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The Adoption of State Wetland Policies: How do Wetlands Fit Within the Theoretical Framework of Environmental Policy Determinants?

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THE ADOPTION OF STATE WETLAND POLICIES: HOW DO WETLANDS FIT WITHIN THE THEORETICAL FRAMEWORK OF ENVIRONMENTAL POLICY DETERMINANTS?

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ABSTRACT

Wetlands are an extremely important natural resource in the United States. They offer storm surge protection, sediment stabilization, groundwater recharging, carbon sequestration, and habitat for many species. Despite their values, wetlands have a long history of being misunderstood. It was not until the mid-1970s that scientific understanding helped transform policy from that of rapid conversion to that of conservation. By this time, the lower 48 states had already lost 53 percent of its total wetlands. The nature of wetlands and federal limitations make the management of this natural resource a primarily state-based responsibility. However, the way that states construct their wetland programs varies greatly. The theoretical framework of "policy determinants" has been continuously explored in past research that seeks to further understand what factors influence a state to adopt certain environmental policies. The goals of this study are to determine which states have the most active wetland programs and what underlying contextual factors may be of importance in explaining variation in those effects.

California, Minnesota, and Wisconsin have the highest level of wetland policy activity and Arizona has the lowest. Four categories of potentially influential underlying conditions include political capacity, bureaucratic and agency capacity, economics, and environmental conditions and pressures. A total of 13 independent variable measurements were used, along with "total wetland policies" as the dependent variable. A Pearson correlation analysis identifies multicollinearity among independent variables and a linear regression identifies which independent variables were significant relative to the level of wetland policy activity. Underlying conditions most present in states with highest levels of policy activity are high levels of historic wetland loss, more wetland area, and stronger environmental group presence. This research provides information that can help states further improve their own wetland programs.

CHAPTER ONE: INTRODCUTION

1.1 Problem Statement

When Europeans began settling the contiguous United States in the early 1600s the country had approximately 221 million acres of pristine wetlands. Out of lower 48 states, Florida had the greatest wetland acreage at 20.3 million acres, followed by Louisiana with 16.9 million acres, and Texas with 15.9 million acres. By the 1980s, the United States' total wetland acreage had dropped by an estimated 53 percent (Dahl and Johnson, 1991). Over a time span of two centuries, the nation went through economic, political, and scientific evolutions, all of which had direct and indirect contributions to the changing amount of this natural resource. The conversion of wetlands to uplands was primarily guided by a lack of scientific understanding and a desire for economic growth. In the 1700s, wetlands were viewed as swampy, insect-ridden wastelands that bred diseases and served as an obstacle to travel and the production of crops. Additionally, the abundance of wetlands made them appear to be a limitless natural resource. For centuries, the composition of wetlands changed dramatically in the United States as they were drained and filled for the purpose of development (Dahl and Allord, 1999). Although the technology to rapidly convert wetlands to uplands did not yet exist at the time, Congress passed the Swamp Land Acts in the mid-1800s, which granted the authority to fifteen states to reclaim swamp lands, or roughly 64.9 million acres of wetlands (Robertson, 2007).

The early 20th century saw an increasing demand for commercial, residential, and industrial developments and agricultural lands as the national population continued to increase. Improved technology made wetland conversion easier and more efficient and the U.S. government continued to support conversion. In the 1930s and 1940s, the federal government instituted programs that offered free engineering services to farmers and helped subsidize the

cost of wetland drainage for agriculture. The following three decades saw 550,000 acres of wetland loss each year as the U.S. Department of Agriculture promoted drainage for crop land; over 80 percent of annual wetland losses during this time were due to agriculture (Yuhas, 1996).

The 1970s brought awareness about the ecological value of wetlands and government policies on both the federal and state levels began to follow suit. Section 404 of the Clean Water Act gave the federal government the authority to grant permits for wetland development (Yuhas, 1996). The Act provided states with a considerable amount of flexibility in choosing their own regulatory methods as well. From the mid-1970s through the mid-1980s, the rate of wetland loss dropped to approximately 290,000 acres per year (Dahl and Johnson, 1991). Conservation and restoration of wetlands have been goals of the federal government for the past three decades. Despite dramatic shifts in scientific understanding and policies, wetland loss, in addition to decreased wetland quality, remains an issue. As it currently stands, the lower 48 states contain about 103 million acres of wetlands with numerous states having experienced significant losses in overall wetland acreage. For example, California has lost 91 percent of its historic wetlands and five other states have lost at least 85 percent of their total wetland acreage, with five being located in the Midwest region (Dahl, 1990). Table 1 is adapted from Dahl (1990) and provides an overview of state-by-state wetland historic losses in the conterminous United States.

Table 1: Historical Wetland Losses in the Conterminous United States (1780s-1980s)

State	Estimates of Original Wetlands (1780s)	Wetlands as % of total surface area (1780s)	Estimates of existing wetlands (1980s)	Wetlands as % of total surface area (1980s)	% of wetlands lost
Alabama	7,567,600	22.9	3,783,000	11.5	50
Arizona	931,000	1.3	600,000	0.8	36
Arkansas	9,848,600	29.0	2,763,600	8.1	72
California	5,000,000	4.9	454,000	0.4	91
Colorado	2,000,000	3.0	1,000,000	1.5	50
Connecticut	670,000	20.9	172,500	5.4	74
Delaware	479,785	36.4	223,000	16.9	54

Table 1 continued

State	Estimates of Original wetlands (1780s)	Wetlands as % of total surface area (1780s)	Estimates of existing wetlands (1980s)	Wetlands as % of total surface area (1980s)	% of wetlands lost
Florida	20,325,013	54.2	11,038,000	29.5	46
Georgia	6,843,200	18.2	5,298,200	14.1	23
Idaho	877,000	1.6	385,700	0.7	56
Illinois	8,212,000	22.8	1,254,500	3.5	85
Indiana	5,600,000	24.1	750,633	3.2	87
Iowa	4,000,000	11.1	421,900	1.2	89
Kansas	841,000	1.6	435,400	0.8	48
Kentucky	1,566,000	6.1	300,000	1.2	81
Louisiana	16,194,500	52.1	8,784,200	28.3	46
Maine	6,460,000	30.4	5,199,200	24.5	20
Maryland	1,650,000	24.4	440,000	6.5	73
Massachusetts	818,000	15.5	588,486	11.1	28
Michigan	11,200,000	30.1	5,583,400	15.0	50
Minnesota	15,070,000	28.0	8,700,000	16.2	42
Mississippi	9,872,000	32.3	4,067,000	13.3	59
Missouri	4,844,000	10.9	643,000	1.4	87
Montana	1,147,000	1.2	840,300	0.9	27
Nebraska	2,910,500	5.9	1,905,500	3.9	35
Nevada	487,350	0.7	263,350	0.3	52
New Hampshire	220,000	3.7	200,000	3.4	9
New Jersey	1,500,000	29.9	915,960	18.3	39
New Mexico	720,000	0.9	481,900	0.6	33
New York	2,562,000	8.1	1,025,000	3.2	60
North Carolina	11,089,500	33.0	5,689,500	16.9	49
North Dakota	4,927,500	10.9	2,490,000	5.5	49
Ohio	5,000,000	19.0	482,800	1.8	90
Oklahoma	2,842,600	6.4	949,700	2.1	67
Oregon	2,262,000	3.6	1,393,900	2.2	38
Pennsylvania	1,127,000	3.9	499,014	1.7	56
Rhode Island	102,690	13.2	65,154	8.4	37
South Carolina	6,414,000	32.3	4,659,000	23.4	27
South Dakota	2,735,100	5.5	1,780,000	3.6	35
Tennessee	1,937,000	7.2	787,000	2.9	59
Texas	15,999,700	9.4	7,612,412	4.4	52
Utah	802,000	1.5	558,000	1.0	30
Vermont	341,000	5.5	220,000	3.6	35
Virginia	1,849,000	7.1	1,074,613	4.1	42
Washington	1,350,000	3.1	938,000	2.1	31
West Virginia	134,000	0.9	102,000	0.7	24
Wisconsin	9,800,000	27.3	5,331,392	14.8	46
Wyoming	2,000,000	3.2	1,250,000	2.0	38

For the remaining wetlands, degradation and the threat of degradation due to hydrologic alteration continue to be a concern (Osmond et al., 1995). Inland wetlands have experienced an overall net increase in acreage, but the overall qualitative status of wetlands is unknown. Additionally, the net gain of wetlands includes the creation of manmade wetlands, such as agricultural ponds (Dahl, 2011). Losses continue to vary from region to region and some regions are experiencing changes that differ from the national trend. Figure 1 shows the areas of the lower 48 states that experienced the highest rate of freshwater wetland loss to upland between 2004 and 2009 (Dahl, 2011). Coastal watersheds in the contiguous United States lost approximately 360,720 acres of wetlands between 2004 and 2009, a statistically significant increase of 25 percent in losses that were recorded between 1998 and 2004 (Dahl and Stedman, 2013). Such continued losses emphasize the need for more effective solutions.

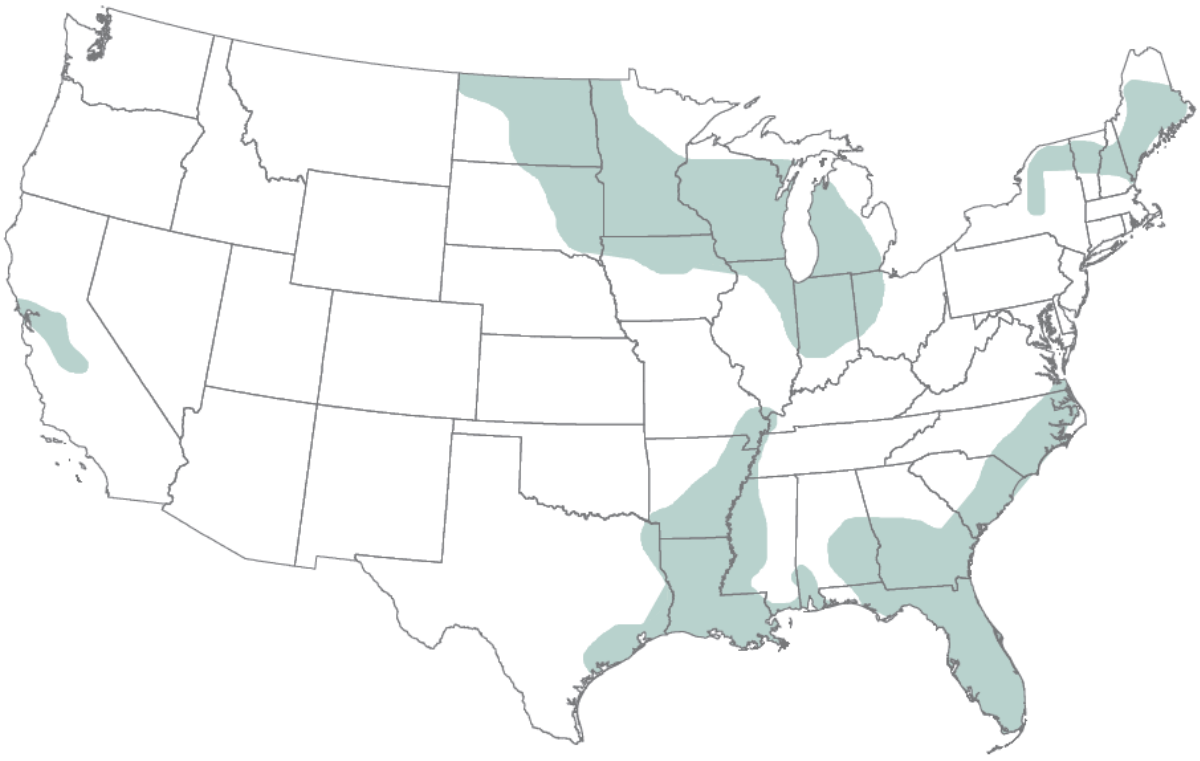

Figure 1: Areas Experiencing Highest Rates of Wetland Loss (2004-2009) (Dahl, 2011)

1.2 Research Goals and Objectives

Qualitative and quantitative wetland losses, the expansive amount of services provided by wetlands, and the complexity of wetland systems all elicit the need to further understand wetland policies, especially how such policies are shaped. A policy scenario based completely on scientific understanding of wetland services would be one in which promoted absolute preservation. However, this is certainly not the case for the nation as a whole or individual states, and scientific understanding is often balanced with human interest. As such, the anthropogenic element of natural resource management adds a level of complexity regarding policy development. A comparative analysis of state wetland policy determinants has the potential to benefit wetland management at the state level. It can provide insight into the factors driving wetland policy activity; specifically it can identify what factors may need to improve or change in order for additional policy innovation to occur. A study by Thomas et al. (2008) notes, "States should be creative and enterprising about how to improve their programs and can learn from other states' experiences to build program elements that work for them. [Other states'] examples should provide a starting point for states seeking to improve one or more of the core elements of their wetland programs."

The overarching goal of this study is to examine the connection between the array of wetland-related policies enacted by each state and four categories of internal circumstances: (1) economics, (2) political capacity and ideology, (3) agency and bureaucratic capacity, and (4) environmental conditions and pressures. This study adds to the body of existing research that has established a framework for environmental policy determinants. So far, this body of research has examined several singular subsets of environmental policy, including air pollution (Potoski and Woods, 2002) climate change and renewable energy (Matisoff, 2008), hazardous waste

management (Daley, 2008), small scale alternative energy projects (Wiener and Koontz, 2010), natural resource issues (Ando and Polasub, 2009), and mining oversight (Hedge et al., 1989). State wetland policies have yet to be studied in the context of the framework of environmental policy determinants. Each state has recognized wetland protection to some extent through the creation of policies. In addition, the state-based nature of natural resource management, as well as the current status of wetlands across the nation makes state wetland policies an ideal candidate for such research. The guiding research questions are: (1) Which states have the highest level of wetland policy activity? (2) What circumstances are present in states with higher levels of policy adoption? (3) How do wetland policies fit in the theoretical framework of environmental policy determinants?

The scope of the study includes all 50 states and examines each state's level of policy development in relation to internal determinants. The internal determinants approach emphasizes the role of state characteristics as a driving force behind a state's ability to enact certain policies (Berry, 1994). The subsequent chapter provides background information on the integrated role of state policy in wetland management and a literature review that highlights existing research on state environmental policy determinants and the framework this research has created so that it may be applied to this specific study. The third chapter entails the methods of the study. More specifically, policy development level serves as the dependent variable and consists of using the state-by-state wetland policy survey conducted by Thomas et al. (2008). In following the research methods used in past research on environmental policy determinants, the study uses four categories of state characteristics as the independent variables and each variable contains several different measurements. With these data presented in the results chapter, the study assesses any statistically significant positive or negative relationships between the independent variables and

the level of policy activity to determine which state characteristics maybe highly correlated with wetland policy development. Additionally, a statistical analysis allows for the assessment of how state wetland policies fit within the framework established by past research and a discussion of the results follow. The final chapter elaborates on the significance and implications of the findings and areas for further development and research on state wetland policies.

CHAPTER TWO: LITERATURE REVIEW AND BACKGROUND

2.1 Background Information

2.1.1 The Value of Wetlands

In order to understand wetland policy activity and why the study of wetland policy is relevant, it is important to understand the issues that are being addressed and the value of what is being protected through such policies. Until the 1970s, there was little scientific knowledge of the value of wetlands and certainly not enough to deter expansive agricultural efforts. The few policies that offered wetland protection early on primarily focused on wetlands as habitat for game birds. The Migratory Bird Hunting Stamp Act of 1934 was one of the first pieces of legislation that provided a financial means for the government to fund the acquisition of wetlands. This policy was supported by an observed link between the destruction of wetlands and the decline in waterfowl populations (Dahl and Allord, 1999). From the 1970s onward, research on the importance of wetlands has thrived and continues to offer a stronger understanding of the complex biological, hydrological, and chemical systems within wetlands and watersheds. Wetlands provide numerous services such as recharging and discharging ground water, improving water quality, providing habitat for species, providing harvestable resources, controlling flooding and storm surges, carbon sequestration, and reducing erosion through the stabilization of sediment (Woodward and Wui, 2001). Research has also specifically focused on attempting to place a market value on wetland services and in doing so has created supporting economic evidence for the conservation and restoration of wetlands. In some cases, scholarly literature has found that a portion of recently restored wetlands have carbon offset values that exceed both the cost of restoration and the opportunity cost of moving land out of agricultural production (Hansen, 2009).

Placing exact market values on wetland services continues to be a point of research. Not all wetlands have the same economic value and there can be major degrees of variation. There are many different types of wetlands and each differs in vegetation, hydrology, climate, soils, and landscape. In addition, every single state contains wetlands, even arid states like Arizona and Nevada, where wetlands can serve a different function than in wetland-dense states like Louisiana and Florida. All of these differences factor into the value of a wetland. A 1998 review of 33 individual studies that took place over the course of 26 years found wetland values quantified from $0.06 to $22,050 per acre. (Heimlich et al., 1998). Even where the same function was being analyzed, the value of a function could differ by two orders of magnitude between two different wetlands (Woodward and Wui, 2001). Regardless, the methods of wetland valuation are still in the phases of development. Certain types of wetlands also provide area-specific services. For example, coastal wetlands are extremely valuable in serving as natural levees for protection against hurricanes. One study estimated that coastal wetlands provide the United States with $23.2 billion per year in storm protection services (Constanza et al., 2008). Scholarly research has provided an overwhelming amount of evidence that supports informed management of wetlands due to the numerous and the variety of services they provide. Overall, "interest in the preservation of wetlands has increased as the value of wetlands has become more fully understood" (Dahl and Allord, 1999).

2.1.2 Integrated and Intergovernmental Wetland Management

A multidisciplinary approach is important in wetland management and successful management combines expertise from both natural and social sciences. Cost-benefit analyses are utilized in the creation of policies. In the case of wetlands, scientific advances regarding the ecological values have provided policy-makers with more informed ecological-economic and

cost-benefit analyses (Turner et al., 2000). Similarly, not all policies can be applied successfully to all wetlands and there is a need to adopt more tailored policies on scales smaller than that of a national scale due to variations in wetland values, available resources, and other circumstances.

On the federal level, the overarching policy is wetland conservation, and preservation in some instances. "No net loss of wetlands" is the national goal originally adopted by George H.W. Bush in 1998 and pledged by every presidential administration since then. Various laws and programs carry out this policy. Section 404 of the Clean Water Act, which created a permitting system for wetland development, is the primary statutory framework for federal wetland conservation. Other programs, like the Wetland Reserve Program and the Swampbuster provision of the Food Security Act, help carry out conservation measures as well (McElfish and Brooks, 2013). The federal government has recognized the role of states regarding wetland management and 33 U.S.C. § 1344(g)(1) of the Clean Water Act authorizes states to assume their own programs that go beyond the protections enacted at the federal level.

States serve an important role in the management and protection of natural resources, including wetlands. For centuries, land use planning has been a constitutional right and responsibility of the states. Because of the numerous types of wetlands, as well as the massive amounts of acreage, state agencies are viewed as having expertise on state natural resources and the policies that influence management. Additionally, the role of states in wetland management is crucial due to legal uncertainty over federal jurisdiction and the limited amount of federal resources dedicated to this cause (Thomas et al., 2008). States are viewed as the government level most capable of carrying out conservation goal: "At present, states hold the most promise for mustering the political will necessary to achieve the comprehensive reforms that no net loss [requires]" (World Wildlife Fund, 1992). Due to the importance of the role of state government

in wetland management, this study seeks to accomplish further understanding of how states operate their wetland programs and underlying factors that may be present in states with more active levels of policy activity.

2.2 Literature Review

2.2.1 State Wetland Policy Research

Wetland policy has been examined in-depth on the federal level but much less research exists on state wetland policies. McElfish and Brooks (2013) provide an overview of the federal, state, and local laws that affect wetlands of the Mid-Atlantic Region and the variations between these select states. Thomas et al. (2008) conducted extensive research of state wetland policy activity and the publication "State Wetland Protection: Status, Trends & Model Approaches," which provides this study's dependent variable, surveys the wetland policies adopted by each state. The publication categorized 41 different policies under one of six categories: regulations, water quality standards, monitoring and assessment, restoration programs and activities, public-private partnerships, or coordination among state and federal agencies. For each of the 41 policies, the study noted whether or not the policy existed in the state with some elaboration on a state's specific structure of the policy or how it varies from others. Additionally, the survey concludes by stating:

> "State-level wetland regulation and conservation programs are extremely diverse due to a variety of circumstances—history, geography, economics, general attitudes toward wetland resources, as well as state agency funding, resources, and enforcement activity. In essence, state wetland programs face diverse landscapes—both literally and figuratively—in providing protection for state wetland resources (61)."

Thomas et al. (2008) draws this conclusion based upon its survey information but without any quantitative analysis. This further emphasizes the need for statistical analyses that either support, and to what degree, or fail to support the relationship between the circumstances the level of wetland policy activity.

Studies on wetland policy determinants have been extremely limited in both abundance and scope. Wetland policy as a subgroup within environmental policy determinant literature has focused on nation-by-nation comparisons, but there has yet to be a study on state wetland policy determinants. La Peyre et al. (2001) considered the influence of political and socioeconomic conditions of as on wetland management activities, following the pre-established framework for environmental policy determinants. The researchers concluded that economic capital was significantly and negatively related to wetland protection, while social capital, government, environmental history, and land-use pressure all had positive relationships. Additionally, economic wealth negatively influenced wetland protection efforts, a finding that contradicted an initial hypothesis. However, due to a lack of literature, understanding the context of this study of state wetland policy determinants relies on the existing framework under general state policy determinants, as well as more recent research that specifies environmental policy determinants.

2.2.2 Theoretical Framework--Explaining Variations in State Policy Activity

The current body of scholarly literature on state policy activity has had numerous broad and singular foci as researchers have attempted to explain what internal factors influence a state's level of policy activity. State policy determinant literature covers extensive policy issues. More recent literature has delved into further subsets of policies, which this study is also aiming to accomplish. Previous research has explored the influence of political or economic variables on dependent variables such as welfare policies (Dawson and Robinson, 1963; Meyers et. al, 2001), disability protection policies (Holbrook and Percy, 1992), and all-around public service policies (Sharkansky and Hofferbert, 1969). Subsequent studies on specific disciplines of state government policies have further assessed the impacts of other independent variables, such as citizen ideology, legislative composition, and the overall liberalism of the state (Berry et al.,

1998; Cook et al., 1993). As this body of research has grown, scholars have developed three types of models for determinants of state policy innovation: two diffusion models, specifically the regional diffusion model and the national interaction model, and the internal determinants model (Berry, 1994). This study covers the internal determinants model, which assumes that each state's policy activity is completely independent and not influenced by another state. Typically in the internal determinants model, the dependent variable of policy activity is a measure of whether or not a state has adopted a policy by a specific date or how early a policy is adopted, the former of which serves as the dependent variable in this study.

In terms of independent variables, there is a consensus among researchers that a state's overall fiscal health and legislative professionalism play an important role. These two factors are repeatedly found to be statistically significant predictors of state policy activity as a whole and are consistently included in most research of this type (Bromley-Trujillo, 2012). However, other determinants of policy and their level of significance seem to be dependent on the specific policy issue being studied and there is also variation between policy subgroups.

2.2.3 Environmental Policy Determinants

State environmental policy determinant research has operated under the framework established by the general literature. As discussed in the previous section, researchers of this subgroup of state policy activity, as well as more narrowed environmental policy issues, include overall fiscal health and legislative professional scores in their analyses while adding independent variables that are particular to environmental policy, such as the number of Sierra Club, Greenpeace, and National Wildlife Federation members per 1,000 residents (Newmark and Witko, 2007; Kerr and Hall, 1991).

Scholarly literature on environmental policy activity has assessed environmental policy on a broad scale as well as focusing on more specific policy issues. Kerr and Hall (1991) developed the Green Index, which is state-by-state guide to environmental health. Although now considered outdated, the index described each state's environmental conditions across a wide range of issues like air pollution, water pollution, and energy use, and each state's corresponding policies. Other studies have looked at a singular set of environmental policy such as state climate change policies (Matisoff, 2008), the incorporation of public participation provisions in hazardous waste policies (Daley, 2008), renewable energy project policies (Wiener and Koontz, 2010; Chandler, 2009), surfacing mining (Scicchitano et al., 1989), spending on environmental programs (Newmark and Witko, 2007; Agthe et al., 1996), and air pollution and water pollution (Potoski and Woods, 2002; Ringquist, 1993). Wetlands as a specific state policy issue have yet to be studied in such a focused way. Other researchers have incorporated wetlands-related policies into their broader literature, such as Newmark and Witko's research on program spending, which included spending on water quality, forestry, and fish and wildlife.

Despite state environmental policy determinant literature covering very broad and very singular policy issues, the current body of this research finds that certain categories of independent variables tend to be significant. Those specific categories include the environmental conditions and pressures, economics, political ideology, and agency and bureaucratic capacity of the state. The following sections of this literature review discuss each category in context of previous literature and present the researchers' findings as to further explain the construction of the current framework for environmental policy determinants.

2.2.4 Economics

Numerous studies on environmental policy literature have assessed the link between policy activity and the economic conditions of a state, using several different measures of economics, particularly income per capita. Researchers typically provide the same initial hypothesis that the less fiscally strapped a state is, the more resources it can dedicate to environmental policies, but this has not always been supported. Matisoff (2008) found that gross state product per capita (GSPPC) was positively related to state climate change policy activity, although the level was not significant and therefore provided no support for any claims. Bacot and Dawes (1997) and Newmark and Witko (2007) had similar findings: overall state fiscal health was positively related to states' environmental policy expenditures but not at a level of significance. The relationship between income per capita and environmental policy activity has had differing results across research. Daley (2008) found a negative correlation at a level of significance between income per capita and public participation provisions of hazardous waste programs, a result that contradicted the author's initial hypothesis. Daley's explanation for this finding was that it is possible that state environmental programs may be aware of environmental justice issues and make take additional steps to ensure public participation. Ando and Polasub (2009) also found a negative, though non-significant relationship between the timing of when states adopt programs to mitigate natural resource damages and income per capita. Oppositely, Bromley-Trujillo's (2012) study on general environmental policy concluded a significant positive relationship, that "as a state becomes wealthier, it becomes more environmentally active." Similarly, Agthe et al.'s (1996) found income per capita to have a positive influence on state environmental spending, although at a level of significance.

Table 2: Summary of Research Findings on Economics and State Environmental Policy

Author	Dependent Variable	Independent Variable	Sign of Relation	Significant?
Matisoff (2008)	Climate Change Policy Activity	GSPPC	+	No
Newmark & Witko (2007)	Environmental Spending	Overall fiscal health	+	No
Daley (2008)	HW programs	Income per capita	-	Yes
Bromley-Trujillo (2012)	Environmental policy activity	Income per capita	+	Yes
Agthe et al. (1996)	Environmental Spending	Income per capita	+	Yes
Ando & Polasub (2009)	Timing of natural resource damage programs	Income per capita	-	No
Bacot & Dawes (1997)	State environmental expenditures	State fiscal health	+	No

2.2.5 Environmental Conditions and Pressures

Environmental policy literature continues to include independent variables of environmental conditions and pressures, including measures of problem severity. Typically these measures are specific to the environmental policy issue being studied. For example, in studying air and water pollution policies, researchers have included population statistics and levels of criteria pollutants under the assumption that the severity of an issue and the number of individuals contributing to and being exposed to an issue positively influence policy activity related to the pollution. Newmark and Witko (2007) and Bacot and Dawes (1997) both found population to be positively associated with state environmental program spending at a level of significance. Newmark and Witko (2007) had contrasting findings from that of Bacot and Dawes (1997) regarding problem severity, with the former finding that pollution severity, as well as land and water area, had no influence on total environmental spending while the latter set of researchers concluded a positive and significant influence. Only when Newmark and Witko (2007) specified spending on forestry programs did they find a significant, although still

negative, influence from pollution severity. Other researchers found positive associations between problem severity and policy activity. Potoski and Woods (2002) found a position and significant relationship between total air emissions and ambient air enforcement programs, as did Ando and Polasub (2009) with the volume of oil spills and the number of proposed and listed Superfund sites on policies that mitigate natural resource damage. Daley (2008) again found an unexpected null finding between the number of existing hazardous waste sites within a state and the public participation measures within hazardous waste programs. Additionally, Matisoff (2008) found varying results between problem severity and the adoption of climate change policies. The carbon dioxide intensity per capita had a significant and negative relationship on this policy activity while the amount of criteria air pollutants per capita had a significant and positive relationship.

Table 3: Research Findings on Environmental Conditions and State Environmental Policy

Author	Dependent Variable	Specific Independent Variable	Sign of Relation	Significant?
Newmark & Witko (2007)	State Environmental Spending	Population	+	Yes,
		Land and water area	-	No
		Problem severity	-	No
Matisoff (2008)	Adoption of Climate Change Policies	CO_2 intensity PC	-	Yes
		Criteria air pollutants PC	+	Yes
Daley (2008)	HW programs	Number of HW sites	-	No
Potoski & Woods (2002)	Ambient Air Enforcement Programs	Total emissions	+	Yes
Ando & Polasub (2009)	Natural Resource Damage Programs	Problem severity: volume of oil spills	+	Yes
		Problem severity: proposed/listed Superfund sites	+	Yes
Bacot & Dawes (1997)	Expenditures on Environmental Programs	Pollution	+	Yes
		Population	+	Yes

2.2.6 Political Ideology

Existing evidence suggests that internal political ideology is influential on a state's political activity. Several studies have assessed this relationship through measuring the overall liberalism of a state, the presence of environmental groups, and legislative professionalism. Typical hypotheses are that the more liberal, the stronger the presence of environmental groups, and the higher the legislative professionalism score, the more likely a state has a higher degree of environmental policy activity. Statistical evidence overall has supported these hypothesis, with some exceptions. Public opinion liberalism, a measurement of how liberal a state's citizens are, has been found to be positively and significantly related to the adoption of climate change policies (Matisoff, 2008), overall environmental policy activity (Bromley-Trujillo, 2012), and public participation provisions of hazardous waste programs (Daley, 2008). Neither Bacot and Dawes (1997) nor Newmark and Witko (2007) were able to establish any statistical relationship between state political ideology and environmental expenditures. Political ideology as an independent variable has also been quantified by environmental group presence in a state. Researchers have hypothesized that environmental groups tend to be influential on a state's environmental policy activity since these groups are typically more active in the political process. Bromley-Trujillo (2012) concluded a positive and significant relationship between the number of Sierra Club members per capita and a state's environmental policy activity. Potoski and Woods (2002) concluded the same between environmental group presence, measured as the number the number of Sierra Club, Greenpeace, and National Wildlife Federation per 1,000 residents, and ambient air standards, as did Bacot and Dawes (1997) when assessing environmental group presence on state environmental spending. However, Ando and Polasub (2009) and Daley (2008) found no significant influence between environmental group presence

and the timing of adopting natural resource damage mitigation policies and public participation provisions of hazardous waste programs respectively.

As a contrasting political capacity and ideology measurement, industry group strength has also been considered with mixed findings being reported. Daley (2008) found that the stronger the presence of the manufacturing industry, the more public participation provisions a state had in its hazardous waste programs. Bromley-Trujillo's (2012) initial hypothesis was consistent with Ringquist's (1993) findings that a state with a larger industry presence would be less likely to adopt stricter environmental policies, but her own findings found the opposite. She concluded that a greater manufacturing presence increases the likelihood that a state enacts more environmental programs. Possible reasons are that businesses prefer government regulations and incurring some of the costs associated with regulations and that a large industry presence simply amplifies environmental problems and therefore more environmental action is taken. Potoski and Woods (2002) had similar findings to Ringquist (1993); less industry presence meant more environmental protections in the form of ambient air standards. Agthe et al. (1996)'s results indicated a positive and significant relationship between legislative professionalism and state environmental spending. Ringquist (1994) concluded the same between legislative professionalism and water pollution and hazardous waste policy activity. As another measure of legislative capacity, Ando and Polasub (2009) attempted to assess the relationship between a state's score from the League of Conservation Voters and the timing of which it adopted natural resource damage mitigation policies but found no such relationship.

Table 4: Research Findings on Political Capacity and State Environmental Policy

Author	Dependent Variable	Specific Independent Variable	Sign of Relation	Significant?
Newmark & Witko (2007)	State Environmental Spending	Public Opinion Liberalism	-	No
Matisoff (2008)	Adoption of Climate Change Policies	Public Opinion Liberalism	+	Yes
Daley (2008)	Public Participation Provision in Hazardous Waste Programs	Environmental group presence	+	No
		Public opinion Liberalism	+	Yes
		Manufacturing/industry strength	+	Yes
Bromley-Trujillo (2012)	Environmental Policy Activity	Public Opinion liberalism	+	Yes
		Sierra Club Membership	+	Yes
		Manufacturing strength	+	Yes
Agthe et al. (1996)	State Environmental spending	Legislative professionalism	+	Yes
Potoski and Woods (2002)	Ambient Air Standards	Environmental group presence	+	Yes
		Industry group presence	-	Yes
Ando and Polasub (2009)	Timing of natural resource damage programs	Sierra Club Membership	-	No
		League of Conservation Voters Senate index	+	No
Bacot and Dawes (1997)	State Environmental Expenditures	Environmental group strength	+	Yes
		Public Opinion Liberalism	+	No
		Industrial group strength	-	No
Ringquist (1994)	Water pollution and hazardous waste policy strength	Legislative professionalism	+	Yes
		Industry strength	+	Yes

2.2.7 Agency and Bureaucratic Capacity

A majority of previous literature has focused on legislative activity with very little research being conducted on agency and bureaucratic influences on a state's policies. Authors that have included agency and bureaucratic capacity have noted that this independent variable is important to consider due to many policies being enacted and structured by agencies albeit being given the authority to do so by a legislature. Agency capacity is usually measured in terms of available resources and oversight structure. Agthe et al. (1996) used the percent of a state's budget devoted to environmental programs as a monetary measure of agency capacity and found that the higher percentage of a state's budget committed to this purpose, the more it spent on environment programs. The authors expected and found this to be the strongest variable. Potoski and Woods (2002) measured bureaucratic capacity in terms of air pollution control budget expenditures and expected states with more capacity to adopt more extensive ambient air monitoring programs. Bureaucratic capacity had no influence on ambient air standards but their reduced model indicated that "state clean air agencies with more bureaucratic capacity are able to establish more extensive monitoring regimes." Finally, Bacot and Dawes (1997) assessed whether the structure of a state's environmental agencies influenced spending on environmental problems. The researchers hypothesized that organizational structure would have a direct, positive effect but the findings concluded no significant bearing.

The past literature discussed in this review is not directly comparable to this study because, as previously stated, wetland policy activity has yet to be examined in the context of state policy determinants. However, the literature provides a crucial overview of what dependent and independent variables have already been assessed and how researchers have attempted to fit environmental policy within the broader framework of state policy determinants while also

testing independent variables that are specific to environmental policy issues. The preceding sections also emphasize different findings between studies that used the same or similar independent variables but different dependent variables. This leaves room for subsequent research within different areas of environmental policy and how independent variables may be influential to these different areas. Despite differing statistical findings and a lack of research pertaining to state wetland policies, past research is particularly helpful in deciding which categories of independent variables are important to include, as well as which new measures of category variables are important to add or be tailored, in a future study that analyzes a subgroup of environmental policy determinants.

Table 5: Research Findings on Bureaucratic Capacity and State Environmental Policy

Author	Dependent Variable	Specific Independent Variable	Sign of Relation	Significance?
Agthe et al. (1996)	State environmental spending	Environmental program budget	+	Yes
Potoski and Woods (2002)	Ambient Air Standards	Air pollution control budget expenditures	-	No
	Ambient Air Monitoring Programs	Air pollution control budget expenditures	+	Yes
Bacot and Dawes (1997)	State Environmental Expenditures	Agency organizational structure	-	No

CHAPTER THREE: DATA AND METHODS

3.1 Data

Following the conclusions from past researchers of state environmental policy determinants, this study includes four categories of independent variables: economics, environmental conditions and pressures, political ideology, and agency and bureaucratic capacity. Each category is discussed individually, referencing past literature and the rationale for its inclusion, as well as the specific quantitative measures that are used as a numerical representative of the category. Table 7 summarizes the independent variable categories, the specific measures, and the source for each set of measurements. Then state wetland policies are examined as the dependent variable of the study.

3.1.1 Independent Variables

3.1.1.1 Economics

State policy determinant literature has consistently referred to a state's economic conditions as one of the core framework elements and state environmental policy determinant studies have continued to include economics as a set of independent variables. The general argument is that a state with more wealth are more able to support environmental policies due to having more resources to allocate to the costs associated with such policies, especially while also balancing with other policies related to non-environmental issues.

A. Per Capita Income

Per capita income serves as a measure of state wealth and has been used as an independent variable measure by Bromley-Trujillo (2012), Agthe et al. (1996), Daley (2008), and Ando and Polasub (2009). Per capita income provides insight on the wealth of a state in terms of available resources and also the overall social condition of its citizens. Not only could states with a lower

income per capita have less financial resources for environmental policies, it could budget more towards policies that target social issues instead. This measure has been used in studies of environmental policy issues that overlap with environmental justice issues as well. Wetland loss is not typically viewed as an environmental justice issue, so using this independent variable measure could provide further insight of this discussion. Per capita income data comes from the most recent edition of the U.S. Census Bureau's American Community Survey and is a 12-month average over 2008 to 2012 of the mean money income received for every individual in a state over the age of 15.

B. Gross State Product Per Capita

State wealth can be measured in gross state product per capita (GSPPC) and also provide a stronger focus of a state's overall economic health instead of quality of life and individual well-being. Matisoff (2008) analyzed GSP per capita as a measurement of state wealth against state climate change mitigation program adoption. GSP per capita data is a 12-month average over 2008 to 2012 and comes from the Bureau of Business and Economic Research at the University of New Mexico. Calculations are made by taking the mid-year population estimates and dividing by the state gross domestic product.

C. Unemployment Rate

The state unemployment rate offers a non-monetary measure of state economic conditions. This data is from the Bureau of Labor Statistics and is the monthly average for the year 2013.

3.1.1.2 Environmental Conditions and Pressures

Problem severity is an important variable to include since policies are typically a response to an issue and researchers have tailored this independent variable to the policy issue

being studied. Wiener and Koontz's (2010) study on renewable energy production policies noted that "History and problem severity matter as well…In addition, numerous scholars have identified the severity of the pollution problem in a state as an important variable influencing environmental policy adoption." This study quantifies environmental conditions and pressures in four measurements.

D. Population Change

Population has been included in environmental policy determinant literature, including Newmark and Witko (2008) and Bacot and Dawes (1997) as an environmental pressure. Regarding wetland loss issues, population change has been influential since a growing population in the 1900s increased the demand for developments and conversion to uplands for agriculture. This study uses the most recent data from the U.S. Census Bureau that measures population in percent change between April 2010 and July of 2013.

E. Historical Wetland Loss

Historical wetland loss, expressed as the percent of wetlands lost by each state between the 1780s and 1980s, serves as a measure of problem severity as tailored specifically to the issue being addressed in the study. Dahl (1990) serves as the source for this set of data.

F. Wetlands as Percent of Total State Area

Newmark and Witko (2007) used total land and water area in their study. However, this study again places an aspect of the status of wetlands within the independent variables. Wetlands as a percent of total state area give an indication of how much wetland acreage states have relative to one another and if there is any type of statistical correlation between the amount of a resource and policies to address issues pertaining to that resource. Newmark and Witko (2007) stated an initial argument of "larger states with more wild lands should demonstrate greater

expenditures on certain types of programs, such as the protection of natural resources and wildlife." These data is again utilized from Dahl (1990).

3.1.1.3 Political Capacity and Ideology

State environmental policy determinant literature has repeatedly used a state's political ideology as an independent variable under the hypothesis that more historically liberal states will adopt more policies that favor environmental protections. Research has utilized different measures for political ideology, including the political affiliation of state citizens and governments, legislative professionalism scores, League of Conservation Voters (LCV) scores, and the presence of interest groups. This study uses five different measures of political ideology.

G. State Public Opinion Liberalism

Berry et al.'s (1998, 2007) index on citizen ideology has been used in several different studies (Matisoff, 2008; Bromley-Trujillo, 2012; Daley, 2008) as a lagged measure of a state's political affiliation on a 0 to 100 continuum, with 0 representing complete conservative affiliation and 100 representing complete liberal affiliation. This study uses the average of a state's score from the ten most recent years of data (2001-2010) in the analysis.

H. Congressional Voting Record

The League of Conservation Voters (LCV) score serves as measure of political ideology relative to environmental policy innovativeness. The score is calculated by taken by averaging each state's Congressional delegation voting record on a wide array of important pieces of environmental legislation. Ando and Polusub (2004) and Wiener and Koontz (2010) used the most recent year's data for their studies and as such, this study uses the LCV scores from 2013.

I. Legislative Professionalism

Political capacity is often measured as legislative professional, which is the "ability of the legislature to process and analyze information to support decision making" (Wiener and Koontz, 2010). Both Lester (1995) and Ringquist (1993) suggest that more professional state legislatures tend to be more likely to adopt policies that favor environmental activism. This study uses the most recent Squire Index (2003) legislative professionalism scores from 2003.

J. Environmental Group Presence

Researchers of environmental policy determinants have measured political capacity and ideology in the presence of environmental groups in each state under the initial assumption that environmental groups have the ability to organize and lobby more strongly for pro-environmental goals than non-organized citizens (Potoski and Woods, 2002; Ando and Polasub, 2009; Daley, 2008; Bacot and Dawes, 1997. Environmental group presence is measured in the number of Sierra Club members per 1,000 residents for each state for the most recent year of 2012. This data was obtained directly through correspondence with the Sierra Club.

K. Industry Presence

In addition to considering environmental group presence, environmental policy determinant literature includes industry group strength. The rationale for doing so is that a strong industry presence can counterbalance environmental group presence since states that are more reliant or more influenced by industry are less likely to impose restrictions. Since there is no data on the number of members in industry groups, past studies have adapted industry strength measurements in other ways, again tailored to the specific issue being considered. Daley (2008) used per capita manufacturing gross state product in the consideration of hazardous waste programs under the logical link between manufacturing and hazardous waste production. Both Potoski and Woods (2002) and Ringquist (1993) used an industry group measure as the "value

added by manufacturing by those industries most responsible for air pollution as a percentage of a state's gross product." In this study, industry presence focuses on the agricultural industry since wetland conversion for agriculture production has historically been the greatest contributor to wetland loss. It is measured as the percentage of state GSP contributed to by agricultural production as a 10-year average between 2002 and 2011 and data is used from the U.S. Department of Commerce Bureau of Economic Analysis.

3.1.1.4 Agency and Bureaucratic Capacity

State agency and bureaucratic capacity has had less examination in research literature but it is an important category of independent variable to include pertaining to state wetland policies. State agency staff typically have specialized knowledge of their state's natural resources. The incorporation of wetland programs into larger state programs typically means wetland-related regulatory and non-regulatory measures can spill over into the oversight by multiple state agencies. This study attempts to build upon this under-examined independent variable category by using two quantifiable measurements.

L. Natural Resource Expenditures

Following in the example of Agthe et al. (1996) and Potoski and Woods (2002), this study uses the percentage of a state's budget used on natural resources expenditure. This measure gives an idea of the fiscal resources made available to agencies for carrying out programs pertaining to natural resources. Wetland-related expenditures is not a feasible measurement to use because, as Thomas et al. (2008) states, "Of the 150 state agency divisions involved in wetland regulation, management, and/or protection nationwide, more than two-thirds, 109 total, were unable to estimate the amount of funding dedicated specifically to wetlands." This study

instead uses the U.S. Census Bureau's 2012 data on state expenditures for natural resources as a percentage of total expenditures.

M. Number of Agencies with Wetland Oversight

The number of agencies as a measure of bureaucratic capacity has yet to be used in environmental policy determinant literature but because wetlands are consistently included in larger programs and thus across oversight of different state agencies, it is utilized in this study. Bacot and Dawes (1997) had the most similar measurement included in their study. They determined whether a state's environmental management administrative structure was similar to a superagency, "where administrative efforts are divided among many different programmatic areas" and if the presence or lack of this structure was connected to state environmental efforts. This study uses the number of agencies with both regulatory and non-regulatory oversight of wetlands, which is available in Thomas et al.'s (2008) study.

Table 6: Summary of Study's Independent Variable Measurements with Data Sources

Independent Variable Category	Variable Measurement	Data Source
Economics	Per Capita Income	U.S. Census Bureau (2012)
	Gross State Product Per Capita	U.S. Census Bureau (2013)
	Unemployment Rate	Bureau of Labor Statistics (2013)
Political Capacity and Ideology	LCV Congressional Voting Record	League of Conservation Voters (2014)
	Public Opinion Liberalism	Berry et al. (1998, 2010)
	Industry Presence	Bureau of Economic Analysis (2012)
	Environmental Group Presence	Sierra Club (2012)
	Legislative Professionalism Score	Squire (1997)
Agency and Bureaucratic Capacity	Number of Agencies with Wetland Oversight	Thomas et al. (2008)
	Natural Resource Expenditures	U.S. Census Bureau (2012)
Environmental Conditions and Pressures	Population Change	U.S. Census Bureau (2013)
	Historical Wetland Loss	Dahl (1990)
	Wetland Acreage as Percent of State Area	Dahl (1990)

3.1.2 Dependent Variable

In using the internal determinants model, the dependent variable is "either some measure of how early a state adopts a policy among the population of potential adopters, or whether or not the state has adopted the policy by a certain date" (Berry, 1994). This study follows the latter. Thomas et al. (2008) provides the most expansive overview of wetland policies adopted by each state as of 2008 and this study utilizes this data in the construction of the dependent variables. The researchers organized wetland-related 41 policies under seven different categories and noted which states had adopted each of the policies, which had not, and which provided no data on the existence or absence of such policy. Table 7 summarizes each policy surveyed by Thomas et al. (2008) and used as dependent variables in this study.

Table 7: Specific State Wetland Policies Surveyed by Policy Category

Policy Category	Policy
Regulations	Dredge and fill permitting authority for coastal and freshwater wetlands
	Regulation of activities in geographically isolated wetlands
	Use of Section 401 certification as the primary or sole form of state-wide wetland regulation
	Definition of state waters implicitly includes wetlands
	Definition of state waters explicitly includes wetlands
	Development of delineation criteria or guidelines other than, or in addition to, the Corps' 1987 Manual
	Provides ongoing review of the Corps NWPs
	Adoption of legislation, policies, and/or guidelines to guide mitigation for impacts to aquatic resources
	Specifically addresses wetland mitigation banking under state laws, regulations, and/or guidelines
	Has approved mitigation banks
	Active participation on interagency MBRTs in coordination with at least one Corps district and other federal agencies
	Specifically addresses in-lieu fee mitigation in state laws, regulations, and/or guidance
	Has approved in-lieu fee programs

Table 7 continued

Policy Category	Policy
Regulations	Operates some system for tracking wetland-related permits, 401 certifications, mitigation, and/or other restoration and conservation activities
Water Quality Standards	Adoption of water quality criteria, designated uses, and/or anti-degradation policies specific to wetland resources
	Adoption of wetland-specific water quality standards that describe water quality criteria narratively
	Adoption of wetland-specific water quality standards with chemical criteria
	Adoption of wetland-specific water quality standards with biological criteria
	Has designated uses specific to wetlands
	Has anti-degradation policies that specify wetlands
Monitoring and Assessment	Report having adopted at least one assessment methodology for wetlands
	Report having adopted two or more assessment methodologies for wetlands
	Have a wetland-specific monitoring and/or assessment program as part of a larger state monitoring program
	Have a volunteer monitoring program that is specific to wetlands
	Adoption of at least one stream assessment methodology
	Adoption of more than two assessment methodologies
Restoration Programs and Activities	Formal restoration program
	Formal restoration goal
	Systematic method for prioritizing wetland restoration
	Registry for wetland restoration
	Monitor restoration
Public-Private Partnerships	Formal program for partnering with private landowners on restoration or conservation
	Conduct outreach and/or provide technical assistance to private landowners
	Coordinate with the USDA on federal landowner partnership programs
Coordination among state and federal agencies	Report regular coordination among state and federal agencies on wetland issues
	Report a formal memoranda or agreement/understanding on wetland issues
	Development of a State Wetland Conservation Plan (SWCP)
	Implementation of a SWCP
Education and Outreach	Has a strategic education and outreach plan that is specific to wetlands
	Has a general education and outreach program that at least has wetland components
	Conducts various wetland-related education and outreach activities

3.2 Methods

The existence or absence of a policy in a state is compositely quantified as the level of state wetland policy activity. For each of the 41 policies, a state is given a score of 0 if it lacks the policy and a score of 1 if it has the policy. No number is recorded if there is no data on whether the state has or does not have the policy. A total composite score for each state is then recorded by adding all the individual scores for each policy. In compiling this composite score, no consideration is given to the quality of individual policies or how successful a state is in enacting a policy since this is outside the scope of the study. Because of this, all policies are given equal weight in the overall composite score. Each state also has a number recorded for each of the thirteen described independent variable measurements.

The remainder of the methods involve statistical analyses in SPSS 22 software. The states are sorted by the number of wetland policies to determine which states have the highest level of policy activity. Then two linear regressions are run. The first linear regression uses the composite policy activity score as the one dependent variable and all 13 independent variables. Prior to initiating the second regression, the Pearson Product Moment Correlation is run with all thirteen independent variables to determine if any are highly correlated or exhibiting a case of multicollinearity. When multicollinearity is present in a model, analyses can have large standard errors, causing imprecision in confidence intervals. Additionally, adding or deleting an explanatory variable can cause significant changes in the values of other variables' regression coefficients. In cases where two independent variables have a significant correlation of greater than ±0.7, only one variable is selected for the following regression. Each regression contains a model summary, Analysis of Variance (ANOVA), and unstandardized and standardized coefficients. The model summary provides values for R, R-square, and adjusted R-square.

ANOVA provides a p-value for total significance of the model and the coefficients table provides the p-value for significance of each independent variable. Significance in all models is determined based on $p \leq 0.05$

Following the first set of data testing, the methods include a factor analysis of all the independent variables and a third and final linear regression with independent variables selected from this factor analysis. The factor analysis is run using Varimax rotation and describes the variability among observed correlated variables in terms of a potentially lower number of unobserved variables. Using a Varimax rotation simplifies the interpretation by scaling the loadings. For each component listed in the factor analysis, the top-loading variable is used in another linear regression with the composite policy activity scores as the dependent variable.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Policy Activity Level Sorting

In response to the research question "which states have the highest level of wetland policy activity?" Table 8 shows the total number of wetland-relates policies adopted by each state. California, Minnesota, and Wisconsin have the highest number of total wetland policies, each with 28 out of 41. Policy activity scores ranged from 5 to 28 and the mean policy activity score was 16.8. Arizona had the lowest policy activity score of 5.

Figure 2 is a map of state wetland policy activity in all 50 states grouped by quartiles with a separate emphasis on the most active and least active states. Based on the visual components of the map, it seems as though the states surrounding the Mississippi River have a level of wetland policy activity at or above the mean, with the exception of Mississippi. Additionally, the lowest levels of policy activity seem to be clustered in the Southwest region. Pacific coastal states, excluding Alaska and Hawaii, also scored above the mean. More variation in policy activity seems to exist on the Atlantic and Gulf coasts.

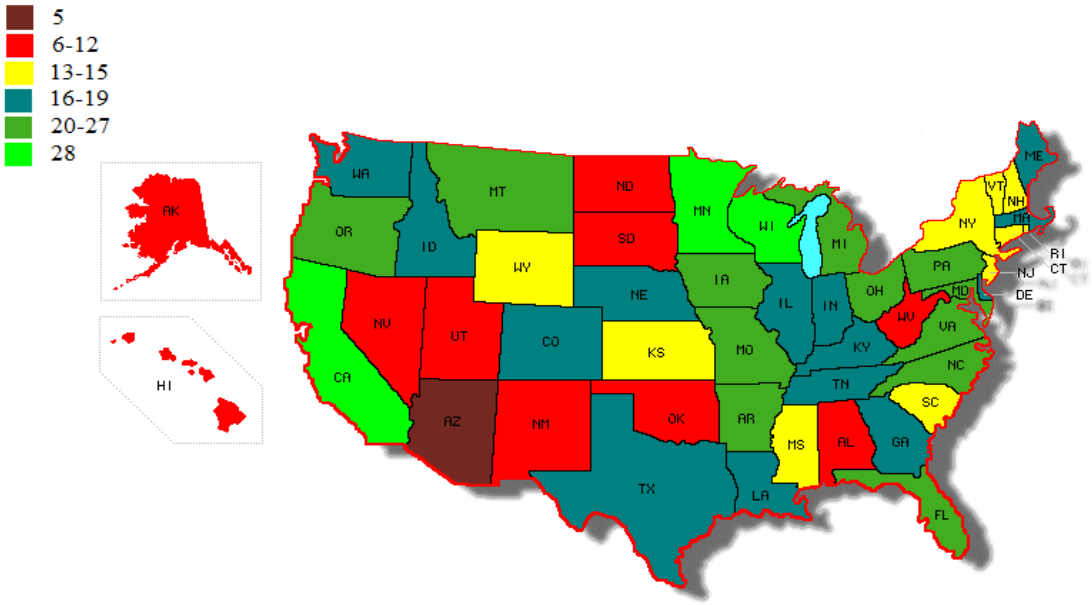

Figure 2: Map of Wetland Policy Activity by State

Table 8: States Listed by Level of Wetland Policy Activity

State	Wetland Policy Activity Score	State	Wetland Policy Activity Score
California	28	Maine	16
Minnesota	28	Massachusetts	16
Wisconsin	28	Missouri	16
North Carolina	27	Texas	16
Ohio	27	Mississippi	15
Arkansas	24	Connecticut	14
Maryland	24	New Jersey	14
Oregon	24	New York	14
Florida	22	Rhode Island	14
Virginia	22	Vermont	14
Iowa	20	Kansas	13
Michigan	20	New Hampshire	13
Montana	20	South Carolina	13
Pennsylvania	19	Wyoming	13
Colorado	18	Hawaii	12
Delaware	18	Nevada	12
Indiana	18	New Mexico	12
Kentucky	18	Oklahoma	12
Louisiana	18	Alaska	11
Nebraska	18	South Dakota	11
Tennessee	18	Alabama	10
Idaho	17	Utah	10
Illinois	17	West Virginia	10
Washington	17	North Dakota	8
Georgia	16	Arizona	5

4.2 First Linear Regression Analysis

The initial linear regression analysis included the one dependent variable and all thirteen of the independent variable measurements. Table 9 shows the standardized coefficient between each of the independent variables and the dependent variable. The standardized coefficients range from -0.465 to 0.496. Two variables, wetland area and historic wetland loss, are highlighted in blue in the table, indicating that the results are significant ($p<0.05$). The standardized coefficient refers to how many standard deviations the dependent variable will change per standard deviation increase in the independent variable. Table 10 is the model

summary from the first linear regression analysis. The adjusted R-squared value for the model, highlighted in green, is 0.285, which is the proportion of total variation of outcomes explained by the model with all thirteen independent variables. Table 11 is summary of the Analysis of Variance (ANOVA) results. The p-value of the ANOVA test is 0.015, as highlighted in orange. With a p-value of 0.015, this indicates that all thirteen of the independent variables as a whole are significantly related to the dependent variable, state wetland policy activity.

Table 9: Standardized Coefficients and Significance for First Regression
(Blue Highlighting Indicates Significant P-value)

Group	Independent Variable Measurement	Standardized Coefficient	Significance
Economics	Income Per Capita	0.053	0.829
	GSPPC	-0.245	0.289
	Unemployment	-0.099	0.600
Political Capacity	Environmental Group Presence	0.271	0.202
	Industry Group Presence	0.004	0.983
	Public Opinion Liberalism	-0.465	0.114
	Congressional Voting Record	0.473	0.188
	Legislative Professionalism	0.250	0.109
Environmental Conditions and Pressures	Population Change	-0.018	0.914
	Historic Wetland Loss	0.496	0.006
	Wetland Area	0.373	0.019
Agency and Bureaucratic Capacity	Number of Agencies with Wetland Oversight	0.104	0.463
	Natural Resource Expenditures	0.048	0.790

Table 10: Model Summary of First Linear Regression (All Variables)

Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate
1	0.689	0.475	0.285	4.61250

Table 11: ANOVA for First Linear Regression
(Significance Highlighted in Orange)

Model		Sum of Squares	df	Mean Square	F	Significance
1	Regression	692.095	13	53.238	2.502	0.015
	Residual	765.905	36	21.275		
	Total	1458.000	49			

4.3 Pearson Product Moment Correlation

A Pearson Product Moment Correlation was initiated in order to determine which independent variables, if any, were highly correlated and to select which variables would be included in a second linear regression that specifically adjusts to reduce any issues with multicollinearity. All thirteen independent variables were incorporated into this analysis and the dependent variable was excluded. Table 12 summarizes the Pearson Product Moment Correlation for only the pairs of independent variables that were found to be significant at a Pearson correlation value of greater than 0.7 or less than -0.7. Pairs of independent variables found to be correlated below this value and at a non-significant level are excluded from this summary table. The statistical analysis indicated that two pairs of variables displayed multicollinearity: (1) income per capita and GSP per capita, and (2) congressional voting score and public opinion liberalism. The first pair had a Pearson correlation value of 0.769 and a highly significant p-value of 0.000. The second pair had an even higher correlation value of 0.889 and also a p-value of 0.000.

Table 12: Pearson Product Moment Correlation Summary

Statistics	Income Per Capita & GSP Per Capita	Congressional Voting Score & Public Opinion Liberalism
Pearson Correlation	0.769	0.889
Significance (2-tailed)	0.000	0.000

4.4 Second Linear Regression Analysis

A second linear regression model was run using eleven of the thirteen original independent variables and the dependent variable. Out of the two multicollinear pairs, income per capita and public opinion liberalism were retained in the second regression analysis due to their higher level of prevalence as independent variable measures in past literature. The results of the modified second linear regression analysis with eleven of the independent variables are displayed in Table 13. Variable measurements at a level of significance ($p \leq 0.05$) are highlighted in blue. The second linear regression results include the same two independent variable measurements, historic wetland loss and wetland area, found to be significant in the first linear regression with the addition of a third significant variable, environmental group presence. Historic wetland loss increased in significance between the first and second analyses by 0.001 while wetland area decreased in significance by 0.009. The significance value of environmental group presence was 0.202 in the first model and 0.019 in the second model.

Table 14 is the model summary of the second regression. With eleven independent variables and the one dependent variable, the adjusted R-square value, or proportion of total variation of outcomes explained by the model is 0.277. The explanatory power decreased between 0.008 between the first and second regression analyses. Table 15 is the ANOVA table for the second regression analyses. The significance of the ANOVA analysis, highlighted again

in orange, is 0.011. When compared to a p-value of significance (≤0.05), this indicates that all together the eleven independent variables selected for this regression are significantly related to the dependent variable. The significance of the ANOVA model between the first and second regression analysis increased by 0.004.

Table 13: Standardized Coefficients and Significance for Second Regression
(Blue Highlighting Indicates Significant P-value)

Group	Independent Variable Measurement	Standardized Coefficient	Significance
Economics	Income Per Capita	-0.069	0.686
	Unemployment	-0.025	0.893
Political Capacity	Environmental Group Presence	0.430	0.019
	Industry Group Presence	0.028	0.887
	Public Opinion Liberalism	-0.156	0.393
	Legislative Professionalism	0.220	0.155
Environmental Conditions and Pressures	Population Change	-0.083	0.603
	Historic Wetland Loss	0.498	0.005
	Wetland Area	0.344	0.028
Agency and Bureaucratic Capacity	Number of Agencies with Wetland Oversight	0.109	0.443
	Natural Resource Expenditures	0.020	0.912

Table 14: Model Summary of Second Linear Regression (Eleven Independent Variables)

Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate
1	0.663	0.440	0.277	4.63723

Table 15: ANOVA for Second Linear Regression
(Significance Highlighted in Orange)

Model		Sum of Squares	df	Mean Square	F	Significance
1	Regression	640.853	11	58.259	2.709	0.011
	Residual	817.147	38	21.504		
	Total	1458.000	49			

4.5 Factor Analysis and Third Regression

A factor analysis using the principal component analysis extraction was conducted as a way to statistically determine if there were any unobserved variables that were reflected in the independent variables. This type of analysis aids in determining which factors explain most of the variance observed in the independent variables. The factor analysis indicated that four components contributed to variance in the independent variables. Table 16 provides a summary of the percent of variance explained by each of the four components, or unobserved factors, as well as the cumulative percentage for the components. The first component accounts for 23.311 percent of variance, component two accounts for 20.649 percent, component three accounts for 14.204 percent, and component four accounts for 12.792 percent. Cumulatively, all four components account for 70.955 percent of variance.

The variable loadings of the four components produced with a Varimax rotation are displayed in Table 17. The top loading variable, or the variable with the most positive or most negative loading, for each of the four components is highlighted in red in the table. In this case, each had a positive loading. Congressional voting record, unemployment rate, GSP per capita, and historic wetland loss are the top loading variables for components one through four respectively.

Table 16: Factor Analysis: Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.030	23.311	23.311
2	2.684	20.649	43.959
3	1.846	14.204	58.163
4	1.663	12.792	70.955

Table 17: Factor Analysis- Rotated Component Matrix
(Top Loading Variables for Each Component Highlighted in Red)

	Component			
	1	2	3	4
Public Opinion Liberalism	0.860	0.223	0.074	-0.074
Natural Resource Expenditures	-0.169	-0.738	0.095	-0.100
Number of Agencies with Wetland Oversight	-0.067	-0.163	0.315	0.652
Congressional Voting Record	0.908	0.228	0.132	0.002
GSP Per Capita	0.332	-0.043	0.822	-0.002
Income Per Capita	0.624	0.137	0.614	-0.030
Unemployment Rate	-0.062	0.839	-0.034	0.079
Industry Group Presence	-0.159	-0.773	-0.106	0.278
Environmental Group Presence	0.828	-0.076	0.023	0.008
Legislative Professionalism	0.254	0.494	0.330	0.418
Population Change	-0.288	-0.537	0.560	0.089
Historic Wetland Loss	-0.170	0.320	-0.147	0.762
Wetland Area	-0.206	0.220	0.454	-0.612

A third linear regression was conducted using the four top loading variables for each component as explained in the previous section. Congressional voting record, GSP per capita, unemployment rate, and historic wetland loss were entered as the independent variables and state policy activity was entered as the dependent variable. Table 18 is the model summary from this linear regression analysis. The adjusted R-square value is 0.157, which is lower than the adjusted R-square values of 0.285 and 0.277 from the first and second linear regression analyses. A much lower R-square value is reasonable in this case since four variables instead of thirteen and twelve are used. Due to higher values, the first two linear regression analyses can be considered better models in predicting state wetland policy activity. Table 19 summarizes the coefficients and

significance values for the four top loading variables included in the third regression analysis. The standardized coefficients range from -0.059 to 0.406 and the only significant variable at $p \leq 0.05$ is historic wetland loss with a value of 0.005, which is highlighted in blue. The ANOVA summary is provided in Table 20. Highlighted in orange is the significance of the third linear regression model. With a p-value of 0.019, this model is significant.

Table 18: Model Summary of Third Linear Regression (Four Top Loading Variables)

Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate
1	0.475	0.225	0.157	5.00966

Table 19: Standardized Coefficients and Significance for Third Regression
(Blue Highlighting Indicates Significant P-Value)

Independent Variable Measure	Standardized Coefficient	Significance
GSP Per Capita	-0.059	0.688
Unemployment Rate	0.040	0.785
Historic Wetland Loss	0.406	0.005
Congressional Voting Record	0.248	0.101

Table 20: ANOVA for Third Linear Regression
(Significance Highlighted in Orange)

Model		Sum of Squares	df	Mean Square	F	Significance
1	Regression	328.648	4	82.162	3.274	0.019
	Residual	1129.352	45	25.097		
	Total	1458.000	49			

4.6 Use of Results and Further Discussion

The results detail three linear regression models conducted in this study. All three models are found to be significant as indicated by the ANOVA tables: 0.015, 0.011, and 0.019 respectively. The first model also had an adjusted R-square value of 0.285 and the second model had an adjusted R-square value of 0.277. However, in providing a discussion and conclusion for this study, the second linear regression model is utilized because it has a similar adjusted R-square value to the first regression model and a higher level of significance. Additionally, the second regression model contains eleven variables due to corrections for multicollinearity as

determined by a Pearson Product Moment Correlation whereas the first regression model contains thirteen variables with no such corrections. The second model determined three variables, historic wetland loss, wetland area, and environmental group presence to be of significance in relation to state wetland policy activity. The first model determined that historic wetland loss and wetland area was significant, excluding environmental group presence. The third regression model used the top loading variables for each of the four components determined by factor analysis; it had a much lower adjusted R-square value of 0.157 and had the lowest level of significance out of all three of the linear regression models. In comparison to significant independent variables contained in the first two models, the third regression model determined that historic wetland loss was the only significant variable.

The second research question is 'what circumstances are present in states with higher levels of policy adoption?' In considering the statistical results as provided in the second linear regression model and in answer of this question, there are three circumstances that appear to be present in states with a higher level of wetland policy activity: wetland area as a percentage of state area, historic wetland loss, and environmental group presence. This is derived from each independent variable measurement having a statistically significant p-value ($p \leq 0.05$). Additionally, each significant variable measurement has a positive standardized coefficient value, providing evidence for the conclusion that states with more wetlands as a percentage of total state area, a higher amount of historic wetland losses, and a stronger environmental group presence tend to have a higher level of wetland policy activity. Furthermore, the eleven independent variable measurements in the second linear regression model accounted for 27.7 percent of the observed variance between the levels of state wetland policy activity. This indicates that the remaining percentage of observed variance is from unobserved variables.

The third and final research question asks 'how do wetland policies fit in the already-established theoretical framework of environmental policy adoption?' As discussed in the literature review section, general state policy determinant literature has indicated that overall state fiscal health and professionalism are consistently found to be statistically significant. However, when narrowed to state environmental policies, there are often inconsistent findings between studies regarding the relationship between independent variables and subsets of environmental policy. In terms of economics, out of the seven studies that used an economic measure as an independent variable, five found a positive relationship between environmental policy activity and economic conditions with only two out of the five reporting a positive relationship at a level of significance. The remaining two studies reported a negative relationship with only one indicating a level of significance. In this study, neither two economic measures, unemployment rate nor income per capita, were found to be at a level of significance. In addition, both economic measures had negative coefficients.

Environmental conditions and pressures have been included as independent variables that are specific to the environmental policy issues being studied. Of the 11 different environmental condition measurements included in the six different studies covered in the literature review, seven variable measurements were determined to have a positive and significant relationship with environmental policy activity. Only one measurement in a single study indicated a significant and negative relationship and the remaining three independent variable measurements concluded a negative relationship but not at a significant level. In terms of this study's assessment of state wetland policy activity, environmental conditions and pressures were found to play the most important role. Out of the three variable measurements included in this study, both historic and wetland loss and wetland area had positive and

significant relationships with wetland policy activity. Similarly, when considering standardized coefficient (beta) weights as a method for assessing variable importance among the three variable measurements determined to be significant in this study, historic wetland loss had the highest value of 0.498. Wetland area had the lowest variable weight at 0.344. The third environmental condition and pressure measurement of population change had a negative relationship with wetland policy activity, but at a non-significant level of 0.603. In the reviewed literature, each inclusion of population as an independent variable measurement indicated a positive and significant level.

Past environmental policy determinant literature assessed political capacity as an independent variable. Out of the five cases where public opinion liberalism was used as an independent variable measurement, four determined a positive relationship with three of those cases also finding a significant relationship. Only one case found a negative and non-significant relationship. This study determined a negative and non-significant relationship between public opinion liberalism and wetland policy activity. Five cases of industry strength were assessed with some differing conclusions: three determined a positive and significant relationship, one determined a negative and significant relationship, and one determined a negative and non-significant relationship. This study found a positive and non-significant relationship between industry presence and wetland policy activity. The two cases of legislative professionalism yielded positive and significant results while this study yielded a positive but non-significant relationship at a very high p-value of 0.887. The final political capacity measurement of environmental group presence in this study was the only measurement in this variable category that indicated a significant, and also positive, relationship. In terms of beta weights, environmental group presence was ranked second out of the three significant variables. Out of

five cases of environmental group presence as an independent variable measurement in past research, three concluded a positive and significant relationship with environmental policy activity. Of the remaining two cases, one determined a positive but non-significant relationship and one determined a negative and non-significant relationship.

In the fourth independent variable category of agency and bureaucratic capacity, which has been studied to a lesser extent as explained in the literature review, both measurements of program expenditures had positive and significant relationships with ambient air monitoring programs and state environmental spending. One case of program expenditures found a negative a non-significant relationship with ambient air standards. A fourth case that measured bureaucratic capacity in terms of organizational structure found negative and non-significant results. This study included number of agencies with wetland oversight and natural resource expenditures as two individual measurements of agency and bureaucratic capacity. Neither two measurements were found to be significant, but both had a positive relationship with wetland policy activity.

CHAPTER FIVE: CONCLUSIONS

The purpose of this study was to statistically determine if the internal determinants model has any validity regarding state wetland policy activity. Three research questions were posed: (1) which states have the highest level of wetland policy activity? (2) What circumstances are present in states with higher levels of policy adoption? (3) How do wetland policies fit in the already-established theoretical framework of environmental policy adoption?

The three states with the highest level of wetland policy activity are California, Minnesota and Wisconsin, each with a score of 28 out of a possible 41. The states with the lowest level of wetland policy activity are Arizona with five policies and North Dakota with eight. All three of the linear regression models were determined to be significant, but the second linear regression model, which corrected for multicollinearity, served as the best predictor. This model indicated that three independent variables were the most important in determining wetland policy activity relative to all the independent variables included in the study: historic wetland loss, wetland area, and environmental group presence. When considering beta weights, historic wetland loss had the strongest relationship, followed by environmental group presence, and then wetland area.

There is published literature on state environmental policy determinants that utilizes the internal determinants model as an explanation for variation in state policies. However, wetlands as a specific subgroup had yet to be studied in such a way prior to the research presented in this paper. This study constructed an original dependent variable of wetland policy activity based on the total number of wetland policies in each state. For the independent variables, this study was guided by past studies that considered four categories of independent variables: state fiscal capacity/economics, political capacity, environmental conditions and pressures, and agency and

bureaucratic capacity. Several measurements were used for each category, some of which were used in past environmental policy determinant literature and some that were tailored to wetland-specific issues.

This study topic is important and relevant. Wetlands are an extremely valuable natural resource that have suffered dramatic historic losses and still face losses today. Additionally, land and resource management have long been the right and responsibility of the states. This, in combination with federal wetland management limitations, emphasizes the importance of further understanding of state-based variations in wetland policy activity. Being able to determine what conditions are present in states with higher levels of policy activity helps guide planning, as well as efforts to adopt additional wetland-related policies. Thomas et al. (2008) notes that states should look to one another and learn from others' examples and experiences when it comes to building up their own wetland programs. The findings of this study provide a statistical overview of wetland policy activity. States can use this research in order to acquire more information about what other states are doing and the internal conditions that are present in more active states. With this information, consideration can be given to adopting additional or improving upon current policies, especially if a state finds its policy activity level is lower than states with similar internal circumstances.

There are some inconsistent findings within the theoretical framework for environmental policy determinants, so the findings described above fit within the framework in some ways but not in others. Regarding the specific policy issue of wetlands, the environmental conditions and pressures determinant seems to be the strongest independent variable relative to all other independent variables. This is consistent with past literature that generally concludes a positive and significant relationship between environmental conditions and policy activity. In the case of

wetland policy, it could be that states with more wetland area have more to lose by not adopting additional policies. Along the same lines, states that have suffered more wetland loss may be more apt to protect their current wetland resources since such a small amount exists relative to the original area. However, past literature provides strong support for political capacity as an internal determinant while this study was only able to determine significance of environmental group presence. All other political capacity measurements, public opinion liberalism, industry presence, and legislative professionalism, had no significant relationship. In terms of economic factors, past environmental policy literature findings have been mixed. This study found no relationship from agency or bureaucratic capacity and economics conditions.

How wetlands fit within the theoretical framework for environmental policy determinants may lie within differences in wetlands as a policy issue. Wetlands are not typically seen as an environmental justice issue the way hazardous waste and air pollution are. Also, wetland related activities span across different agencies, so much so that many states are unsure of expenditures devoted to wetland policies. Other studies have found a relationship between environmental interest groups and policy activity, and they rationalized this finding by arguing that stronger environmental group strength could mean more organized and informed lobbying for policies on the state level. While this could also be possible the case in wetlands, there are other potential reasons to consider. Several states rely on partnerships and coordination on many levels, including on volunteer groups, which may explain the connection between interest group strength and policy activity. Environmental interest groups may serve as extra resources, making the adoption and execution of wetland programs more feasible.

These findings may indicate good news for wetlands since policies are typically seen as solutions to problems. By finding historic wetland loss and wetland area as significant and

positively associated variables, there is indication that states may be giving considerable weight to wetland problems and their existing wetland resources when adopting policies. This deviates from studies that found significant relationships between public opinion liberalism, industry group strength, and economics and policy activity. Researchers in these studies rationalized that a state's ability to adopt environmental protections was influenced by underlying political agendas or economic or bureaucratic limitations.

Improvements and additions could be made in further research on state wetland policy determinants. The current study did not take the effectiveness or success of individual policies into account and all policies were weighted equally. Two states could have the same general policy but could differ considerably in the degree of success. Because two other explanatory models for variation in state policy variation exist, it would be useful to assess wetland policy activity in light of these models to see what role regional diffusion and national diffusion play, if any. There are a large number of untested variables that could also be associated with the level of wetland policy activity, especially since the combination of variables in this study only accounted for 27.7 percent of the variance in policy activity. Finally, additional studies could consider multiple years of data to provide a better view on how policies have been influenced by changing independent variables, especially pre- and post-1970s. This study only takes a small section of time into account, thus providing a snapshot of what conditions are present in states with higher levels of policy activity as opposed to providing evidence for influence or causation on behalf of the independent variables. Even in light of the various ways in which this research could be enhanced or further explored, the findings are still useful in providing information to states seeking to improve their wetland programs.

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THE VITA

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