as any one of these conditions change in an area, the amount of permitted wetland fill may be directly affected. It also suggests the possibility of influential interactions between them. These results support much of the conventional wisdom of wetland regulators who comment on population changes being driving forces behind the caseload of permits they review. Because of this particular program outcome's relationship to population-based variables, a regression model specific to permitted wetland loss will likely be enriched by incorporating, some, if not all, of those variables.

The number of wetland fill permits issued, however, does not demonstrate as strong of a relationship to population changes. This program outcome is unresponsive to changes in population densities. It continues to have a strong relationship with increases in the total population and population growth rates, however. This cross-spectrum relationship with other program outcomes suggests the strength of the aggregate influence that the total population of an area can have on the USACE wetland regulatory program. Of all the population measures this one demonstrates the greatest potential to influence a regression model specific to the number of permits issued.

Despite its wide-reaching influence, total population is not, however, a population characteristic that varies systematically with WRUs that are grouped by state wetland regulatory program type. Population growth rate is also no such characteristic. In both cases, there is inconclusive evidence of significant difference between groups identified by state program type. Only population density demonstrates evidence of a relationship with the type of state wetland regulatory present in WRUs.

On average, WRUs with statute-based state wetland regulatory programs have significantly more dense populations than other WRUs. WRUs subject to statute-based state wetland regulatory programs are also significantly wealthier than other WRUs and have lower population growth rates. This suggests that those areas with wealthier, slower growing, and denser populations are more likely to be subjected to statute-based state wetland regulatory programs than poorer, more quickly growing, less densely populated areas.

This is not meant to suggest wealthier and denser WRUs permit fewer acres of wetland loss than other WRUs. On average, WRUs with higher median annual family incomes such as these may issue higher numbers of wetland permits for greater amounts of wetland fill. These increased permits, however, do not necessarily result in more significant impacts, as they are also subjected to higher mitigation rates.

In total, these results support the assertions of the regulatory community that knowledge about these socioeconomic variables is key to understanding the outcomes of the USACE wetland regulatory program. They also suggest there may be specific socioeconomic profiles to the residents of WRUs that are subject to different types of state wetland regulatory programs. This provides additional support for the inclusion of some measures for these terms into regression models for the various wetland regulatory program outcomes, in an effort to control for these potentially confounding variations.

APPENDIX C: LANDSCAPE VARIABLE EVALUATION

Introduction

Wetland Regulatory Units (WRU)s are the unit of analysis for this study because their boundaries physically incorporate real administrative areas and allow analysis of the intergovernmental relationships. Since they functionally describe actual geographical areas, however, they also incorporate real variations inherent in subdivisions of the landscape. As a result, two major characteristics of the landscape's composition must be considered; WRU size, wetland abundance within WRUs.

If wetland fill activity were uniform across the nation, it would be understandable that larger WRUs would capture larger proportions of fill than smaller WRUs. It has been suggested by wetland regulators and resource managers, however, that the amount of wetland fill permitted in a given area is, in part, directly related to the abundance of wetlands in that area. Although no prior examination in the literature has attempted to verify the relationship between either assessment area size or wetland abundance and amounts of permitted wetland fill, the potential existence of such relationships warrant examination. If either landscape condition is related to the amount of permitted wetland fill, their potential influence may need to be accounted for as a component of a comprehensive model of the USACE's wetland regulatory program outcomes.

Analysis of Variance and Assumption Testing for WRU Size

The characteristic of greatest concern is the size of WRUs. Because WRUs are created from intersections between state and USACE administrative boundaries they are ultimately unequal in size. This inequality has the potential to not only influence the response variables of this study, it may also influence other key characteristics of WRUs that mark their similarities and differences from one another. Therefore, a regression model describing permitted wetland loss may be incomplete without a variable that accounts for variations in the size of WRUs.

The size of each WRU is described in terms of acres. A box-plot of all 87 WRUs, however, demonstrates how size is not an attribute that is evenly distributed among WRUS. It is a characteristic that is skewed by the Alaska-Alaska WRU (Figure C.1). In addition, when grouped according to the type of state program present, it is difficult to determine if the data meets the assumption of constant variance (Figure C.2). This is also due to the skewness created by the Alaska-Alaska WRU.

Figure C.1 Size.

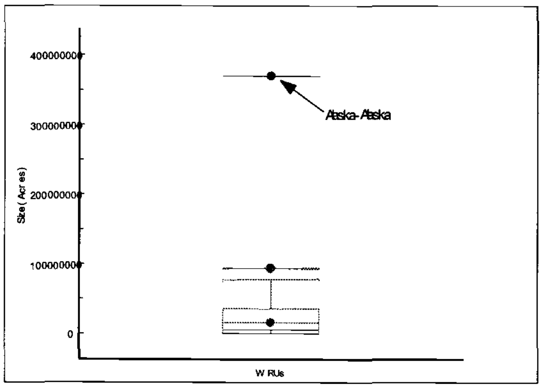
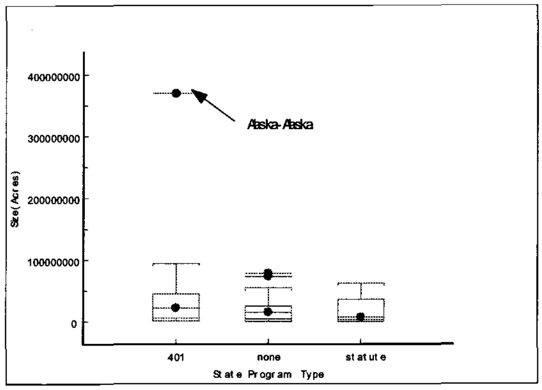


Figure C.2 Size/ program type.



The estimated size for this WRU is not a result of data contamination and it is not otherwise in error. Alaska is a very large state. It is also one of only 14 states that are completely contained within one WRU. Most of the other states, which share this distinction, however, are much smaller, while most other large states are split into multiple WRUs. There is also no other compelling evidence for removing it as an outlier in the dataset.

A transformation of the size variable onto the log scale produces both a normal distribution of the data and reasonably constant variation between WRUs grouped by state wetland regulatory program type. A comparison of the median size of WRUs subject to different program types provides suggestive, but inconclusive evidence to suggest that the type of state wetland regulatory program is systematically related in any way to WRU size (p-value = 0.0784, analysis of variance f-test). A closer inspection of the amount of overlap between the confidence intervals for the estimated medians, however, suggests that WRUs subject to Section 401 wetland regulatory programs may tend to be larger geographic units than WRUs subject to other types of state programs. A larger population size would be necessary in order to conclusively determine this potential difference.

Figure C.3 Log size.

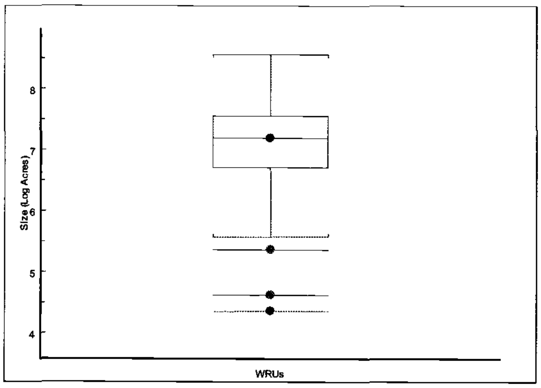
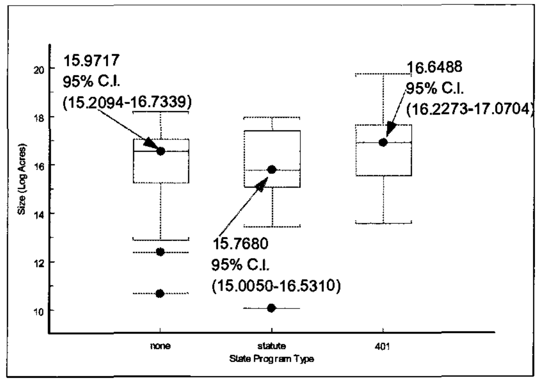


Figure C.4 Log size/program type.



The central focus of this study is the development of a robust linear regression model of permitted wetland fill aid in testing the applicability of the separated-authority model of intergovernmental relations. Because of the selection of this model-type, for WRU size to be incorporated into this final model, it must also relate linearly to the permitted wetland fill.

A simple regression against the log of the total acres of permitted wetland fill, provides overwhelming evidence that WRU size does meet this assumption (p-value < 0.0001; simple linear regression). Figure C.5 illustrates the evidence of this relationship. It may be that the amount of wetland fill permitted increases as the size of the WRU increases, because larger WRUs cast a larger net in which to capture more wetland fill activity. This does not necessarily mean that the size of the WRU is intrinsically related to the amount of permitted wetland fill. It is more likely that size has more to do with a WRU's ability to capture larger amounts of other independent variables discussed in Appendix B and D that are related to the amount of permitted wetland fill. Because of its linear relationship to the response variable, and its potential ties with many of the other independent variables, the size of WRUs may be a strong independent variable the regression model of permitted wetland fill.

Figure. C.5 Log size/log wetland fill.

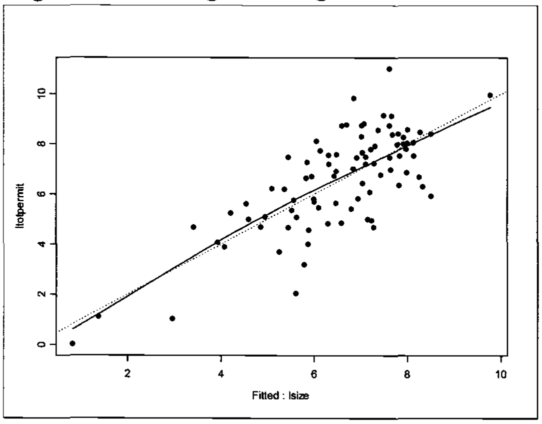
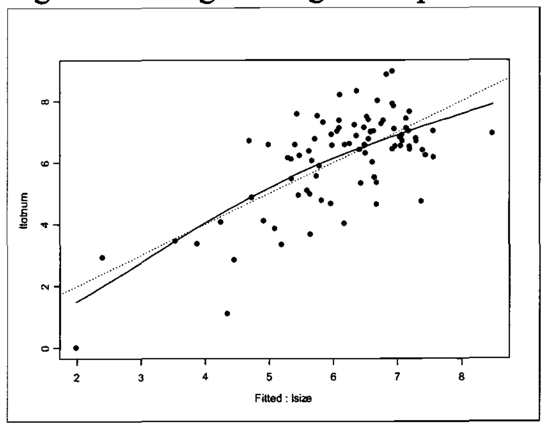


Figure C.6 Log size/log no. of permits.



There is also overwhelming evidence that the same linear relationship with the size of the WRU exists with the log of the average number of permits issued each year as well (p-value < 0.0001; simple linear regression). This relationship is illustrated by Figure C.6. As with the amount of wetland fill, this relationship is also not surprising, as the larger the WRU the more potential opportunity for wetland fill permits to be issued. Because of its potential ties with many of the other independent variables and its linear relationship to this secondary response variable, the size of WRUs may also be a strong independent variable an exploratory regression model of the average annual number of wetland fill permits.

It is not expected, however, that the secondary program outcomes of permit ratios and mitigation ratios would demonstrate a linear relationship with the size of the WRUs. No defensible argument has been constructed to justify how such a linear relationship might exist as the permit approval and limitation decisions made by the USACE have no theoretical relationship to the size of the WRU. The test of linearity against both variables confirms these expectations (Figures C.7 and C.8). The evidence of a slight relationship between WRU size and permit ratios is inconclusive, at best, while there is no evidence of any relationship with mitigation ratios (p-values of 0.0942 and

0.8260 respectively; simple linear regressions). As a result, regression models for the permit ratios or mitigation ratios in WRUs may not be strengthened by including a variable for the size of the WRUs unless the other independent variables demonstrate an interaction with this variable.

Figure C.7 Log size/permit ratio.

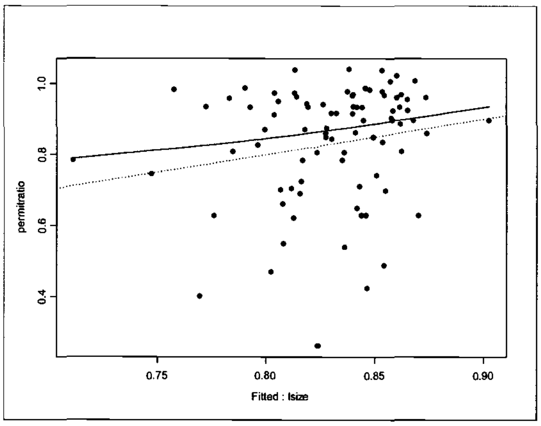
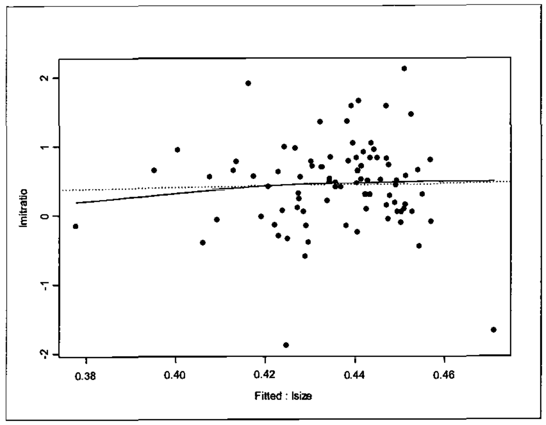


Figure C.8 Log size/log mit ratio.



<u>Analysis of Variance and Assumption Testing for Wetland Abundance</u>

The other landscape variable of considerable interest is the total amount of wetlands present in each WRU. Since the issuance of a wetland permit is predicated upon the presence of wetlands in the landscape, it is feasible that both the amount of permitted wetland fill and the average number of permits issued in WRUs each year could be directly related to the amount of wetlands located within those WRUs. Likewise, it is very likely that other independent variables only influence the amount of permitted wetland fill, when they are magnified by the process of interacting with the presence of wetlands. The distribution of wetland abundance, therefore, is a variable that deserves additional investigation.

Wetland abundance is described in terms of acres. As with WRU size, a box-plot of all 87 WRUs demonstrates how the distribution of wetland abundance is skewed by the Alaska-Alaska WRU (Figure C.9). In addition, when grouped according to the type of state program present, the skewness created by the Alaska-Alaska WRU makes it difficult to determine if the data meets the assumption of constant variance (Figure

C.10). Alaska has long been known to have considerable wetland resources, and it is a very large state. There is no justification, therefore, to suggest the unusually high estimate of wetland abundance in Alaska is vastly overestimated or a result of data contamination. There is also no other compelling evidence for removing it as an outlier in the dataset.

Figure C.9 Wetlands.

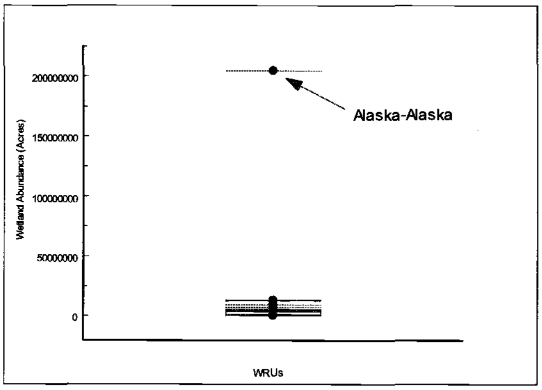
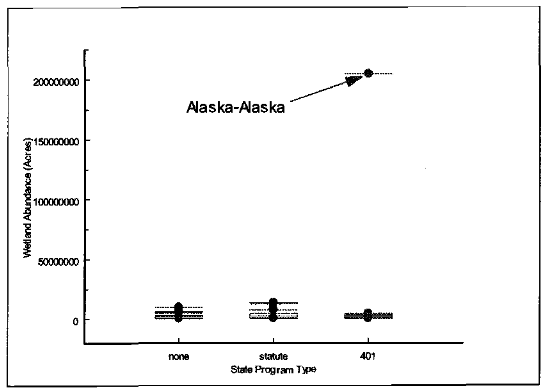


Figure C.10 Wetlands/program type.



A transformation of wetland abundance onto the log scale produces both a normal distribution of the data and reasonably constant variation between WRUs when grouped by state wetland regulatory program type (Figures C.11 and C.12). A test comparing the means of these groups, however, produced no evidence that the type of state wetland regulatory program is systematically related in any way to wetland abundance (p-value = 0.5794; analysis of variance f-test). It appears, therefore, that wetland abundance, by itself, may not be a determinant factor in the type of state wetland regulatory program in effect within WRUs.

Having been found to comply with the assumptions of normality and constant variance, wetland abundance must also meet the assumption of a linear relationship with the response variable in order to also be included in the linear regression model of permitted wetland fill. A simple regression against the log of the total acres of permitted wetland fill, demonstrates overwhelming evidence that wetland abundance does meet this assumption (p-value < 0.0001; simple linear regression). It is not surprising that the amount of wetland permitted wetland fill might increase as wetland abundance increases, because the presence of more wetlands may create more opportunities for wetlands to be filled (Figure C.13). However, until now, no previous publication has described this relationship. Because of its potential ties with many of the other independent variables as well as its linear relationship to the response variable, wetland abundance may be strong independent variable the regression model of permitted wetland fill.

Figure C.11 Log wetlands.

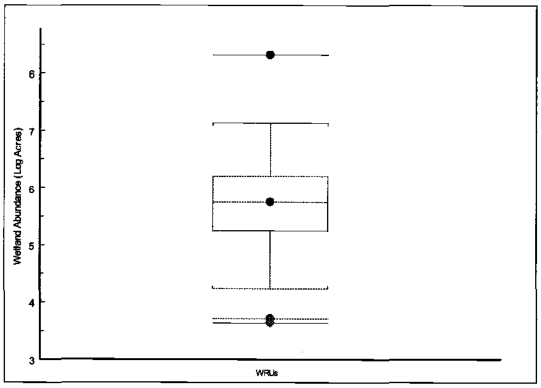


Figure C.12 Log wetlands/program type.

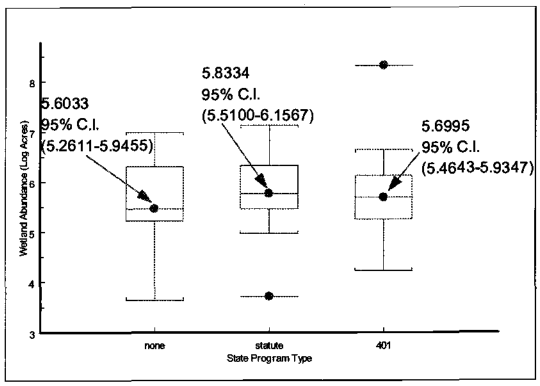


Figure C.13 Log wetlands/log wetland fill.

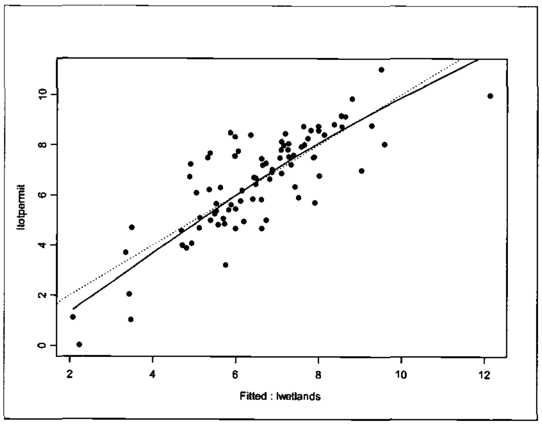
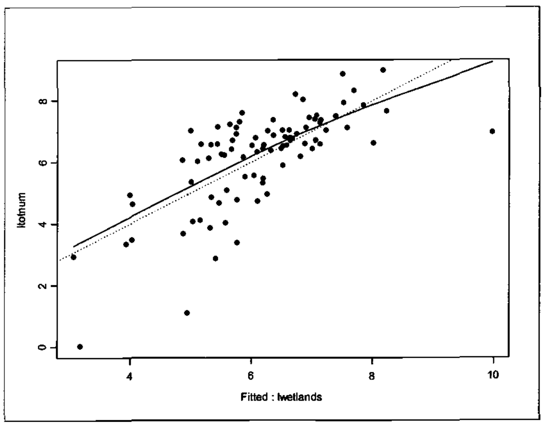


Figure C.14 Log wetlands/log no. of permits.



There is also overwhelming evidence that the same linear relationship between wetland abundance and the amount of permitted wetland fill also exists with the log of the average number of permits issued each year as well (p-value < 0.0001; simple linear regression). This relationship, as well, is also not surprising, as the more abundant wetlands become the more opportunity there is for wetland fill permits to be issued (Figure C.14). Because of its potential ties with many of the other independent variables and its linear relationship to this secondary response variable, wetland abundance may also be a strong independent variable an exploratory regression model of the average annual number of wetland fill permits.

It is not expected, however, that the secondary program outcomes of permit ratios and mitigation ratios would demonstrate a linear relationship with wetland abundance. No reasonable argument can be constructed to justify how such a linear relationship might exist as the permit approval and limitation decisions made by the USACE have no theoretical relationship to the amount of wetlands present within a WRU. Tests of linearity against both variables confirm these expectations. Neither provides evidence of any relationship between wetland abundance and mitigation ratios (p-values of 0.3271 and 0.8355 respectively; simple linear regressions). Figures C.15 and C.16 illustrate the lack of evidence for either of these relationships. As a result, regression models for the permit ratios or mitigation ratios in WRUs may not be strengthened by including a variable for wetland abundance unless the other independent variables demonstrate an interaction with this variable.

Figure C.15 Log wetlands/permit ratio.

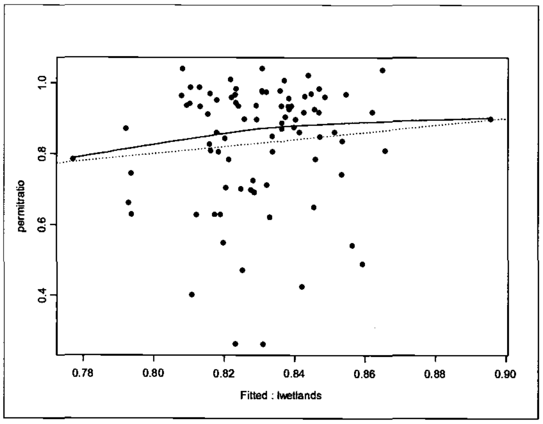
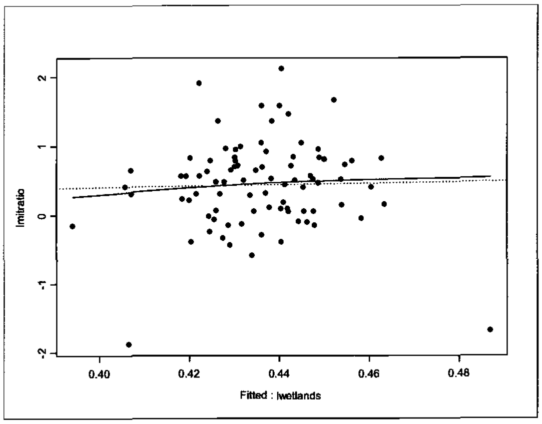


Figure C.16 Log wetlands/log mit. ratio.



Exclusion of Wetland Density

Wetland density is an alternative measure of wetland abundance for which the merits of its inclusion into a final model for wetland permit activity must be assessed. Along this measure that takes into account both the size of an area and the amount of wetlands located within it the distribution of WRUs is no longer as strongly skewed as it was in the other two landscape variables. There is still, however, a long-tail within this distribution of a few WRUs with exceptionally high wetland density values (Figure C.17). Specifically, all three of the WRUs in Louisiana, along with the Alaska-Alaska, Baltimore-Maryland, and Jacksonville-Florida WRUs have exceptionally high wetland densities. This long-tailed distribution makes determining differences in variance difficult (Figure C.18).

Figure C.17 Wet density.

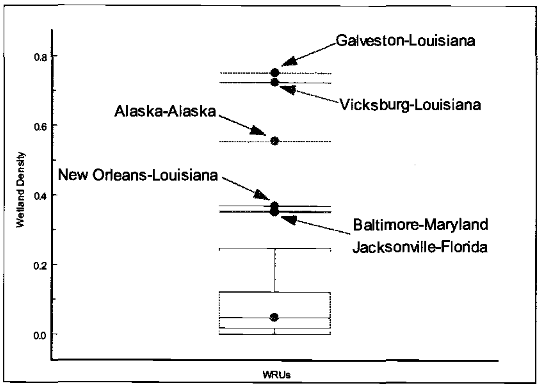
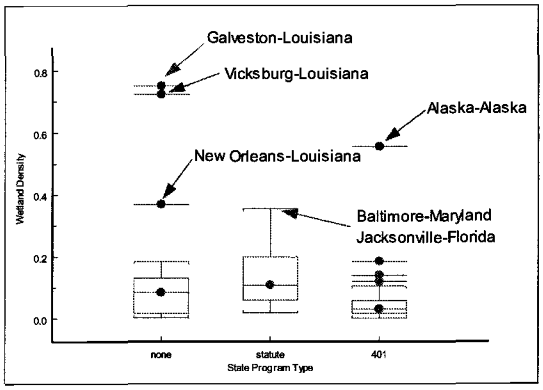


Figure C.18 Wet density/program type.



A transformation onto the log scale produced a more normal distribution of the data (Figure C.19). It also provided only minor departures from relatively constant variances between WRUs grouped by state program type (Figure C.20). An analysis of the estimated median values for the wetland densities of these three groups of WRUs produced convincing evidence that there are significant differences between the groups (p-value = 0.0011; analysis of variance f-test). In fact, the median wetland density of WRUs subject to statute-based programs is higher than the densities of WRUs subject to either other type of state wetland regulatory program. This suggests that wetland density seems to be a determinant factor in a state decision to draft its own wetland regulations. Accounting for wetland density, may be an appropriate term to include into a multiple regression analysis for wetland loss, if it can be demonstrated that a linear relationship exists between the two conditions.

Figure C.19 Log wetland density.

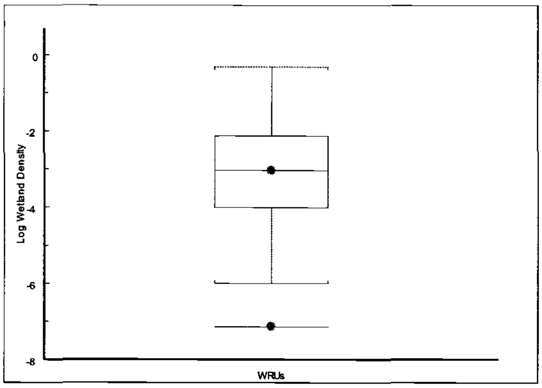
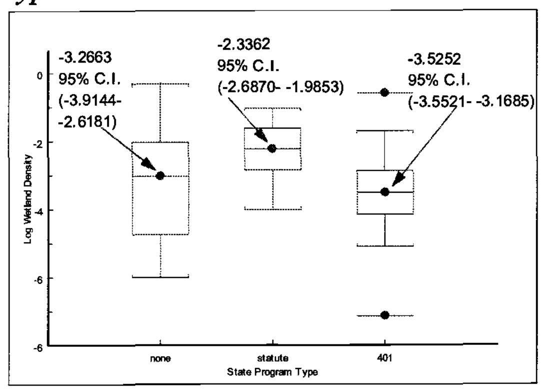


Figure C.20 Log wet density/program type.



Given that both their size and the abundance of wetlands contained are positively related to the amount of permitted wetland fill within WRUs, it could be expected to observe a relationship between wetland density and the amount of permitted wetland fill. However, establishing a ratio of wetland abundance against the size of a WRU appears to serve the opposite role of reducing the correlation of both variables against the response variables (Figure C.21). In fact, a calculation of wetland density, demonstrates no evidence of a linear relationship with the log of the amount of permitted wetland fill (p-value = 0.3162; simple linear regression). Furthermore, there is also no evidence of any such relationship with the secondary program outcome of the log of the average annual number of wetland permits (p-value = 0.5820; simple linear regression). Figure C.22 illustrates the lack of evidence for this relationship.

In addition, no evidence was produced supporting a linear relationship between the permit ratios or the log of the mitigation ratios of WRUs and the log of their wetland density (p-values of 0.8320 and 0.8147 respectively; simple linear regressions). Figures C.23 and C.24 illustrate the lack of evidence for these relationships. Similar inconclusive or non-relationships could be potentially present between wetland density and many other independent variables as well. Therefore, barring the presence of any strong linear interactions with other independent variables, it is not likely that linear regression models for any of the program outcomes will be enriched by the inclusion of a wetland density variable.

Figure C.21 Log wet density/log wetland fill.

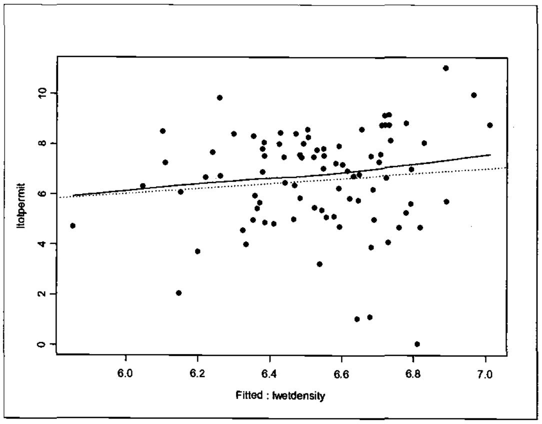


Figure C.22 Log wet density/no. of permits.

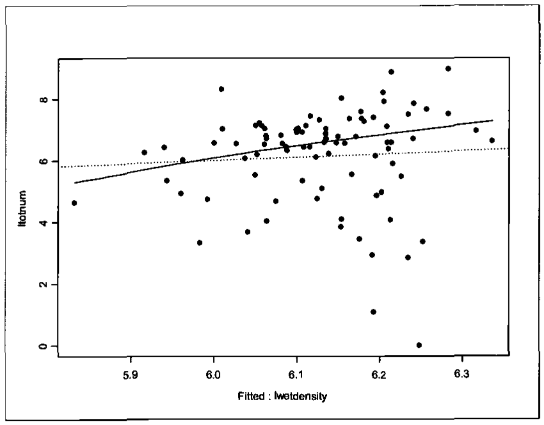


Figure C.23 Log wet density/permit ratio.

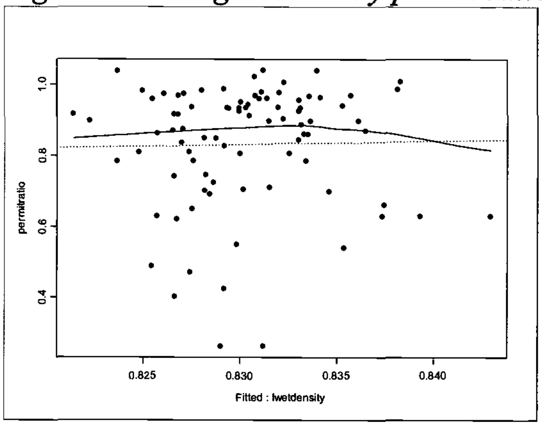
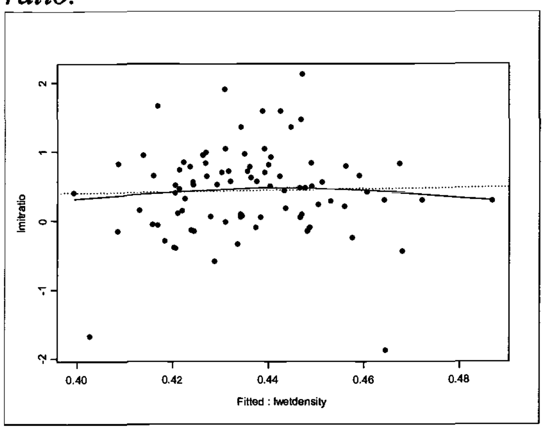


Figure C.24 Log wet density/log mit. ratio.



Conclusion

Since this study investigates intergovernmental relationships developed during the administration of programs that are geographically based, it is necessary to ensure that the final model incorporates certain relevant landscape characteristics. Simple linear regression models provide convincing evidence that WRU size and wetland abundance are two such characteristics.

WRU size is potentially relevant, not only because of its strong relationships to the number of permits issued and the amount of fill permitted, but also because of potential relationships to other independent variables that may be geographically based. A relationship between certain regulatory program outcomes and the amount of land subject to those regulations may be an assumed relationship for many public administrators. However, documentation of this relationship and its inherent value beyond simply interacting with other independent variables may contribute significantly to a model of permitted wetland fill.

Wetland abundance may also show additional relationships with other independent variables as well, but its direct linear relationship with both the amount of wetland fill and number of issued permits is of most interest. Prior to this study, the literature has completely ignored the description of any landscape condition characteristic that may be related to the outcomes of wetland regulatory programs. The direct nature of the relationship between wetland abundance and these program outcomes provides the most revelation. For the first time, evidence is presented here that the amount of permitted wetland fill in the United States may largely and simply be a function of the amount of wetlands present.

Had the relationship been more curvilinear in nature, it might have been suggested that the USACE provides either greater or less protections to wetlands when they are rare or abundant components of the landscape. The linearity of the relationship, however, demonstrates that the relationship varies uniformly across all WRUS and does not vary greater or less depending upon abundance. The lack of linear relationships between wetland abundance and either the permit ratio or the mitigation ratio, also carries significance. This lack of a relationship presents a clear picture of a wetland regulatory program that potentially functions without discrimination against wetland rarity. Wetland permits appear to be approved with the same prejudice and restrictions regardless of how small of a landscape component they represent.

It has also determined that there are landscape differences between WRUs that may carry practical significance. While the data suggest that WRUs subject to Section 401 programs may tend to be larger in size than other WRUs, a similar such relationship does not exist in either measure of wetland abundance. In fact, while wetland abundance does not demonstrate any evidence of a relationship with state program type, those WRUs in which there are statute-based programs also have higher densities of wetlands than WRUs subject to either of the other types of state programs.

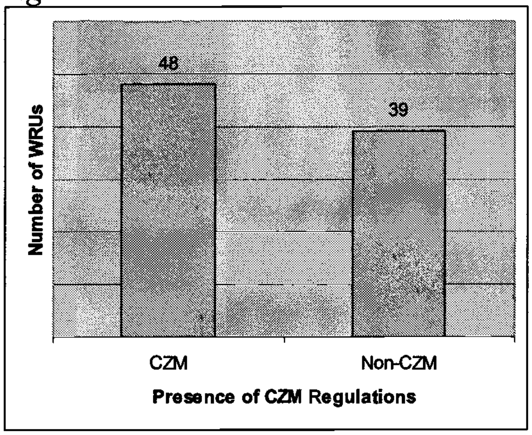
Understanding the relationship of the program outcomes with measures for WRU size and wetland abundance may open the door for explanations of relationships between these program outcomes and other bottom-up independent variables such as socioeconomic or demographic data. The evidence of these relationships, may also serve as a touchstone for the investigation of other landscape conditions that may be related to either state wetland regulatory program types, or wetland regulatory program outcomes.

Because no linear relationships exist between wetland density and any of the program outcomes, the inclusion of this particular measure into a future model would have to be predicated on its interaction with another more directly related variable. In addition, since strong linear relationships exist between each of these variables and both the total amount of permitted wetland fill and the average annual number of issued permits, any regression model for these program outcomes will be strengthened by the inclusion of these variables. These terms may not, however, be particularly helpful when constructing regression models of permit or mitigation ratios unless they closely interact with other independent variables.

COASTAL ZONE MANAGEMENT VARIABLE EVALUATION

Introduction

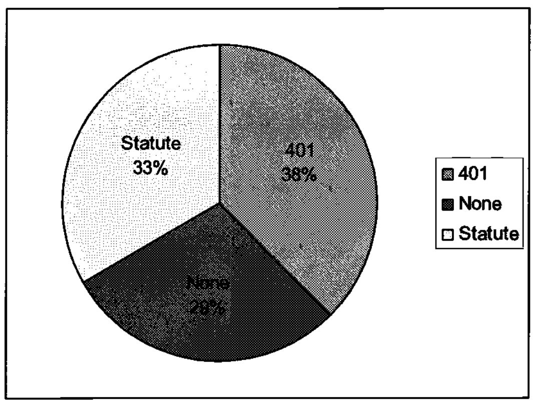
Figure D.1 CZM/non-CZM WRUs.



The federal consistency provisions of the Coastal Zone Management Act (CZMA) require the US Army Corps of Engineers (USACE) to only issue permits for wetland fill activities that meet additional standards established by state Coastal Zone Management (CZM) programs. These extra protections are not, however, applied equally to all wetlands in every WRU. They are exclusively applied to wetlands located within specifically identified coastal zone areas. In total, there are 48 WRUs that contain coastal zone areas. This leaves 39 WRUs in which no coastal zone areas are located (Figure D.1).

WRUs with coastal zone areas contain virtually all of the nation's tidal wetlands (correlation coefficient 0.95), but many also contain some non-tidal wetlands. As a result of the federal consistency provisions of CZM programs, USACE regulatory staff operating in these WRUs must coordinate all of these tidal permit reviews closely with state CZM agencies, and some of their non-tidal permits if they too are located in coastal zone areas.

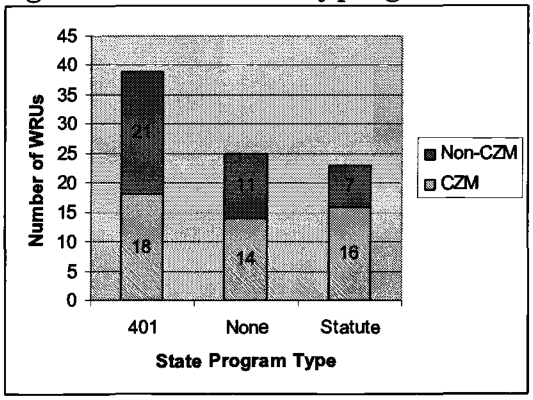
Figure D.2 CZM/program type.



The distribution of coastal zone areas is fairly evenly shared among WRUs with different types of state wetland programs. No single program type makes up a large majority of those WRUs that contain coastal zone areas. As a result, a WRU containing a coastal zone area is no more likely to be subjected to any one state wetland regulatory program over any other program (Figure D.2).

Likewise no state program type is made up entirely of WRUs containing coastal zone areas. The most unequal distribution occurs within the 23 WRUs that have statute-based programs, where almost 70% of those WRUs contain coastal zone areas. This means the likelihood that a WRU will contain a coastal zone area is higher if it is subject to a statute-based state wetland program than if it is subject to a 401 water quality certification process or no state wetland program at all (Figure D.3).

Figure D.3 CZM share of programs.



Often times, in those WRUS where there are either Section 401 or statute-based state wetland regulatory programs, state CZM agencies are also the state wetland regulatory agencies. In other cases the CZM agencies are separate from the agencies responsible for administering state wetland regulations. If state bureaucracies were perfectly efficient organizations, the process of administering a state CZM program with the USACE could conceivably result in a spill-over of additional coordination between the goals of a broader state wetland regulatory programs and the USACE. State agencies do not, however, always demonstrate model communication practices within their own organization, let alone between themselves and other organization. Previous analysis in this study of the subpopulation of the 48 WRUs subject to CZM regulation, therefore, revealed no evidence to suggest that any relationship is expressed between the type of state wetland regulatory program present and the amount of wetland fill permitted by the USACE.

Regardless of the potential interaction between the presence of any particular type of state wetland regulatory program and CZM programs, a higher level of state coordination is not required in any WRU that does not contain a coastal zone area. Therefore, it is possible that even absent specific state program relationships, the federal consistency provisions could result in variations between the program outcomes of WRUs containing coastal zone areas and WRUs that do not contain coastal zone areas. Most directly, it is possible that fewer acres of wetland fill are permitted in WRUs subject to CZM programs than in WRUs not subject to CZM programs.

Analyses of Variance

An analysis was conducted on the total amount of permitted wetland fill between groups of WRUs containing coastal zone areas and those not containing coastal zone areas (Figure D.4). This analysis provided no evidence, however, that there are any significant differences between the mean amounts of wetland fill permitted in these groups (two-sided p-value = 0.3229; two-sample t-test on the log scale).

Figure D.4 Log wetland fill/CZM program.

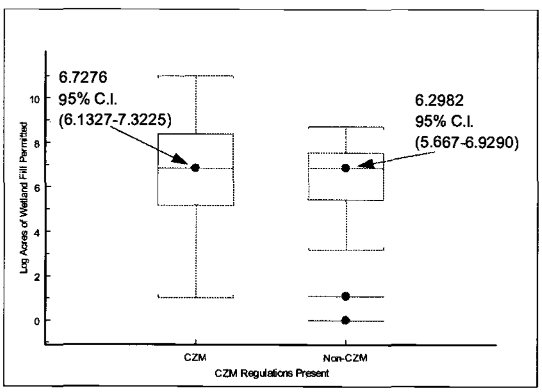
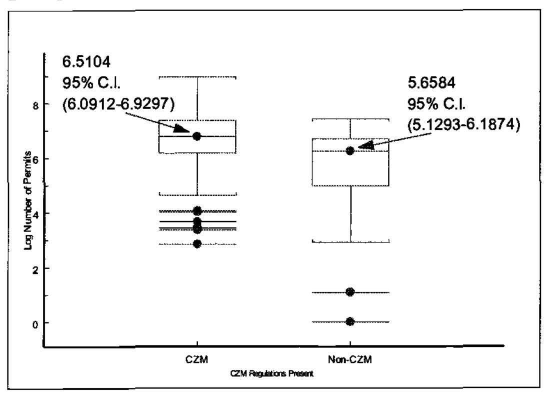


Figure D.5 Log no. of permits/CZM program.



This lack of difference in the amount of permitted fill persists despite strong evidence that there is a significant difference in the average number of permits issued each year (two-sided p-value = 0.0115; two-sample t-test on the log scale). In fact, as a group, WRUs containing coastal zone areas approve a total of 43,904 more permits per year than WRUs without coastal zone areas. This amounts to WRUs containing coastal zone areas issuing an average of 812 more permits than WRUs with coastal zone areas over WRUs without coastal zone areas (Figure D.5). This is, however, a simple comparison that does not account for the many landscape and socioeconomic differences discussed in Appendices B and C that may exist between these two distinct classes of WRUs. Future analyses may build upon these measures to develop a regression model that would identify and measure the relative contributes of measures for each of those potentially confounding terms.

Despite evidence of a higher number of permits within those WRUs with coastal zone areas than within those without them, there is no conclusive evidence of any differences in each group's permit ratios or mitigation ratios (two-sided p-values = 0.1942 and 0.3285 respectively; two-sample t-tests). Figures D.6 and D.7 illustrate this lack of evidence. This suggests that while the USACE may be issuing many more permits with relatively the same total amount of wetland impact in WRUs containing coastal zone areas as compared to WRUs without them, these outcomes are not due to documented USACE efforts during the permit review process to condition the permits in a way that limits the size of the overall amount of impact of the approved permits.

Figure D.6 Permit ratio/CZM program.

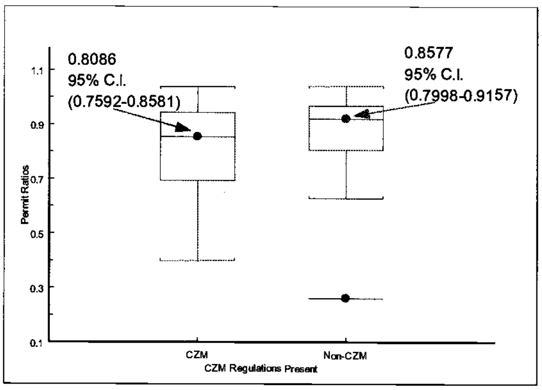
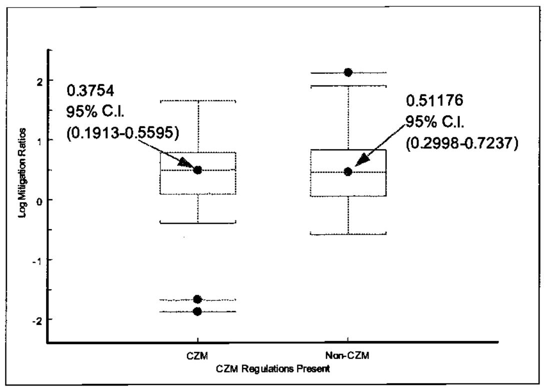


Figure D.7 Log mit. ratio/CZM program.



With no significant differences in permit or mitigation ratios, the cause for the differences in permit number may be a result of the USACE approving more but smaller permits in these WRUs because the applicants themselves are requesting sufficiently more permits with smaller impacts in the first place. This may occur for a variety of reasons, none the least of which could be an artifact of applicant efforts to comply with stringent state CZM regulations. Because of the strict enforcement of CZM regulations, many applicants may get ushered into the USACE wetland regulatory program that might otherwise have pursued their actions without first seeking such permits. There is, after all, considerable evidence in the literature to suggest that a considerable amount of illegal wetland fill activity does occur in the United States. CZM regulations may serve as a state-sponsored screening process that boosts the activity level of the USACE's permit programs.

General Vs. Standard Actions

Given that the number of issued permits is the only program outcome that may differ based upon the presence of coastal zone areas, some investigation into the potential causes of this occurrence is warranted. Two possible conditions could exist that could produce a higher number of issued permits in WRUs containing coastal zone areas. It is possible that the higher number of permits is a result of CZM programs limiting the size of impacts that can be issued through permits. Small impacts are generally approved through the USACE's general action permit process. As a result, if the number of permits is increased solely because of lower maximum limits set by CZM programs, an increase in the number of general permits might be observed.

It is also possible that the higher number of permits is a result of CZM programs requiring more detailed comment and review by USACE staff prior to approval. Impacts requiring closer scrutiny and review are generally approved through the USACE's standard action permit process. As a result, if the number of permits is increased solely because of CZM requirements for additional staff attention, an increase in the number of standard permits would be observed.

An analysis of both the total number of general and standard permits reveals that the overall higher number of permits is due to higher numbers of both types of permits (Figures D.8 and D.9). The evidence, suggests, however a relatively stronger increase in the number of standard actions. There is convincing evidence that the number of permitted standard actions is significantly higher in WRUs with coastal zone areas than in WRUs without them (two-sided p-value = 0.0026; two-sample t-test on the log scale). This supports the possibility that increased levels of scrutiny required by CZM programs may at least, in part, be a reason for the inflated number of permits in WRUs containing coastal zone areas. The practical significance of potential influence, however, may ultimately be shadowed by any number of other variables discussed in Appendices B and C also specific to coastal WRUs such as higher wetland abundance or population growth rates and income levels.

Figure D.8 Log no. of standard permits/ CZM program.

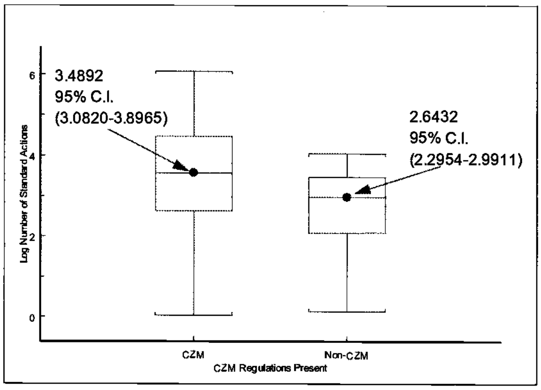
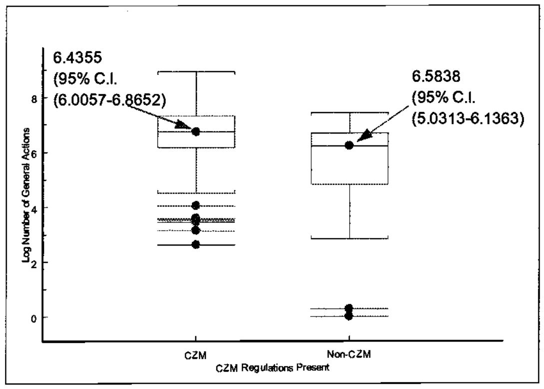


Figure D.9 Log no. of general permits/ CZM program.



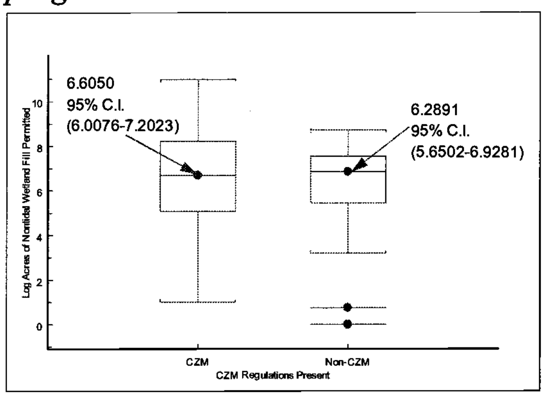
There is also strong evidence that the number of permitted general actions is significantly higher in WRUs with coastal zone areas than in WRUs without them (two-sided p-value = 0.0146; two-sample t-test on the log scale). This additional evidence supports the possibility that the lower impact limit may also in part be a reason for the increased number of permits in WRUs containing coastal zone areas. Again, however, the practical significance of potential influence, however, may ultimately need to be interpreted within the context of any number of other variables discussed in Appendices B and C, such as higher wetland abundance or population growth rates and income levels, which may also create conditions that are specific to coastal WRUs.

Tidal Vs. Non-Tidal Wetlands

As previously discussed, the USACE does not track the number of permits issued for the fill of tidal or non-tidal wetlands. This makes it impossible to use these data in order to investigate wetland type as a potential source of the variance between the numbers of permits issued in WRUs containing coastal zone areas and in those that do not. Therefore, the pursuit of a source of cause for this variance within this dataset is concluded with the analysis of the type of permit.

The expressed lack of evidence for any difference between these groups of WRUs in the total acres of wetland fill, however, may still be further explored by these data. The previous analysis was based upon a combination of tidal and non-tidal wetland fill permit data. The data for the tidal wetlands, however, is not uniformly distributed among all WRUs. Because, virtually all tidal wetlands are located within WRUs that contain coastal zone areas there are practically no tidal wetlands located within WRUs that do not contain coastal zone areas. Under these conditions, no separate comparison can be made in the permitted tidal wetland impacts between these two groups of WRUs.

Figure D.10 Log non-tidal fill/CZM program.



It is possible, however, to conduct a separate comparison in the permitted non-tidal wetland impacts between these two groups of WRUs (Figure D.10). If there is a difference that might otherwise be offset by the unequal distribution of the additional tidal wetland data a separate analysis of the non-tidal permits might identify it. However, when this analysis was conducted, it produced no evidence of any difference (two-sided p-value = 0..4701; two-sample t-test on the log scale).

This additional lack of evidence rules out the possibility of describing any potential differences in the amounts of permitted wetland fill in terms of the presence of CZM programs. Furthermore, secondary tests of the permit and mitigation ratios of permitted non-tidal wetland fill also produced no evidence of any differences between the two groups (two-sided p-values = 0.2808 and 0.3091 respectively; two-sample t-tests). Figures D.11 and D.12 illustrate the lack of evidence for any differences in the values of these program outcomes. Therefore, the average annual number of permits issued to stands alone as the only program outcome that appears to be related to the presence of CZM programs.

Figure D.11 Permit ratio/CZM program.

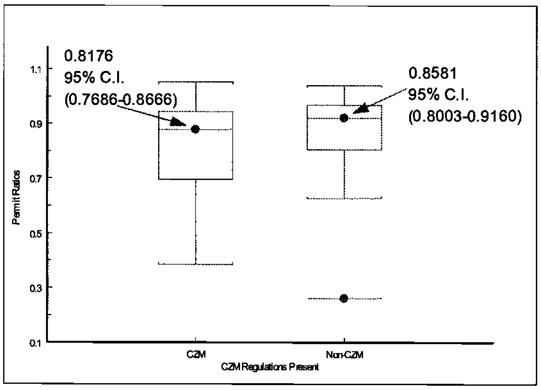
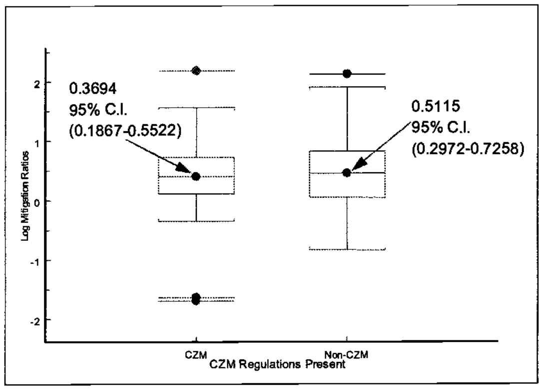


Figure D.12 Log mit.ratio/CZM program.



Conclusion

WRUs can easily be divided into two classes; those that contain coastal zone areas and those that do not. The meaning of this classification, however, is not as easily determined. While those WRUs that contain coastal zone areas are equally as likely to be subjected to any one of the three types of state wetland regulatory programs, not all WRUs have the same likelihood of containing coastal zone areas. Those WRUs that are subjected to statute-based wetland regulatory programs are more likely to also contain coastal zone areas than WRUs that are subjected to other types of state wetland programs.

Furthermore, the presence of coastal zone areas only appears to affect the average number of wetland permits issued by the USACE each year. The total amount of permitted wetland fill does not vary based upon the presence of CZM areas; neither do the permit or mitigation ratios. There are many possible reasons for the isolated detected variation in the number of permits. One such possibility is that CZM programs increase the traffic of USACE permit applications by raising the awareness and profile of the USACE regulatory program to applicants that might otherwise not seek such permits. It is also possible that CZM programs could establish such prohibitive limitations on those projects that require USACE review, that not only are the permitted impacts diminished in size, but they are so much smaller the USACE has little opportunity within their regulations to restrict the size of their impacts further. These scenarios could account not only for the increased number of permits but also for the lack of any corresponding increase in the amounts of wetland fill or any restrictions in the permit or mitigation ratios. They are not, however, the only possible reasons for why numbers of permits are higher in these WRUs. It is possible that these values are inflated because of several confounding socioeconomic and landscape conditions evaluated in Appendices B and C. Accounting for those additional variations is a topic future investigations may find ample opportunities for exploration. The results of these studies could, as a result, provide additional insight into specific conditions that may also affect the entire suite of tidal wetland fill activities.

In conclusion, no evidence has been found to justify the inclusion of an indicator variable for the presence of CZM programs in a regression model against the amount of wetland impact permitted through the USACE wetland regulatory program. Likewise there is no evidence that secondary models for the permit ratios or mitigation ratios would be enriched by the inclusion of a CZM indicator variable. It appears that only a regression model against the secondary program outcome of the average number of wetland fill permits would benefit from the inclusion of CZM indicator variable. Verification of these findings will be presented in the chapter describing the model-fitting procedure.