ABSTRACT

GERLACH, JOHN DAVID II. An Examination of Factors that Explain the Use of Data in the Natural Resource Policy Process. (Under the direction of Dr. Dennis M. Daley.)

Natural resource policy-making agencies often seek to make decisions based on *best available science*. However, the sources of biological information available to decision makers have multiplied significantly over the past several years. This study identifies key factors which predict why natural resource professionals choose one data source over another. The findings of this study may be used by researchers, practitioners, and data producers to better understand the use of science in making natural resource policy.

This study draws upon neo-institutional theory literature to pinpoint potential organizational factors which influence data selection, as well as diffusion theory literature to identify potential environmental factors. These factors inform a research model, which is tested through the collection of original data. These data are used to examine a series of theory-driven organizational and environmental research questions and hypotheses. This study serves to determine the salience of specific aspects of neo-institutional and diffusion theories with regard to explaining data selection decisions.

Data were collected using a web-based survey, which asked questions pertaining to data use, organizational characteristics and perceptions, and decision-making practices. The survey was sent via e-mail to 557 U.S. Fish & Wildlife Service field offices, representing all eight regions of the agency. Some 204 field offices completed the survey, providing a response rate of 36.6%. Multiple analysis of covariance (MANCOVA) procedures were conducted to assess the effects of 22 organizational and

environmental independent variables on dependent variables measuring data selection and data newness (federal, state or local, and non-governmental sources).

This study suggests that federal data are used most frequently by U.S. Fish & Wildlife Service field offices for the purpose of making natural resource policy decisions, followed by state or local data and non-governmental data sources, respectively. Results indicate the U.S. Fish & Wildlife Service may influence its field offices to use non-governmental data sources to supplement governmental data when making policy decisions. This study also suggests that collaborating with a non-governmental organization when making natural resource policy is positively related to the selection of non-governmental data sources. However, the data marketing efforts of non-governmental data producers do not positively relate to non-governmental data selection.

Certain aspects of neo-institutional and diffusion theories were proven salient with regard to explaining data selection among U.S. Fish & Wildlife Service field offices. The neo-institutional theory tenets of institutional isomorphism and path dependency were proven explanatory of data selection decisions. Diffusion theory literature which suggests that interest or advocacy group relationships and the adoption of an innovation by a similar entity positively affect the diffusion of innovations was also proven salient with regard to explaining data selection.

This study recommends that natural resource agency field offices continually reassess their data selection procedures in an effort to select data based on quality. In the quest to make natural resource policy decisions based on *best available science*, it appears that field offices “satisfice” in their data selection decisions and are highly influenced 1) by relationships with non-governmental organizations and 2) the data selection decisions of other field offices. "Satisficing" potentially leads to making natural resource policy based on popular data rather than quality data. This study also recommends that collaboration with natural resource agencies is the best avenue by which data producers can assure their data sets impact policy.

An Examination of Factors that Explain the Use of Data in the
Natural Resource Policy Process

by
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A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Public Administration

Raleigh, North Carolina

2009

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DEDICATION

In memory of my grandmother, Mabel Gerlach Jamison. You always asked me, “How *do* people get Ph.D.s?” Nan, I found out.

In memory of my grandfather, Jimmie Lee Fitzwater, who taught me to never shy away from hard work.

With love for my grandmother, Evelyn Lilly Fitzwater. Thank you for your constant support. I will always strive to make you proud.

With love for my beautiful wife, Amanda, and wonderful daughter, Maya. Having you two in my life is all the motivation I’ll ever need. Amanda, you know this degree is *ours*, not *mine*. I could never ask for a more supportive and loving wife.

BIOGRAPHY

John David Gerlach, II grew up seven miles outside of Point Pleasant, WV. He earned an undergraduate degree in wildlife and fisheries resources from West Virginia University in 2001. In 2003, he earned his M.P.A. from Southern Illinois University Edwardsville. Mr. Gerlach began his doctoral studies in public administration at North Carolina State University in 2004. He taught Introduction to American Government and Introduction to Nonprofits in the Department of Political Science at North Carolina State University from 2004 through 2009. He also taught American Government and International Relations at Durham Technical Community College from 2007 through 2009. He will be on faculty in the Department of Political Science at Texas Tech University beginning in August, 2009.

ACKNOWLEDGEMENTS

This section would be severely lacking if I did not begin by once again expressing my heartfelt gratitude to my wife, Amanda. Without your love and support this dissertation would not be complete, nor would my sanity be intact. I would also like to thank my advisory committee chairperson, Dr. Dennis Daley, for all the time and effort spent in seeing this dissertation through to completion. I would like to thank the rest of my committee members, Drs. Ryan Bosworth, Rich Clerkin, Dave Garson, and Graduate School representative Dr. Bob Pond. I am deeply appreciative of all your help along the way. Special thanks to Dr. Kevin Gergely for your advice on this dissertation and for taking a chance on a fellow West Virginian. Special thanks to Dr. Patricia Heglund, Head Refuge Biologist for Region 3 of the U.S. Fish & Wildlife Service, as well as Dr. Dan Ashe, Science Advisor to the Director of the U.S. Fish & Wildlife Service. Without your willingness to help a complete stranger I would still be working on this project. Special thanks as well to Dr. Roxana Toma, a wonderful colleague and friend, for all of your advice, guidance, and time. Last but not least, I would like to thank my parents, John and Carolyn Gerlach, for teaching me to never be satisfied with "average." You believed in me from the day I was born and still do. The path from Rayburn Road to here was made possible by the two of you. Please know that I'll always follow that path home.

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CHAPTER ONE: INTRODUCTION

As our world changes due to population growth, urban sprawl, and increased consumption of natural resources, it becomes imperative that we enact sound policies governing the use of our natural resources while ensuring their conservation and renewal. The task of creating such policies has never been more complex (Gap Analysis Program [GAP], 2007). Researchers have long sought to identify economic and efficient means by which to maintain our natural resources through the use of sound decision-making strategies and policy analysis (Stroup & Baden, 1983). These decision-making strategies depend on reliable science, i.e. biological information or data, to inform management and policy professionals of priority areas for conservation.

As federal, state, and nonprofit organizations collect biological data based on mapping and the use of geographic information systems (GIS), the selection of these data by policy-making agencies for use in informing the policy process has become increasingly complex. Biological science is produced in a variety of different ways and by a variety of different entities (National Biological Information Infrastructure [NBII], 2007). The traditional role of science in natural resource policy making has been to inform and support the process in a non-biased, policy-relevant, and value-neutral manner (Lackey, 2007; Scott et al., 2007). Today, this role is impeded by two factors, 1) the advocacy of personal policy preferences by certain biological science suppliers and 2) the unclear and seemingly unenforceable standard of *best available science* (Lackey, 2007; Pilkey-Jarvis & Pilkey, 2008; Sullivan et al., 2006). These factors, combined with the sheer volume of biological data available to decision makers, have, at times, led to science playing an insignificant and even detrimental role in the natural resource policy-making process (Pilkey-Jarvis & Pilkey, 2008; Sarewitz, 2004; Sullivan et al., 2006).

This chapter provides a discussion of the research problem and general overview of the theories tested in this study. This is followed by an examination of natural resource policy throughout American history and the evolution of the role of science therein. It should be noted that the terms *natural resource policy making* and *biodiversity management decisions* are used interchangeably throughout this dissertation. Biodiversity management represents a specific natural resource policy issue, and is the focus of this research. The term *biodiversity management decisions* is used throughout the dissertation as the empirical illustration of the more general term, *natural resource policy making.* The current role of science in the natural resource policy process is also discussed and examples of the ambiguity surrounding the use of biological information for decision making are provided. The chapter concludes with an explanation of the relevance of this study to the academic and natural resource governance communities as well as a preview of following chapters.

RESEARCH STATEMENT

The prevalence of science in the natural resource policy-making process presents fertile ground for research pertaining to the factors which explain its selection and subsequent use. Existing social science theories offer potential for explaining these factors. This research examined two sets of theory-driven factors which may explain data selection by policy makers. Neo-institutional theory is the basis for a set of organizational factors. The second set, regarding environmental factors, is supported by diffusion theory. This research determined which tenets of each theory are most salient and indicative of why certain sources of biological information are used in the natural resource policy process and which factors supported by each theory contribute to a sound explanatory model. The research tested the model depicted in Figure 1.1, which incorporates both sets of factors in an effort to explain data selection in a complete and parsimonious manner. It was expected that factors supported by both neo-institutionalism and diffusion theory combine to provide a strong model for the explanation of data use.

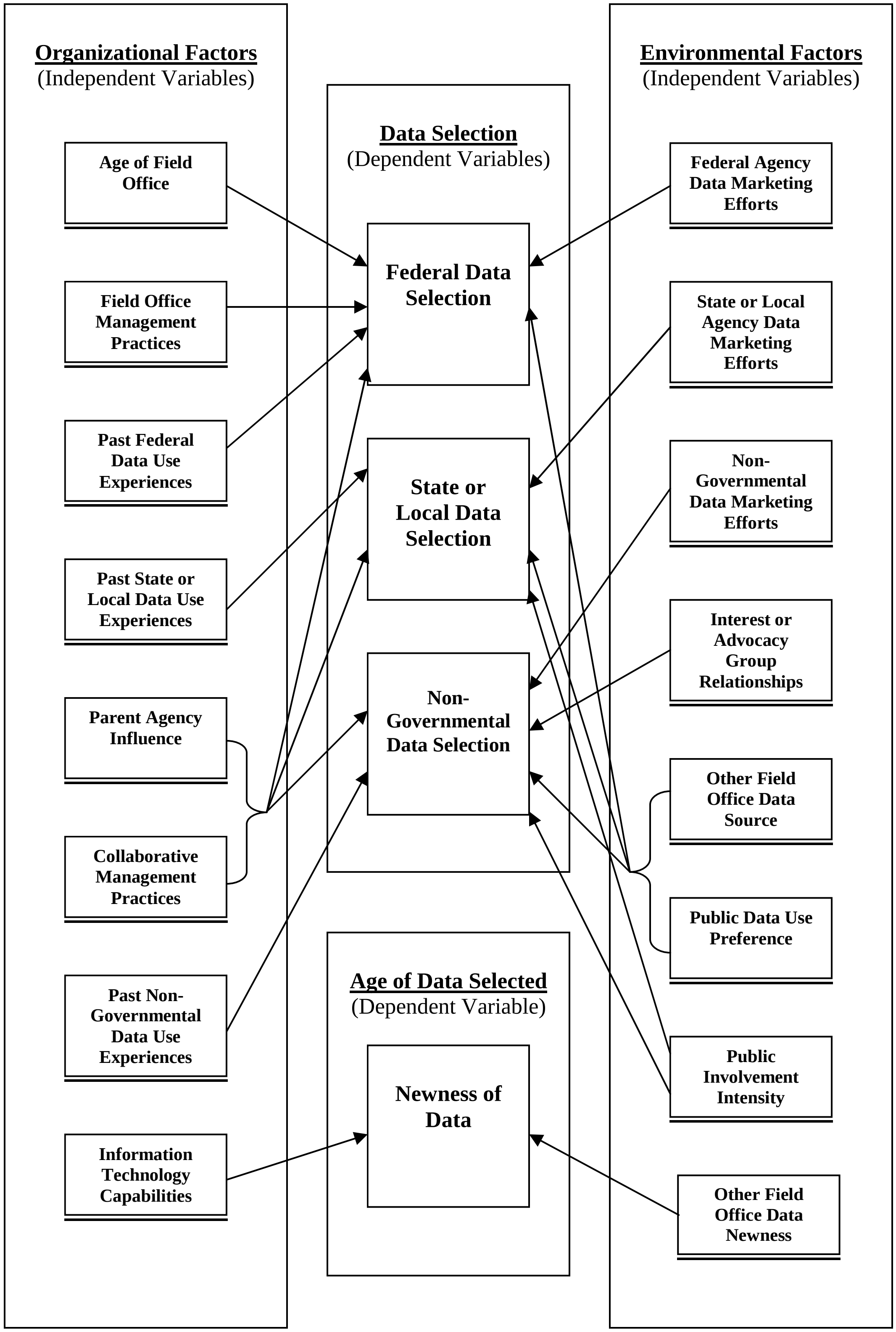

Figure 1.1: Research Model (*arrows indicate hypothesized relationships)

The Research Question

This dissertation answered the following question: Which factors affect natural resource agency field office data selection for use in the natural resource policy-making process? The objective of this study was to determine which organizational characteristics of the natural resource policy-making agency field office and environmental factors influence data selection for making management, conservation, and protection decisions. An additional research objective was to formulate and test a theory-driven research model in an effort to provide a parsimonious explanatory model which incorporates the most salient and telling aspects of neo-institutional and diffusion theories in explaining data selection.

Research objectives were met by surveying the U.S. Fish & Wildlife Service, a federal natural resource agency. The U.S. Fish & Wildlife Service is partitioned into nine regions, including the Washington, D.C. headquarters, and scores of local field offices (U.S. Fish & Wildlife Service [USFWS], 2007). U.S. Fish & Wildlife Service biologists make ground-level natural resource policy decisions, which are often referred to as *biodiversity management decisions*, the term introduced above (Gerlach, 2005). The survey was informed by two prevalent theories, neo-institutionalism and diffusion theory. Neo-institutionalism offers much insight into the organizational factors which may influence data selection, while diffusion theory serves to explain environmental factors at play. The following subsections offer a general overview of each theory. A more detailed examination of neo-institutional and diffusion theories and how they potentially explain data selection follows in chapter two.

Neo-institutional Theory

Elinor Ostrom (1990) defines institutions as "the set of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions" (p. 51). An *institution* has also been described as a social pattern characterized by standard interaction sequences (Jepperson, 1991). Institutions may act as intervening variables in individual decision making and serve to shape organizational potential for policy innovation (Koelble, 1995; Weir, 1992). Neo-institutional theory attempts to explain the change-resistant nature of political organizations and their effect on individual choices (Ostrom, 1990; Pierson, 2000). Neo-institutionalism in organizational theory focuses on organizational structures and processes that are broad in scope (DiMaggio & Powell, 1991).

Neo-institutional theory is divided into three unique schools of thought, referred to in scholarly literature as historical, rational choice, and sociological institutionalism (Hall & Taylor, 1996). According to Koelble (1995), each area of neo-institutionalism is necessary to understanding political phenomena. Though each field of neo-institutionalism possesses unique characteristics, they are bound together by a common theoretical core, the rejection of the behavioralist view that observable behavior is sufficient to explain all political or government actions (Immergut, 1998).

Neo-institutional theory also possesses a strong political science component. Works by Bendor, Moe, & Shotts (2001) and Olsen (2001) comprise a debate over how neo-institutional thought applies to the Garbage Can / Multiple Streams Model, introduced by Cohen, March, & Olsen (1972) and later modified by Kingdon (1984). Literature pertaining to these differing viewpoints, as well as additional political science research related to neo-institutional theory, is detailed in chapter two.

Neo-institutional theory supports several potential organizational factors explaining the use of biological data in the natural resource policy process. A more thorough review of neo-institutionalism, included in chapter two, informs several hypotheses pertaining to organizational factors influencing the selection and use of biological information by natural resource policy-making professionals.

Diffusion Theory

Rogers (1962) defines diffusion as "the process by which an innovation is communicated through certain channels over time among members of a social system" (p. 5). The diffusion of innovations requires four elements: 1) an innovation, 2) a communication system, 3) a social system, and 4) time (Rogers, 1962; Garson, 2008). Strang and Meyer (1993) assert that facilitators to diffusion include actors that fall into the same category, structural conditions, and formal organization. Garson (2008) reports that classic diffusion theory dictates that diffusions occur through a five-stage timeline:

1. knowledge (awareness of the existence of an innovation)
2. persuasion (mobilizing positive attitudes toward the innovation)
3. decision (securing commitment to adopt the innovation)
4. implementation (operationalization in use)

5. confirmation (positive outcomes reinforce the process of diffusion)

This research examined environmental factors influencing the selection of biological information for use in the natural resource policy-making process through the lens of diffusion theory. Chapter two specifically details how the four elements of diffusion theory explained by Rogers (1962) inform the manner in which a natural resource agency field office uses science to make policy. However, prior to a more thorough explanation of the social science theories supporting this research, it is imperative that the development of the natural resource policy process in America and the role of science therein be well understood.

BACKGROUND AND CONTEXT

Stroup and Baden (1983) state, "Natural resources are fundamental components of human welfare" (p. 3). They provide enormous opportunities for human growth (Libby & Clouser, 1990). Governing our natural resources and protecting the environment has been at the forefront of American public policy since Westward expansion became a goal of the United States government in the early 1800s. Though the particular issues and challenges have changed with time, our responsibility to manage, protect, and sustain our natural resources has remained a constant throughout American history.

In the 19th century, United States environmental policy was mostly land and water based, focusing on economic development. The role of science in the policy process was very minimal. The federal government needed Western lands settled and worked. Therefore, laws such as the Homestead Act of 1862 offered lands to new settlers at extremely affordable prices (Andrews, 1999). The lure and promise of landownership, new railroads funded by substantial land grants, and favorable mineral and mining policies caused an influx of Westward expansion. The latter part of the 19^{th} century ushered in the Progressive Era, championed by President Theodore Roosevelt (Andrews, 1999). The Roosevelt administration sought a larger role for government in natural resource and environmental policy making, especially in the area of forest policy. Progressive Era reforms sought to use principles of scientific management, championed by Frederick Taylor (1895), to manage forests for national use and the timber industry (Brunner, Steelman, Coe-Junell, Cromley, Edwards, & Tucker, 2005). Scientific management sought to find, through scientific research, the one best way by which a task should be performed, rise above politics, and gain efficiency through the application of scientific knowledge (Brunner et al., 2005; Taylor, 1895). Thus, the Progressive Era led to the development of conservation agencies, such as the U.S. Forest Service, Bureau of Fisheries and Bureau of Biological Survey, the latter two later consolidated to create the U.S. Fish & Wildlife Service, which implemented hierarchical approaches to managing the United States' forest lands (Andrews, 1999; USFWS, 2007). These conservation agencies also started the United States on a path toward collecting and using biological information to inform policy.

The New Deal represented a turning point in American natural resource and environmental history. The economy was struggling and environmental dilemmas such as uncontrolled flooding and dust storms ravaged the Midwest (Andrews, 1999). The Franklin D. Roosevelt administration responded to these problems with the New Deal. The New Deal saved the environment and economy simultaneously by creating jobs to build shelter belts, take on rural electrification projects, and tackle flood control (Andrews, 1999). The Flood Control Act of 1936 was born out of the nation's need to better evaluate and prepare for flood risks (Andrews, 1999). Under the New Deal, dams were built as newly formed organizations, such as the Civilian Conservation Corps, the Tennessee Valley Authority, and the Works Progress Administration, fought escalating flood problems (Andrews, 1999). The well-known Hoover Dam was built as a result of New Deal policies.

World War II and the years to follow brought about new natural resource policy challenges, which brought science to the forefront of biodiversity conservation. The United States experienced an enormous demographic shift in the 1940s, 50s, and 60s. Americans were moving to urban areas in record numbers (Andrews, 1999). The National Highway System came into existence, presenting new environmental issues and concerns of its own. Under "Mission 66" visitors poured into national parks, forests, and protected lands in droves, presenting unique challenges to the protection of biodiversity and the conservation of these lands' pristine nature (Andrews, 1999). The need for sound biological information to inform policy and management decisions grew alongside the increased use and exploitation of our natural resources.

The "Environmental Movement" arrived in the 1970s as the public reacted to the Cranberry Scare and Rachel Carson's *Silent Spring*. Among other questions, Carson (1962) asked, "Where have all the songbirds gone?" Public mobilization led to the establishment of the National Environmental Policy Act, signed on New Year's Day, 1970 and the creation of the Environmental Protection Agency (EPA) that same year (Andrews, 1999). The establishment of the EPA marked a significant turning point in American natural resource policy history. The agency would soon require environmental impact statements (EIS) for any project with potential to alter the environment. Only entities that could detail their project objectives, methods, impacts on the environment, and mitigation efforts would receive EPA permits to proceed (Vig & Kraft, 2006). The groundwork was thus laid for scientific information to play a permanent and significant role in the natural resource policy-making process (Vig & Kraft, 2006).

The Current Role of Science in Natural Resource Policy Decisions

In the early 1970s, the EPA set a rather vague standard for the use of science in natural resource policy making (Sullivan et al., 2006). The EPA emphasized the use of *best available science* in formulating environmental and natural resource policies, such as the Clean Water Act (Sullivan et al., 2006). The phrase became common and showed up in the wording of the 1973 Endangered Species Act (ESA). The ESA stipulates the listing of threatened or endangered species must be based on the "best scientific and commercial data available" (Sullivan et al., 2006). The National Standard 2 of the Magnuson-Stevens Fishery Conservation and Management Act states that conservation and management efforts must be based on the "best scientific information available" (Sullivan et al., 2006). Recently, the EPA incorporated the phrase "best available scientific information" into describing the process of creating and implementing projects designed to protect the American public from environmental risks (Sullivan et al., 2006). The same wording was used in a 2004 fiscal year report outlining broad and long-term agency goals and objectives (U.S. Environmental

Protection Agency, 2004). However, the definition of *best available science* is not straightforward (Sullivan et al., 2006).

The ambiguous notion of *best available science* coupled with the political nature of policy making opens the door to a variety of obstacles in securing sound natural resource policies. Advocating personal policy preferences through the supply of carefully screened scientific information, termed *normative science,* occurs frequently within the natural resource policy-making community (Lackey, 2007). While natural resource policy-making history dictates that science should “strive to describe the world accurately and is characterized by transparency, reproducibility, and independence” (Lackey, 2007, p. 14), the role of science in policy making today is not perceived as value-free. Citing the work of Daniel Sarewitz (2004), Director of the Consortium for Science, Policy and Outcomes, Robert Lackey (2007) states, “Most science is funded by government agencies, businesses and corporations, and a myriad of public and private interest and advocacy groups” (p. 13). Organizations with vested interests in policy outcomes do not use value-neutral language (Scott et al., 2007). Some natural resource and conservation scholars believe that these groups, coupled with the right divisive issue, can serve to further cloud the ambiguous notion of *best available science* and worsen natural resource policy controversies (Pilkey-Jarvis & Pilkey, 2008; Sarewtiz, 2004).

Today, the lurking question exists: To whom shall natural resource policy-making agencies turn for sound science? Organizations such as the U.S. National Research Council provide technical reviews and evaluations, which are renowned for their objectivity and use of value-neutral language (Scott et al., 2007). On the opposite end of the spectrum, advocacy groups, such as the World Wildlife Fund, also provide scientific information and can be rather tenacious in their attempts to bring that data to decision makers, because they believe in the quality of their data products (Scott et al., 2007). Recently, we have seen these organizations and others across the continuum of *value-neutral* to *normative* science producers take their seats at natural resource policy-making tables. With no straightforward definition of what constitutes *best available science*, the voices to be heard are numerous (Lackey, 2007; Sullivan et al., 2006).

Sources of Biological Information

The amount of biological information available to policy makers is overwhelming. The National Biological Information Infrastructure (NBII) is a "broad, collaborative program [designed] to provide increased access to data and information on the nation's biological resources" (NBII, 2007). NBII collaborates with scores of partners whose overarching goal is to provide natural resource data to policy makers. NBII includes nonprofit, private sector industrial, government agency, academic, and advocacy group producers and suppliers of biological data (NBII, 2007). Most federal land management and science agencies, such as the EPA and Bureau of Land Management, are NBII partners (NBII, 2007). Nonprofit organizations, such as Ducks Unlimited and the American Fisheries Society, also supply biological data through NBII (NBII, 2007). Even private sector consulting firms, such as Loftus Consulting and Natural Resources Information Management, Inc., are NBII partners (NBII, 2007). Though not all sources of biological information are affiliated with NBII, most are, and the program offers a wealth of scientific information which can inform natural resource policy makers at any point in the policy process. NBII prescreens biological information included in its database for accuracy, completeness, and usability, though a correctness and completeness guarantee is not offered (NBII, 2007).

Federal natural resource agencies are well known for producing biological data. The U.S. Geological Survey, which administers the NBII Program, continues to produce data on land stewardship, land cover, species distribution, and habitat protection throughout the United States (GAP, 2007). The Gap Analysis Program (GAP) of the U.S. Geological Survey "provide[s] regional assessments of the conservation status of native vertebrate species and natural land cover types to facilitate the application of this information to land management activities" (GAP, 2007; Gerlach & Jolley, 2007). GAP collects biological data and presents this information to policy makers on the federal, state, or local levels via the program's web portal or software packages (GAP, 2007). GAP is one of many federal government efforts to produce viable biological information. The U.S. Fish & Wildlife Service, U.S. Forest Service, Bureau of Land Management, and other agencies are also producers of biological data (NBII, 2007).

With all of these sources of biological information available to natural resource policy-making agencies and field offices and no clear-cut guidelines dictating which data are acceptable for use, the need for this study was born. This research brought theories which are prevalent in social science literature to bear on the issue of data selection in an attempt to explain why certain sources of biological data are used by policy-making agencies. The current role of science in the natural resource policy process is quite ambiguous, with uncertainty being its hallmark.

Evidence of the Uncertain Role of Science in Natural Resource Policy Making

The aforementioned difficulties are evident in current natural resource policy issues. Two current issues which illustrate the debate over the role of science in natural resource policy making are mountaintop removal mining and forest planning regulations. These issues warrant more detailed discussion.

The Mountaintop Removal Mining Debate

Mountaintop removal mining (MRM) is a surface mining method which extracts multiple coal seams within whole or minimum rock dilution in very steep mountainous terrain (Peng, 2000). This process has been used for nearly thirty years in the Central Appalachian Coalfield, which spans Kentucky, Tennessee, Virginia, Pennsylvania, West Virginia, and a small portion of Ohio (Peng, 2000). MRM is a highly efficient means by which to extract coal from seams either small in size or in close proximity to one another. However, the methods by which MRM is conducted produce adverse environmental side effects, creating a hotly debated environmental policy dilemma (Peng, 2000).

The EPA has asserted itself as the dominant policy-making agency in the MRM debate. The EPA is responsible for issuing MRM permits to coal companies after an application review process that relies on interagency coordination among the EPA, the U.S. Army Corps of Engineers, and state natural resource agencies (Peng, 2000). Consistent with its policy to use *best available science* in decision-making processes, the EPA asked the U.S. Army Corps of Engineers to prepare an EIS on MRM in 2003. The EIS concluded that alternative means for monitoring the MRM permit process and related practices are crucial to the environmental health of MRM sites and surrounding areas (U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Office of Surface Mining, U.S. Fish & Wildlife Service, & West Virginia Department of Environmental Protection, 2003). The MRM permit process is of particular interest in this case. Coal companies are allowed to submit as part of their MRM applications scientific evidence of the effectiveness of their mining methods and reclamation efforts (Peng, 2000).

Arch Coal, one of the nation's largest coal extraction companies, has offered scientific evidence of effectively reclaiming MRM sites. While the company fills 32 miles of railcars with coal each day and supplies 7% of America's electricity, it claims to have planted 1.5 million trees on reclaimed mine sites between 1996 and 2005 (Arch Coal, 2005). The EPA has seen evidence that Arch Coal and other companies have worked to reduce the adverse environmental effects of MRM in recent years. Since 1998, there have been 30% fewer valley fills and a 25% reduction in overall stream impact within West Virginia alone (U.S. Environmental Protection Agency, 2002). However, Arch Coal understands that many do not approve of their land reclamation efforts. The company states, "The challenge for all of us is to get beyond inflammatory rhetoric and endless litigation and work toward an open and collaborative process. Surface mining today is as much a land reclamation process as it is a way of extracting coal" (Arch Coal, 2005). The company continues to provide the EPA with scientific evidence that MRM is environmentally safe when coupled with sound reclamation policies. Opponents of MRM provide scientific evidence to the contrary (Peng, 2000).

While the U.S. Army Corps of Engineers' 2003 EIS on MRM is considered by the EPA to meet their standards of *best available science*, several advocacy groups are providing their own opinions and statistics, which can serve to muddy the waters of making sound policies that serve the common interest (Sarewitz, 2004). Appalachian Voices, an environmental advocacy group focusing on Appalachia, asserts that nearly 500 mountains have been destroyed for coal, adjacent property values have plummeted, and mine runoff into waterways has made them unfit for human and wildlife use (Appalachian Voices, 2004). According to the Sierra Club (2005), more than 1,000 miles of streams have been buried by MRM practices. The Sierra Club (2005) also contends that the landscape is permanently damaged due to valley fills, the air is inundated with dust and debris from blasting, and drinking water is polluted.

The MRM mining debate continues under the Obama administration and is a prime example of the unclear role of science in the policy-making process. No straightforward definition of *best available science* exists, and the consistent use of sound data sources in the policy process is severely lacking. The MRM permit process suffers from the infiltration of data from a variety of different organizations with differing viewpoints on the merits or risks of MRM. Pilkey-Jarvis and Pilkey (2008) assert, "…models are easily distorted to provide inaccurate cost estimates or overly optimistic environmental impact estimates" (p. 472). Speaking specifically of the mining industry, Pilkey-Jarvis and Pilkey (2008) also contend that "consultants simply find the truth according to their clients' needs" (p. 475). This scientific information distortion, which likely occurs on both sides of any given environmental issue, inhibits progress in the policy debate, and further fuels the controversy that surrounds MRM. Meanwhile, questions abound regarding why certain sources of biological information are selected for and used in making MRM permit and practice decisions.

Forest Planning Regulations

In 2004, the Bush administration revised U.S. forest planning regulations (FPR). FPR dictate how the U.S. Forest Service manages the 192 million acres of national forests within the United States' borders (Eilperin, 2004). The Bush administration's goals were to streamline the planning process, allow forest supervisors more ground-level policy discretion, and create a more holistic approach to forest planning and management (Eilperin, 2004). New Environmental Management Systems (NEMS) were created to allow foresters greater discretion to set goals and implement management decisions ("Forest Service Publishes," 2005). NEMS were also designed to cut planning costs and implementation time. A small management change would require a modest or no formal EIS ("Forest Service Publishes," 2005). However, a large, sweeping policy change would require a thorough EIS ("Forest Service Publishes," 2005).

The Bush administration's FPR require the use of *best available science* in making all forest planning, management, and implementation decisions (Eilperin, 2004). As in the case of MRM, *best available science* is non-definitive and unenforceable. Science, especially when used in predictive modeling procedures, can be distorted to meet the objectives of any advocacy group rather than accurately address a given environmental or natural resource issue (Pilkey-Jarvis & Pilkey, 2008). Environmental groups, such as Defenders of Wildlife, vehemently oppose the Bush administration's FPR and seek to provide scientific information of their own in hopes of influencing forest planning and management policies (Berman, 2004). It remains to be seen whether or not their efforts are fruitful under the Obama administration. However, the notion of *best available science* has been attacked by both the U.S. Forest Service and environmental nonprofit organizations in this case, providing yet another example of the ambiguity that exists in applying science to policy decisions.

RELEVANCE OF THE RESEARCH

The goal of biological information is to effectively inform natural resource policy making and aid in necessary policy changes (GAP, 2007). Scientific examination provides the means to evaluate policy alternatives and options (Clark, 2002). Sound biological information should also be transparent, reproducible, and independently gathered (Lackey, 2007; Pilkey-Jarvis & Pilkey, 2008). According to U.S. Fish & Wildlife Service biologists working in North Carolina, science should play a significant role in informing decision makers of the current and projected status of natural resource policy issues (Gerlach, 2005). However, choosing data for this purpose is an arduous task due to the voluminous sources of scientific information available. This research sought to clarify the factors influencing how biological information is selected for use in the natural resource policy process. A greater understanding of these factors has theoretical and practical benefits.

From the standpoint of theoretical relevance, this research tested the applicability of two well-known theories, neo-institutional theory and diffusion theory, in the natural resource policy-making arena. These theories have received relatively little exploration in the natural resource policy process and little to no attention in determining factors related to scientific data selection. This study further tested the merits of neo-institutional theory and diffusion theory and adds to the literature on each a greater understanding of how they apply in yet another area of public policy. The results of this research provide a parsimonious explanatory model based on principles of neo-institutional theory and diffusion theory that may be tested in other areas of public policy making.

This study contributes to the practical realm of natural resource policy in three ways. First, natural resource policy-making professionals are better equipped with the knowledge necessary to evaluate agency data selection processes at the field office level, where most regional and local policies are either informed or conceptualized. Second, the results of this study inform suppliers of biological information of the factors which indicate a policy-making office with the capability to select and use sound, policy-relevant data in making conservation and management decisions. Third, this research provides a better understanding of the diffusion of biological information throughout the natural resource policy-making community. The chapters to follow illuminate the pathway by which these results were obtained and detail their interpretation and applicability to natural resource policy-making agencies and field offices.

PREVIEW OF CHAPTERS

Chapter two discusses the literature and theories germane to the research. Potential factors influencing the selection of data for use in the natural resource policy-making process are identified and discussed. Organizational and environmental factors are explored as potential indicators of data selection. Based on this literature review, hypotheses were postulated for examination.

Chapter three details the research methodology followed in the study. This chapter discusses the rationale behind the selection of U.S. Fish & Wildlife Service field offices as the study's unit of analysis, how the data were gathered, and data analysis methods and tools. Research questions and hypotheses are outlined in further detail. Chapter three also discusses the operationalization of key research variables.

The remaining chapters of this dissertation detail the data analysis procedures and conclusions drawn from the analysis. Chapters four and five examine descriptive statistics of key variables used in the study. Key bivariate Pearson correlations as well as multiple analysis of covariance (MANCOVA) procedures, which tested the validity of hypothesized organizational and environmental factors which affect data selection decisions, are discussed. Chapter four is devoted to the analysis of organizational factors, while chapter five is devoted to environmental factors. This study concludes with a discussion of the findings and implications of this research in chapter six.

CHAPTER TWO: REVIEW OF THEORETIC LITERATURE

Social science research and theory offers significant insight into potential factors influencing the selection of biological data for use in making natural resource policy, or, as is the focus of this study, biodiversity management decisions. In addition to traditional social science literature, research pertaining to the natural resource policy process also explains the use of science in making conservation and management decisions. This chapter discusses the theoretical bases for a series of testable hypotheses designed to explain data selection decisions made by natural resource agency field offices.

In this study, factors affecting data selection were divided into two categories, organizational and environmental. Organizational factors are important to understanding the use of science in natural resource policy making because they offer insight into the culture and norms which govern a natural resource agency, or in the case of this research, an agency field office. Environmental factors provide information pertaining to the natural resource policy-making climate as well as the pressures facing decision-making agencies and field offices. When combined, the exploration of organizational and environmental factors offers a more thorough understanding of why biological data sources are selected for use in the natural resource policy-making process.

Neo-institutional and diffusion theories provided the theoretical bases for nine hypotheses pertaining to the selection of biological information by natural resource agency field offices. Neo-institutional theory lends a significant amount of support to potential organizational factors, while diffusion theory is the basis for most environmental factors identified. However, it should be noted that certain tenets of each theory are shown to compliment one another in the formulation of some hypotheses as well as lend support to natural resource policy research in illuminating potential influencing factors. The research discussed in this chapter and the hypotheses which it supports serves as the theoretical basis for the research model presented in Figure 2.1 (repeat of Figure 1.1). The model was empirically tested to 1) determine which tenets of each major theory are most salient and indicative of data selection and 2) provide a parsimonious explanatory model which may be applied to data selection decisions throughout the natural resource policy-making community.

The following literature review achieves four main objectives. First, research pertaining to neo-institutional and diffusion theories is discussed as the theories and their relevance to the current study are detailed. Second, potential organizational factors supported by neo-institutional theory are identified which may influence the selection of biological information by natural resource agency field offices. Third, potential environmental factors tied to diffusion theory are identified which may also play a role in influencing data selection. Fourth, a series of theoretically-based hypotheses are presented to test the hypothesized relationships in the model shown in Figure 2.1.

ORGANIZATIONAL FACTORS

A sound knowledge of scholarly literature describing organizational factors at play within a public agency is imperative to understanding natural resource data selection within policy-making field offices. Such an understanding of the organization provides context within which decisions can be studied as well as a feel for the power structure at work within the organization (Thomas & Griffin, 2003). While it is important to note that the individual within the organization may play a large role in organizational decisions (Aronson, 2003; Meglino & Korsgaard, 2004), this study focused on the organization, specifically the natural resource agency field office, as the unit of analysis when considering organizational factors influencing data selection. More specifically, the institutionalization of organizational practices offers significant insight into the data selection decisions of natural resource agency field offices.

Organization-focused research is abundant. However, literature pertaining to neo-institutional theory provides a clear lens through which to view potential organizational factors influencing data selection. This portion of the chapter discusses neo-institutional theory in detail as well as the contributions of other social science and natural resource policy research. Under a neo-institutional umbrella, hypotheses pertaining to potential organizational factors influencing the selection of biological information for use in the natural resource policy process are presented.

Neo-institutional Theory

As expressed in chapter one, Elinor Ostrom (1990) defines institutions as “the set of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on their actions” (p. 51). According to Immergut (1998), neo-institutional theory is predicated on three assumptions: 1) political behavior does not reveal an individual's *real* interests due to the presence of other factors influencing that action, 2) individual behaviors or interests do not sum up to collective action because the methods for aggregating interests also influence outcomes, and 3) institutional structures, such as the decision-making process, are biased toward particular sets of interests and may need to be reformed to improve the justness of institutional outcomes. Neo-institutional theory holds that behavior within an organization is influenced greatly by the institutional context in which it occurs (Immergut, 1998).

Neo-institutionalism does not constitute a unified body of thought. Rather, three different analytical approaches contribute to neo-institutional theory, each of which offers a unique perspective on institutions and institutional change. Those schools of thought are 1) historical, 2) rational choice, and 3) sociological institutionalism. Koelble (1995) maintains that an understanding of each area of neo-institutional theory is necessary to analyzing political phenomena. To understand the effects of institutions on organizational actions, a sound comprehension of the similarities and differences between the three schools of neo-institutional thought is imperative.

Historical institutionalism developed in response to group theory and structural-functionalism (Hall & Taylor, 1996). This school of thought maintains that conflict among rival groups for scarce resources lies at the heart of politics (Hall & Taylor, 1996). Historical institutionalism views the relationship between the institution and individual as either a "calculus approach" or "cultural approach" (Hall & Taylor, 1996). The "calculus approach" suggests that individuals are profit maximizers, carefully calculating each action (Hall & Taylor, 1996). The "cultural approach" suggests that the individual's actions are bound by his or her worldview (Hall & Taylor, 1996). Historical institutionalism is known for portraying the lack of choices available to the individual due to the confinement of the institution.

Historical institutionalism describes institutional change as “path dependent” (North, 1990; Pierson, 2000). *Path dependency* refers to the adaptations to previous arrangements that make policy reversal costly and unattractive (Pierson, 2000). As elaborate social and economic networks are built to implement choices, those initial choices “lock in” options that increase the cost of exit from those arrangements (Pierson, 2000). Historical institutionalism views institutional change as extremely difficult, particularly due to the self perpetuation of accepted practices (North, 1990). Institutional changes face considerable obstacles due to the presence of long-standing rules and the self perpetuation of organizational norms (North, 1990; Pierson, 2000). Historical institutionalism maintains that institutions are born into a world replete with older institutions that govern action and change likelihood.

Rational choice institutionalism views institutional creation as the product of voluntary agreements among relevant actors (Hall & Taylor, 1996). According to Margaret Levi (1997), the rational choice school of thought contributes a major tenet to neo-institutional theory: It reveals how intentional and rational actors generate collective outcomes and aggregate behaviors. Rational choice institutionalism suggests that actors in policy decisions have fixed preferences, behave entirely instrumentally as to maximize the attainment of those preferences, and do so in a highly strategic manner that presumes extensive calculation (Hall & Taylor, 1996). While historical institutionalism views institutions as standing alone in the determination of individual preferences, the rational choice school of thought asserts that individuals *do* have choices within the context of the institution (Hall & Taylor, 1996).

Rational choice institutionalism views institutional change through the lens of profit maximization and strategic interaction. Levi (1990) posits that institutional change is most likely when the effectiveness of those seeking change increases and that of those supporting the status quo decreases. Rational choice institutionalism views institutional change as a social bargain in which there are returns for compliance (Levi, 1990). When the factors upon which compliance is based begin to break down, compliance may be withdrawn, leading to a redistribution of power and eventual institutional change (Levi, 1990).

Sociological institutionalism arose primarily within the subfield of organizational theory (Hall & Taylor, 1996). The sociological school of thought argues that many institutional forms and procedures are not adopted solely because they are the most efficient means to an end. Rather, many of these forms and procedures can be viewed as culturally-specific practices. According to sociological institutionalism, bureaucratic practices of any type can be explained in cultural terms (Hall & Taylor, 1996). Sociological institutionalism seeks explanations for why organizations take on specific institutional forms, procedures, or symbols, while emphasizing the diffusion of practices throughout organizational fields (Hall & Taylor, 1996). Sociological institutionalism seeks to redefine "culture" as "institutions" and maintains that the main goal of an institution is the attainment of social legitimacy (Hall & Taylor, 1996; Koelble, 1995).

Sociological institutionalism views institutional change very different than the other two schools of neo-institutional thought. Sociological institutionalist thought maintains that institutions originate and change due to cultural pulls in order to enhance the social legitimacy of either the organization or the individual (Hall & Taylor, 1996). Sociological institutionalism does not view institutional change as a vehicle to equilibrium, where relevant actors are all satisfied, nor does it view change as difficult to achieve (Levi, 1990). Rather, sociological institutionalism views change as a necessary function of institutions as those governed by them continually seek legitimacy in society and culture (Levi, 1990).

Immergut (1998) outlines three common theoretical themes among the historical, rational choice, and sociological schools of neo-institutional thought. First, political behavior does not reveal *real* preferences (Immergut, 1998). Other factors influence the behavior of individuals within the institution (Immergut, 1998). Second, individual behavior does not sum to collective action (Immergut, 1998). Rather, methods of aggregation also influence outcomes. Third, institutional structures are biased toward particular interests. Historical institutionalism seeks to maintain a status quo level of comfort, rational choice seeks to strategically interact and maximize gains (maintain equilibrium when gains are acceptable), and sociological institutionalism seeks to structure institutions in a quest for social legitimacy (Hall & Taylor, 1996; Immergut, 1998).

Political Science and Neo-Institutional Theory

Recent debate within political science literature has focused on the Garbage Can / Multiple Streams Model, introduced by Cohen, March, and Olsen (1972) and later modified by Kingdon (1984), and its contributions to neo-institutional thought. Bendor, Moe, and Shotts (2001) assert that the verbal theory of Cohen et al.'s (1972) Garbage Can approach to how choices are made and the computer model they provide are misaligned. Bendor et al. (2001) state:

> Decision makers in the verbal theory confront a chaotic world in which they, solutions, and problems dance around one another, meeting by chance in choice arenas. But in the simulation, packs of decision makers – and often problems as well – march in lockstep from arena to arena. And solutions never move at all. (p. 182)

Bendor et al. (2001) do not believe the Garbage Can Model is reaching its full potential due to its ambiguity.

Johan Olsen (2001) vehemently rebuts the claims of Bendor et al. (2001). Olsen (2001) asserts that the original 1972 work offers only assumptions within a model that "problems, solutions, decision makers, and choice opportunities are independent, exogenous streams flowing through a system" (p. 191). Cohen et al. (1972) did not claim *the* Garbage Can *Theory*, as stated by Bendor et al. (2001). Rather, the authors presented *a* Garbage Can *Model*, leaving the door open for both the expansion of their model and the formulation of additional models to inform neo-institutional thought (Olsen, 2001). Olsen (2001) claims that Bendor et al. (2001) "build on a narrow concept of what is valuable political science" (p. 196) and miss key components of the Garbage Can Model dialogue.

In addition to debate, neo-institutional thought encounters its share of dissent among political science and behavioral literature today. Kim (2005) asserts that neo-institutionalism fails to adequately explain institutional change, choosing to focus only on institutional embeddedness. According to Kim (2005), a systems perspective would argue that institutional embeddedness *is* the source of institutional change. Furthermore, neo-institutionalism attempts to explain institutional change through the aggregation of several exogenous factors, including technology, culture, and ideology (Hira & Hira, 2000). This provides for an unclear explanation of institutional change. These multiple factors, coupled with differing approaches to the study of institutional change, lend more to a multi-theoretic approach to understanding change within the organization (Hira & Hira, 2000; Lowndes, 1996). Detractors assert that more can be accomplished by separately examining the factors included in the neo-institutional view of institutional change, such as formal and informal rules, the role of rational action, institutional stability, technology, culture, and ideology, than can be learned by studying neo-institutional theory (Hira & Hira, 2000; Kim, 2005; Lowndes, 1996).

Regardless of dissent, the overwhelming study and acceptance of neo-institutional theory demanded its exploration as a theoretical basis for potential organizational factors influencing data selection by natural resource policy-making field offices. Tenets of neo-institutional thought apply to natural resource agencies, just as they do other areas of public administration. Neo-institutional literature and its relationship to the natural resource policy-making arena provided ample support for testable hypotheses regarding institutions and their effects on field office data selection.

Neo-Institutional Theory and Natural Resource Data Selection

A common theme exists in neo-institutional literature: Institutions affect choice (Hall & Taylor, 1996; Immergut, 1998; Ostrom, 1990). Organizational behavior is influenced by the institutional context in which it occurs (Immergut, 1998). These long-standing institutional constraints are difficult to break. Natural resource policy literature suggests natural resource agencies strive for power and influence on the national policy-making landscape, with varying degrees of success (Clarke & McCool, 1996). Of the three schools of neo-institutional thought, sociological institutionalism seems to offer the most insight into why natural resource agency field offices select certain sources of biological information. Sociological institutionalism is predicated on a quest for social legitimacy (Hall & Taylor, 1996; Levi, 1990), which may explain why field offices select certain data sources over others. This study examined the impact of neo-institutional theory on the data selection decisions of the natural resource agency field office mainly through the lens of sociological institutionalism.

As part of the quest for legitimacy within natural resource agencies (and their field offices), the concept of institutional isomorphism may play a role in determining data selection among field offices. As the natural resource agency fights for acceptance within the policy-making community, the possibility exists that certain coercive pressures are placed on field offices to make data selection decisions that will advance the agenda of the parent agency. Additionally, the policy-making landscape and trends in natural resource management may place added mimetic and normative pressures on field offices to select and use certain forms of biological information in making policy decisions. Therefore, as an extension of the sociological institutionalism discussion, institutional isomorphism was considered as a potential factor influencing data selection.

As field office practices are institutionalized, the need to pay particular attention to path dependency exists. Pierson (2000) introduced the concept of *institutional stickiness*, the idea that formal political institutions are change-resistant due to the designers seeking to constrain themselves or successors creating rules that make policy arrangements difficult to reverse. The self perpetuation of institutional practices creates the aforementioned path dependency, which leads individuals and organizations to act according to a mythical notion of what is appropriate (March & Olsen, 1989; North, 1990). In this manner, institutions serve as an undeniable variable in the choices of individuals and organizations (Koelble, 1995). In conjunction with the natural resource agency and field office quest for legitimacy in the policy-making community, the establishment of path dependency warranted exploration as a potential factor influencing data selection decisions at the field office level.

The institutionalization of practices within natural resource agencies and their field offices has sparked a call for a new framework for approaching natural resource policy as well as a new role for science in the policy process (Carden, 2006). In this study, the salience of neo-institutional theory was tested on natural resource agency field office data selection by examining 1) the contributions of sociological institutionalism to our understanding of the research problem and, specifically, how institutional isomorphism may affect field office data selection, and 2) the tendency of field offices to be path dependent in their data selection decisions.

Sociological Institutionalism and Natural Resource Data Selection

While each school of thought within neo-institutional theory offers insight into natural resource data selection, sociological institutionalism seems to offer the best explanation for these decisions. Zucker (1991) asserts that policy makers select policies based on cultural conformity rather than other considerations. Organizations are thought to imitate decisions that are viewed as highly legitimate and deemed “acceptable” by others in the same organizational community (Zucker, 1991). Sociological institutionalism emphasizes embeddedness in multiple relationships, such as culture, society, and organizational identity (Hall & Taylor, 1996). From this standpoint, sociological institutionalism offers insight into how the culture within which an organization exists impacts its decision-making.

Much research has been devoted to studying sociological institutionalism in public policy-making processes. McAdam, Tarrow, and Tilly (1997) identified three main orienting concepts through which policy decisions are made: 1) political opportunities, 2) mobilizing structures, and 3) framing processes. The sociological institutionalist argument for framing decisions is that policy decisions must be made that will enhance the social legitimacy of the organization (Hall & Taylor, 1996; McAdam et al., 1997). Research shows that government organizations often make policy decisions in an effort to mimic other organizations rather than respond to internal needs (Knoke, 1982; Tolbert & Zucker, 1983). For example, Tolbert and Zucker (1983) found that cities adopting a council-manager form of government in the early 1900s did so to conform to the cultural norms at play within the municipal government community. Making policy decisions that represent appropriate solutions to problems can be a secondary objective in many organizations to a quest for social legitimacy and acceptance (Zucker, 1991; Tolbert & Zucker, 1983).

Natural resource agencies and field offices are not immune from the decision-making constraints of sociological institutionalism. It is common for a natural resource agency to seek power and legitimacy within the natural resource community (Clarke & McCool, 1996). Those that accomplish legitimacy are able to secure a stable niche within the natural resource environment. Clarke & McCool (1996) call these agencies "bureaucratic superstars" because of their abilities to adapt to their environments and continually influence policy. Clarke & McCool (1996) label the U.S. Army Corps of Engineers and the U.S. Forest Service, two of the oldest natural resource agencies in American history, as such agencies. This research examined the elements of legitimacy and organizational age within the realm of data selection at the field office level. A rundown of NBII (2007) partners and their organizational histories indicates that federal government data sources largely pre-date state or local government sources, which are often older than non-governmental data sources. Previous research corroborates this line of thinking among field biologists (Gerlach, 2005). This study tested the relationship between the age of a field office and the selection of federal government agency data by examining the following hypothesis.

- ***H_1: The age of a field office is positively associated with its selection of federal government agency data.***

Institutional Isomorphism

Literature pertaining to institutional isomorphism also offers insight into organizational (as well as environmental) factors which may explain natural resource data selection among field offices. The concept of institutional isomorphism has ties to sociological institutionalism literature. Meyer and Rowan (1991) assert that increasing organizational homogeneity is the result of organizations changing structures or practices in accordance with socially legitimated myths. Isomorphism is predicated on the thought that by incorporating accepted structures or practices, organizations can increase their legitimacy and boost their resources and survival prospects (Meyer & Rowan, 1991; Townley, 1997). However, policies created along an isomorphic pathway do not always offer optimal solutions to problems facing the organization (Meyer & Rowan, 1991; Townley, 1997; Zucker, 1991).

Institutional isomorphism occurs in three forms: 1) coercive, 2) mimetic, and 3) normative (DiMaggio & Powell, 1983). *Coercive* isomorphism is the result of an authoritative entity giving direct or subtle cues to conform to an accepted organizational model or suffer the consequences of not doing so (Meyer & Scott, 1992; Scott, 1991). *Mimetic* isomorphism occurs as organizations copy established decision-making patterns in an effort to reap similar rewards or profits (Meyer & Scott, 1992; Scott, 1991). In some cases, mimetic isomorphism may occur after coercive isomorphism (Meyer & Scott, 1992). *Normative* isomorphism has perhaps the strongest ties to the social legitimacy factor presented in sociological institutionalism literature. Normative isomorphism often follows coercive and / or mimetic isomorphism as the perception grows that established decision-making practices have become sanctioned by "successful" organizational leaders within a particular organizational community (Meyer & Scott, 1992). In this study, coercive and normative isomorphism within natural resource agencies and field offices were examined under the umbrella of organizational factors which may influence data selection. Attention was also paid to mimetic and normative isomorphic processes as they pertain to diffusion theory and environmental factors influencing data selection.

Coercive Isomorphism and Natural Resource Agency Field Offices

Hannan and Freeman (1977) suggest an evolutionary explanation to organizational isomorphism. Competition theory states that organizations will compete most intensely with similar size organizations for resources and will contribute to a type of natural selection through competition (Hannan & Freeman, 1977). As survival goes, Baum and Oliver (1992) assert that as organizations become more embedded in institutional environments survival advantages are provided by resource access and legitimacy. Institutionally linked organizations possess a strong survival advantage over detached organizations (Baum & Oliver, 1992). Within the natural resource community, the U.S. Fish & Wildlife Service is commonly viewed as institutionally linked to the Natural Resources and Conservation Service and the National Park Service (Clarke & McCool, 1996). This institutional linkage and desire to compete in the natural resource funding game makes top-down, agency-to-field office coercive isomorphism a plausible factor in field office data selection decisions.

The concept of coercive isomorphism provides a lens through which to examine the impact of the natural resource agency on the selection of biological information at the field office level. DiMaggio and Powell (1991) argue that coercive isomorphism is most likely to occur where there is financial dependence, centralized resources with limited alternatives, and where the dependent organization has ambiguous goals or outputs. The natural resource agency field office is certainly financially dependent on the agency as a whole. The U.S. Fish & Wildlife Service is structured such that field offices are the administrative branches of the Washington, D.C. headquarters and regional offices (USFWS, 2007). However, field offices exercise a significant amount of autonomy in making data selection and many natural resource policy, or biodiversity management, decisions (Gerlach, 2005). In the race for government funding, the natural resource agency may feel a substantial amount of pressure to follow the suggestion of Hannan and Freeman (1984): either "fit" into its environment or be "selected against" and die. Scholarly literature is replete with stories of natural resource agencies that have lost power and become what Clarke and McCool (1996) label as "organizational shooting stars," or agencies which are losing or have lost their credibility within the natural resource community. Due to the fact that the natural resource community is competitive and the agency holds a substantial amount of financial and administrative power over the field office, coercive isomorphism warranted exploration as a potential organizational factor influencing field office data selection.

As natural resource agency field offices have the option of using federal government-produced biological information, it stands to reason that the incentive exists for the agency to pressure field offices to select such data sources. As evidenced by the existing technology discrepancy among U.S. Fish & Wildlife Service field offices (Gerlach, 2005), discretionary funding may be a significant motivator in the field office selection of federal government data. Coercive isomorphism has not been studied in the realm of natural resource agency field offices. However, based on applicable scholarly literature as well as my previous research, this study tested the following hypothesis to assess direct and indirect coercive isomorphism.

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***

Normative Isomorphism and Natural Resource Agency Field Offices

Normative isomorphism exhibits perhaps the strongest ties to the social legitimacy quest of natural resource organizations, in the case of this research, field offices. Normative isomorphism is often a product of certain practices or decision-making processes being thought of as acceptable protocol within a particular community (Meyer & Scott, 1992). The role of normative isomorphism in natural resource data selection can best be studied through the lens of the changing trend toward more ecosystem-level and collaborative management among field offices. As ecosystem-level and collaborative management practices become more socially acceptable among natural resource agencies and field offices, field office data selection decisions may be altered by elements of normative isomorphism.

Natural Resource Management Practices

Natural resource agencies deal with a variety of conservation, management, and protection issues. The U.S. Fish & Wildlife Service is structured such that field offices are strategically placed near areas in which the agency's services are most needed (USFWS, 2007). A recent trend toward large-scale ecosystem management using the cooperation of other natural resource agencies and organizations warranted the exploration of differing management practices as a potential catalyst for normative isomorphic behavior influencing field office data selection. Some sources of biological information cater more to species-level management efforts, while others are designed for ecosystem maintenance (Gerlach, 2005). Our understanding of field office data selection is enhanced by an exploration of potential influencing factors pertaining to the management style and practices of these offices.

Natural resource policy literature suggests that management practices differ from agency to agency, and even field office to field office. Collaborative approaches to biodiversity conservation aid agencies in finding legitimacy, within the natural resource community and society at large, and making an impact in the policy-making and implementation processes (Sabatier et al., 2004). Sabatier et al. (2004) state, “Collaborative institutions consist of formal and informal rules for making collective decisions and governing actual resource use behavior” (p. 262). Incentives to collaborate and cooperate with other agencies include easier management of large landholdings and the preservation of complex species (Thomas, 2003). Collaborative efforts can benefit an agency or field office by allowing it to share data and other resources, thus reducing operating costs (Thomas, 2003). Collaborative efforts also uniquely combat complex problems, and, with public input, can foster community-based initiatives designed to remedy natural resource dilemmas on a more localized level (Brunner et al., 2005).

Arm-in-arm with the move toward more collaborative management efforts is a trend toward ecosystem-level management within natural resource agencies (Clark, 2002). Clark (2002) asserts that “ecosystem management appeared in the last two decades of the twentieth century” (p. 44). This management style calls for a holistic and integrated science, public involvement, collaborative decision making, and adaptable institutions (Cortner, 2000). Ecosystem management involves the conservation of biodiversity on the ecosystem level, as opposed to species-level management, which focuses on an individual species (Gerlach, 2005). Some scholars argue for a full-scale movement toward ecosystem-level management as standard operating procedure, but acknowledge that institutional change would be necessary for this to occur (Cortner, 2000). The move toward ecosystem-level and collaborative management efforts seems to be the currently accepted norm within the natural resource community (Clark, 2002), and may have a significant impact on data selection.

Differences in natural resource management practices have been shown to impact data selection in the state of North Carolina (Gerlach, 2005). During an August, 2005 meeting of the Roanoke-Tar-Neuse-Cape Fear Biologists Committee, U.S. Fish & Wildlife Service biologists were given an opportunity to comment on data selection and their impressions of the U.S. Geological Survey GAP Ecosystem Data Explorer Tool, a biological database providing species range, habitat, land cover, and land stewardship data (Gerlach, 2005). Several biologists indicated that GAP data (a federal source) provides too coarse a GIS filter for use on the refuge level, which often includes species-level management (Gerlach, 2005). State and local government agency data is often better equipped for making more localized species- or refuge-level natural resource policy decisions (Gerlach, 2005). Conversely, the move toward ecosystem-level management may call for increased use of federal government data (Gerlach, 2005).

Examining the impact of natural resource management practices on data selection for use in the policy-making process offers a unique contribution to natural resource policy literature. Based on the limited research available pertaining to collaboration, management levels, and science as well as the sociological institutionalist approach to making policy decisions, this study examined the following hypotheses pertaining to management practices and normative isomorphic tendencies among field offices.

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***
- ***H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.***

Natural Resource Agency Field Offices and Path Dependency

Much attention within neo-institutional research has been paid to path dependency. Pierson (2000) asserts that adherence to institutionalized methods of operation often make undergoing change too costly for an organization. Pierson and Skocpol (2002) state, "…once actors have ventured far down a particular path, they are likely to find it very difficult to reverse course…The path not taken or the political alternatives that were once quite plausible may become irretrievably lost" (p. 695). Existing research on the path dependent tendencies of organizations, as well as the potential institutionalization of data selection processes resulting from the search for social legitimacy and institutional isomorphism, warranted its exploration within natural resource agency field offices.

Path dependency has been proven to affect rates of organizational change and adaptation. Duit (2007) tested path dependency in the midst of widespread industrial change regarding emissions control in Sweden. Duit (2007) found that organizational reactions to new developments within the emissions industry were highly path dependent, even in the face of far-reaching reforms implemented in the 1990s. Similar results have been achieved by path dependency research conducted in public school systems. In examining social promotion policies in public schools, Robinson and Meier (2006) found that past decisions 1) directly affect the scope of alternatives available to an organization and 2) indirectly affect available alternatives by changing the relationship between the organization's environment and its current alternatives. In both cases, the authors assert that failing to account for path dependencies in modeling the outputs of organizations or administrative agencies would be an egregious error (Duit, 2007; Robinson & Meier, 2006).

The concept of *repetitive momentum* should be discussed alongside path dependency. Repetitive momentum describes the tendency to maintain direction and emphasis on prior actions in current behavior (Baum, 1996). If a particular change becomes causally linked with success in the minds of organizational leaders, reinforcement effects will make that new action more likely to continue (Baum, 1996). Natural resource agencies are known for developing path dependent and repetitive momentum tendencies over time (Clarke & McCool, 1996; Clark, 2002). In a natural resource agency field office, a positive experience using a particular data set can lead to the current, and perhaps future, use of data from similar sources (Gerlach, 2005). The aforementioned literature called for an examination of the following hypothesis.

- ***H_4: Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.***

Information Technology and Path Dependency

A potential contributing factor to path dependency within a natural resource agency field office is information technology capabilities. Given the differing software capabilities among U.S. Fish & Wildlife Service field offices found in previous research (Gerlach, 2005), the current study further examined those inequities. The information technology capacities of individual field offices may force them into path dependent behaviors by placing additional constraints on organizational decision-making with regards to data selection. Additional resources are necessary to overcome technological obstacles (Karch, 2006). However, those additional resources are not always available or handed down to the field office (Gerlach, 2005).

The U.S. Fish & Wildlife Service and other natural resource agencies use a variety of scientific software packages to analyze data and make policy decisions (USFWS, 2007). However, even when they use the same software, biological data software packages are not always available to each field office in the same version (Gerlach, 2005). ArcView is a GIS and mapping software which allows the natural resource professional to create maps, read existing data sets, add data to existing data sets, and which facilitates the integration and sharing of data organization-wide (ESRI, 2007). Based on previous research, ArcView is the most commonly used full-featured GIS software within the U.S. Fish & Wildlife Service (Gerlach, 2005). The software allows one to examine the geographic context of data, investigate species relationships and patterns, and make scientifically-supported natural resource policy decisions (ESRI, 2007). Many existing data sets are early-version ArcView compatible. However, the U.S. Geological Survey, for example, provides some data through the GAP program that cannot be navigated by field offices with access only to ArcView version 3.1 (Gerlach, 2005). As many biological data sets are available to decision makers in ArcView 9.2 and other more recent software packages, natural resource agency field offices struggle to stay current from an information technology standpoint (Gerlach, 2005).

Information technology capabilities can be either a facilitator or barrier to the selection and use of certain biological data (Gerlach, 2005). Technology introduces competitive advantages and can render the competencies of existing agencies obsolete (Baum, 1996). With time, an agency must adapt to new technological advancements and the environment in which it exists (Baum, 1996). However, there is evidence that some natural resource agencies have not done so across all locations and field offices, especially in the area of information technology (Gerlach, 2005). While GIS software choices are limited (and usually confined to a version of ArcView within the U.S. Fish & Wildlife Service), the translation dilemma between different versions seems to be prevalent. Such information technology issues contribute to path dependency within natural resource agency field offices and limit access to newer data sets. To test the effect of information technology capabilities on data selection, this study examined the following hypothesis.

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***

Summary of Hypotheses Pertaining to Organizational Factors

Neo-institutional and natural resource policy literature provide the theoretical bases for hypotheses pertaining to organizational factors which may influence the selection of data for use in the natural resource policy process. Specifically, literature pertaining to 1) the contributions of sociological institutionalism and the concept of institutional isomorphism, and 2) the tendency of field offices to be path dependent suggest potential factors influencing biological data selection. In summary, hypotheses associated with possible organizational factors influencing data selection are restated as follows.

- ***H_1: The age of a field office is positively associated with its selection of federal government agency data.***

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***

- ***H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.***

- ***H_4: Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.***

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***

ENVIRONMENTAL FACTORS

This study also explored a set of theoretically-based environmental factors which may influence data selection by natural resource agency field offices. As the natural resource policy landscape rapidly changes, the need to identify environmental factors which influence decision-making processes becomes increasingly paramount. Tim Clark (2002) asserts that changes within the natural resource community "…are accompanied by range, wildlife, and forest management reforms on public lands and new working relationships with the public and business" (pp. 1-2). Clark (2002) goes on to say, "All these changes put new demands on professional practice" (p. 2). Natural resource agencies and field offices today operate as "open systems," as described by Katz and Kahn (1966) and Thompson (1967), and are forced to continually adapt to environmental forces. Therefore, a study of factors influencing the selection of biological information to inform the natural resource policy-making process would be incomplete without accounting for environmental pressures.

Though potential environmental factors impacting data selection could admittedly be identified within several fields of scholarly literature, this study focused on diffusion theory as the main theoretical lens through which to view environmental influences. This portion of the literature review details diffusion theory and the contributions of other social science and natural resource policy research which serve to explain the environmental factors influencing data selection. With diffusion theory serving as a theoretical backbone, hypotheses pertaining to potential environmental factors influencing the selection of biological information for use in the natural resource policy process are presented.

Diffusion Theory

Everett M. Rogers' classic book, *Diffusion of Innovation* (1962), is widely regarded as the seminal work on diffusion theory. The book is now in its fifth edition (2003) and continues to be widely cited as the foremost work on the diffusion of innovations. Rogers (1962; 2003) defines *diffusion* as "the process by which an innovation is communicated through certain channels over time among members of a social system" (p. 5). Rogers (1962; 2003) defines an *innovation* as an "idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12). Rogers (1962) reports that the diffusion of innovations requires four elements: 1) an innovation, 2) a communication system, 3) a social system, and 4) time (as cited in Garson, 2008). Strang and Meyer (1993) assert that facilitators to diffusion include actors that fall into the same category, structural conditions, and formal organization. Garson (2008) reports that classic diffusion theory dictates that diffusions occur through a five-stage timeline:

1. knowledge (awareness of the existence of an innovation)
2. persuasion (mobilizing positive attitudes toward the innovation)
3. decision (securing commitment to adopt the innovation)
4. implementation (operationalization in use)
5. confirmation (positive outcomes reinforce the process of diffusion)

Much attention has been paid in scholarly literature to the adoption of innovations. Rogers (1962) indicates that early adopters are influenced by importance, space, and time. Research shows that areas of higher importance tend to adopt innovations earlier (Brown & Cox, 1971; Garson, 2008; Leichter, 1983; Rogers, 1962; Walker, 1969). The closeness of a particular organization to an innovation also has a positive impact on the quickness of adoption (Brown & Cox, 1971; Garson, 2008; Hagerstrand, 1967; Klingman, 1980; Rogers, 1962). Brown and Cox (1971) state, "The rate of adoption follows an S-shaped logistic curve with slow increases in adoptions until a tipping point is reached when adoptions accelerate rapidly, then plateau and increase slowly to reach the last adopters" (p. 551; as cited in Garson, 2008). In sum, types of adopters may be characterized as innovators, early adopters, early majority, late majority, and laggards (Garson, 2008).

A common theme among diffusion literature is research conducted on state adoption of innovative federal programs or policies. Sapat (2004) suggests that four factors affect state adoption of national innovations: 1) severity of the policy issue, 2) importance of the institutional factors involved, 3) interest group roles, and 4) contextual factors. Sapat (2004) asserts that agencies adopt innovations that deal with problems created within their realm of expertise. States are also more likely to adopt innovative policy initiatives if all stakeholders are included in the policy process (Sapat, 2004). Berry and Berry (1999) add that states will adopt policy initiatives based on three motives: 1) copying what has been a success elsewhere, 2) seeking competitive advantage, and 3) responding to citizen pressure. Should a state's governor become involved in the adoption process, he or she will look to ideologically similar states for knowledge regarding a policy innovation (Grossback, Nicholson-Crotty, & Peterson, 2004).

Diffusion Theory and Natural Resource Data Selection

Federal natural resource agencies provide an ideal laboratory within which to study diffusion theory as it pertains to natural resource policy making. Specifically, the structure of the U.S. Fish & Wildlife Service is one reason the agency is a logical setting for this research. As mentioned, much of the U.S. Fish & Wildlife Service's work is done in its field offices across the nation (USFWS, 2007). This localized approach is said to be due to a heavy workload brought on by the National Environmental Protection Act of 1970 (Clark &

McCool, 1996). U.S. Fish & Wildlife Service biologists are expected to play an integral part in the natural resource policy-making process by acting as "scientific advocates," or professionals who make policy recommendations based on biological information selected for use by the field office (Gerlach, 2005). It is within this setting that environmental factors affecting such data selection were studied through the lens of diffusion theory.

This research focused, in part, on the environmental factors which may influence the selection of data from a deep pool of sources at the field office level. The adoption of such data may be subject to a series of potential exogenous influencing factors. Research shows that interest group pressure impacts more localized policy making (Daley, 2007; Sapat, 2004). Additionally, scholarly literature suggests that state governments may be heavily influenced by the actions of surrounding states (Daley, 2007; Grossback et al., 2004). There has also been a call for increased public involvement, not just in solving natural resource dilemmas, but in public administration practices on the whole (Brunner et al., 2005; King et al., 1998; Stivers, 1994). It is reasonable to surmise that the decisions of natural resource agency field offices are impacted by 1) interest groups, 2) the actions of surrounding field offices, and 3) the general public – all of which may act as exogenous influences on the data selection process. In this study, each of these three potential environmental factors was examined under the umbrella of diffusion theory. This work made an attempt to answer Walker's (1973) call for more research of diffusion theory in public policy, by extending tenets of the theory into an exploration of environmental factors affecting data selection decisions. Several testable hypotheses are presented based on the suggestions of scholarly literature.

Interest Groups, Scientific Advocacy, and Natural Resource Agency Field Offices

It is difficult to find an aspect of government or public administration today which is devoid of interest or advocacy groups. Patterson (2008) defines an interest group as "a 'faction,' 'pressure group,' or 'special interest' [which] has two characteristics: an organized membership and the pursuit of policy goals that stem from its members' shared interests" (p. 294). The question of how much policy influence an interest group is capable of exerting is often at the forefront of policy-making processes. Nicholson-Crotty and Nicholson-Crotty (2004) assert that interest or advocacy groups with significant access to decision makers can affect policy rather easily. Interest group strength has been shown to significantly impact the diffusion of policies and government innovations as well (Godwin & Schroedel, 2000). However, rather than a blanket acceptance of interest groups as part of everyday political life, perspectives on interest group participation in the policy process within the natural resource community differ starkly.

The Advocacy Debate

Interest or advocacy groups usually elicit a strong response, in one direction or another, within the natural resource community. Many scholars believe advocacy to be a positive force in the selection and use of biological information in the natural resource decision-making process (Meine & Meffe, 1996; Noss, 2007; Shrader-Frechette, 1996). Dissenters claim that the dividing line between science and advocacy should be absolute and distinct (Lackey, 2007; Martin, 2006; Scott et al., 2007). Both sides of the debate are well represented in natural resource literature.

Supporters of interest or advocacy groups base their arguments on four cornerstone claims. First, advocacy informs the public (Brussard & Tull, 2007). Advocacy for science informs the public of the composition and use of science (Brussard & Tull, 2007). Advocacy for the natural world markets the outdoors to a human population that is becoming more isolated from nature (Brussard & Tull, 2007). Second, if credible scientists go on record in support of a particular policy action, that action is far more assured than if scientists simply hand over facts to policy makers and allow them to choose a course of action (Noss, 2007). Noss (2007) contends that making policy recommendations does not overstep the bounds of a scientist's job. Rather, empirical evidence and a rigorous process for obtaining it remain essential standards in science (Noss, 2007). Third, it can be argued that without advocacy and politics there would be no biodiversity (Blockstein, 2002). It is necessary in today's political climate that interest or advocacy groups have a seat at any policy-making table, including those tackling natural resource decisions (Blockstein, 2002). Finally, a noncommittal scientist can unknowingly advocate the status quo (Shrader-Frechette, 1996). Shrader-Frechette (1996) claims, "If scientists never act as advocates, they can inadvertently serve the status quo, especially ethical and environmental errors in the status quo" (p. 913).

Opponents of the notion that interest or advocacy groups should play a significant role in the natural resource policy-making process base their opinions on three main arguments. First, policy makers want the truth from scientists, not their personal opinions (Pouyat, 1999; Rykiel, 2001). Though postmodern philosophers may deny that science is objective and suggest that scientists who strive for objectivity are naïve realists, policy makers still demand objectivity (Rykiel, 2001). Second, many challenges to the status or conservation plans of endangered species provide far too much at stake for reliance on scientific opinion (Martin, 2006). Rather, scientists and citizens should demand the use of independently-reviewed, objective science in making such decisions (Martin, 2006). Third, science should be value-free (Lackey, 2007). Scientists should present their findings in a value-neutral format as to not influence policy making through normative science (Lackey, 2007; Scott et al., 2007). According to Lackey (2007), the ethical norms of natural resource policy making dictate that policy-neutral science should “strive to describe the world accurately and is characterized by transparency, reproducibility, and independence” (p. 14).

Interest Groups, Advocacy, and Data Selection

Despite the debate over the proper role of interest or advocacy groups and scientists in the natural resource policy process, there are many sources of biological information available to policymakers (NBII, 2007). In other words, interest groups and scientific advocacy does exist. This much must be accepted as fact. These data producers employ various methods of marketing their data products (GIS software packages, maps, etc.) to policy-making agencies. Scholarly literature provides useful insight into the potential role interest groups play in natural resource data selection.

Research on the role of interest groups in the diffusion of innovations indicates a positive relationship between such advocacy and the adoption of innovative policies (Daley, 2007; Martin, 2001; Mintrom & Vergari, 1998; Sapat, 2004). Martin (2001) studied the diffusion of living wage policies among American municipalities. The diffusion of such laws was found to be aided significantly by interest groups, in this case, labor unions (Martin, 2001). Mintrom and Vergari (1998) suggest that greater involvement in policy networks significantly increases the likelihood of policy leaders achieving their goals. The matter of fact, association with interest groups and various networks has been shown to allow policy entrepreneurs the opportunity to determine how and when to best present their ideas and impact policy (Mintrom & Vergari, 1998).

The literature also suggests that interest groups may provide the motivation to adopt particular ideas within an organization. Previous research on the adoption of U.S. Geological Survey GAP data in the state of North Carolina suggests that the data marketing efforts of producers of biological information can provide the motivation to select a particular data set over another (Gerlach, 2005). GAP is not shy about marketing their data products to various stakeholders it deems may have an impact on conservation biodiversity policy (GAP, 2007). Mohr (1969) asserts that the probability of an innovation is, in part, directly related to an organization's motivation to innovate. Given that producers of biological information and advocates of particular policy issues market their products and stances to natural resource agencies and field offices so vigorously (GAP, 2007; Gerlach, 2005; Lackey, 2007; Scott et al., 2007), it is imperative that interest group pressures on the adoption and selection of data be explored. With the support of the aforementioned literature, the following hypotheses pertaining to interest group pressures were tested in this study.

- ***H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.***
- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***

Surrounding Organizations and the Diffusion of Innovations

Scholarly literature pertaining to diffusion theory offers much insight into the impact of surrounding organizations on organizational decision-making. A significant portion of this research has been done on state-to-state policy diffusion (Buckley & Westerland, 2004; Soule & Zylan, 1997). Research shows that state governments are heavily influenced in the policy-making and adoption processes by the actions of surrounding states (Daley, 2007: Grossback et al., 2004). Daley & Garand (2005) assert that states are precisely in tune with the pressures indirectly applied by the successes or failures of surrounding states to either implement or scrap similar policies. Elazar (1972) goes so far as to suggest that state policy makers tend to view nearby states as experimental laboratories for policies, viewing neighboring states as a critical source of information in overcoming the obstacle of policy uncertainty. Elazar's (1972) assertions are supported by Clemens (1998), who found that reform-minded administrators often use states as "experiment stations."

Much of the current research on state-to-state policy diffusion corroborates the work of Brown & Cox (1971) and Walker (1969) in asserting that the closeness of a particular organization to an innovation has a positive effect on the rate of adoption. Research confirms Walker's (1969) suggestions that 1) the likelihood of a state adopting an innovation is higher if other states have already adopted the idea, 2) the likelihood of adoption is higher if the early adopting state is viewed as a legitimate point of comparison, and 3) interstate communication is an important factor in the diffusion of innovations between states. State-to-state policy diffusion also follows the traditional S-shaped curve posited by Brown and Cox (1971) (Frederickson, Johnson, & Wood, 2004).

Findings within scholarly literature pertaining to mimetic and normative isomorphism also warranted exploration in connection to the diffusion of innovations and natural resource agency field office data selection. As stated earlier, mimetic isomorphism occurs as organizations copy established decision-making patterns in an effort to reap similar rewards or profits, while normative isomorphism often follows as the perception grows that established decision-making practices have become sanctioned by "successful" organizational leaders within a particular organizational community (Meyer & Scott, 1992; Scott, 1991). Berry and Berry (1990) suggest that as neighboring states adopt policies that show success, in the case of their research, lottery adoption, other states will attempt to mimic their actions. McVoy's (1940) often-cited research on diffusion patterns in the United States also asserts that innovations ripple to other areas from central locations once proven successful. Should an innovation prove to supply a payoff of some sort, adoption by surrounding organizations (or governments) usually follows (Gianakis & McCue, 1997). The institutionalization of a particular innovation, brought on by proving the effectiveness of the innovation to practitioners (or policy makers), often leads to its acceptance as normative routine (Yin, 1981). DiMaggio and Powell (1983) call this phenomenon *institutional* isomorphism. This study will test the merits of this literature on field office data selection decisions.

The Impact of Other Field Offices on Data Selection

Though state-to-state, and even federal-to-state, interactions make up much of the existing research on the diffusion of innovations, this study applied the principals of previous diffusion research to an examination of how other field offices may impact the selection of biological information for use in making biodiversity management decisions. The U.S. Fish & Wildlife Service provided an ideal laboratory within which to assess the potential influence of other field offices on data selection. This study tested whether or not data selection decisions mirror those of other U.S. Fish & Wildlife Service field offices.

Existing research also shows that states will adopt newer innovations when they become convinced they are falling behind other similar states (Walker, 1969). Especially when success is visible under the implementation of such an innovation, research shows that mimicking occurs (Berry & Berry, 1990; Meyer & Scott, 1992; Scott, 1991). U.S. Fish & Wildlife Service biologists working in North Carolina indicate that data newness is a potential driving force in selecting a particular source of biological information (Gerlach, 2005). This study examined whether or not the perception that other field offices are using newer, more innovative data sets impacts the use of newer data by a particular field office. Diffusion research pertaining to natural resource data selection is minimal at best. Therefore, this study explored the role of other field offices as a potential environmental factor influencing data selection by testing the following hypotheses.

- ***H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.***

- ***H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.***

Public Involvement

Scholarly literature presents differing levels of support for public involvement in public administration. Stivers (1994) suggests that public participation promotes democratic accountability. Other scholars fear the public is often misguided, and public outcry can serve to hinder necessary policies (Dombeck, Williams, & Wood, 2004). While there are certainly two sides to the debate, the majority of public administration literature believes public involvement to be a positive force in that it helps build social capital, community, and a sense of accountability among bureaucrats (Nalbandian, 1999; Pretty & Smith, 2004; Stivers, 1994).

Researchers have recently expressed a desire for increased public participation in public decisions (King, Feltey, & Susel, 1998). Bureaucrats and politicians can work to use public involvement to their benefit (Nalbandian, 1999; Pretty & Smith, 2004). For example, city managers must be skilled at facilitative leadership and building partnerships (Nalbandian, 1999). From these skills, managers can build community, civil infrastructure, political capital, and work toward lasting policy change (Nalbandian, 1999; Pretty & Smith, 2004). King et al. (1998) lobby for increased public participation that is more effective and less confrontational than initial attempts. They believe that public involvement must occur far earlier in the decision process than it has historically and that administrative structures must adapt to facilitate public input (King et al., 1998). Stivers (1994) asserts that responsiveness to public input is expected of bureaucrats today. The role of the bureaucrat has morphed into that of a responsive “listener,” which serves to welcome the public voice in policy decisions and hold bureaucratic agencies more accountable for their actions (Stivers, 1994).

Public Involvement in Natural Resource Policy Making

As with public administration on the whole, public involvement in natural resource policy making is a growing trend. Brunner et al. (2005) encourage community involvement in finding practical solutions to natural resource problems in the form of community-based initiatives, or answers to natural resources challenges which are developed on the ground level. Working toward solutions that serve the common interest requires involving the public at the local level (Brunner et al., 2005). The community-based initiative is predicated on doing just that, working with local, state, and federal agencies, environmental groups, and even private sector organizations if necessary to settle on a common interest solution to natural resource dilemmas (Brunner et al., 2005).

Aside from the community-based initiative, public input has been sought on a variety of different environmental and natural resource issues in multiple forms. The public has played an important advocacy role in prescribing solutions to wildfire issues, grazing rights, water demands, and several other natural resource dilemmas (Brunner et al., 2005; Clark, 2002; Dombeck et al., 2004). The public has mobilized efforts to combat the negative effects of mountaintop removal mining in the Central Appalachian Coalfield by forming advocacy groups and joining existing environmental groups wherein strength lies in numbers (Appalachian Voices, 2004; Sierra Club, 2005). The desire for public involvement in natural resource decision making is seemingly at an all-time high. After all, natural resources are the property of the citizenry of the United States and should be used for the collective good (Andrews, 1999; Ostrom, 1990). The move toward public involvement in making natural resource policy is part of a growing trend toward bringing the decision-making process to those most directly affected by its consequences and away from federal bureaucrats with less intimate knowledge of the issues in question (Brunner et al., 2005; Clark, 2002).

Public Involvement and Natural Resource Data Selection

The prevalence of public involvement in today's natural resource policy-making process demanded its inclusion as a factor which may influence data selection within natural resource field offices. By design, the field office serves a particular locale and has more direct contact with the local community than does a regional or federal office within a natural resource agency (USFWS, 2007). Diffusion literature suggests that public support of a particular policy action may significantly intensify the motivation to adopt said policy (Elazar, 1972). Previous research suggests that public involvement in the natural resource policy-making process on the local level may lead to the selection of data from more localized or non-governmental sources (Gerlach, 2005). However, little is actually known about how the public impacts data selection decisions. The increase of public involvement in the natural resource, and, more specifically, the biodiversity conservation policy-making process warranted an examination of the impact of public pressures on data selection by field offices. This study tested the following hypotheses pertaining to public pressures.

- ***H_{9a}: High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state and local government agency data.***

- ***H_{9b}: High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***

Summary of Hypotheses Pertaining to Environmental Factors

Social science and natural resource policy literature provides a sound theoretical backbone for hypotheses pertaining to the effects of environmental influences on the selection of data for use in the natural resource policy process. Specifically, research pertaining to the diffusion of innovations provides a theoretical lens through which to study potential exogenous pressures influencing biological data selection. Literature which focuses on the impacts of interest or advocacy groups, other field offices, and the general public lies at the core of several testable hypotheses examined in this study. In summary, hypotheses associated with potential environmental factors influencing data selection are restated as follows.

- ***H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.***

- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***

- ***H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.***

- ***H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.***

- ***H_{9a}: High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state and local government agency data.***

- ***H_{9b}: High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***

PREVIEW OF THE STUDY

Based on social science and natural resource policy literature, this study tested nine hypotheses, exhibited in Table 2.1, regarding factors influencing data selection in natural resource agency field offices. This research focused on the organizational and environmental factors which potentially influence data selection. More specifically, this study examined organizational factors supported by neo-institutional theory pertaining to 1) the contributions of sociological institutionalism and institutional isomorphism to our understanding of the research problem, and 2) the tendency of field offices to be path dependent. Research also shows that environmental factors which potentially influence data selection may be studied through the lens of diffusion theory. Potential environmental factors include 1) the impact of interest or advocacy groups, 2) the data selection decisions of other field offices, and 3) public involvement in the policy-making process.

Chapter three details the research methodology employed in this study. The chapter discusses the survey instrument used, rationale behind surveying the U.S. Fish & Wildlife Service, operationalization of variables, and statistical techniques employed. This research tested the hypotheses shown in Table 2.1 and the theoretically-supported research model depicted in Figure 2.1 (repeat of Figure 1.1).

Table 2.1: Research Hypotheses 1-9

Organizational Factors	Environmental Factors
H_1: The age of a field office is positively associated with its selection of federal government agency data.	***H_6:*** High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.
H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.	***H_7:*** A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.
H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions. ***H_{3b}:*** Ecosystem-level management practices are positively associated with the selection of federal government agency data.	***H_{8a}:*** Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions. ***H_{8b}:*** The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.
H_4: Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.	***H_{9a}:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state and local government agency data. ***H_{9b}:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data. ***H_{9c}:*** Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.
H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.	

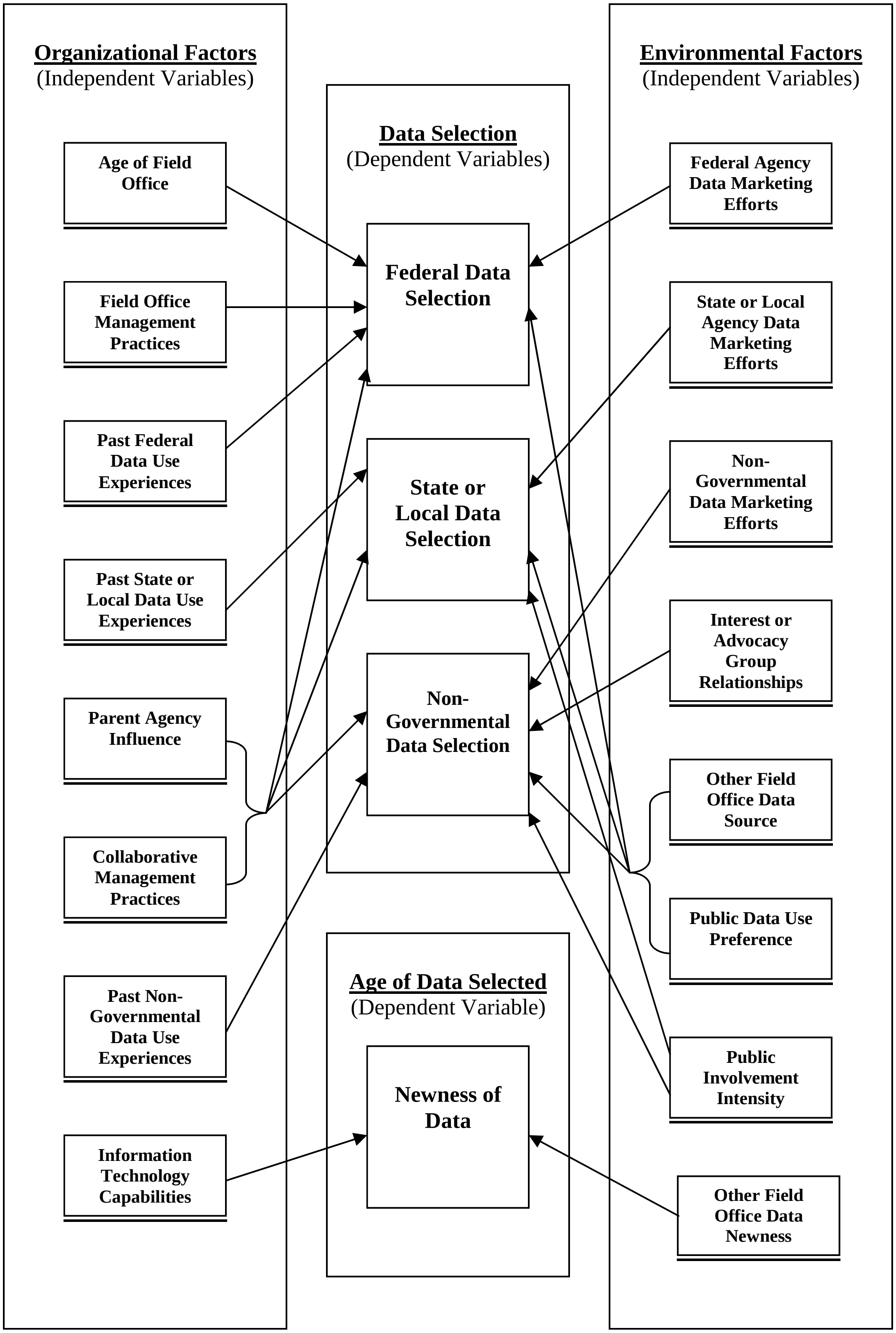

Figure 2.1: Research Model (repeat of Figure 1.1) (*arrows indicate hypothesized relationships)

CHAPTER 3: METHODOLOGY

This chapter describes the methodology used in this investigation. The chapter accomplishes three main objectives. 1) The research design employed in this study is discussed in detail. Research participants, validity concerns, and a summary of the research questions and hypotheses are presented. 2) The operationalization of variables used to test the hypotheses and research model is discussed. 3) Tools for analyzing the data collected and testing hypotheses are detailed. The variables used in this study are summarized in Table 3.3, and the survey instrument used is provided as Appendix A.

RESEARCH DESIGN

This study employed a quasi-experimental research design. Citing Cook and Campbell (1979), Garson (2008) states, "A design is quasi-experimental if subjects are not randomly assigned to groups but there is still a control or comparison group. While subjects are not randomly *assigned*, they are randomly *selected* (sampled) or are all the relevant cases." This research used an original survey of the U.S. Fish & Wildlife Service, and, in keeping with precedent set by previous dissertation research, controls were statistical rather than physical (Rogers, 2006). The survey contained questions pertaining to the selection of biological data in the policy-making process, factors that influence data selection, and characteristics of the particular field office.

The survey was built using Survey Monkey, an online survey builder tool. The survey was web-based, and was administered via e-mail. This eliminated the need for participants to physically mail responses and saved substantially on administrative costs.

Participants were able to access the survey through a web link provided in an introductory e-mail message and participation was completely confidential. The survey was piloted to faculty members in the North Carolina State University College of Natural Resources to assess their suggestions on refining its structure and flow. The survey was administered to 557 U.S. Fish & Wildlife Service field offices across all eight regions (headquarters excluded) of the agency. A complete list of U.S. Fish & Wildlife Service field offices is readily available on the agency's website (USFWS, 2007).

The Web-Based Survey

An online survey was used in this study for several reasons. Scholarly literature suggests that web-based surveys are an overall effective means by which to collect data (Anderson & Gansneder, 1995). Research costs associated with administering an online survey are relatively low compared to other data collection methods (Anderson & Gansneder, 1995; Kiesler & Sproull, 1986; Parker, 1992; Sproull, 1986). Web-based surveys can also reach a large group of participants in a relatively short amount of time (Garson, 2008). The implementation time of online surveys is low, and response turnaround is often quicker than other survey methods (Anderson & Gansneder, 1995; Garson, 2008).

The web-based survey tool used in this study provided added efficiency. Survey Monkey allows for the creation of a survey based on questions or question sets. Questions within the survey may be ordered as desired. Once the survey has been built to the researcher's specifications, Survey Monkey provides the option of placing the survey online. As the survey is placed in online mode, a survey URL is created. The researcher may then e-mail the survey URL to participants for administration. Participant responses may be kept confidential, as was the case with this research. Data are collected and available for downloading into a spreadsheet format. These data may be imported into SPSS with only minor cleaning steps necessary. From creation to collection, Survey Monkey is efficient and saves time and money versus other survey methods. The tool can be accessed by anyone with a valid subscription at http://www.surveymonkey.com/.

Though the administration of a web-based survey presents many advantages, the onus is on the researcher to pay particularly close attention to response rate. Anderson & Gansneder (1995) assert, "Overall, researchers employing e-mail surveys have reported response rates between 41% and 76%" (p. 33). However, Garson (2008) suggests that web-based surveys have been shown to affect response rates in a similar manner to mail surveys. In an effort to maximize response, follow-up contact was made with participants via e-mail and telephone on several occasions. Initially, 97 field offices responded to the survey, a response rate of 17.4%. The final survey response rate (after all follow-ups) was 36.6%, with 204 field offices fully participating (completing the survey) out of 557. Due to the fact that randomness cannot be assumed in web surveys, response was examined by U.S. Fish & Wildlife Service region in a section to follow.

The use of a web-based survey required approval from the North Carolina State University Institutional Review Board for the Protection of Human Subjects in Research (IRB). An application for formal review exemption was submitted to the IRB along with the informed consent form provided to all study participants. The informed consent form is included as Appendix B of this dissertation. The IRB approved the exemption request on the basis that survey research in which respondent confidentiality is maintained does not pose risks to human subjects. Field offices were permitted to decline participation in this study at any time with no fear of repercussions.

Participants

The U.S. Fish & Wildlife Service

The U.S. Fish & Wildlife Service is a scientific agency which makes and implements policy regarding endangered species, migratory birds, fisheries, wetlands, and biodiversity conservation (USFWS, 2007). The agency uses science in making many ground-level conservation and management decisions (Gerlach, 2005). The U.S. Fish & Wildlife Service oversees the 93 million-acre National Wildlife Refuge System and governs several fish hatcheries, fishery resource offices, and ecological services field stations (USFWS, 2007). The agency is at the forefront of the biodiversity conservation policy process, and heavily relies on the use of data in making such decisions (Gerlach, 2005; USFWS, 2007).

Justification for Surveying the U.S. Fish & Wildlife Service

The U.S. Fish & Wildlife Service was surveyed in this study for two reasons. First, the agency's mission is "to work with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people" (USFWS, 2007). Fulfilling this mission entails making policy at many different levels within the agency, most notably for this study, at the field office level. The U.S. Fish & Wildlife Service employs field biologists, GIS analysts, and managers who make ground-level policy decisions based on the use of biological information as a scientific guide (Gerlach, 2005). Second, the U.S. Fish & Wildlife Service is a large, national natural resource agency, which allowed for the examination of differing organizational and environmental characteristics among field offices to be tested as possible factors influencing data selection.

The U.S. Fish & Wildlife Service is currently housed within the Department of the Interior. However, the agency was first formed in 1871 as the U.S. Bureau of Fisheries in the Department of Commerce and Labor (Clarke & McCool, 1996). The Bureau of Fisheries spent many years focusing mainly on the Alaskan fishing industry until its reorganization in 1940 (Clarke & McCool). In 1940, the U.S. Department of the Interior combined the Bureau of Fisheries with the Bureau of Biological Survey into the present day U.S. Fish & Wildlife Service (USFWS, 2007). The Fish and Wildlife Act of 1956 created the Bureau of Sport Fisheries and Wildlife to be housed within the U.S. Fish & Wildlife Service (USFWS, 2007). However, the act was amended in 1974 and abolished the position of Commissioner of Fish and Wildlife, thus designating the Bureau as the U.S. Fish & Wildlife Service (USFWS, 2007). Currently, the agency seeks to meet the following three objectives (USFWS, 2007)

1. Assist in the development and application of an environmental stewardship ethic for our society, based on ecological principles, scientific knowledge of fish and wildlife, and a sense of moral responsibility.
2. Guide the conservation, development, and management of the nation's fish and wildlife resources.
3. Administer a national program to provide the public opportunities to understand, appreciate, and wisely use fish and wildlife resources.

The current U.S. Fish & Wildlife Service was significantly shaped by the National Environmental Policy Act of 1970 (Clarke & McCool). Issues of wetland protection and the Endangered Species Act heaped trouble on the agency (Clarke & McCool, 1996). The agency was overwhelmed by inadequate resources, controversies, and difficult assignments (Clarke & McCool, 1996). In 1993, the newly formed National Biological Service gained 90% of its budget and 80% of its workforce from the U.S. Fish & Wildlife Service (Clarke & McCool, 1996). Nevertheless, the U.S. Fish & Wildlife Service currently employs approximately 7,500 people across its eight regions and Washington, D.C. headquarters (USFWS, 2007). The agency operates on an annual budget of over $2 billion (USFWS, 2007).

Unit of Analysis

The unit of analysis for this study was the natural resource agency field office. Previous research indicates that biological data are selected for and used at the field office level by biologists who serve their managers as scientific advocates for policy decisions regarding the management and conservation of flora, fauna, and habitat (Gerlach, 2005). The survey was sent to 557 total U.S. Fish & Wildlife Service field offices to be answered by a staff biologist. U.S. Fish & Wildlife Service biologists work intimately with biological information and have the unenviable task of selecting data for use in the policy-making process (Gerlach, 2005). Therefore, they constituted the most credible source of respondents for the purposes of this study.

Response

The overall response rate for the survey administered in this study was 36.6%. Some 204 U.S. Fish & Wildlife Service field offices completed the survey out of 557 approached. This response rate was aided considerably by the endorsement of Dr. Dan Ashe, Science Advisor to the Director of the U.S. Fish & Wildlife Service. Figure 3.1 shows the breakdown of response by U.S. Fish & Wildlife Service region.

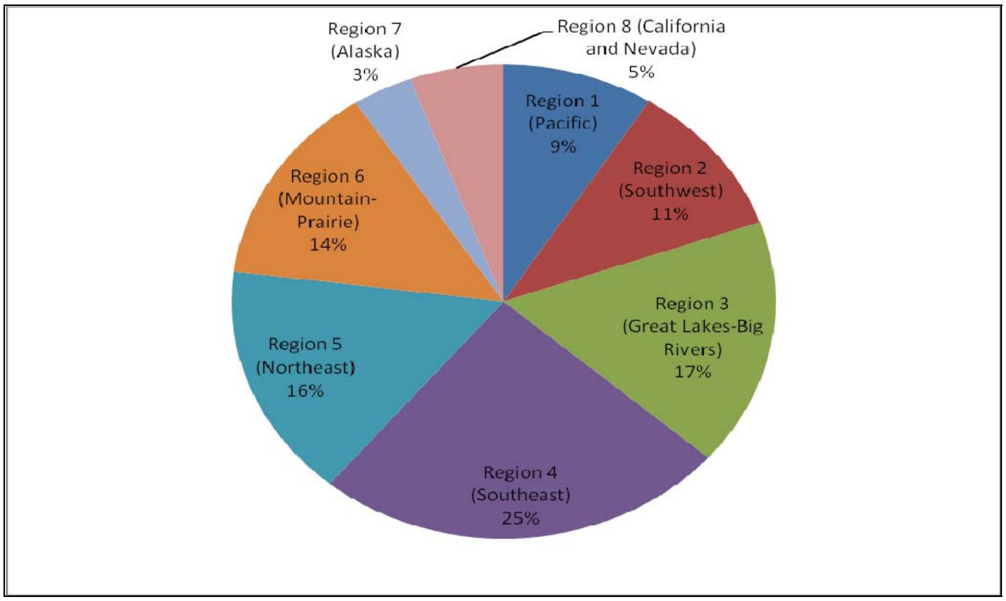

Figure 3.1: Survey Response by U.S. Fish & Wildlife Service Region

Table 3.1 illustrates a chi-square goodness of fit test that revealed the distribution of survey responses by region is not significantly different from what would be expected based on the actual distribution of field offices surveyed by region ($p = .56$).

Table 3.1: Chi-Square Test of Sample vs. Population Distribution

Region	Population	Population Scaled (Expected Distribution)	Sample (Observed)
1 (Pacific)	50	18.31	22
2 (Southwest)	59	21.61	25
3 (Great Lakes-Big Rivers)	94	34.43	35
4 (Southeast)	137	50.18	43
5 (Northeast)	89	32.60	32
6 (Mountain-Prairie)	77	28.20	22
7 (Alaska)	20	7.32	10
8 (California and Nevada)	31	11.35	15
Sum	557	204	204
Degrees of Freedom		7	
Critical Value		0.56	

Validity Threats

Internal Validity

According to Garson (2008), "A study is valid if measures actually measure what they claim to, and if there are no logical errors in drawing conclusions from the data." Internal validity refers to whether or not a study is appropriately controlled and can be effectively repeated (Rogers, 2006). This study recognized and addressed two types of internal validity: 1) face validity and 2) content validity. According to Paul Spector (2006), "*Face* validity means that a measure appears to assess what it was designed to assess" (p. 37). The face validity of this study was examined by the pilot test group. *Content* validity refers to how well a multiple-item measure of a variable covers the entire domain of the variable (Spector, 2006). Where possible, content validity was assured based on previous research designs in the literature. Content validity was also informed by the pilot test group.

The Pilot Test

The survey instrument was piloted to faculty members in the North Carolina State University College of Natural Resources, many of whom work closely with members of the U.S. Fish & Wildlife Service. This pilot study served 1) to aid in the assessment of face and content validity and 2) to finalize the structure and flow of the survey. Some 55 faculty members were given the survey and asked for their opinions and constructive criticisms. Of those approached, 17 responded (30.9%) with advice on strengthening the survey instrument to meet the challenges of face and content validity. Questions were reworded and rearranged until the survey instrument used in this study (Appendix A) was achieved. The structure, flow, and content of the survey instrument were heavily informed by the pilot test. Based on the pilot participants' expertise and relationships with the U.S. Fish & Wildlife Service, as well as information gleaned from scholarly literature, face and content validity issues associated with this study were appropriately addressed.

External Validity

External validity refers to how well the results of a study can be generalized to a larger population, to other subject populations, or to other settings (Garson, 2008). It is reasonable to conclude that external validity for this study is high due to the inclusion of every staffed national wildlife refuge and ecological services field office within the U.S. Fish & Wildlife Service. The chi-square test of sample versus population distribution shown in Table 3.1 illustrates that the distribution of survey responses by region was not significantly different from what would be expected based on the actual distribution of field offices surveyed by region ($p = .56$). Therefore, it is reasonable to surmise the results of this study may be generalized to the entire U.S. Fish & Wildlife Service.

Summary of Research Questions, Related Hypotheses, and Measurement Items

This dissertation sought to answer the following primary research question: Which factors affect natural resource agency field office data selection for use in the natural resource policy-making process? The main objective of this study was to determine which organizational characteristics of the natural resource policy-making agency field office and environmental factors influence data selection for making natural resource policy, or biodiversity management decisions. Biodiversity management decisions represent the type of natural resource policy that is the focus of this dissertation. This study also formulated and tested a theory-driven research model in an effort to provide a parsimonious model which includes the most salient and telling aspects of neo-institutional and diffusion theories in explaining data selection. The primary research question is answered by investigating a series of more focused research questions regarding the impact of organizational and environmental forces on data selection. Table 3.2 details the research questions pertaining to organizational factors addressed in this dissertation as well as related hypotheses, variables, and survey items associated with each. Table 3.3 summarizes the research questions, hypotheses, variables, and survey items pertaining to environmental factors.

Table 3.2: Organizational Factors: Research Questions, Related Hypotheses, Variables, and Survey Items

Research Questions	Related Hypotheses	Variables	Survey Items
RQ1: *What is the effect of field office age on data selection?*	***H_1:*** The age of a field office is positively associated with its selection of federal government agency data.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IV:** - *Age of field office* (FO_open)	**DVs:** 1, 2 **IV:** 19
RQ2: *What is the effect of parent agency pressures influence data selection?*	***H_2:*** The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IV:** - *Parent agency influence* (add_fund)	**DVs:** 1, 2 **IV:** 8
RQ3: *What is the effect of field office management practices on data selection?*	***H_{3a}:*** Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp;	**DVs:** 1, 2 **IVs:** 14, 15

Table 3.2: Continued

	for making biodiversity management decisions. ***H_{3b}:*** Ecosystem-level management practices are positively associated with the selection of federal government agency data.	SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IVs:** - *Field office management practices* (bio_mgmt) - *Collaborative management practices* (info_FWS; info_Fed; info_SL; info_NG)	
RQ4: *What is the effect of past data use experiences on data selection?*	***H_4:*** Past positive experiences in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IVs:** - *Past federal data use experiences* (FDexp) - *Past state or local data use experiences* (SLDexp) - *Past non-governmental data use experiences* (NGDexp)	**DVs:** 1, 2 **IVs:** 6

Table 3.2: Continued

RQ5: *What is the effect of field office information technology capabilities on data selection?*	***H_5:*** A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.	**DV:** *Newness of data* (DataSetUpd; DataSetEst) **IV:** *Information technology capabilities* (ArcView)	**DV:** 4, 5 **IV:** 17

Table 3.3: Environmental Factors: Research Questions, Related Hypotheses, Variables, and Survey Items

Research Questions	Related Hypotheses	Variables	Survey Items
RQ6: *How do data marketing efforts affect data selection?*	***H_6:*** High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IVs:** - *Federal agency data marketing efforts* (FD_market) - *State or local agency data marketing efforts* (SLD_market) - *Non-governmental data marketing efforts* (NG_market)	**DVs:** 1, 2 **IVs:** 9

Table 3.3: Continued

RQ7: *What effects do interest or advocacy groups have on data selection?*	***H_7:*** A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IV:** - *Interest or advocacy group relationships* (confer_NPO; confer_PrivSec; confer_Acad)	**DVs:** 1, 2 **IV:** 10
RQ8: *How do other field offices affect data selection?*	***H_{8a}:*** Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions. ***H_{8b}:*** The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) - *Newness of data* (DataSetUpd; DataSetEst) **IVs:** - *Other field office data source* (data_infl) - *Other field office data newness* (new_infl)	**DVs:** 1, 2, 4, 5 **IVs:** 16

Table 3.3: Continued

RQ9: *How does public involvement affect data selection?*	***H_{9a}:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state and local government agency data. ***H_{9b}:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data. ***H_{9c}:*** Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.	**DVs:** - *Federal data selection* (FDimp; FDfreq) - *State or local data selection* (SLDimp; SLDfreq) - *Non-governmental data selection* (NGDimp; NGDfreq) **IVs:** - *Public involvement intensity* (pub_inform; pub_numbers) - *Public data use preference* (pub_datapref)	**DVs:** 1, 2 **IVs:** 11, 12, 13

Figure 3.2 (a repeat of Figures 2.1 and 1.1) depicts the research model tested in this study, wherein arrows indicate hypothesized relationships. Variables were added to the model based on research detailed in chapter two. The remainder of the current chapter is devoted to 1) the measurement and operationalization of the variables used in this study and 2) a discussion of the analytic tools used to test the research hypotheses. It should be noted that many variables were assigned labels which correspond to accepted natural resource policy terminology. For example, the independent variable labeled *field office management practices* represents a term which is recognizable to practitioners in the natural resource community (Gerlach, 2005). An effort was made to label variables consistent with their mention in the field as well as scholarly literature.

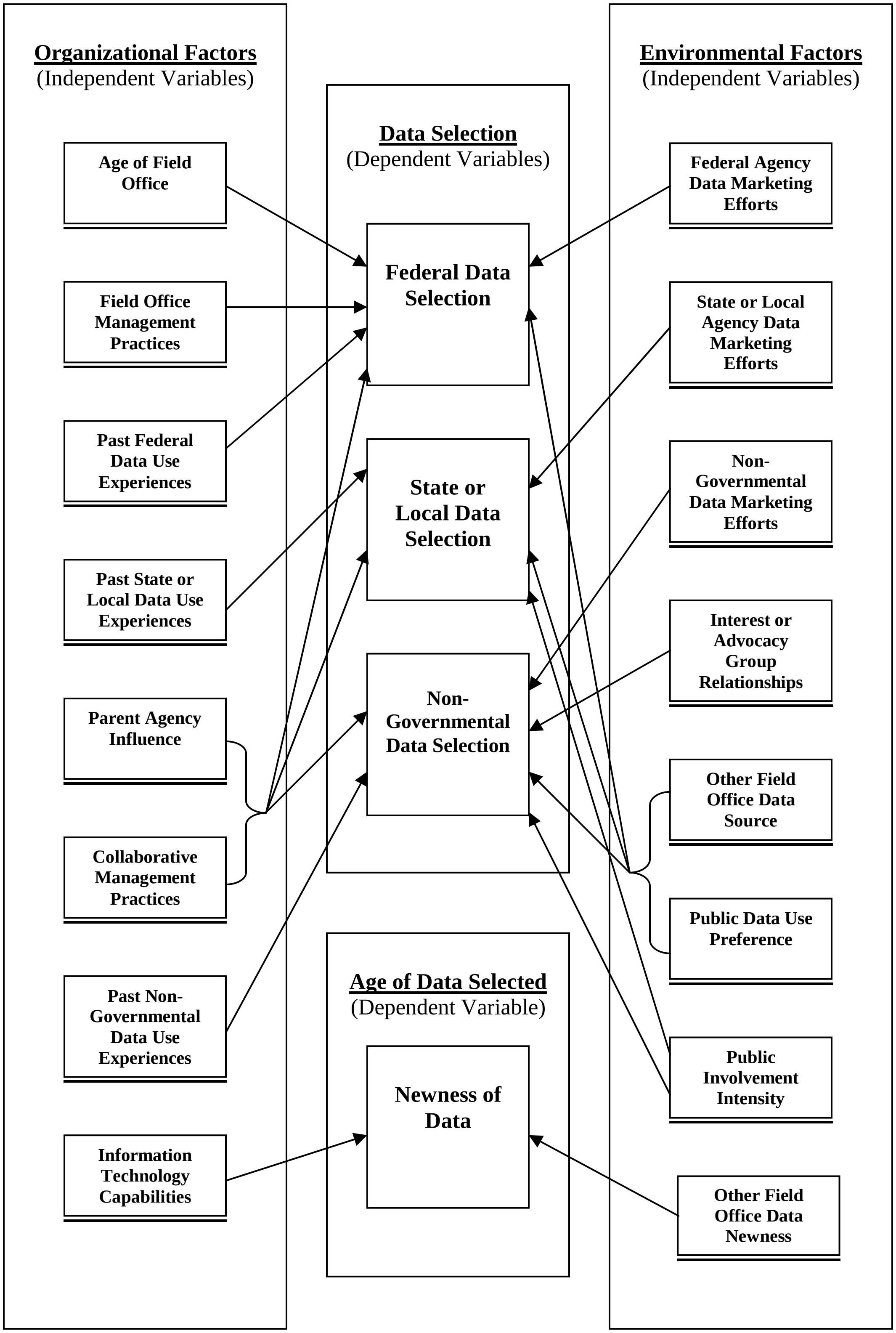

Figure 3.2: Research Model (repeat of Figure 1.1)

OPERATIONALIZATION OF VARIABLES

This study was heavily informed by previous research regarding the biodiversity conservation policy process within the state of North Carolina. Many of the survey questions were supported by focus groups and individual interviews with natural resource professionals. The data used in this research were collected through an original survey of the U.S. Fish & Wildlife Service.

Dependent Variables

Dependent variables measured the type of scientific data used for making biodiversity management decisions. Data selection was measured by the dependent variables *federal data importance, state or local data importance, non-governmental data importance federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use.* The National Biological Information Infrastructure (NBII) suggests that data used in natural resource policy making comes from federal, state, local, nonprofit, academic, and private sector sources (NBII, 2007). The use of data generated by federal agencies is obvious. For the purposes of this study, state and local government agency data were examined together and nonprofit, academic, and private sector data were combined, as noted in the above dependent variable labels. By combining state and local government agency data and grouping nonprofit, academic, and private sector data together, the likelihood of variance among responses to survey measures increased. Previous research indicates that data may be selected by natural resource agency field offices based on newness as well as source (Gerlach, 2005). For this reason, newness of data selected was also included in the research model and was measured by the dependent variables *year of last update of data set most relied upon* and *decade of establishment of data set most relied upon*.

Dependent Variable Measures

Federal, state or local, and non-governmental data selection was measured by assessing the importance of the data source [*federal data importance* (FDimp); *state or local data importance* (SLDimp); *non-governmental data importance* (NGDimp)] and its frequency of use [*federal data frequency of use* (FDfreq); *state or local data frequency of use* (SLDfreq); *non-governmental data frequency of use* (NGDfreq)]. The importance item was based on a ten-point Likert scale, where 1=Least Important and 10=Most Important. The frequency of use item used a series of responses rated on a seven-point Likert scale (1=Daily, 2=Weekly, 3=Monthly, 4=Quarterly, 5=Annually, 6=Rarely, 7=Never). The frequency of use scale was informed by the Gap Analysis Program at North Carolina State University (Gerlach, 2005) and a 2002 Democratic Leadership Council survey (Democratic Leadership Council, 2002). Responses to the frequency of use item were reverse coded to allow higher scores to represent greater frequencies of data use.

Dependent variables *federal data importance, state or local data importance, non-governmental data importance federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* were measured by the following items.

- "When selecting data, how important are the following data sources to your field office?"

- “When selecting data, how frequently does your field office use the following data sources in making biodiversity management decisions?”

The sub-questions presented in the rows beneath the main items included 1) Federal Data (FDimp; FDfreq), 2) State or Local Data (SLDimp; SLDfreq), and 3) Non-governmental Data (NGDimp; NGDfreq).

Newness of data was measured by responses to two open-ended questions regarding the age of the data set a particular field office relies on most. Following an open-ended set-up question which asked for the name of the data set the field office relies on most, the dependent variables *year of last update of data set most relied upon* (DataSetUpd) and *decade of establishment of data set most relied upon* (DataSetEst) were measured by the following items.

- “In approximately what year was this data set last updated?” (DataSetUpd)
- “In approximately what year (or decade if year is unknown) was this data set established?” (DataSetEst)

Independent Variables

Scholarly literature pertaining to neo-institutional and diffusion theories suggests several potential indicators of field office data selection and age of data selected. These indicators constitute organizational and environmental factors which may influence the selection of certain sources of biological data in the policy-making process. The organizational and environmental independent variables examined in this study were tested to determine their impacts on data selection. The following is a list of these independent variables with multiple measurement items denoted where necessary.

Organizational Factors

1. Age of field office (FO_open)

2. Parent agency influence (add_fund)

3. Field office management practices (bio_mgmt)

4. Collaborative management practices
   - *information exchange w/ other FWS field offices* (info_FWS)
   - *information exchange w/ other federal agencies* (info_Fed)
   - *information exchange w/ state or local agencies* (info_SL)
   - *information exchange w/ non-governmental organizations* (info_NG)

5. Past federal data use experiences (FDexp)

6. Past state or local data use experiences (SLDexp)

7. Past non-governmental data use experiences (NGDexp)

8. Information technology capabilities (ArcView)

Environmental Factors

9. Federal agency data marketing efforts (FD_market)

10. State or local agency data marketing efforts (SLD_market)

11. Non-governmental data marketing efforts (NG_market)

12. Interest or advocacy group relationships
    - *confer w/ nonprofit organizations* (confer_NPO)
    - *confer w/ private sector businesses* (confer_PrivSec)
    - *confer w/ academic institutions* (confer_Acad)

13. Other field office data source (data_infl)

14. Other field office data newness (new_infl)

15. Public involvement intensity
    - *public participation frequency* (pub_inform)
    - *public participation intensity* (pub_numbers)

16. Public data use preference (pub_datapref)

Independent Variable Measures

Organizational Factor Measures

Based on neo-institutional theory, this study examined several organizational factors which may influence data selection among natural resource agency field offices. To test the research model shown in Figure 3.2 (a repeat of Figures 1.1. and 2.1), several independent variables related to organizational factors were examined. Those variables were measured as follows.

(1) *Age of field office* was measured by responses to the following item.

- “In approximately what year did your field office open?” (FO_open)

Patten (2001) indicates that age categories are a viable option for conducting survey research and recommends using open-ended response questions “sparingly” (pp. 19-20). However, given the nature of this research, an open-ended response item was thought to best capture the information being sought from each of the 557 U.S. Fish & Wildlife Service field offices surveyed.

(2) *Parent agency influence* was measured by responses to the following item. Responses were rated on a five-point Likert scale (1=Federal Data, 2=State or Local Data, 3=Non-governmental Data, 4=A combination of the above, 5=Doesn't make a difference).

- "Which of the following choices makes this statement most true? 'My office receives additional resources (funding, information technology capabilities, staffing) from the U.S. Fish & Wildlife Service for using _________ in making biodiversity management decisions.'" (add_fund)

This study examined funding, information technology capabilities, and staffing as potential agency-to-field office incentives based on their mention in scholarly literature on natural resource agencies as well as their prevalence in previous research (Clarke & McCool, 1996; Gerlach, 2005).

(3) *Field office management practices* was measured by the following item.

- "Please rate your field office's overall approach to biodiversity management." (bio_mgmt)

The item was rated on a ten-point Likert scale, where 1=Exclusively Species-level and 10=Exclusively Ecosystem-level.

(4) Collaborative management practices (*information exchange w/ other FWS field offices, information exchange w/ other federal agencies, information exchange w/ state or local agencies,* and *information exchange w/ non-governmental organizations*) were measured by responses to the sub-questions contained in the following item.

- "How important is the exchange of information relevant to making biodiversity management decisions with the following?"

The sub-questions presented in the rows beneath the main item include 1) Other U.S. Fish & Wildlife Service field offices (info_FWS), 2) Other Federal natural resource agencies (info_Fed), 3) State or Local natural resource agencies (info_SL), and 4) Non-governmental organizations (info_NG). Responses were rated on a ten-point Likert scale for each sub-question, where 1=Very Unimportant and 10=Very Important.

(5) *Past federal data use experiences,* (6) *past state or local data use experiences,* and (7) *past non-governmental data use experiences* were measured by three sub-questions contained in the following item.

- "On average, my field office has had positive experiences using the following data sources in making biodiversity management decisions."

The sub-questions presented in the rows beneath the main item included 1) Federal Data (FDexp), 2) State or Local Data (SLDexp), and 3) Non-governmental Data (NGDexp). Participants were asked to respond on a five-point Likert scale suggested by Patten (2001), whereby 1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree, 5=Strongly Disagree.

(8) *Information technology capabilities* was measured by the following item.

- "What is the most up-to-date version of ArcView software available in your field office?" (ArcView)

Responses were rated on a six-point Likert scale (1=3.x, 2=8.x, 3=9.1, 4=9.2, 5=Other, 6=My office does not use ArcView software.). Previous research strongly suggests that a particular field office's version of ArcView viewing software is a very pressing information technology issue with regard to data selection within the U.S. Fish & Wildlife Service (Gerlach, 2005). Based on the versions of ArcView available to U.S. Fish & Wildlife Service biologists, the aforementioned measurement scale was developed.

Environmental Factor Measures

Through the lens of diffusion theory, this study examined several environmental factors which may influence data selection among natural resource agency field offices. To test the research model shown in Figure 3.2 (a repeat of Figures 1.1. and 2.1), several independent variables related to environmental factors were examined. Those variables were measured as follows.

(9) *Federal agency data marketing efforts,* (10) *state or local agency data marketing efforts,* and (11) *non-governmental data marketing efforts* were measured by three sub-questions contained in one survey item. While scholarly literature does not set a sound precedent for the measurement of these variables, field biologists interviewed in previous research activities significantly informed their measurement and related scale (Gerlach, 2005). A six-point Likert scale (1=Weekly, 2=Monthly, 3=Quarterly, 4=Annually, 5=Rarely, 6=Never) was used to rate responses to the three sub-questions within the following item. Reverse coding allowed higher scores to represent higher levels of data marketing. The sub-questions

presented in the rows beneath the main item included 1) Federal Government Agencies (FD_market), 2) State or Local Government Agencies (SLD_market), and 3) Non-governmental Organizations (NG_market).

- “In general, how frequently do the following market their data products to your field office?”

(12) Interest or advocacy group relationships (*confer w/ nonprofit organizations, confer w/ private sector businesses*, and *confer w/ academic institutions*) were measured by responses to the three sub-questions presented in rows beneath the following item.

- “How often does your field office confer with the following when making biodiversity management decisions?”

The sub-questions represented 1) Nonprofit Organizations (confer_NPO), 2) Private Sector Businesses (confer_PrivSec), and 3) Academic Institutions (confer_Acad). Responses were rated on the seven-point Likert scale whereby 1=Daily, 2=Weekly, 3=Monthly, 4=Quarterly, 5=Annually, 6=Rarely, and 7=Never. Responses were reverse coded to allow higher scores to indicate a closer relationship between the field office and interest or advocacy groups. NBII (2007) suggests nonprofit, private sector, and academic data sources may be considered as non-governmental.

(13) *Other field office data source* and (14) *other field office data newness* assessed perceptions of the data selection decisions of other U.S. Fish & Wildlife Service field offices. The two variables were measured by sub-questions representing 1) Data sources used by

other U.S. Fish & Wildlife Service field offices (data_infl) and 2) The newness (age) of data used by other U.S. Fish & Wildlife Service field offices (new_infl). The sub-questions were presented in rows beneath the following survey item. Responses were rated on a ten-point Likert scale, where 1=Not Influential and 10=Very Influential.

- "The adoption of data is important in making biodiversity management decisions. When your field office is adopting data, how influential are each of the following?"

(15) Public involvement intensity was measured by the independent variables *public participation frequency* and *public participation intensity*. These variables were measured by the following two items, respectively. The first item, measuring frequency of public participation in making biodiversity management decisions, was rated on a seven-point Likert scale (1=Daily, 2=Weekly, 3=Monthly, 4=Quarterly, 5=Annually, 6=Rarely, 7=Never). This was the same scale used to rate previous measures, was informed by previous research, and complies with suggestions in questionnaire research literature (Gerlach, 2005; Patten, 2001). This variable was reverse coded so that higher ratings represented more frequent public participation. The second item, assessing number of participants, was rated on a six-point Likert scale (1=1-5, 2=6-10, 3=11-15, 4=16-20, 5=Over 20, 6=Individual members of the general public never offer information.). Previous research shows that public involvement usually occurs within the parameters included in the scale developed to measure this item (Gerlach, 2005).

1. “How frequently does your field office receive information relevant to biodiversity management decisions from individual members of the general public (not organized interest groups)?” (pub_inform)
2. “When your field office receives such information from the general public (not organized interest groups), how many citizens, on average, offer information?” (pub_numbers)

(16) *Public data use preference* was measured by one item. The item was rated on a five-point Likert scale (1=Federal Data, 2=State or Local Data, 3=Non-governmental Data, 4=A combination of the above, 5=Individual members of the general public do not express a preference.). The rating scale was based on the dependent variables measured in this study.

- “On average, which data source do individual members of the general public (not organized interest groups) encourage your field office to use when making biodiversity management decisions?” (pub_datapref)

Control Variables

Three control variables were measured in this study, *employees in field office, Service region,* and *tenure w/ FWS* ([U.S.] Fish & Wildlife Service). The *employees in field office* variable includes measures of the number of full- and part-time employees in a field office. Intuitively, a greater number of employees in the office could mean more data selection ideas and opinions. Previous research indicates that the greater the number of employees invested in data selection, the more discussion and disagreement accompanies the data selection process (Gerlach, 2005). *Service region* measured the U.S. Fish & Wildlife Service region to which a responding field office belongs. The vast amount of differing policy issues covered across the United States is partially born out of the species and habitat diversity which exists from one region of the country to the next (Gerlach, 2005; USFWS, 2007). The region to which a particular field office belongs may influence how data are selected based on variations in policy issues across the country. Therefore, an examination of organizational and environmental factors which influence data selection while controlling for U.S. Fish & Wildlife Service region was necessary. *Tenure w/ FWS* measured how long the respondent has been an employee of the U.S. Fish & Wildlife Service. Previous research indicates the U.S. Fish & Wildlife Service workforce spans a broad spectrum with regard to tenure (Gerlach, 2005). Due to the possibility that differing lengths of service to the agency influence the data selection philosophies of U.S. Fish & Wildlife Service employees, it was thought best to control for tenure when examining the aforementioned independent variables.

Employees in field office was measured by two open-ended survey items, which assessed the number of full- and part-time employees working in the participating field office. To eliminate confusion in the calculation of office employees, a two-item approach to measuring this variable was most appropriate.

1. "Approximately how many people does your office employ full-time?" (emp_FT)
2. "Approximately how many people does your office employ part-time?" (emp_PT)

These measurement variables were then combined to create the *employees in field office* control variable (FTE). The creation of this variable is detailed in Table 3.5.

Service region was measured on an eight-point Likert scale (1=Region 1 [Pacific], 2=Region 2 [Southwest], 3=Region 3 [Great Lakes – Big Rivers], 4=Region 4 [Southeast], 5=Region 5 [Northeast], 6=Region 6 [Mountain – Prairie], 7=Region 7 [Alaska], 8=Region 8 [California and Nevada]) (USFWS, 2007) by the following item.

- "To which region of the U.S. Fish & Wildlife Service does your field office belong?" (region)

Tenure with FWS was measured by the following open-ended survey item. Responses were adjusted to reflect the number of years the participant has worked for the U.S. Fish & Wildlife Service.

- "Approximately how long have you been working for the U.S. Fish & Wildlife Service?" (tenure)

Initial Variable Operationalization Summary

Table 3.4 summarizes the initial operationalization of each variable used in this study. The table includes information on variable name, type, measure, potential values, and corresponding survey item(s).

Table 3.4: Initial Variable Operationalization

Variable Name	Type	Measure	Potential Values	Survey Item(s)
Federal Data Importance (FDimp) *Federal Data Frequency of Use* FDfreq)	Dependents measuring federal data selection	Two questions regarding 1)importance of data sources and 2)frequency of data use.	Item 1: Scale of 1 to 10, where 1=Least Important and 10=Most Important Item 2: 1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Annually 6=Rarely 7=Never	1, 2
State or Local Data Importance (SLDimp) *State or Local Data Frequency of Use* (SLDfreq)	Dependents measuring state or local data selection	Two questions regarding 1)importance of data sources and 2)frequency of data use.	Item 1: Scale of 1 to 10, where 1=Least Important and 10=Most Important Item 2: 1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Annually 6=Rarely 7=Never	1, 2
Non-governmental Data Importance (NGDimp) *Non-governmental Data Frequency of Use* (NGDfreq)	Dependents measuring non-governmental data selection	Two questions regarding 1)importance of data sources and 2)frequency of data use.	Item 1: Scale of 1 to 10, where 1=Least Important and 10=Most Important Item 2: 1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Annually 6=Rarely 7=Never	1, 2
Year of Last Update of Data Set Most Relied Upon (DataSetUpd) *Decade of Establishment of Data Set Most Relied Upon* (DataSetEst)	Dependents measuring newness of data	Two questions regarding when data set relied on most was 1)last updated and 2)established	Open-ended	4, 5

Table 3.4: Continued

Age of Field Office (FO_open)	Independent	Question regarding the approximate year the field office opened	Open-ended	19
Parent Agency Influence (add_fund)	Independent	Question regarding which data source leads to increased resources from the parent agency	1=Federal Data 2=State or Local Data 3=Non-governmental Data 4=A combination of the above 5=Doesn't make a difference	8
Field Office Management Practices (bio_mgmt)	Independent	Statement instructing the participant to rate their field office's overall approach to biodiversity management	Scale of 1 to 10, where 1=Exclusively Species-level and 10=Exclusively Ecosystem-level	14
Information Exchange w/ Other FWS Field Offices (info_FWS) *Information Exchange w/ Other Federal Agencies* (info_Fed) *Information Exchange w/ State or Local Agencies* (info_SL) *Information Exchange w/ Non-governmental Organizations* (info_NG)	Independents measuring collaborative management practices	Question regarding the importance of exchanging information with 1)other U.S. Fish & Wildlife Service field offices, 2)other federal natural resource agencies, 3)state or local natural resource agencies, and 4)non-governmental organizations when making biodiversity management decisions.	Scale of 1 to 10, where 1=Very Unimportant and 10=Very Important	15
Past Federal Data Use Experiences (FDexp)	Independent	Statement instructing the participant to rate the accuracy of their average past federal data use experiences being positive	1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly disagree	6

Table 3.4: Continued

Past State or Local Data Use Experiences (SLDexp)	Independent	Statement instructing the participant to rate the accuracy of their average past state or local data use experiences being positive	1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly disagree	6
Past Non-governmental Data Use Experiences (NGDexp)	Independent	Statement instructing the participant to rate the accuracy of their average past non-governmental data use experiences being positive	1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly disagree	6
Information Technology Capabilities (ArcView)	Independent	Question about the most up-to-date version of ArcView software in the field office	1=3.x 2=8.x 3=9.1 4=9.2 5=Other 6=My field office does not use ArcView software.	17
Federal Agency Data Marketing Efforts (FD_market)	Independent	Question regarding frequency of federal data marketing efforts	1=Weekly 2=Monthly 3=Quarterly 4=Annually 5=Rarely 6=Never	9
State or Local Agency Data Marketing Efforts (SLD_market)	Independent	Question regarding frequency of state or local data marketing efforts	1=Weekly 2=Monthly 3=Quarterly 4=Annually 5=Rarely 6=Never	9
Non-governmental Data Marketing Efforts (NG_market)	Independent	Question regarding frequency of non-governmental data marketing efforts	1=Weekly 2=Monthly 3=Quarterly 4=Annually 5=Rarely 6=Never	9
Confer w/ Nonprofit Organizations (confer_NPO) *Confer w/ Private Sector Businesses* (confer_PrivSec) *Confer w/ Academic Institutions* (confer_Acad)	Independents measuring interest or advocacy group relationships	Question regarding how often the field office confers with 1)nonprofit organizations, 2)private sector businesses, and 3)academic institutions when making biodiversity decisions	1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Annually 6=Rarely 7=Never	10

Table 3.4: Continued

Other Field Office Data Source (data_infl)	Independent	Question regarding how influential data sources used by other field offices are in making data adoption decisions	Scale of 1 to 10, where 1=No Influence and 10=Very Influential	16
Other Field Office Data Newness (new_infl)	Independent	Question regarding how influential the newness of data used by other field offices are in making data adoption decisions	Scale of 1 to 10, where 1=No Influence and 10=Very Influential	16
Public Participation Frequency (pub_inform) *Public Participation Intensity* (pub_numbers)	Independents measuring public involvement intensity	Two items regarding 1)the frequency that members of the general public offer information relevant to biodiversity management decisions and 2)how many offer such information on a particular issue	Item 1: 1=Daily 2=Weekly 3=Monthly 4=Quarterly 5=Annually 6=Rarely 7=Never Item 2: 1=1-5 2=6-10 3=11-15 4=16-20 5=Over 20 6=Individual members of the general public never offer information.	11, 12
Public Data Use Preference (pub_datapref)	Independent	Question regarding the source of data individual members of the general public encourages the field office to use when making biodiversity management decisions	1=Federal Data 2=State or Local Data 3=Non-governmental Data 4=A combination of the above 5=Individual members of the general public do not express a preference.	13
Employees in Field Office Combination of full- (emp_FT) and part-time (emp_PT) employees	Control	Two questions regarding how many individuals are employed by the field office 1)full-time and 2)part-time	Open-ended	20, 21

Table 3.4: Continued

Service Region (region)	Control	Question regarding region to which the field office belongs	1=Region 1 (Pacific) 2=Region 2 (Southwest) 3=Region 3 (Great Lakes – Big Rivers) 4=Region 4 (Southeast) 5=Region 5 (Northeast) 6=Region 6 (Mountain-Prairie) 7=Region 7 (Alaska) 8=Region 8 (California and Nevada)	18
Tenure w/ FWS (tenure)	Control	Question regarding how long the participating employee has worked for the U.S. Fish & Wildlife Service.	Open-ended	22

Variable Recoding

Many of the variables used in the statistical analysis portion of this study were recoded. This recoding allowed for more meaningful statistical analysis. Several of the variables, in continuous form, were so unevenly distributed that collapsing them was a necessary step to achieve more concise statistical analysis. Recoding provided simplicity and parsimony as well as more easily understood and clearly defined results. Variable recoding procedures are outlined and individually justified in Table 3.5. The variable codebook used in this study is included as Appendix C of this dissertation. The frequency distributions of original variables can be viewed as Appendix D. Frequency distributions associated with recoded variables are included as Appendix E. Additional discussion is devoted to the recoding of certain variables and what may be gleaned from some original frequency distributions in terms of overall results in chapters four and five.

Table 3.5: Variable Recoding

Measurement Variable	Original Frequencies	Recoded Frequencies	Justification
Federal Data Importance (FDimp)	1(Unimportant) = 2 2 = 3 3 = 0 4 = 2 5 = 6 6 = 4 7 = 14 8 = 31 9 = 40 10(Important) = 131	1(Unimportant) = 13 **(combined choices 1-5)** 2(Somewhat Important) = 89 **(combined choices 6-9)** 3(Very Important) = 131 **(choice 10)**	The original frequency distribution showed an intense preference for viewing federal data as important. The distribution appears well approximated by a trichotomous variable.
State or Local Data Importance (SLDimp)	1(Unimportant) = 3 2 = 3 3 = 5 4 = 3 5 = 10 6 = 8 7 = 17 8 = 40 9 = 39 10(Important) = 105	1(Unimportant) = 24 **(combined choices 1-5)** 2(Somewhat Important) = 104 **(combined choices 6-9)** 3(Very Important) = 105 **(choice 10)**	The original frequency distribution showed an intense preference for viewing state or local data as important. The distribution appears well approximated by a trichotomous variable.
Non-governmental Data Importance (NGDimp)	1(Unimportant) = 4 2 = 4 3 = 3 4 = 3 5 = 20 6 = 18 7 = 27 8 = 35 9 = 32 10(Important) = 86	1(Unimportant) = 34 **(combined choices 1-5)** 2(Somewhat Important) = 112 **(combined choices 6-9)** 3(Very Important) = 86 **(choice 10)**	Though original responses were more normally distributed than *FDimp* and *SLDimp*, a trichotomous variable was created to maintain consistency among data importance variables.
Federal Data Frequency of Use (FDfreq)	1(Never) = 4 2(Rarely) = 16 3(Annually) = 38 4(Quarterly) = 29 5(Monthly) = 45 6(Weekly) = 50 7(Daily) = 44	NOT RECODED.	Original responses were acceptably distributed. Therefore, the original scale was kept in place.
State or Local Data Frequency of Use (SLDfreq)	1(Never) = 4 2(Rarely) = 17 3(Annually) = 48 4(Quarterly) = 43 5(Monthly) = 49	NOT RECODED.	Original responses were acceptably distributed. Therefore, the original scale was kept in place.

Table 3.5: Continued

	6(Weekly) = 38 7(Daily) = 26		
Non-governmental Data Frequency of Use (NGDfreq)	1(Never) = 5 2(Rarely) = 37 3(Annually) = 55 4(Quarterly) = 31 5(Monthly) = 44 6(Weekly) = 34 7(Daily) = 17	NOT RECODED.	Original responses were acceptably distributed. Therefore, the original scale was kept in place.
Year of Last Update of Data Set Most Relied Upon (DataSetUpd)	Open-ended responses.	1(2008) = 109 2(2007) = 34 3(Before 2007) = 16	Responses were heavily skewed toward the year in which the survey was disseminated. A trichotomous variable was created to allow for more meaningful statistical analysis.
Decade of Establishment of Data Set Most Relied Upon (DataSetEst)	Open-ended responses coded by decade: 1(2000s) = 39 2(1990s) = 26 3(1980s) = 24 4(1970s) = 14 5(1960s) = 12 6(1950s) = 5 7(1940s) = 4 8(1930s) = 3 9(Before 1930) = 3 10(Don't Know) = 35	1(2000s) = 39 2(1990s) = 26 3(1980s) = 24 4(1970s) = 14 5(1960s) = 12 6(Before 1960) = 15 **(combined choices 6-9)** 7(Don't Know) = 35 **(choice 10)**	Responses were collapsed to create a more even distribution of responses.
Age of Field Office (FO_open)	Open-ended responses stating the year in which the field office opened for operation.	1(2000s) = 7 2(1990s) = 36 3(1980s) = 31 4(1970s) = 25 5(1960s) = 24 6(Before 1960) = 71	Collapsing the continuous responses was necessary to achieve a more even distribution of responses.
Parent Agency Influence (add_fund)	1(Federal Data) = 15 2(State or Local Data) = 4 3(Non-governmental Data) = 5 4(A combination of data sources) = 66 5(Doesn't make a difference) = 109	NOT RECODED.	Though the frequency distribution is uneven, maintaining original categories was necessary to allow for meaningful statistical analysis and the testing of the associated hypothesis.
Field Office Management Practices (bio_mgmt)	1(Exclusively Species-level) = 3 2 = 8 3 = 17 4 = 14 5 = 44 6 = 30	NOT RECODED.	Original responses were normally distributed. Therefore, the original scale was kept in place.

Table 3.5: Continued

	7 = 43 8 = 31 9 = 10 10(Exclusively Ecosystem-level) = 4		
Information Exchange w/ Other FWS Field Offices (info_FWS)	1(Unimportant) = 0 2 = 2 3 = 1 4 = 0 5 = 4 6 = 10 7 = 12 8 = 29 9 = 43 10(Important) = 102	1(Unimportant) = 9 **(combined choices 1-5)** 2(Somewhat Important) = 94 **(combined choices 6-9)** 3(Very Important) 102 **(choice 10)**	The original frequency distribution showed an intense preference for viewing information exchange with other FWS field offices as important. The distribution appears well approximated by a trichotomous variable.
Information Exchange w/ Other Federal Agencies (info_Fed)	1(Unimportant) = 2 2 = 2 3 = 1 4 = 4 5 = 14 6 = 9 7 = 23 8 = 49 9 = 39 10(Important) = 61	1(Unimportant) = 23 **(combined choices 1-5)** 2(Somewhat Important) = 120 **(combined choices 6-9)** 3(Very Important) 61 **(choice 10)**	The original frequency distribution showed a preference for viewing information exchange with other federal agencies as important. The distribution appears well approximated by a trichotomous variable.
Information Exchange w/ State or Local Agencies (info_SL)	1(Unimportant) = 2 2 = 0 3 = 1 4 = 2 5 = 6 6 = 10 7 = 19 8 = 46 9 = 42 10(Important) = 76	1(Unimportant) = 11 **(combined choices 1-5)** 2(Somewhat Important) = 117 **(combined choices 6-9)** 3(Very Important) 76 **(choice 10)**	The original frequency distribution showed a preference for viewing information exchange with state or local agencies as important. The distribution appears well approximated by a trichotomous variable.
Information Exchange w/ Non-governmental Organizations (info_NG)	1(Unimportant) = 2 2 = 6 3 = 3 4 = 5 5 = 20 6 = 21 7 = 29 8 = 45 9 = 27 10(Important) = 46	1(Unimportant) = 36 **(combined choices 1-5)** 2(Somewhat Important) = 122 **(combined choices 6-9)** 3(Very Important) 46 **(choice 10)**	The original frequency distribution showed a preference for viewing information exchange with non-governmental organizations as important. The distribution appears well approximated by a trichotomous variable.
Past Federal Data Use Experiences (FDexp)	1(Strongly Disagree) = 2 2(Disagree) = 1 3(Neutral) = 27 4(Agree) = 110 5(Strongly Agree) = 63	1(Do Not Agree) = 30 **(combined choices 1-3)** 2(Agree) = 110 **(choice 4)** 3(Strongly Agree) = 63 **(choice 5)**	Responses were collapsed to create a more even distribution of responses.

Table 3.5: Continued

Past State or Local Data Use Experiences (SLDexp)	1(Strongly Disagree) = 3 2(Disagree) = 4 3(Neutral) = 29 4(Agree) = 119 5(Strongly Agree) = 48	1(Do Not Agree) = 36 **(combined choices 1-3)** 2(Agree) = 119 **(choice 4)** 3(Strongly Agree) = 48 **(choice 5)**	Responses were collapsed to create a more even distribution of responses.
Past Non-governmental Data Use Experiences (NGDexp)	1(Strongly Disagree) = 2 2(Disagree) = 4 3(Neutral) = 55 4(Agree) = 96 5(Strongly Agree) = 45	1(Do Not Agree) = 61 **(combined choices 1-3)** 2(Agree) = 96 **(choice 4)** 3(Strongly Agree) = 45 **(choice 5)**	Responses were collapsed to create a more even distribution of responses.
Information Technology Capabilities (ArcView)	1(My field office does not use ArcView software.) = 31 2(3.x) = 5 3(8.x) = 9 4(9.1) = 33 5(9.2) = 116 6(Other) = 3	1(My field office does not use ArcView software.) = 31 **(choice 1)** 2(Earlier Version) = 91 **(combined choices 2-4 and 6)** 3(Version 9.2) = 116 **(choice 5)**	Due to an intense preference for newer versions of ArcView software, a trichotomous variable was created to allow for more meaningful statistical analysis and more evenly distributed data.
Federal Agency Data Marketing Efforts (FD_market)	1(Never) = 43 2(Rarely) = 50 3(Annually) = 51 4(Quarterly) = 18 5(Monthly) = 28 6(Weekly) = 9	NOT RECODED.	Original responses were normally distributed. Therefore, the original scale was kept in place.
State or Local Agency Data Marketing Efforts (SLD_market)	1(Never) = 47 2(Rarely) = 76 3(Annually) = 43 4(Quarterly) = 19 5(Monthly) = 12 6(Weekly) = 3	NOT RECODED.	The original scale was kept in place to maintain consistency with *FD_market* and *NG_market*. Though the "Weekly" category only contains three cases, other categories are well distributed.
Non-governmental Data Marketing Efforts (NG_market)	1(Never) = 40 2(Rarely) = 82 3(Annually) = 31 4(Quarterly) = 26 5(Monthly) = 14 6(Weekly) = 5	NOT RECODED.	The original scale was kept in place to maintain consistency with *FD_market* and *SLD_market*. Though the "Weekly" category only contains five cases, other categories are well distributed.

Table 3.5: Continued

Confer w/ Nonprofit Organizations (confer_NPO)	1(Never) = 12 2(Rarely) = 70 3(Annually) = 40 4(Quarterly) = 42 5(Monthly) = 22 6(Weekly) = 13 7(Daily) = 5	1(Never) = 12 2(Rarely) = 70 3(Annually) = 40 4(Quarterly) = 42 5(Monthly) = 22 6(Weekly) = 18 **(combined choices 6-7)**	The mechanical, pragmatic decision was made to combine the "Weekly" and "Daily" categories to allow for more even distribution of responses.
Confer w/ Private Sector Businesses (confer_PrivSec)	1(Never) = 29 2(Rarely) = 95 3(Annually) = 29 4(Quarterly) = 20 5(Monthly) = 14 6(Weekly) = 14 7(Daily) = 4	1(Never) = 29 2(Rarely) = 95 3(Annually) = 29 4(Quarterly) = 20 5(Monthly) = 14 6(Weekly) = 18 **(combined choices 6-7)**	The mechanical, pragmatic decision was made to combine the "Weekly" and "Daily" categories to allow for more even distribution of responses.
Confer w/ Academic Institutions (confer_Acad)	1(Never) = 2 2(Rarely) = 23 3(Annually) = 56 4(Quarterly) = 49 5(Monthly) = 49 6(Weekly) = 20 7(Daily) = 6	1(Never) = 2 2(Rarely) = 23 3(Annually) = 56 4(Quarterly) = 49 5(Monthly) = 49 6(Weekly) = 26 **(combined choices 6-7)**	The mechanical, pragmatic decision was made to combine the "Weekly" and "Daily" categories to allow for more even distribution of responses. The "Never" category was kept for this variable to maintain consistency with *confer_NPO* and *confer_PrivSec*.
Other Field Office Data Source (data_infl)	1(Not Influential) = 4 2 = 0 3 = 1 4 = 3 5 = 23 6 = 12 7 = 31 8 = 36 9 = 40 10(Very Influential) = 49	1(Not Influential) = 31 **(combined choices 1-5)** 2(Somewhat Influential) = 119 **(combined choices 6-9)** 3(Very Influential) = 49 **(choice 10)**	The original frequency distribution showed a preference for viewing data sources used by other field offices as influential in making data selection decisions. The distribution appears well approximated by a trichotomous variable.
Other Field Office Data Newness (new_infl)	1(Not Influential) = 3 2 = 0 3 = 0 4 = 1 5 = 17 6 = 13 7 = 32 8 = 43 9 = 35 10(Very Influential) = 55	1(Not Influential) = 21 **(combined choices 1-5)** 2(Somewhat Influential) = 123 **(combined choices 6-9)** 3(Very Influential) = 55 **(choice 10)**	The original frequency distribution showed a relatively strong preference for viewing the newness of data used by other field offices as influential in making data selection decisions. The distribution appears well approximated by a trichotomous variable.

Table 3.5: Continued

Public Participation Frequency (pub_inform)	1(Never) = 24 2(Rarely) = 107 3(Annually) = 24 4(Quarterly) = 20 5(Monthly) = 22 6(Weekly) = 7 7(Daily) = 0	1(Never) = 24 2(Rarely) = 107 3(Annually) = 24 4(Quarterly) = 20 5(Monthly) = 22 6(Weekly) = 7 **(essentially dropped choice 7)**	The "Daily" category was dropped from the variable due to a lack of cases. The new distribution of responses allowed for meaningful statistical analysis.
Public Participation Intensity (pub_numbers)	1(Individual members of the general public never offer information.) = 27 2(1-5) = 152 3(6-10) = 12 4(11-15) = 4 5(16-20) = 0 6(Over 20) = 7	1(Individual members of the general public never offer information.) = 27 2(1-5) = 152 3(Over 5) = 23	A trichotomous variable was the only viable way to pursue meaningful statistical analysis. The survey item (#12) should have been an open-ended response question.
Public Data Use Preference (pub_datapref)	1(Individual members of the general public do not express a preference.) = 119 2(Federal Data) = 7 3(State or Local Data) = 4 4(Non-governmental Data) = 23 5(A combination of data sources) = 49	NOT RECODED.	Though the frequency distribution is uneven, maintaining original categories was necessary to allow for meaningful statistical analysis and the testing of the associated hypothesis.
Full-time Employees in Field Office (emp_FT) *Part-time Employees in Field Office* (emp_PT)	Open-ended responses. Open-ended responses.	**Computed new continuous variable (FTE):** *Employees in Field Office* (FTE) = emp_FT + (emp_PT(.5))	The variable *FTE* was computed to create a continuous index of employees in the FWS field office. MANCOVA supports the use of continuous control variables (Garson, 2008).
Service Region (region)	1(Pacific) = 22 2(Southwest) = 25 3(Great Lakes-Big Rivers) = 35 4(Southeast) = 43 5(Northeast) = 32 6(Mountain-Prairie) = 22 7(Alaska) = 10 8(California and Nevada) = 15	NOT RECODED.	The variable *region* is coded by FWS region and was analyzed as a control variable.
Tenure w/ FWS (tenure)	Open-ended responses (in years).	NOT RECODED.	MANCOVA supports the use of continuous control variables (Garson, 2008). Therefore, this variable was not recoded.

DATA ANALYSIS TOOLS AND PROCEDURES

Data analysis for this study was done using SPSS 16.0, because it represents the version of SPSS most readily available to College of Humanities and Social Sciences graduate students at North Carolina State University. The analysis was conducted through a four-step process. First, the data were screened for missing values, and appropriate deletion or imputation steps were taken where necessary. Second, bivariate Pearson correlations were run to assess initial relationships between variables and check for issues of multicollinearity and singularity. The correlation matrix produced is included as Appendix F of this dissertation. Third, multiple analysis of covariance (MANCOVA) procedures were conducted. Finally, appropriate post-hoc tests were conducted. The goals of these analyses were to test the various organizational and environmental hypotheses posed in chapter two and determine the accuracy of the research model depicted in Figure 3.2.

Data Screening

Data were screened for regional response bias, as shown in Table 3.1. The chi-square goodness of fit test revealed that the distribution of survey responses by region was not significantly different from what would be expected based on the actual distribution of field offices surveyed by region ($p = .56$). Screening methods also served to examine the data for missing values as well as other assumptions of MANCOVA that must be met. The assumptions of MANCOVA are discussed in the following section, while special attention is paid to the issue of missing values below.

Missing Values

Missing values were examined using the Missing Values Analysis (MVA) function in SPSS 16.0. Values which are not missing completely at randomly (MCAR) should be estimated, likely by maximum likelihood (ML) estimation (Garson, 2008). ML estimation is generally considered to be preferable to data imputation by regression analysis, because it places fewer demands on the data with regards to statistical assumptions (Garson, 2008). The MVA procedure in SPSS 16.0 supports imputation of missing values using ML (expected maximization) estimation. (Garson, 2008). MVA was conducted on all measurement variables with >5% missing cases. Table 3.6 shows the number of valid and missing cases for each variable used in this study. Variables missing >5% have their percentages missing highlighted in bold.

Table 3.6: Missing Values

Measurement Variable	Valid Cases	Missing Cases	% Missing
Federal Data Importance (FDimp)	233	5	2.10
State or Local Data Importance (SLDimp)	233	5	2.10
Non-governmental Data Importance (NGDimp)	232	6	2.52
Federal Data Frequency of Use (FDfreq)	226	12	**5.04**
State or Local Data Frequency of Use (SLDfreq)	225	13	**5.46**
Non-governmental Data Frequency of Use (NGDfreq)	223	15	**6.30**
Data Set Most Relied Upon (DataSet)	184	54	**22.69**
Year of Last Update of Data Set Most Relied Upon (DataSetUpd)	159	79	**33.19**
Decade of Establishment of Data Set Most Relied Upon (DataSetEst)	165	73	**30.67**
Age of Field Office (FO_open)	194	44	**18.49**
Parent Agency Influence (add_fund)	199	39	**16.39**
Field Office Management Practices (bio_mgmt)	204	34	**14.29**

Table 3.6: Continued

Information Exchange w/ Other FWS Field Offices (info_FWS)	205	33	**13.87**
Information Exchange w/ Other Federal Agencies (info_Fed)	204	34	**14.29**
Information Exchange w/ State or Local Agencies (info_SL)	204	34	**14.29**
Information Exchange w/ Non-governmental Organizations (info_NG)	204	34	**14.29**
Past Federal Data Use Experiences (FDexp)	203	35	**14.71**
Past State or Local Data Use Experiences (SLDexp)	203	35	**14.71**
Past Non-governmental Data Use Experiences (NGDexp)	202	36	**15.13**
Information Technology Capabilities (ArcView)	238	0	0.00
Federal Agency Data Marketing Efforts (FD_market)	199	39	**16.39**
State or Local Agency Data Marketing Efforts (SLD_market)	200	38	**15.97**
Non-governmental Data Marketing Efforts (NG_market)	198	40	**16.81**
Confer w/ Nonprofit Organizations (confer_NPO)	204	34	**14.29**
Confer w/ Private Sector Businesses (confer_PrivSec)	205	33	**13.87**
Confer w/ Academic Institutions (confer_Acad)	205	33	**13.87**
Other Field Office Data Source (data_infl)	199	39	**16.39**
Other Field Office Data Newness (new_infl)	199	39	**16.39**
Public Participation Frequency (pub_inform)	204	34	**14.29**
Public Participation Intensity (pub_numbers)	202	36	**15.13**
Public Data Use Preference (pub_datapref)	202	36	**15.13**
Employees in Field Office (FTE)	198	40	**16.81**
Service Region (region)	204	34	**14.29**
Tenure w/ FWS (tenure)	201	37	**15.55**

MVA Results

The MVA in SPSS 16.0 supports Little's MCAR test (Garson, 2008). Little's MCAR test is a chi-square test for missing completely at random (Garson, 2008). MCAR was confirmed on missing values for the data used in this study (p = .11). The missing values within the data set were determined to be randomly distributed across all observations. Therefore, missing values were dropped by pairwise deletion. Pairwise deletion was chosen over listwise deletion due to the relatively small sample size used in this study as well as the number of cases with missing data being large (Garson, 2008). If data are MCAR, then dropping the missing cases should not affect the reliability of calculations even if more than 5% are missing (Garson, 2008). Therefore, simple deletion was appropriate.

Bivariate Pearson Correlations

Bivariate Pearson correlations were run to initially assess relationships between the variables used in this study. Potential instances of multicollinearity and singularity were flagged based on these correlations. However, potential multicollinearity and singularity issues were examined in further detail and determined not to be a threat to this study's main data analysis, as discussed in chapter four. Bivariate Pearson correlations also provided insight into the relationships between independent and dependent variables examined in this study. It should be noted that while bivariate correlations can be revealing, they can also be deceptive. Multivariate analysis may reveal some seemingly significant bivariate correlations to be spurious when other variables are controlled. Multivariate analysis can also reveal some seemingly non-significant relationships to have been suppressed by control variables and to actually be significant. The following section details the multivariate analysis procedures employed in this study.

Multiple Analysis of Covariance (MANCOVA)

To test the hypotheses informed by neo-institutional and diffusion theories, a series of MANCOVA models were run. MANCOVA is an extension of multiple analysis of variance (MANOVA) . According to Tabachnick and Fidell (2001), "(MANOVA) is a generalization of ANOVA (analysis of variance) to a situation in which there are several dependent variables" (p. 322). MANOVA allows for the analysis of main and interaction effects of categorical independent variables on several interval dependent variables (Garson, 2008). Multivariate analysis was appropriate in this study due to the structure of the data as well as the nature of the analyses conducted, all of which called for the inclusion of two or more dependent variables. MANOVA / MANCOVA was preferable to running several ANOVA procedures for two primary reasons. First, conducting separate ANOVA procedures for each dependent variable serves to significantly inflate the likelihood of Type I error (Allaire, 2009; Field, 2005; Tabachnick & Fidell, 2001). Second, the chances of finding a group difference are greater when one measures multiple dependent variables (Allaire, 2009; Tabachnick & Fidell, 2001). In sum, a multivariate approach is always more powerful than a series of univariate analyses.

MANCOVA, while similar to MANOVA, allows the testing of interval independent variables as covariates (Garson, 2008). MANCOVA also allows continuous control variables to be examined as covariates (Garson, 2008). In this study, control variables *employees in field office, Service region,* and *tenure w/ FWS* were used to study their effects on dependent variables and to provide more meaningful statistical analysis of independent variables. Therefore, MANCOVA was a logical choice for certain analytic portions of the study.

SPSS 16.0 was used to conduct MANCOVA procedures for this study. The analyses were run using a two-step process. First, overall significance tests were run to assess main and interaction effects. Second, post-hoc tests were conducted on the models which showed significant main and interaction effects. Post-hoc tests reveal which group means differ from others (Garson, 2008). For the purposes of this study, Bonferroni post-hoc tests were employed, though LSD post-hoc tests were used in instances of comparing variables which contain several levels. Garson (2008) asserts that LSD post-hoc tests are more liberal than Bonferroni and more appropriate when comparing several variables with multiple levels. SPSS 16.0 was also used to test MANCOVA assumptions, such as the equality of covariance matrices and equality of error variances.

Separate MANCOVA models were run to assess the impacts of organizational factors on data selection than were conducted to assess the impacts of environmental factors on data selection. Preferably, an omnibus MANCOVA model would have been run to allow for the control of organizational independent variables while testing environmental independent variables and vice versa. However, this study lacked the sample adequacy (only 204 respondents completed the survey) to run an omnibus MANCOVA model including 22 independent variables. The model was attempted, but violated a major assumption of MANCOVA (sample adequacy). However, steps were taken to assess the most significant results of this study while controlling for other variables. All MANCOVA procedures are detailed in chapters four and five.

Major Assumptions of MANCOVA

For the purposes of MANCOVA, four major assumptions should be met. First, observations should be independent of one another. According to Garson (2008), “The usual MANOVA is not robust when the selection of one observation depends on the selection of one or more earlier ones.” The examination of environmental factors grounded in diffusion theory makes meeting this assumption difficult. Glass and Hopkins (1984) state, “But where treatments involve interaction among persons…the observations may influence each other” (p. 353), as quoted in Stevens (2002, p. 259). Survey questions pertaining to data selection as well as items which assessed the influence of other field offices’ data selection decisions potentially violated the assumption of independent observations. Therefore, this study only offers exploratory causal results, and is better suited to reporting correlations between independent and dependent variables.

The other three major assumptions of MANCOVA were easily satisfied. A second assumption dictates that data should be collected from a random sample and measured at an interval level (Field, 2005). This assumption was met by the data collection procedures associated with this study. Third, dependent variables used in MANCOVA should meet the assumption of multivariate normality (Allaire, 2009; Field, 2005). A failure to meet the normality assumption can result in a loss of trustworthiness associated with resulting effect size estimates (Alliare, 2009). The normality assumption was met in this study through evaluation of frequency distributions. Recoding was conducted when necessary to achieve dependent variable normality. Finally, MANCOVA demands homogeneity of variances and covariances (homoscedasticity) (Allaire, 2009; Field, 2009; Garson, 2008). In SPSS, Levene's test evaluates whether the error variance of each interval dependent variable is similar, as well as the similarity in covariance between any two dependents (Garson, 2008). SPSS also provides an assessment of the homoscedasticity assumption through Box's M (Box's Test of Equality of Covariance Matrices) (Alliare, 2009; Garson, 2008). The F distribution is used in this test, and a $p(M)>.05$ indicates the assumption has been met (Garson, 2008). Levene's test and Box's M were used in this study to assess compliance with the homoscedasticity assumption. Where this assumption was violated, main and interaction effects are reported using Pillai's Trace instead of the more common Wilk's Lambda. Pillai's Trace is more robust in the face of such a violation (Allaire, 2009).

MANCOVA procedures also demand adequate sample size. Garson (2008) states, "Small samples may have lower power. At a minimum, every cell must have more cases than there are dependent variables." Recoding procedures were also aimed at meeting this assumption. Only in unique circumstances where grouping responses seemed counterintuitive or where attempts were made to maintain consistent measurement scales among like variables were fewer than five cases left in a category (variables *FDfreq, SLDfreq, bio_mgmt, SLD_market* ,and *confer_Acad*). Every attempt was made to boost cell counts by grouping variables, if necessary, into logical, yet more evenly distributed categories.

PREVIEW OF UPCOMING CHAPTERS

Chapters four and five detail the statistical analyses conducted in this study. Chapter four examines the organizational factors which may influence data selection decisions within the U.S. Fish & Wildlife Service. Organizational hypotheses are tested in chapter four, and decisions on their acceptance or rejection are made. Through testing these hypotheses, research questions pertaining to organizational factors were answered. Chapter five is structured similarly to chapter four, but details the examination of environmental factors which may affect data selection.

The dissertation concludes with chapter six, a discussion of this study's results. Chapter six also provides a rundown of the limitations associated with this study and future research considerations. Most importantly, chapter six offers insights and recommendations for natural resource professionals and data producers with regard to how data are used to impact natural resource policy. The most significant findings of this study are summarized and their theoretical and practical relevance is discussed.

CHAPTER 4: ANALYSIS OF ORGANIZATIONAL FACTORS

This chapter details the statistical analysis of organizational factors which may affect data selection. These organizational factors were identified in chapter two of this dissertation, and their examination aids in the understanding of how neo-institutional theory might be used to explain data selection. This chapter is organized into four main sections. First, descriptive statistics related to the dependent variables used in this study are discussed. Descriptive statistics related to organizational independent variables are also highlighted. Second, bivariate correlations are presented. The organizational correlates of data selection and data newness are discussed and potential multicollinearity and singularity concerns are addressed. Third, MANCOVA procedures are detailed, which tested on a multivariate basis this study's organizational hypotheses. The MANCOVA models described in this chapter tested only the organizational independent variables studied in this dissertation and examined only organizational hypotheses. However, the issue of controlling for environmental independent variables is discussed at the end of the MANCOVA section. The chapter concludes with a summary of organizational hypotheses, decisions regarding their acceptance or rejection, and the salience of the theoretical concepts behind each hypothesis in explaining data selection within the U.S. Fish & Wildlife Service.

DESCRIPTIVE STATISTICS

Data Selection Dependent Variables

Survey results indicate that U.S. Fish & Wildlife Service field offices believe each of the three sources of data explored in this study to be very important. Survey item #1 asked, "How important are the following data sources to your field office?" Field offices were allowed to rate "Federal Data," "State or Local Data," and "Non-governmental Data" on three separate ten-point scales, with 1 representing "Unimportant" and 10 representing "Important." The three data sources were not rated against one another. Some 56% of field offices assigned federal data the highest possible importance rating. State or local data was assigned the highest possible importance rating by 45% of responding field offices, while 37% assigned non-governmental data the highest importance rating.

Figures 4.1, 4.2, and 4.3 illustrate the high value placed on each of the three data sources by U.S. Fish & Wildlife Service field offices. Figure 4.1 shows that 86% of field offices assigned federal data an importance rating of 8 or higher on a ten-point scale. Some 79% of field offices assigned state or local data an importance rating of 8 or higher, as depicted in Figure 4.2. Figure 4.3 shows that a smaller percentage of field offices believe non-governmental data to be very important. However, 66% of field offices assigned non-governmental data an importance rating of 8 or higher. These figures illustrate that U.S. Fish & Wildlife Service field offices place a high value on each of the three data sources examined in this study. The levels of importance assigned to each data source provided even more reason to examine the organizational and environmental factors which may be driving these perceptions of importance.

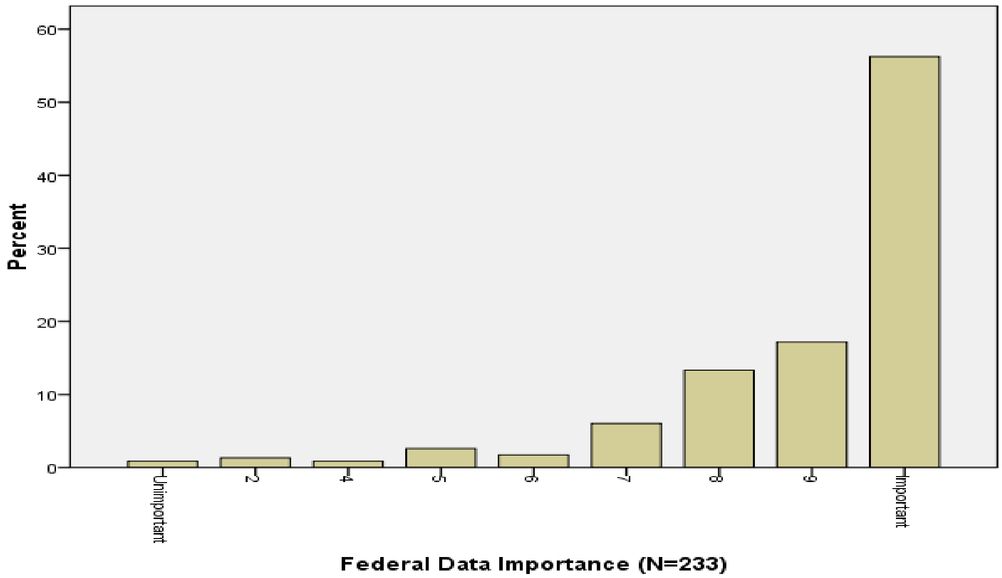

Figure 4.1: Perception of Federal Data Importance

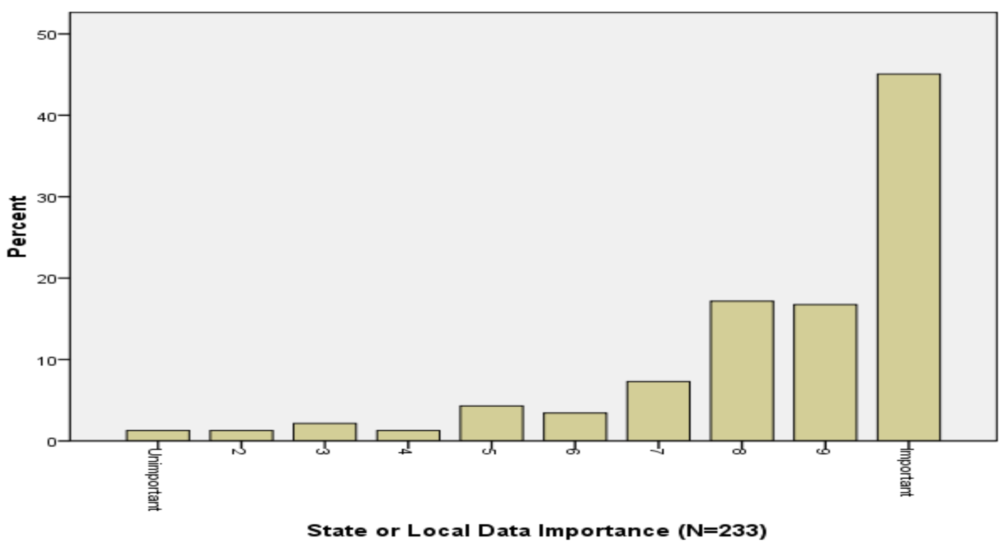

Figure 4.2: Perception of State or Local Data Importance

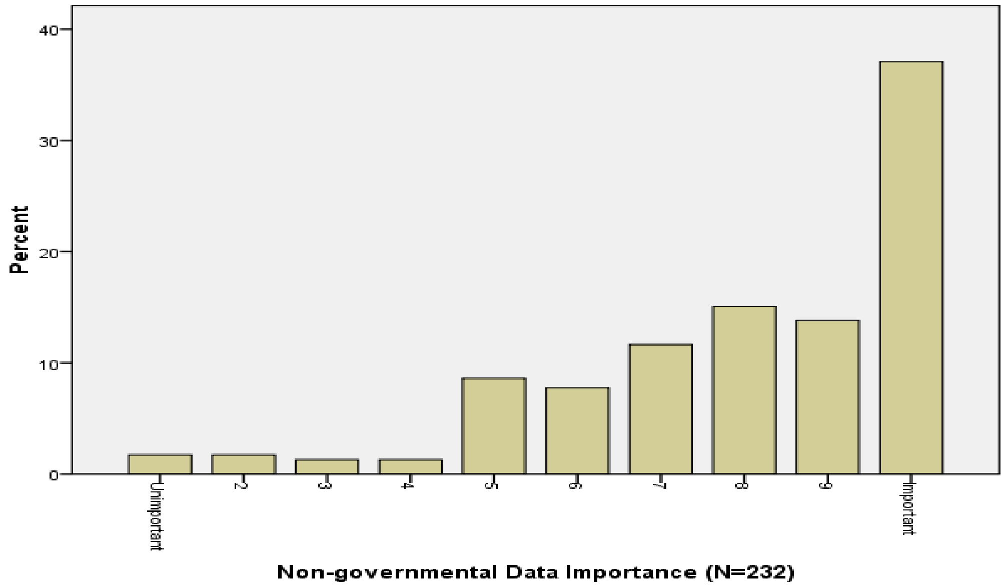

Figure 4.3: Perception of Non-governmental Data Importance

Due to the high importance assigned to each of the three data sources and low response levels within the bottom half of the ten-point scales, the dependent variables pertaining to importance were recoded to allow for more meaningful statistical analysis. As stated in chapter three, the distributions of these three variables are well approximated by a trichotomy (Unimportant = original choices 1-5; Somewhat Important = original choices 6-9; Important = original choice 10). For use in MANCOVA procedures, the recoded data importance dependents reflect the frequency distributions shown in Tables 4.1, 4.2, and 4.3.

Table 4.1: Perception of Federal Data Importance (recoded)

Federal Data Importance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	13	5.5	5.6	5.6
	Somewhat Important	89	37.4	38.2	43.8
	Very Important	131	55.0	56.2	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

Table 4.2: Perception of State or Local Data Importance (recoded)

State or Local Data Importance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	24	10.1	10.3	10.3
	Somewhat Important	104	43.7	44.6	54.9
	Very Important	105	44.1	45.1	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

Table 4.3: Perception of Non-governmental Data Importance (recoded)

Non-governmental Data Importance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	34	14.3	14.7	14.7
	Somewhat Important	112	47.1	48.3	62.9
	Very Important	86	36.1	37.1	100.0
	Total	232	97.5	100.0	
Missing	System	6	2.5		
Total		238	100.0		

Survey results show that federal, state or local, and non-governmental data sources are perceived to be highly important by U.S. Fish & Wildlife Service field offices. In an attempt to further explain data selection, this study also examined frequency of use of these data sources. The rationale behind examining both data importance and frequency of use is that even though a field office may perceive a data source to be important, that information is of little value if the field office rarely uses the data source in making biodiversity management decisions. Therefore, frequency of use dependent variables were also examined in MANCOVA procedures.

Original responses to the survey question, "How frequently does your field office use the following data sources in making biodiversity management decisions?" were more evenly distributed than data importance responses. Therefore, data frequency dependent variables were not recoded. Figures 4.4, 4.5, and 4.6 illustrate frequency of use responses pertaining to federal, state or local, and non-governmental data sources. These figures represent the data selection dependent variables *federal data frequency of use, state or local data frequency of* *use*, and *non-governmental data frequency of use*, respectively. Figure 4.4 shows that 42% of field offices use federal data sources at least once per week. Some 29% of field offices use state or local data sources at least weekly (Figure 4.5), while 23% use non-governmental data sources at least once weekly (Figure 4.6). This study examined how organizational and environmental factors influence the frequency with which field offices use these three data sources.

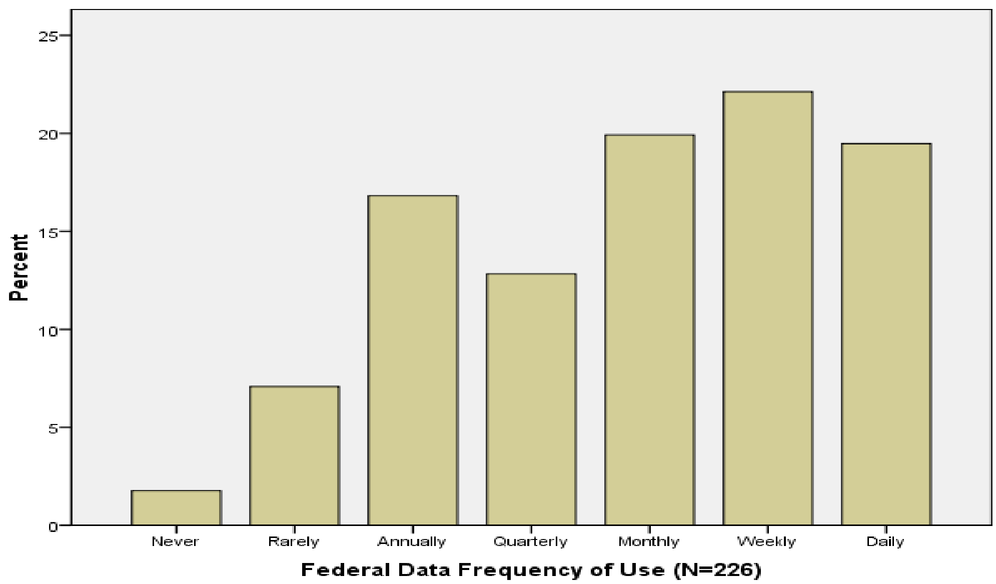

Figure 4.4: Frequency of Use of Federal Data Sources

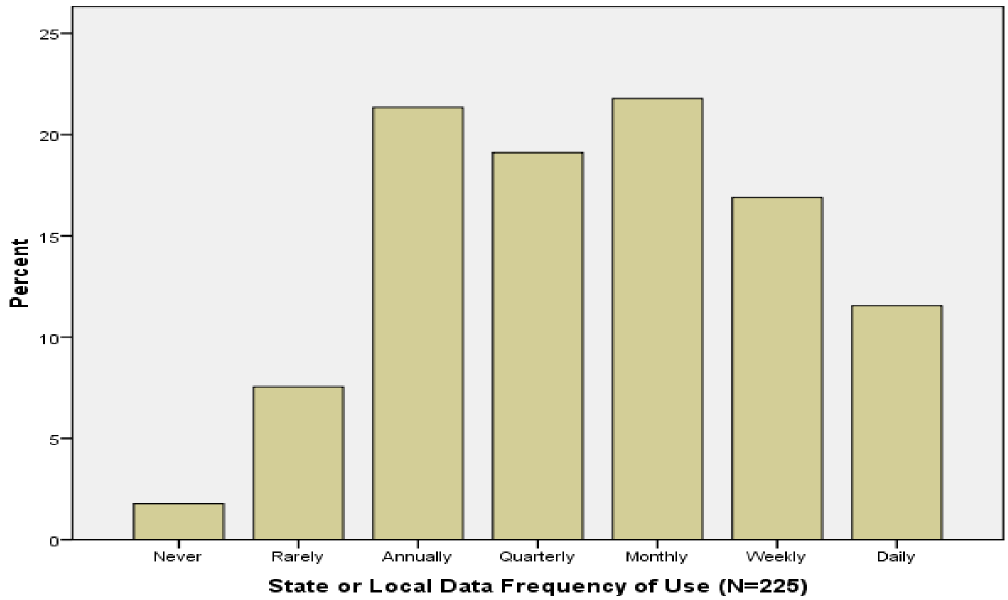

Figure 4.5: Frequency of Use of State or Local Data Sources

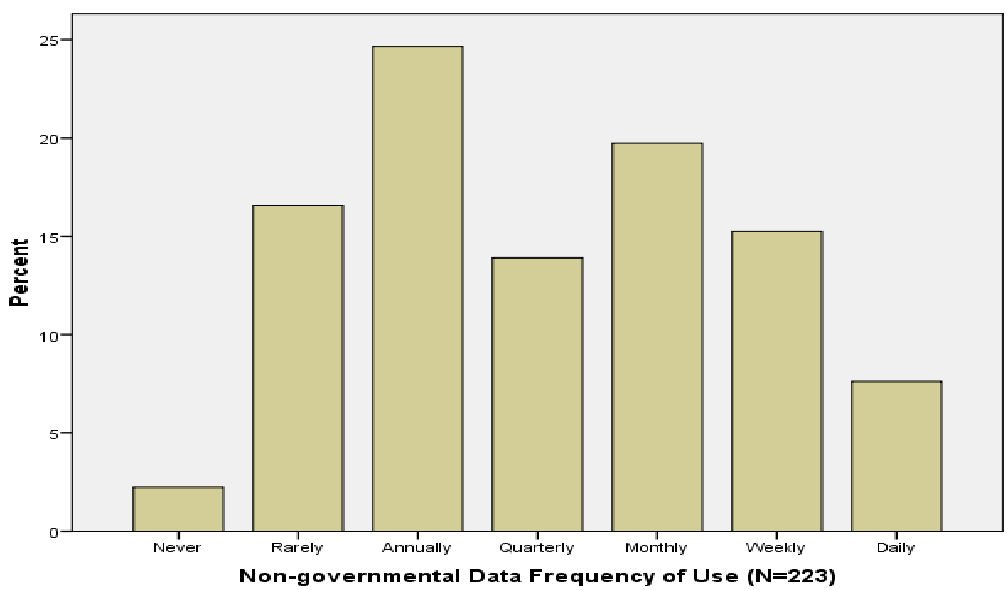

Figure 4.6: Frequency of Use of Non-governmental Data Sources

To examine the perceptions of data importance and frequency of data use distributions more closely, chi-square goodness of fit tests were conducted using the *Service region* control variable. The chi-square tests revealed that most distributions of federal, state or local, and non-governmental data importance and frequency of use responses do not significantly differ by U.S. Fish & Wildlife Service region from what would be expected based on the overall frequency distributions illustrated in Figures 4.4, 4.5, and 4.6. However, the chi-square tests showed that regions 1 (Pacific) and 4 (Southeast) of the U.S. Fish & Wildlife Service significantly differ from the agency as a whole with regard to their respective regional views on the importance of non-governmental data. A crosstabulation analysis showed that field offices in region 1 collectively assigned lesser importance ratings to non-governmental data than did the entire U.S. Fish & Wildlife Service, while field offices in region 4 collectively viewed non-governmental data as more important than the agency as a whole. These discrepancies may be attributed to a small sample size. However, future research is warranted to further explore these chi-square results. Table 4.4 shows the critical values for each region of the U.S. Fish & Wildlife Service.

Table 4.4: Chi-Square Tests of Perception of Data Importance and Frequency of Data Use by Region vs. Overall Distribution (p values)

Region	**N**	*Federal Data Importance*	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
1 (Pacific)	22	.68	.70	**.02**	.77	.53	.83
2 (Southwest)	25	.41	.59	.73	.66	.58	.38

Table 4.4: Continued

3 (Great Lakes– Big Rivers)	35	.46	.24	.90	.65	.74	.89
4 (Southeast)	43	.80	.27	**.01**	1.00	.70	.64
5 (Northeast)	32	.84	.81	.48	.51	.70	.97
6 (Mountain-Prairie)	22	.79	.66	.26	.20	.81	.79
7 (Alaska)	10	.77	.97	.76	.87	.78	.78
8 (California-Nevada)	15	.95	.93	.90	.42	.21	.62
TOTAL (all regions)	20 4	.97	.93	.24	.44	.32	.81

The above results suggest that no one region of the U.S. Fish & Wildlife Service uses a particular data source with greater frequency than the rest of the agency. This finding is of particular interest considering the fact that policy issues and ground-level management decisions often differ by region (USFWS, 2007).

Data Newness Dependent Variables

Data newness dependent variables measured 1) the year in which the data set most relied upon by the field office was last updated and 2) the decade in which the data set most relied upon was established. Survey results show that 69% of field offices most rely upon data sets updated in 2008, while 21% most rely upon data sets last updated in 2007. A mere 10% most rely upon data sets last updated before 2007. These data show a strong preference for recently updated data sets, which is reasonable given the ever-changing nature of biodiversity management. Open-ended survey responses were recoded into the trichotomous variable *year of last update of data set most relied upon* in order to achieve the most meaningful statistical analysis possible given such heavily skewed (toward recent years) data.

The dependent variable *decade of establishment of data set most relied upon* provided more information regarding the age of these most popular data sets. As illustrated in Figure 4.7, 54% of U.S. Fish & Wildlife Service field offices reported most relying upon data sets established between 1980 and the present. Of field offices with reported a known decade of establishment, 69% most rely upon data sets established since 1980. Survey results show a strong preference for the use of newer data in making biodiversity management decisions. However, the *decade of establishment of data set most relied upon* variable offered enough variance to test organizational hypotheses related to data newness and was not recoded for the purpose of multivariate analysis.

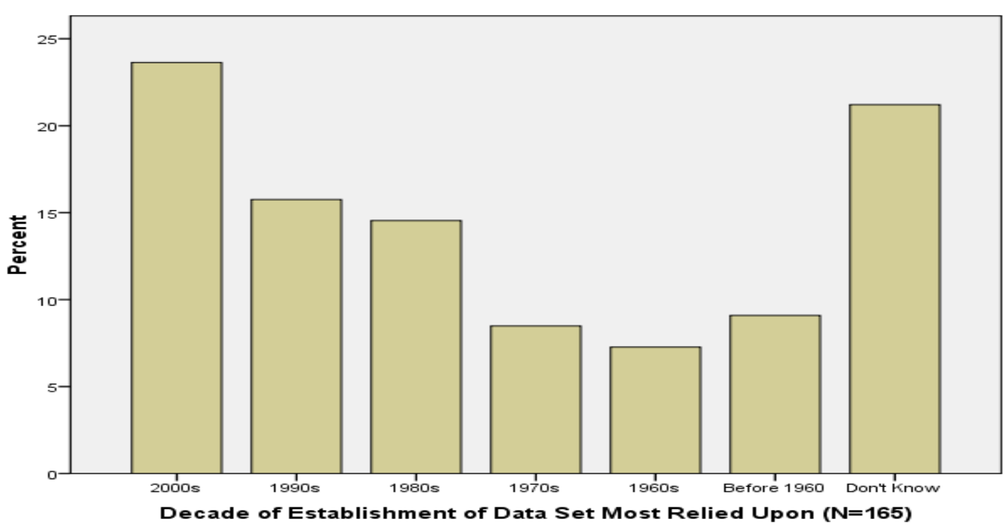

Figure 4.7: Decade of Establishment of Data Set Most Relied Upon

Organizational Independent Variables

This study examined the potential impact of nine organizational factors (informed by neo-institutional theory) on data selection for use in natural resource policy making. The survey instrument included as Appendix A of this dissertation measured the following organizational independent variables.

- Age of field office (FO_open)

- Parent agency influence (add_fund)

- Field office management practices (bio_mgmt)

- Collaborative management practices
    - *information exchange w/ other FWS field offices* (info_FWS)
    - *information exchange w/ other federal agencies* (info_Fed)
    - *information exchange w/ state or local agencies* (info_SL)
    - *information exchange w/ non-governmental organizations* (info_NG)

- Past federal data use experiences (FDexp)

- Past state or local data use experiences (SLDexp)
- Past non-governmental data use experiences (NGDexp)

- Information technology capabilities (ArcView)

The organizational independent variables examined in this study measured key tenets of neo-institutional theory as well as elements of biodiversity management literature. In testing organizational factors which potentially influence data selection, these organizational independent variables were used to determine the impacts of certain aspects of social science theories (discussed in chapter two of this dissertation) on data selection decisions, with the key theory under examination in this chapter being neo-institutionalism. The organizational independent variables were used to test a series of theory-driven hypotheses which sought to explain why certain data sources are selected for use over others in the natural resource policy-making process. The original frequency distributions of these organizational independents are included as Appendix D of this dissertation. The recoded frequencies are included as Appendix E. However, some frequency distributions were more interesting than others in terms of shedding light on particular organizational hypotheses. These findings are discussed in the following section.

Interesting Independent Variable Frequency Distributions

Parent Agency Influence

The organizational independent variable *parent agency influence* was measured by the survey item, "Which of the following choices makes this statement most true? 'My office receives additional resources (funding, information technology capabilities, staffing) from the U.S. Fish & Wildlife Service for using ________ in making biodiversity management decisions.'" Survey participants chose from the following choices.

- Federal Data
- State or Local Data
- Non-governmental Data
- A combination of the above
- Doesn't make a difference

Assessing *parent agency influence* was imperative to testing the following organizational hypothesis:

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***

Survey responses indicate that 55% of U.S. Fish & Wildlife Service field offices do not believe the selection of one data source over another makes a difference in the amount of resource support they receive from the parent agency. Only 8% of field offices believe the selection of federal data sources makes a difference in support from the parent agency. The frequency distribution for the independent variable *parent agency influence* is shown in Table 4.5.

Table 4.5: Perception of Data Source Impact on Agency Resources Shared with Field Office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Federal Data		6.3	7.5	7.5
	State or Local Data	4	1.7	2.0	9.5
	Non-governmental Data	5	2.1	2.5	12.1
	A combination of data sources	66	27.7	33.2	45.2
	Doesn't make a difference	109	45.8	54.8	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Collaborative Management Practices

Collaborative management practices were measured by an assessment of the importance of information exchange with other U.S. Fish & Wildlife Service field offices (*info_FWS*), other federal government agencies (*info_Fed*), state or local government agencies (*info_SL*), and non-governmental organizations (*info_NG*). A survey item which asked, “How important is the exchange of information relevant to making biodiversity management decisions with the following?” allowed participants to rate each of the aforementioned choices on a scale of 1 to 10, with 1 representing “Unimportant” and 10 indicating “Important.” Table 4.6 shows the percentage of U.S. Fish & Wildlife Service field offices that assigned each rating along the ten-point importance scale to the exchange of information with other field offices, other federal government agencies, state or local agencies, and non-governmental organizations.

Table 4.6: Field Office Perception of the Importance of Information Exchange in Making Biodiversity Management Decisions (Percentage of Response)

	1 (Unimportant)	2	3	4	5	6	7	8	9	10 (Important)
Other FWS Field Offices (N=205)	1.0	1.0	0.5	0.0	2.0	4.9	5.9	14.1	21.0	49.8
Other Federal Agencies (N=204)	1.0	1.0	0.5	2.0	6.9	4.4	11.3	24.0	19.1	29.9
State or Local Agencies (N=204)	1.0	0.0	0.5	1.0	2.9	4.9	9.3	22.5	20.6	37.3
Non-governmental Agencies (N=204)	1.0	2.9	1.5	2.5	9.8	10.3	14.2	22.1	13.2	22.5

As Table 4.6 indicates, field offices attach great importance to collaborating with other U.S. Fish & Wildlife Service field offices or natural resource agencies or organizations. Hypothesis 3a asserts that the greater the collaboration with federal, state or local, or non-governmental natural resource entities, the greater the chance those respective data sources will be selected for use in making biodiversity management decisions.

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***

To test this hypothesis, the variables measuring collaborative management practices were recoded, as stated in chapter three, and, specifically, Table 3.5 to allow for more meaningful statistical analysis (Unimportant = original choices 1-5; Somewhat Important = original choices 6-9; Very Important = original choice 10).

Past Data Use Experiences

The following hypothesis was tested by examining the effect of the organizational independent variables *past federal data use experiences, past state or local data use experiences,* and *past non-governmental data use experiences* on data selection.

- ***H_4: Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.***

A significant percentage of U.S. Fish & Wildlife Service field offices reported having had positive experiences using data from all three sources. Table 4.7 shows how field offices responded to item #6 of the survey (included as Appendix A of this dissertation).

Table 4.7: Assessment of Past Data Use Experiences (Percentage of Response)

"On average, my field office has had positive experiences using the following data sources in making biodiversity management decisions."

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Federal Data (N=203)	1.0	0.5	13.3	54.2	31.0
State or Local Data (N=203)	1.5	2.0	14.3	58.6	23.6
Non-governmental Data (N=204)	1.0	2.0	27.2	47.5	22.3

Due to the overwhelming identification among field offices with positive experiences using all three data sources, *past federal data use experiences, past state or local data use experiences*, and *past non-governmental data use experiences* were recoded into trichotomous variables that more evenly distributed responses (Do Not Agree = original choices 1-3; Agree = original choice 4; Strongly Agree = original choice 5). This recoding is detailed in chapter three (Table 3.5).

<u>Information Technology Capabilities</u>

Information technology capabilities was measured by assessing the most up-to-date version of ArcView software to which U.S. Fish & Wildlife Service field offices have access. The following organizational hypothesis was tested by examining the impact of *information technology capabilities* (*ArcView*) on data newness dependent variables (*DataSetUpd; DataSetEst*).

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***

Field offices were asked, "What is the most up-to-date version of ArcView software available in your field office?" Some 59% of field offices reported having access to ArcView 9.2, while 17% have access to ArcView 9.1. These results illustrate a strong preference for more up-to-date versions of ArcView software, yet still indicate a divide among field offices in information technology capabilities, as previous research suggests (Gerlach, 2005). For the purposes of more evenly distributing responses to the aforementioned survey item, the organizational independent variable *information technology capabilities* was recoded. The recoded variable reflects the following frequency distribution.

Table 4.8: Most Up-To-Date Version of ArcView Software Available to the Field Office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Version 9.2	116	48.7	48.7	48.7
	Earlier Version	91	38.2	38.2	87.0
	My field office does not use ArcView software.	31	13.0	13.0	100.0
	Total	238	100.0	100.0	

Control Variables

Three control variables were used in this study, one categorical and two continuous. *Service region* measures the region of the U.S. Fish & Wildlife Service within which the participating field office is housed. Table 4.9 shows response by region.

Table 4.9: Response by Region of the U.S. Fish & Wildlife Service

Region	Frequency	Percentage of Response
1 (Pacific)	22	10.8
2 (Southwest)	25	12.3
3 (Great Lakes-Big Rivers)	35	17.2
4 (Southeast)	43	21.1
5 (Northeast)	32	15.7
6 (Mountain-Prairie)	22	10.8
7 (Alaska)	10	4.9
8 (California and Nevada)	15	7.4
TOTAL	**204**	**100.0**

As discussed in chapter three and illustrated in Table 3.1, a chi-square goodness of fit test revealed the distribution of survey responses by region was not significantly different from what would be expected based on the actual distribution of field offices surveyed (p=.56).

Employees in field office and *tenure with FWS* are both continuous control variables. MANCOVA allows continuous control variables to be examined as covariates (Garson, 2008). Table 4.10 provides descriptive statistics for these two variables.

Table 4.10: Descriptive Statistics for Continuous Control Variables

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Employees in field office	198	1.00	102.50	15.0707	15.23005	2.656	.173	9.290	.344
Tenure with FWS	201	1.5	39	16.63	9.135	.388	.172	-.902	.341
Valid N (listwise)	196								

The mean number of years participants representing their field offices have worked for the U.S. Fish & Wildlife Service is 16.63. Responding employees ranged from one individual with 1.5 years experience with the agency to one respondent with 39 years experience. Skewness and kurtosis statistics were within the acceptable range of +/- 2 for the control variable *tenure with FWS.*

Responding field offices range between one employee in size to 102.5 calculated full-time employees. The mean number of employees in the responding field office is approximately 15. The skewness and kurtosis statistics for *employees in field office* were not within the acceptable range of +/- 2. Rather, both statistics were high, as shown in Table 4.10. This indicates non-normality, an assumption against which MANCOVA is normally robust (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). However, non-normality caused by outliers presents a special problem in MANCOVA (Garson, 2008). Outliers must either be dropped or analyzed separately.

Garson (2008) states, “It is common to define outliers as cases which are more than plus or minus three standard deviations from the mean of the variable.” The standard deviation statistic for *employees in field office* was 15.23. The precise mean statistic for the variable was 15.0707. Therefore, any calculation of *employees in field office* (full-time employees + part-time employees(.5)) greater than 60 was considered an outlier. The data contain only five outliers associated with the continuous control variable *employees in field office*. For the purposes of this study, those outliers were simply dropped due to the variable having an adequate number of cases (N=198). Deletion of the five outliers brought the skewness and kurtosis figures back within the acceptable range of +/- 2. Table 4.11 illustrates the new descriptive statistics for *employees in field office* after dropping the five outliers.

Table 4.11: Descriptive Statistics for *employees in field office* After Deletion of Outliers

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Employees in Field Office	193	1.00	57.50	13.3575	10.83465	1.453	.175	1.784	.348
Valid N (listwise)	193								

The five outlier cases associated with *employees in field office* were analyzed separately for similarities among them or any indication of why the field offices might employ so many people. The field office which reported 82 employees opened in 1980 and belongs to region 4 (Southeast) of the U.S. Fish & Wildlife Service. Two additional outlier field offices also belong to region 4, those which reported 102.5 employees (opened in 1960) and 75 employees (opened in 1955). The remaining two outlier cases associated with *employees in field office* represent U.S. Fish & Wildlife Service field offices from the western part of the United States. The field office which reported 66 employees opened in 1985 and is housed in region 8 (California and Nevada) of the agency. The office which reported 80.5 employees operates out of region 1 (Pacific). This field office did not report an establishment date.

The outlier cases associated with *employees in field office* were examined using bivariate Pearson correlations to determine if their relationship with the dependent variables used in this study differed from the relationship between the remaining cases and the dependent variables. The control variable *employees in field office* significantly correlates to the dependent variables *federal data frequency of use* (Pearson correlation=.199, p=.006), *state or local data frequency of use* (Pearson correlation=.195, p=.007), and *non-governmental data frequency of use* (Pearson correlation=.212, p=.003) when the five outlier cases were included in the variable. However, after deletion of the five outliers, *employees in field office* significantly correlates to only the dependent variable *federal data frequency of use* (Pearson correlation=.150, p=.040). Although deletion of these cases was necessary to normalize the *employees in field office* variable, it is clear that these five largest field offices use data more frequently, especially data from state or local and non-governmental sources. For the remaining cases in the *employees in field office* control variable, there was no significant relationship with frequency of state or local or non-governmental data use. Additionally, all MANCOVA models associated with this study were run with the original *employees in field office* control variable and the variable after deletion of the five outlier cases in order to assess any differences in outcomes. The findings of this study were shown to be robust in the face of dropping the five *employees in field office* outliers.

Summary of Descriptive Statistics Findings

The descriptive statistics of organizational independent variables offer insight into the variables used to test organizational hypotheses. Table 4.12 summarizes the interesting findings gleaned from organizational independent variable descriptive statistics. It should be noted, however, that descriptive statistics could not be used to fully evaluate the organizational hypotheses examined in this study. Rather, bivariate and multivariate analyses were conducted, as detailed in the sections to follow.

Table 4.12: Summary of Substantive Findings Based on Descriptive Statistics Associated with Organizational Independent Variables

Organizational Hypotheses	Substantive Findings Based on Descriptive Statistics of Organizational Independent Variables
H_1: The age of a field office is positively associated with its selection of federal government agency data.	• *No substantive findings based on the descriptive statistics of organizational independent variables.*
H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.	• Over half (55%) of U.S. Fish & Wildlife Service field offices do not believe that the selection of one data source over another impacts the amount of resources they receive from agency headquarters • Only 8% of U.S. Fish & Wildlife Service field offices believe the selection of federal data sources makes a difference in the amount of resources they receive from agency headquarters

Table 4.12: Continued

H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.	• 85% of U.S. Fish & Wildlife Service field offices rated the importance of information exchange with other field offices as an 8 or higher on a ten-point scale whereby 1 represents "Unimportant" and 10 represents "Important" • 73% of field offices rated the importance of information exchange with other federal agencies as an 8 or higher on a separate, yet similar ten-point scale • 80% of field offices rated the importance of information exchange with state or local agencies as an 8 or higher on a separate, yet similar ten-point scale • 58% of field offices rated the importance of information exchange with non-governmental organizations as an 8 or higher on a separate, yet similar ten-point scale *NOTE: The four entities were not rated against one another.
H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.	• *No substantive findings based on the descriptive statistics of organizational independent variables.*
H_4: Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.	• 54% of U.S. Fish & Wildlife Service field offices "agree" that they have had positive experiences using federal data, while an additional 31% "strongly agree" • 59% of field offices "agree" that they have had positive experiences using state or local data, while an additional 24% "strongly agree" • 48% of field offices "agree" that they have had positive experiences using non-governmental data, while an additional 22% "strongly agree"
H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.	• 59% of U.S. Fish & Wildlife Service field offices reported having access to the most recent version of ArcView software, indicating a divide among field offices in information technology capabilities

BIVARIATE CORRELATIONS

Organizational Independent Variables and Data Selection Dependent Variables

Several organizational independent variables show significant Pearson correlations with data selection dependents. Table 4.13 shows these correlations and their corresponding levels of significance. The full correlation matrix which includes statistics for significant and non-significant correlations among all variables is included as Appendix F of this dissertation. The discussion following Table 4.13 highlights some of the stronger, more interesting correlations shown in the table.

Table 4.13: Significant Bivariate Pearson Correlations with Data Selection Dependent Variables

	Data Selection Dependent Variables					
Organizational Independent Variables	*Federal Data Importance*	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
Parent Agency Influence	-	-	-.084**	-	-	-
Field Office Management Practices	-	-	.148*	-	-	-
Information Exchange w/ Other FWS Field Offices	.280**	.225**	-	-	.146*	-
Information Exchange w/ Other Federal Agencies	.314**	.353**	.229**	.155*	.246**	.276**
Information Exchange w/ State or Local Agencies	.319**	.375**	.197**	.174*	.298**	.256**
Information Exchange w/ Non-governmental Organizations	.258**	.247**	.351**	-	-	.258**
Past Federal Data Use Experiences	.271**	.193**	-	.398**	.243**	.185**
Past State or Local Data Use Experiences	.258**	.372**	.218**	.303**	.323**	.209**
Past Non-governmental Data Use Experiences	-	.211**	.391**	.165*	.159*	.417**
Information Technology Capabilities	-	-	-	.223**	.186**	.162*

**Correlation is significant at the .01 level (two-tailed, N=238).
*Correlation is significant at the .05 level (two-tailed, N=238).

Survey results indicate that the exchange of information with other natural resource offices, agencies, or organizations is correlated with field office perceptions of data importance as well as frequency of data use. Among the highest correlations involving these variables is the exchange of information with state or local agencies and perception of state or local data importance (Pearson correlation=.375, p=.000). The exchange of information with state or local agencies is also related to frequency of state or local data use (Pearson correlation=.298, p=.000). The exchange of information with other federal agencies significantly correlates with field office perceptions of federal data importance (Pearson correlation=.314, p=.000) as well as perceptions of state or local data importance (Pearson correlation=.353, p=.000) and non-governmental data importance (Pearson correlation=.229, p=.001). These results indicate that collaboration with other federal natural resource agencies is not only related to a higher perception of federal data importance, but a higher perception of the importance of all data sources.

Past data use experiences significantly correlate to field office perceptions of data importance and frequency of data use. Field offices which reported more positive experiences using federal data also attached a higher level of importance to federal data (Pearson correlation=.271, p=.000) and reported using federal data more frequently (Pearson correlation=.398, p=.000). Field offices which reported similar positive experiences for state or local data attached a higher level of importance to state or local data (Pearson correlation=.372, p=.000) and reported using state or local data more frequently (Pearson correlation=.323, p=.000). The same trend was observed for reporting positive experiences using non-governmental data and assigning it a higher level of importance (Pearson correlation=.391, p=.000) and using those data sources more frequently (Pearson correlation=.417, p=.000). These findings may be of particular interest to data producers which seek to enhance the experiences of users through training workshops and seminars in an attempt to ensure future use of their data products.

Another significant correlation of interest exists between field office management practices and perceptions of non-governmental data importance. Survey results indicate that field offices which employ a more ecosystem-based approach to managing biodiversity assign a greater level of importance to non-governmental data (Pearson correlation=.148, p=.036). Given a recent trend toward ecosystem-level management (Clark, 2002), this finding suggests that non-governmental data may be able to play a more substantial role in making biodiversity management decisions. Previous research suggests a potential increased role for federal data due to the trend toward ecosystem-level management (Gerlach, 2005). The relationship between more ecosystem-level management practices and perceptions of non-governmental data importance is an intriguing and somewhat surprising one.

Organizational Independent Variables and Data Newness Dependent Variables

Table 4.14 shows significant Pearson correlations between organizational independent variables and data newness dependent variables, as well as their corresponding levels of significance. The full correlation matrix is included as Appendix F of this dissertation. High levels of correlation with data newness dependents were only expected for one of these independent variables, *information technology capabilities* (*ArcView*). However, some unexpected correlations were revealed in the data.

The exchange of information with other U.S. Fish & Wildlife Service field offices (Pearson correlation=.174, p=.031), state or local agencies (Pearson correlation=.176, p=.029), and non-governmental organizations (Pearson correlation=.194, p=.016) is positively related to the decade during with the data set most relied upon by a particular U.S. Fish & Wildlife Service field office was established. Positive correlations exist between the exchange of information with these natural resource entities and the age of the original data sets most relied upon by responding field offices. This finding suggests that field offices relying upon older data sets for making biodiversity management decisions attach higher levels of importance to collaborative management practices which involve other U.S. Fish & Wildlife Service field offices, state or local agencies, and non-governmental organizations. One possible explanation for this finding is that if field offices are using older data sets they may have a greater potential for interacting with other field offices using the same data sets and which face similar biodiversity management decisions. This finding was somewhat unexpected and warrants further exploration in a future study.

Table 4.14: Significant Bivariate Pearson Correlations with Data Newness Dependent Variables

	Data Newness Dependent Variables	
Organizational Independent Variables	*Year of Last Update (Data Set Most Relied Upon)*	*Decade of Establishment (Data Set Most Relied Upon)*
Information Exchange w/ Other FWS Field Offices	-	.174*
Information Exchange w/ State or Local Agencies	-	.176*
Information Exchange w/ Non-governmental Organizations	-	.194*

**Correlation is significant at the .01 level (two-tailed, N=238).
*Correlation is significant at the .05 level (two-tailed, N=238).

The hypothesized relationship between information technology capabilities and data newness was not confirmed by the Pearson correlation matrix (Appendix F). A significant correlation does not exist between the version of ArcView software available to a U.S. Fish & Wildlife Service field office and the selection of newer data sets for making biodiversity management decisions. This result is inconsistent with the findings of previous research pertaining to the use of U.S. Geological Survey Gap Analysis Program data among U.S. Fish & Wildlife Service biologists in the state of North Carolina (Gerlach, 2005). The results of the previous study indicate that a barrier exists between the availability of newer biological data sets and the ability of a field office to effectively put them to policy-making use given the age of their GIS viewing software (Gerlach, 2005). The correlation matrix included as Appendix F does not confirm this finding. However, MANCOVA procedures were conducted to further test the hypothesized relationship between information technology capabilities and data newness.

Control and Dependent Variables

Appendix F of this dissertation also shows bivariate Pearson correlations between the control variables and all eight dependent variables (data selection and data newness) used in this study. The correlation matrix illustrates one interesting finding. The number of employees in the U.S. Fish & Wildlife Service field office positively correlates to frequency of federal data use (Pearson correlation=.199, p=.006), state or local data use (Pearson correlation=.195, p=.007), and non-governmental data use (Pearson correlation=.212, p=.003). These findings suggest that larger field offices use data from all sources more often.

While this seems like an intuitive finding, these results indicate that perhaps more scientifically-informed biodiversity management decisions are made in larger field offices than in smaller ones. Though this finding is not germane to this study, these results could potentially be the focus of future research.

Assessing Bivariate Correlations for Multicollinearity and Singularity Threats

MANCOVA procedures are sensitive to multicollinearity (independent variables that are highly correlated) and singularity (dependent variables that near perfect correlation). The literature differs with regard to the level of bivariate correlation that signals a potential multicollinearity or singularity problem. Tabachnick and Fidell (2001) warn the researcher to “think carefully before including two variables with a bivariate correlation of, say, .70 or more in the same analysis” (p. 84). Field (2005) sets the threshold at “correlations of above .80 or .90” (p. 175). Garson (2008) also indicates that correlations higher than .80 or .90 may be troublesome. For the purposes of this study, correlations among all (organizational and environmental) independent variables (multicollinearity) and dependent variables (singularity) above .70 were further examined to determine if a variable should be dropped from the analysis or if variables should be combined. The bivariate Pearson correlation matrix used is available as Appendix F.

Multicollinearity Threats

The correlation matrix in Appendix F of this dissertation indicates three potentially multicollinear relationships among independent variables.

- *information exchange w/ other federal agencies* highly correlates to *information exchange w/ state or local agencies* (Pearson correlation=.769, p=.000)
- *past federal data use experiences* highly correlates to *past state or local data use experiences* (Pearson correlation=.726, p=.000)
- *federal agency data marketing efforts* highly correlates to *state or local agency data marketing efforts* (Pearson correlation=.765, p=.000)

While none of these correlations are above .80 or .90, as some scholars indicate is the danger threshold when identifying multicollinearity problems (Field, 2005; Garson, 2008), collinearity diagnostics were conducted on the independent variables in question. Before making any hasty judgments on the exclusion of an independent variable whose inclusion in this study is supported by the scholarly literature detailed in chapter two, collinearity diagnostics were the next logical step to further analyze potential problems of multicollinearity.

The literature indicates that tolerance and variance inflation factor (VIF) are viable statistics by which to further assess potential mulitcollinearity concerns (Allaire, 2009; Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). The tolerance statistic is simply the reciprocal of VIF (Field, 2005). A tolerance statistic below .20 is cause for concern that multicollinearity exists and the researcher should consider dropping one of the independent variables (Field, 2005; Garson, 2008; Menard, 1995). The literature differs more substantially on the danger threshold related to VIF. Garson (2008) indicates that a VIF statistic greater than 4.0 may flag multicollinearity. Cited in Field (2005, p. 175), Myers

(1990) asserts that a VIF of 10.0 is the threshold for concern. Table 4.15 illustrates the collinearity statistics associated with the independent variables under examination.

Table 4.15: Collinearity Statistics for Highly Correlated Independent Variables

Variable	Tolerance	VIF
information exchange w/ other federal agencies	.394	2.535
information exchange w/ state or local agencies	.387	2.587
past federal data use experiences	.454	2.203
past state or local data use experiences	.447	2.239
federal agency data marketing efforts	.399	2.504
state or local agency data marketing efforts	.396	2.528

Based on the tolerance and VIF statistics for the independent variables which show high Pearson correlations, the decision was made not to drop or combine any of the variables. As shown in Table 4.15, all tolerance and VIF statistics were within acceptable range and did not indicate multicollinearity. These findings, coupled with the fact that no correlations among independent variables exceed .80, were the basis for keeping all independent variables in the MANCOVA analyses. To remove a theoretically-supported independent variable from the main multivariate analysis would warrant more compelling evidence of multicollinearity.

Singularity Concerns Addressed

Singularity arises when a correlation among dependent variables approaches 1.0. The correlation matrix in Appendix F includes the eight dependent variables used in this study, six data selection dependents and two data newness dependents. The correlation matrix illustrates three correlations which could potentially signal singularity issues.

- *federal data frequency of use* highly correlates to *state or local data frequency of use* (Pearson correlation=.791, p=.000)
- *state or local data frequency of use* highly correlates to *non-governmental data frequency of use* (Pearson correlation=.722, p=.000)
- *state or local data importance* highly correlates to *non-governmental data importance* (Pearson correlation=.701, p=.000)

As with the issue of possible multicollinearity among independent variables, tolerance and VIF statistics were examined for the dependent variables in question. While the three correlations greater than .70 warranted further exploration, they were, as was the case with the multicollinearity concerns, not above .80. Table 4.16 illustrates tolerance and VIF statistics for the dependent variables listed above.

Table 4.16: Collinearity Statistics for Highly Correlated Dependent Variables

Variable	Tolerance	VIF
federal data frequency of use	.306	3.264
state or local data frequency of use	.241	4.148
non-governmental data frequency of use	.315	3.174
state or local data importance	.293	3.408
non-governmental data importance	.307	3.259

All of the dependent variables' tolerance and VIF statistics were within acceptable range with the possible exception of the VIF (4.148) for *state or local data frequency of use*. While most researchers want to see a VIF statistic <= 4.0, some extend that threshold to <=5.0 (Garson, 2008). As previously mentioned, Myers (1990) extends the acceptable VIF threshold to <=10.0. For the purposes of this study, a VIF of greater than 4.0 was cause for concern. However, the tolerance statistic for *state or local data frequency of use* was within normal range (.241). Therefore, no dependent variables were dropped from MANCOVA procedures. Though there are three high correlations among dependents, the tolerance and VIF statistics did not warrant discarding any of the dependents.

ANALYSIS OF ORGANIZATIONAL FACTORS USING MANCOVA

Organizational hypotheses were tested using MANCOVA procedures. While bivariate correlations can be revealing, they can also be deceptive. Multivariate analysis may reveal some seemingly significant bivariate correlations to be spurious when other variables are controlled. Multivariate analysis can also reveal some seemingly non-significant relationships to have been suppressed by control variables and to actually be significant. The variables used in these models are detailed in Table 3.2 of this dissertation. By testing organizational hypotheses tied to neo-institutional theory, organizational research questions (also contained in Table 3.2) were answered and components of the research model were either confirmed or rejected. The discussion of MANCOVA results in the sections to follow examines each research question and related hypothesis individually. A determination was made whether or not to confirm or reject each hypothesis based on these analyses.

Organizational Research Questions and Hypotheses

Research Question 1

The first research question examined the effect of field office age on data selection. Hypothesis 1 was tested by a MANCOVA model which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance*, *federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* as well as the independent variable *age of field office*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in the model.

- ***H_1: The age of a field office is positively associated with its selection of federal government agency data.***

<u>MANCOVA Model 1</u>

A six-way MANCOVA model was run to test hypothesis 1. The Box's M test was non-significant (p = .142). Therefore, the assumption of equality of covariance matrices was met (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed a violation of the homogeneity of variance assumption for the dependent variables *state or local data importance* (p = .032) and *state or local data frequency of use* (p = .039). MANCOVA is generally robust even when this assumption is violated, especially when sample sizes are relatively equal and there are no outliers (Tabachnick & Fidell, 2001). As noted earlier in the chapter, outliers were removed. However, Allaire (2009) suggests reporting Pillai's Trace multivariate test results when either of the above assumptions is violated.

The main effect of *age of field office* on the group of dependent variables was shown to be non-significant. The Pillai's Trace multivariate test of overall differences among groups showed non-significance, F(5, 169) = .481, p = .992. The Pillai's Trace power level was .480. This statistic did not cross the .80 threshold, which indicates acceptable power to conclude that Type II error is not a problem (Garson, 2008). Therefore, it cannot confidently be concluded that a relationship between *age of field offices* and the group of data selection dependent variables does not exist. Rather, this study failed to conclude there is a relationship.

A significant main effect was discovered for the control variable *Service region*. The Pillai's Trace test of overall differences among groups yielded $F(1, 169) = 3.063$, $p = .007$. Therefore, the null hypothesis that no relationship exists between *Service region* and the six data selection dependent variables was rejected. However, the partial eta-squared statistic was .102 for the Pillai's Trace test. The effect of this relationship is moderate at best, accounting for only 10.2% of the overall variance in the dependent variable group when controlling for other variables in the model.

Univariate between-subjects tests failed to identify a significant relationship between *age of field office* and any of the six data selection dependent variables.

- *federal data importance,* $F(5, 169) = .511$, $p = .768$, power = .187
- *state or local data importance,* $F(5, 169) = .549$, $p = .739$, power = .199
- *non-governmental data importance,* $F(5, 169) = .655$, $p = .658$, power = .234
- *federal data frequency of use,* $F(5, 169) = .251$, $p = .939$, power = .110
- *state or local data frequency of use,* $F(5, 169) = .374$, $p = .866$, power = .145
- *non-governmental data frequency of use,* $F(5, 169) = .601$, $p = .699$, power = .216

Significance tests failed to reject the null assumption that the strength of these relationships is zero. However, there was inadequate power to go further and accept the null hypothesis that the relationships do not exist. Therefore, this study simply failed to conclude that these relationships exist. The results of the multivariate and univariate tests involving *age of field office* did not warrant post-hoc tests.

Univariate between-subjects tests showed some significant relationships between control variables and data selection dependents. The region to which a U.S. Fish & Wildlife Service field office belongs was significantly and moderately related to its frequency of federal (p = .000, partial eta-squared = .073), state or local (p = .012, partial eta-squared = .037), and non-governmental (p = .047, partial eta-squared = .024) data use. The U.S. Fish & Wildlife Service region to which a field office belongs accounts for 7.3% of the variance in frequency of federal data use, 3.7% of the variance in state or local data use, and 2.4% of the variance in non-governmental data use when controlling for other variables in the model.

Though Bonferroni post-hoc tests were predominantly conducted in this study, LSD post-hoc tests were run to further assess the impact of U.S. Fish & Wildlife Service region on frequency of data use due to their liberality and robust nature when comparing several levels of a variable (Garson, 2008). Post-hoc tests revealed some statistically significant results. Region 1 (Pacific) uses federal data with greater frequency than do regions 6 (Mountain-Prairie) (mean difference = 1.14, p = .021) and 8 (California and Nevada) (mean difference = 1.08, p = .046). Region 3 (Great Lakes-Big Rivers) also uses federal data more frequently than region 6 (mean difference = .93, p = .036). These results suggest that region 6 lags behind other regions in frequency of federal data use. With regard to state or local data, region 1 also uses these data sources with greater frequency than region 8 (mean difference = 1.05, p = .042), representing the only statistically significant LSD post-hoc test result involving the dependent variable *state or local data frequency of use* and the control variable

Service region. Finally, with regard to frequency of non-governmental data use, region 3 uses these data sources more frequently than region 7 (Alaska) (mean difference = 1.14, p = .049). While the LSD post-hoc tests did not reveal many statistically significant results, it is apparent that federal and state or local data sources are used more often in the Pacific Northwest than they are in California and Nevada and that non-governmental data sources are used with greater frequency in the Midwest than they are in Alaska.

The tenure of a U.S. Fish & Wildlife Service employee who responded to the survey used in this study is significantly related to the reported frequency of state or local data use of his or her field office. The univariate between-subjects test showed that relationship to be significant at p = .020, but weak (partial eta-squared = .032). The null hypothesis that no relationship exists between these two variables was rejected. LSD post-hoc tests show the source of this significant relationship to be that U.S. Fish & Wildlife Service respondents with six to 10 years of experience use state or local data with greater frequency than respondents with 21 to 25 years of experience with the agency (mean difference = .87, p = .047). In order to run the post-hoc tests, the control variable *tenure w/ FWS* was recoded from its continuous form to a categorical variable with levels of 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, and over 30 years experience with the U.S. Fish & Wildlife Service. The variable was recoded for the purpose of post-hoc tests only, and is used in the MANCOVA models as a continuous covariate.

Finally, the model suggested significant relationships between the number of employees in a U.S. Fish & Wildlife Service field office and its use of federal and state or local data. Univariate between-subjects tests showed that *employees in field office* is significantly and moderately related to *federal data frequency of use* (p = .007, partial eta-squared = .043) and *state or local data frequency of use* (p = .043, partial eta-squared = .024). The partial eta-squared statistics showed that the number of employees in a field office accounts for 4.3% of the variance in frequency of federal data use and 2.4% of the variance in frequency of state or local data use when controlling for other variables in the model. Bonferroni post-hoc tests revealed the source of the relationship between *employees in field office* and *federal data frequency of use* to be that field offices which employ over 30 individuals use federal data more frequently than field offices which have 10 or fewer employees (mean difference = .99, p = .049). With regard to the relationship between *employees in field office* and *state or local data frequency of use,* Bonferroni post-hoc tests showed no significant differences among levels of the control variable. However, LSD post-hoc tests showed that field offices with over 30 employees use state or local data with greater frequency than field offices with 10 or fewer employees (mean difference = .90, p = .010). Again, LSD post-hoc tests are more liberal than Bonferroni, especially when there are several levels of a particular variable to be compared (Garson, 2008). The control variable *employees in field office* was recoded only for the purpose of conducting post-hoc tests, using levels of 0-10, 11-20, 21-30, and over 30 employees. *Employees in field office* was used as a continuous covariate in the MANCOVA models examined in this study.

Hypothesis 1 Decision

Using the customary significance criterion ($p < .05$), hypothesis 1 was not confirmed.

- ***H_1: The age of a field office is positively associated with its selection of federal government agency data.***
    - Hypothesis 1: Not Supported

Based on the MANCOVA model, one is forced to conclude that the age of a U.S. Fish & Wildlife Service field office has no significant effect on data selection. The tenets of neo-institutional theory tested in hypothesis 1 (institutional embeddedness; sociological institutionalism) were not shown to be salient with regard to field office age. The implications of these results are further discussed in chapter six of this dissertation.

Research Question 2

The second research question examined the effect of parent agency pressures on data selection. Hypothesis 2 was tested by a MANCOVA model which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* and the independent variable *parent agency influence*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in this model as well.

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***

MANCOVA Model 2

A five-way MANCOVA model was run to test hypothesis 2. The Box's M test was significant (*p* = .023), indicating a violation of the assumption of equality of covariance matrices (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). However, sample sizes were relatively equal in this model and MANCOVA is robust in the face of a significant Box's M statistic when there are no outliers (Alliare, 2009). The Levene's test of equality of error variances showed the homogeneity of variance assumption to be met for all six data selection dependent variables. Main effects are reported using Pillai's Trace (Allaire, 2009).

The main effect of *parent agency influence* on the group of dependent variables was shown to be significant. The Pillai's Trace multivariate test of overall differences among groups indicated this significance, $F(4, 173) = 2.483$, $p = .000$. The partial eta-squared statistic (.081) revealed this relationship to be a weak to moderate one, with field office perception that the selection of a particular data source results in increased agency support accounting for 8.1% of the variance in the dependent variable group when controlling for other variables in the model.

Univariate between-subjects tests showed a significant, but weak relationship between *parent agency influence* and the dependent variable *non-governmental data importance*, $F(4, 173) = 2.698$, $p = .032$, partial eta-squared = .060). However, *parent agency influence* was not shown to be significantly related to the other five data selection dependent variables.

- *federal data importance*, $F(4, 173) = .718$, $p = .581$, power = .229
- *state or local data importance*, $F(4, 173) = 1.359$, $p = .250$, power = .481
- *federal data frequency of use*, $F(4, 173) = 1.132$, $p = .343$, power = .351

- *state or local data frequency of use*, $F(4, 173) = 2.118$, $p = .081$, power = .619
- *non-governmental data frequency of use*, $F(4, 173) = .682$, $p = .605$, power = .218

None of the observed power statistics were above the .80 threshold (Garson, 2008). Though significance tests failed to reject the null assumption that these relationships do not exist, there was insufficient power to accept the null hypothesis that the strength of these relationships is indeed zero. However, the MANCOVA model suggested a relationship between field office perception that it stands to gain the favor of the parent agency by selecting a particular data source and perception of non-governmental data importance. Bonferroni post-hoc tests were conducted to further examine this relationship.

Bonferroni Post-hoc Tests

Bonferroni post-hoc tests were conducted to identify specific significant differences among levels of the independent variable *parent agency influence* and field office perception of non-governmental data importance. These tests revealed that field offices which indicated they stand to gain increased parent agency assistance (funds, equipment, staffing) by using a "combination of data sources" rated non-governmental data sources as significantly more important (mean difference = .3582, $p = .013$) than field offices which believe it "doesn't make a difference" which data source(s) they use. This finding implies that U.S. Fish & Wildlife Service field offices which rely upon a diversified set of data sources believe non-governmental data to be an important part of their biodiversity management decision-making processes and that perhaps the use of this data is rewarded by the U.S. Fish & Wildlife Service.

Hypothesis 2 Decision

Using the customary significance criterion ($p < .05$), hypothesis 2 was partially confirmed.

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***
    - Hypothesis 2: Partially Supported

Based on the MANCOVA model, it was concluded that the higher the field office perception that the parent agency rewards using a combination of data sources in decision making, the more importance a field office attaches to non-governmental data. Hypothesis 2 was partially supported by the confirmation of a relationship between parent agency influence and non-governmental data selection (the *non-governmental data importance* dependent variable). Based on these findings, the notion of institutional isomorphism, particularly coercive isomorphism, appears to have some salience with regard to explaining data selection. The implications of these results are further discussed in chapter six of this dissertation.

Research Question 3

The third research question examined the effect of field office management practices on data selection. Hypotheses 3a and 3b were tested by two separate MANCOVA models, each of which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use*, *state or local data frequency of use,* and *non-governmental data frequency of use*.

MANCOVA model 3a, which corresponds to hypothesis 3a, used the independent variables *information exchange w/ other FWS field offices, information exchange w/ other federal agencies, information exchange w/ state or local agencies,* and *information exchange w/ non-governmental organizations.* MANCOVA model 3b, which corresponds to hypothesis 3b, used the independent variable *field office management practices*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in both models.

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***

- ***H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.***

MANCOVA Model 3a

A three-way MANCOVA model was run to test hypothesis 3a. The Box's M test was non-significant (p = .480), indicating that the assumption of equality of covariance matrices was satisfied (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was violated for all six data selection dependent variables. Therefore, main effects are reported using Pillai's Trace due to its robust nature in the face of such a violation when there are no outliers (Allaire, 2009).

Tests of multivariate main and interaction effects showed only one significant effect. The Pillai's Trace test of overall differences among groups indicated statistical significance regarding the independent variable *information exchange w/ non-governmental organizations*, $F(29, 151) = 2.335$, $p = .007$. The partial eta-squared statistic (.089) revealed this relationship to be a moderate one at best, with field office perception of the importance of collaborating with non-governmental organizations accounting for 8.9% of the variance in the dependent variable group.

Tests of univariate between-subjects effects were conducted to further analyze the impact of independent variables and their interactions on individual dependents. Significant relationships are detailed in Table 4.17.

Table 4.17: Significant Between-Subjects Effects for MANCOVA Model 3a

Dependent Variable	Source of Variation	df	*F*	Sig.	Partial Eta-Squared
State or Local Data Importance	*Information Exchange w/ Other FWS Field Offices*	2	3.129	.047	.041
Non-governmental Data Importance	*Information Exchange w/ Non-governmental Organizations*	2	4.497	.013	.057
Federal Data Frequency of Use	*Information Exchange w/ Non-governmental Organizations*	2	6.178	.003	.077
State or Local Data Frequency of Use	*Information Exchange w/ Non-governmental Organizations*	2	5.684	.004	.071
	*Information Exchange w/ Other FWS Field Offices * Information Exchange w/ Non-governmental Organizations*	3	2.803	.042	.054

Table 4.17: Continued

Non-governmental Data Frequency of Use	*Information Exchange w/ Non-governmental Organizations*	2	9.254	.000	.111
	*Information Exchange w/ Other FWS Field Offices * Information Exchange w/ Non-governmental Organizations*	3	3.654	.014	.069

Table 4.17 illustrates several significant relationships involving independent variable *information exchange w/ non-governmental organizations* and data selection dependent variables. When controlling for other variables in the model, field office perception of the importance of collaborating with non-governmental organizations when making biodiversity decisions accounts for:

- 5.7% of the variance in dependent variable *non-governmental data importance*
- 7.7% of the variance in dependent variable *federal data frequency of use*
- 7.1% of the variance in dependent variable *state or local data frequency of use*
- 11.1% of the variance in dependent variable *non-governmental data frequency of use*

The interaction between *information exchange w/ non-governmental organizations* and the independent variable *information exchange w/ other FWS field offices* accounts for 5.4% of the variance in the dependent variable *state or local data frequency of use* and 6.9% of the variance in the dependent variable *non-governmental data frequency of use*. These relationships are weak to moderate at best. The impact of field office perception of the importance of collaborating with non-governmental organizations when making biodiversity management decisions on data selection dependent variables was further examined through Bonferroni post-hoc tests.

Bonferroni Post-hoc Tests

Bonferroni post-hoc tests were conducted to identify specific significant differences among levels of the independent variable *information exchange w/ non-governmental organizations* and data selection dependent variables. These tests showed that field offices that rated information exchange with non-governmental organizations as "very important" were more likely to assign a higher level of importance to federal data than those which rated such collaboration with non-governmental organizations as "unimportant" (mean difference = .4638, p = .001). Additionally, those which rated information exchange with non-governmental organizations as "somewhat important" placed a higher importance level on federal data than field offices which view such information exchange as "unimportant" (mean difference = .2513, p = .048).

Similar relationships exist between levels of the independent variable *information exchange w/ non-governmental organizations* and field office perception of state or local data importance. Field offices that rated information exchange with non-governmental organizations as "very important" were more likely to assign a higher level of importance to state or local data than those which rated such collaboration as "unimportant" (mean difference = .5761, p = .000). Field offices that rated information exchange with non-governmental organizations as "somewhat important" were also more likely to view state or local data as important than those which rated such information exchange with non-governmental organizations as "unimportant" (mean difference = .3358, p = .012).

Perhaps the most interesting findings of the Bonferroni post-hoc tests involved the independent variable *information exchange w/ non-governmental organizations* and the non-governmental data selection dependent variables (*non-governmental data importance* and *non-governmental data frequency of use*). Field offices which believe the exchange of information with non-governmental organizations when making biodiversity management decisions is "very important" assigned non-governmental data higher importance levels than those which rated such information exchange as "somewhat important" (mean difference = .2870, $p = .039$) and "unimportant" (mean difference = .8153, $p = .000$). Field offices which view such collaboration with non-governmental organizations as "very important" also use non-governmental data more frequently than those which believe the exchange of information with non-governmental organizations to be "unimportant" (mean difference = 1.36, $p = .000$).

Hypothesis 3a Decision

Using the customary significance criterion ($p < .05$), hypothesis 3a was partially confirmed.

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***
    - Hypothesis 3a: Partially Supported

Based on the MANCOVA model, it was concluded a relationship exists between the importance field offices attach to collaborating with non-governmental organizations in making biodiversity management decisions and their selection of non-governmental data sources for use in making such decisions (perception of importance and frequency of use). The implications of this finding could be far-reaching. Non-governmental organizations which hope to see their data sets impact natural resource policy should not only produce such data, but become involved in the policy-making process. The results of this study indicate that U.S. Fish & Wildlife Service field offices are more likely to use non-governmental data if they perceive that collaboration with non-governmental organizations is an important part of the policy-making process. It would stand to reason that non-governmental organizations should either strive to become or maintain their status as an actor in making biodiversity management decisions if they desire to see their data sets achieve or maintain policy-making relevance.

MANCOVA Model 3b

A ten-way MANCOVA model was run to test hypothesis 3b. The Box's M test was non-significant (p = .449), indicating that the assumption of equality of covariance matrices was satisfied (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was met for all six data selection dependent variables. Therefore, main effects are reported using Wilk's Lambda (Allaire, 2009).

The Wilk's Lambda test of overall differences among groups was statistically non-significant, $F(9, 171) = 1.337$, p = .057. The Wilk's Lambda power level was .992, indicating that the null hypothesis was accepted that a relationship between the type of biodiversity management style (species-level, ecosystem-level, or in between) employed by a field office and the data selection dependent variables does not exist.

Univariate between-subjects tests showed two significant relationships among data selection dependent variables and the independent variable *field office management practices*. The biodiversity management style of a U.S. Fish & Wildlife Service field office was significantly and moderately related to field office perception of non-governmental data importance, $F(9, 171) = 1.956$, $p = .047$, partial eta-squared = .095), and frequency of non-governmental data use, $F(9, 171) = 2.170$, $p = .026$, partial eta-squared = .104). *Field office management practices* did not show a significant relationship with the following data selection dependent variables.

- *federal data importance,* $F(9, 171) = .796$, $p = .621$, power = .386
- *state or local data importance,* $F(9, 171) = .551$, $p = .835$, power = .265
- *federal data frequency of use,* $F(9, 171) = 1.268$, $p = .258$, power = .608
- *state or local data frequency of use,* $F(9, 171) = 1.082$, $p = .378$, power = .525

It should be noted that the power statistics associated with the above non-significant relationships were not above the .80 threshold (Garson, 2008). Though significance tests failed to reject the null assumption that these relationships do not exist, there was inadequate power to accept the null hypothesis that the strength of these relationships is zero. Therefore, this study simply failed to find statistically significant relationships involving these data selection dependent variables and the independent variable *field office management practices*.

Hypothesis 3b Decision

Using the customary significance criterion ($p < .05$), hypothesis 3b was not confirmed.

- ***H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.***
    - Hypothesis 3b: Not Supported

Based on the MANCOVA model, it was concluded that ecosystem-level management practices are not significantly related to the selection of federal data. Contrary to U.S. Fish & Wildlife Service biologists' suggestions when conducting previous research (Gerlach, 2005), ecosystem-level management practices do not necessarily relate to an increased selection of federal data sources for use in biodiversity management decision making.

Research Question 4

The fourth research question examined the effect of past data use experiences on data selection. Hypothesis 4 was tested by a MANCOVA model which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* and the independent variables *past federal data use experiences, past state or local data use experiences,* and *past non-governmental data use experiences*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in this model.

- ***H_4: Past positive experiences in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.***

MANCOVA Model 4

A three-way MANCOVA model was run to test hypothesis 4. The Box's M test was significant (p = .000), indicating a violation of the assumption of equality of covariance matrices (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). However, one can be confident that MANCOVA is robust in the face of a significant Box's M statistic when sample sizes are relatively equal and there are no outliers, as was the case in this model (Alliare, 2009). The Levene's test of equality of error variances showed the homogeneity of variance assumption was violated for three of the six data selection dependent variables, *federal data importance, state or local data frequency of use,* and *non-governmental data frequency of use.* Due to the violation of these assumptions, main and interaction effects are reported using Pillai's Trace (Allaire, 2009). Table 4.18 shows the main and interaction effects on the data selection dependent variables used in this model.

Table 4.18: Main and Interaction Effects for MANCOVA Model 4

Source of Variation	Pillai's Trace *F*	Sig.	Partial Eta-Squared	Power
Past Federal Data Use Experiences	2.462	.004	.089	N/A
Past State or Local Data Use Experiences	3.686	.000	.127	N/A
Past Non-governmental Data Use Experiences	3.268	.000	.114	N/A
*Past Federal Data Use Experiences * Past State or Local Data Use Experiences*	1.165	.286	.044	.805
*Past Federal Data Use Experiences * Past Non-governmental Data Use Experiences*	1.997	.003	.072	N/A

Table 4.18: Continued

*Past State or Local Data Use Experiences * Past Non-governmental Data Use Experiences*	1.545	.047	.057	N/A
*Past Federal Data Use Experiences * Past State or Local Data Use Experiences * Past Non-governmental Data Use Experiences*	1.644	.139	.061	.615

Tests of univariate between-subjects effects were conducted to further analyze the impact of independent variables and their interactions on individual dependents. Significant relationships are detailed in Table 4.19.

Table 4.19: Significant Between-Subjects Effects for MANCOVA Model 4

Dependent Variable	**Source of Variation**	**Df**	***F***	**Sig.**	**Partial Eta-Squared**
Federal Data Importance	*Past State or Local Data Use Experiences*	2	5.852	.003	.063
	Past Non-governmental Data Use Experiences	2	3.919	.022	.043
	*Past Federal Data Use Experiences * Past Non-governmental Data Use Experiences*	4	3.445	.010	.073
State or Local Data Importance	*Past State or Local Data Use Experiences*	2	11.551	.000	.117
Non-governmental Data Importance	*Past Non-governmental Data Use Experiences*	2	4.742	.010	.051
Federal Data Frequency of Use	*Past Federal Data Use Experiences*	2	3.953	.021	.043
	Past Non-governmental Data Use Experiences	2	3.705	.027	.041

Table 4.19: Continued

	*Past Federal Data Use Experiences * Past Non-governmental Data Use Experiences*	4	2.634	.036	.057
State or Local Data Frequency of Use	*Past Federal Data Use Experiences * Past Non-governmental Data Use Experiences*	4	3.338	.012	.071
Non-governmental Data Frequency of Use	*Past Non-governmental Data Use Experiences*	2	5.535	.005	.059

With regard to hypothesis 4, the between-subjects tests showed that when controlling for other variables in the model field office perception of past federal data use experiences accounts for 4.3% of the variance in the dependent variable *federal data frequency of use*. The interaction between independent variables *past federal data use experiences* and *past non-governmental data use experiences* explains 7.3% of the variance in dependent variable *federal data importance.* Though weak, a statistically significant relationship involving these variables does exist. This study failed to conclude a significant relationship between *past federal data use experiences* and *federal data importance*, (p = .066, power = .540).

Field office perception of past state or local data use experiences was shown to affect one of the two state or local data selection dependent variables. As shown in Table 4.19, a significant, but moderate relationship exists between independent variable *past state or local data use experiences* and dependent variable *state or local data importance*. However, this study failed to conclude that a significant relationship exists between field office perception of past state or local data use experiences and the frequency with which state or local data are used (p = .091, power = .485).

Finally with regard to hypothesis 4, significant relationships were found between field office perception of past non-governmental data use experiences and both non-governmental data selection dependent variables. As shown in Table 4.19, the independent variable *past non-governmental data use experiences* was shown to account for 5.1% of the variance in dependent variable *non-governmental data importance* and 5.9% of the variance in dependent variable *non-governmental data frequency of use* when controlling for other variables in the model. These and all other significant relationships were further examined using Bonferroni post-hoc tests.

<u>Bonferroni post-hoc tests</u>

Bonferroni post-hoc tests were conducted to further examine the significant relationships between the independent variables used in MANCOVA model 4 and data selection dependent variables. With regard to testing hypothesis 4, post-hoc tests revealed that U.S. Fish & Wildlife Service field offices that “strongly agree” that they have had positive experiences using data from federal sources were more likely to perceive federal data as “important” than those which simply “agree” (mean difference = .3189, p = .001). Field offices which “strongly agree” that they have had positive federal data use experiences were even more inclined to attach higher importance levels to federal data than those which “do not agree” that they have had positive experiences using federal data (mean difference = .4562, p = .001). Additionally, field offices which “strongly agree” regarding positive past federal data use experiences use federal data sources more frequently than those that simply “agree” (mean difference = .76, p = .004) and field offices which “do not agree” (mean difference = 2.02, p = .000).

Bonferroni post-hoc tests revealed similar results for the relationship between the independent variable *past state or local data use experiences* and state or local data selection dependent variables. Field offices which “strongly agree” that they have had positive past state or local data use experiences assigned higher importance levels to state or local data than those which “agree” (mean difference = .5005, p = .000) and “do not agree” (mean difference = .7660, p = .000). U.S. Fish & Wildlife Service field offices which “strongly agree” that they have had positive past state or local data use experiences also use state or local data sources more frequently than those which simply “agree” (mean difference = .81, p = .003) or “do not agree” (mean difference = 1.52, p = .000).

Similarly, with regard to hypothesis 4, post-hoc tests revealed that U.S. Fish & Wildlife Service field offices which identify with positive past experiences using non-governmental data are more likely to use non-governmental data when making biodiversity management decisions than those which do not. Field offices which “strongly agree” that they have had positive past non-governmental data use experiences assigned higher importance levels to non-governmental data than field offices which “agree” (mean difference = .3221, p = .022) and those which “do not agree” that they have had positive experiences using such data sources (mean difference = .7313, p = .000). Additionally, field offices which “strongly agree” that they have had positive past non-governmental data use experiences also use non-governmental data sources more frequently than those which simply "agree" (mean difference = .78, p = .010) or "do not agree" (mean difference = 1.82, p = .000).

Hypothesis 4 Decision

Using the customary significance criterion ($p < .05$), hypothesis 4 was confirmed.

- ***H_4: Past positive experiences in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.***
    - Hypothesis 4: Supported

Based on MANCOVA model 4, it was concluded that past positive data use experiences are positively related to data selection. The neo-institutional theory tenet of *path dependency* (Pierson, 2000; Pierson & Skocpol, 2002) was found to be salient in making data selection decisions for use in the natural resource policy process. The concept of *repetitive momentum* (Baum, 1996) also appears to play a significant role in explaining data selection. The implications of these findings and their effect on the research model are discussed further in chapter six of this dissertation.

Research Question 5

The fifth and final organizational research question examined the effect of information technology capabilities on data selection. Hypothesis 5 was tested by a MANCOVA model which included two data newness dependent variables, *year of last update of data set most relied upon* and *decade of establishment of data set most relied upon,* and the independent variable *information technology capabilities*. The control variables

Service region, tenure w/ FWS, and *employees in field office* served as covariates in MANCOVA model 5.

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***

<u>MANCOVA Model 5</u>

A three-way MANCOVA model was run to test hypothesis 5. The Box's M test was non-significant (p = .426), indicating that the assumption of equality of covariance matrices was met (Field, 2005; Garson, 2008, Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed the homogeneity of variance assumption to be violated for the dependent variable *decade of establishment of data set most relied upon* (p = .006). Due to the violation of this assumption, main effects are reported using Pillai's Trace, which is more robust in the face of such a violation when there are no outliers (Allaire, 2009).

The Pillai's Trace multivariate test of overall differences among groups was statistically non-significant for the independent variable *information technology capabilities*, F(2, 128) = .448, p = .774, power = .155. Pillai's Trace multivariate tests also revealed that overall differences among groups were non-significant for each of the control variables used in the MANCOVA model.

- *Service region,* F(1, 128) = .163, p = .850, power = .075
- *tenure w/ FWS*, F(1, 128) = .916, p = .403, power = .206
- *employees in field office,* F(1, 128) = .113, p = .893, power = .067

The observed power statistics for these multivariate tests were very low, falling well shy of the .80 threshold (Garson, 2008). Though significance tests failed to reject the null assumption that these relationships do not exist, there was insufficient power to claim that the relationships are indeed zero. Therefore, this study simply failed to conclude any significant differences among groups.

Univariate tests of between-subjects effects showed that the version of ArcView software available to a U.S. Fish & Wildlife Service field office (independent variable *information technology capabilities*) is not significantly related to either data newness dependent variable.

- *year of last update of data set most relied upon,* $F(2, 128) = .235$, $p = .791$, power = .086
- *decade of establishment of data set most relied upon,* $F(2, 128) = .647$, $p = .525$, power = .157

Additionally, no control variable was shown to be significantly related to either of the data newness dependents.

Service region:

- *year of last update of data set most relied upon,* $F(1, 128) = .079$, $p = .779$, power = .059
- *decade of establishment of data set most relied upon,* $F(1, 128) = .191$, $p = .663$, power = .072

tenure w/ FWS:

- *year of last update of data set most relied upon,* $F(1, 128) = .002$, $p = .956$, power = .050
- *decade of establishment of data set most relied upon,* $F(1, 128) = 1.803$, $p = .182$, power = .266

employees in field office:

- *year of last update of data set most relied upon,* $F(1, 128) = .123$, $p = .726$, power = .064
- *decade of establishment of data set most relied upon,* $F(1, 128) = .147$, $p = .702$, power = .067

It should be noted that the observed power statistics for these non-significant univariate between-subjects tests all failed to meet the .80 threshold (Garson, 2008). This forces one to conclude that this study simply did not find significant relationships between the independent / control variables and the two data newness dependent variables. However, results of the analysis failed to accept the null hypothesis that these relationships do not exist.

Hypothesis 5 Decision

Using the customary significance criterion ($p < .05$), hypothesis 5 was not confirmed.

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***
    - Hypothesis 5: Not Supported

MANCOVA model 5 failed to find a significant relationship, in either direction, between the version of ArcView software accessible by a U.S. Fish & Wildlife Service field office and its selection of newer, more recently updated data sets for use in making natural resource policy. Previous research findings related to technological barriers to data selection (Gerlach, 2005) were not confirmed in this study, nor was the availability of newer versions of ArcView software (ESRI, 2007) shown to impact the newness of data used in the policy-making process. The research model tested in this study was altered accordingly in chapter six of this dissertation.

Controlling for Environmental Independent Variables

The organizational MANCOVA models discussed in this chapter only tested organizational independent variables. This was by design, but also out of necessity. The organizational research questions examined through the testing of related hypotheses sought to isolate elements of neo-institutional theory in an effort to determine their explanatory value with regard to data selection in the natural resource policy process. An omnibus MANCOVA model consisting of all organizational and environmental independent variables was attempted in this study to assess the significance of all independent variables when controlling for others. Ideally, the results of this omnibus model would have been compared to the results of the MANCOVA models which tested each organizational hypothesis. However, there was insufficient sample adequacy to run such a model. A sample size of 204 cases (respondents which completed the survey) falls well short of what is necessary to run a MANCOVA model with 22 multi-leveled independent variables. Therefore, the omnibus model violated a major MANCOVA assumption. Garson (2008) states, "Small samples may have lower power. At a minimum, every cell must have more cases than there are dependent variables." It is also recommended that no fewer than 80% of cells have less than five cases, with no cells containing zero cases (Garson, 2008).

While the omnibus MANCOVA model proved inappropriate due to a small sample size, a smaller MANCOVA model was run which included the organizational independent variables *parent agency influence* and *information exchange w/ non-governmental organizations* and the environmental independent variables *confer w/ nonprofit organizations* and *other field office data source.* This MANCOVA model included the same data selection dependent variables used in previous models and those discussed in chapter five (*federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use*). The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates. The independent variables used in this MANCOVA model represent the most important findings discussed in this chapter and chapter five with regard to data selection. Other significant findings seem more intuitive, as discussed in chapter six. While an omnibus MANCOVA model containing all 22 independent variables is preferred to this model, this smaller MANCOVA model examined the robustness of significant results involving organizational and environmental independent variables while satisfying the MANCOVA assumption of an adequate sample size. The results of previous MANCOVA models containing the independent variables *parent agency influence, information exchange w/ non-governmental organizations, confer w/ nonprofit organizations,* and *other field office data source* were proven to be robust when examining these four organizational and environmental independent variables together in the same model. While these results seem to indicate the robustness of this study's most significant findings, future research efforts which examine a larger sample of natural resource agency field offices are necessary to include more multi-leveled independent variables in an omnibus MANCOVA model.

SUMMARY OF ORGANIZATIONAL HYPOTHESES AND DECISIONS

Based on the MANCOVA models run to test the organizational hypotheses in this study, some aspects of neo-institutional theory are more salient than others with regard to data selection for use in the natural resource policy-making process. Table 4.20 summarizes the decisions made regarding the organizational hypotheses tested.

Table 4.20: Organizational Hypotheses and Decisions

Hypothesis	Decision	Concept(s) from the Literature Tested
H_1: The age of a field office is positively associated with its selection of federal government agency data.	Not Confirmed	Sociological institutionalism Institutional embeddedness
H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.	Partially Confirmed	Institutional isomorphism • Coercive isomorphism
H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.	Partially Confirmed	Institutional isomorphism • Normative isomorphism Collaborative management
H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.	Not Confirmed	Institutional isomorphism • Normative isomorphism Trend toward ecosystem-level Management
H_4: Past positive experiences in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.	Confirmed	Path dependency Repetitive momentum

Table 4.20: Continued

H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.	Not Confirmed	Path dependency Technological advantage

It is clear that some aspects of neo-institutional theory help explain data selection decisions within the U.S. Fish & Wildlife Service. Others are not so explanatory. For instance, regarding hypothesis 1, sociological institutionalism and the concept of institutional embeddedness (Hall & Taylor, 1996; McAdam et al., 1997) would have predicted that U.S. Fish & Wildlife Service field offices select the older, more established data source (federal data) most often. However, this study did not confirm that hypothesis. Conversely, the statistical analysis did confirm coercive isomorphism to be an explanatory tenet of neo-institutional theory with regard to the selection of non-governmental data. In testing hypothesis 2, the concept of coercive isomorphism (DiMaggio & Powell, 1991) was shown to impact field office perceptions of the importance of non-governmental data sources.

Scholarly literature partially explains the relationship between field office management practices and data selection. With regard to hypothesis 3a, the concept of normative isomorphism (Meyer & Rowan, 1991; Meyer & Scott, 1992) was thought to be able to predict the effect of collaboration with other natural resource agencies or organizations on data selection. Multivariate analysis partially confirmed this belief by showing that collaboration with non-governmental organizations, a common practice in biodiversity management today, is positively associated with the selection of non-governmental data. However, biodiversity management literature and previous research

(Gerlach, 2005; Thomas, 2003) would have predicted that ecosystem-level management practices are positively associated with the selection of federal data (hypothesis 3b). Multivariate analysis did not confirm that prediction.

Hypothesis 4 predicted, based on the neo-institutional theory tenet of path dependency (Duit, 2007; Pierson, 2000; Pierson & Skocpol, 2002) as well as literature pertaining to repetitive momentum (Baum, 1996), that positive data use experiences are positively associated with the present day selection of data from that particular source. MANCOVA model 4 supported this prediction. Based on multivariate analysis, this study concludes that path dependency and repetitive momentum are salient concepts in explaining data selection from an organizational standpoint.

Finally, previous research indicates that path dependency may have a negative impact on the selection of newer data sources for using in making biodiversity management decisions (Gerlach, 2005). Whereas path dependency would have predicted that a lack of access to newer versions of ArcView GIS software may negatively impact the selection of newer data sets (hypothesis 5), the results of this study do not support that prediction. Rather, MANCOVA model 5 failed to indicate that a relationship exists, positive or negative, between the version of ArcView software available to a particular U.S. Fish & Wildlife Service field office and its selection of data for use in the policy-making process. This finding, as well as others detailed in this section, is discussed further in chapter six. There, the findings of the organizational MANCOVA models are used to alter the research model in an attempt to accurately reflect the salience of certain aspects of neo-institutional theory and biodiversity management literature which informed hypotheses 1 through 5.

CHAPTER 5: ANALYSIS OF ENVIRONMENTAL FACTORS

This chapter details the statistical analysis of environmental factors which may affect data selection. Like chapter four, this chapter is organized into four main sections. First, descriptive statistics are discussed. Interesting descriptive statistics related to environmental independent variables are highlighted. Second, bivariate correlations are presented. The environmental correlates of data selection and data newness are discussed. Third, MANCOVA procedures are detailed, which tested on a multivariate basis this study's environmental hypotheses. These hypotheses are grounded in diffusion theory. The MANCOVA models described in this chapter tested only the environmental independent variables studied in this dissertation and examined only environmental hypotheses. However, the issue of controlling for organizational variables is discussed at the end of the MANCOVA section. The chapter concludes with a summary of environmental hypotheses, decisions regarding their acceptance or rejection, and the salience of theoretical concepts behind each hypothesis in explaining data selection within the U.S. Fish & Wildlife Service.

DESCRIPTIVE STATISTICS

This section details descriptive statistics pertaining to the environmental independent variables used in this study. Chapter four highlights descriptive statistics associated with the dependent variables used in the study, as well as control variables used in the analyses. Therefore, those variables are not discussed further in this chapter with regard to descriptive statistics. However, Table 5.9 at the end of this section does summarize findings related to the environmental hypotheses tested in this study which can be gleaned from an analysis of descriptive statistics. It is important to note that an examination of bivariate correlations and, most importantly, multivariate analysis were necessary to fully test the environmental hypotheses.

Environmental Independent Variables

This study examined the potential impact of eight environmental factors (informed by diffusion theory) on data selection for use in natural resource policy making. The survey instrument included as Appendix A of this dissertation measured the following environmental independent variables.

- Federal agency data marketing efforts (FD_market)
- State or local agency data marketing efforts (SLD_market)
- Non-governmental data marketing efforts (NG_market)
- Interest or advocacy group relationships
    - *confer w/ nonprofit organizations* (confer_NPO)
    - *confer w/ private sector businesses* (confer_PrivSec)
    - *confer w/ academic institutions* (confer_Acad)
- Other field office data source (data_infl)
- Other field office data newness (new_infl)
- Public involvement intensity
    - *public participation frequency* (pub_inform)
    - *public participation intensity* (pub_numbers)
- Public data use preference (pub_datapref)

The environmental independent variables examined in this study measured key aspects of diffusion theory along with elements of biodiversity management literature. In testing environmental factors which potentially influence data selection, these environmental independent variables were used to determine the impact of certain aspects of diffusion theory (discussed in chapter two of this dissertation) on data selection decisions. The environmental independent variables measured a series of theory-driven hypotheses which sought to explain why certain data sources are selected for use over others in the natural resource policy-making process. Like the organizational independent variables, the original frequency distributions of environmental independents are included as Appendix D of this dissertation. The recoded frequencies are included as Appendix E. Some frequency distributions were more insightful than others with regard to answering initial questions related to particular environmental hypotheses. These findings are discussed in the following section.

Interesting Environmental Independent Variable Frequency Distributions

<u>Interest or Advocacy Group Relationships</u>

The environmental independent variables which assessed interest or advocacy group relationships were measured by the survey item, "How often does your field office confer with the following when making biodiversity management decisions?" Survey participants rated the frequency with which their field offices confer with nonprofit organizations (*confer_NPO*), private sector businesses (*confer_PrivSec*), and academic institutions (*confer_Acad*) by selecting from the following choices.

- Daily
- Weekly
- Monthly

- Quarterly
- Annually
- Rarely
- Never

An assessment of interest or advocacy group relationships was central to testing the following environmental hypothesis:

- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***

Survey responses indicate that 20% of U.S. Fish & Wildlife Service field offices confer with nonprofit organizations at least monthly for the purpose of making biodiversity management decisions. Some 16% of field offices confer with private sector businesses at least monthly, while 37% confer with academic institutions at least monthly. These results indicate the importance of conferring with non-governmental organizations when making ground-level policy decisions, with the most frequent need for conference belonging to academic institutions. U.S. Fish & Wildlife Service field offices appear most closely reliant upon frequent collaboration with academic institutions when making such decisions. The frequency distributions for the environmental independent variables which measured interest or advocacy group relationships are illustrated in Tables 5.1 through 5.3.

Table 5.1: Frequency of Conference with Nonprofit Organizations for the Purpose of Making Biodiversity Management Decisions

Confer w/ Nonprofit Organizations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	12	5.0	5.9	5.9
	Rarely	70	29.4	34.3	40.2
	Annually	40	16.8	19.6	59.8
	Quarterly	42	17.6	20.6	80.4
	Monthly	22	9.2	10.8	91.2
	Weekly	13	5.5	6.4	97.5
	Daily	5	2.1	2.5	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Table 5.2: Frequency of Conference with Private Sector Businesses for the Purpose of Making Biodiversity Management Decisions

Confer w/ Private Sector Businesses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	29	12.2	14.1	14.1
	Rarely	95	39.9	46.3	60.5
	Annually	29	12.2	14.1	74.6
	Quarterly	20	8.4	9.8	84.4
	Monthly	14	5.9	6.8	91.2
	Weekly	14	5.9	6.8	98.0
	Daily	4	1.7	2.0	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Table 5.3: Frequency of Conference with Academic Institutions for the Purpose of Making Biodiversity Management Decisions

Confer w/ Academic Institutions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	.8	1.0	1.0
	Rarely	23	9.7	11.2	12.2
	Annually	56	23.5	27.3	39.5
	Quarterly	49	20.6	23.9	63.4
	Monthly	49	20.6	23.9	87.3
	Weekly	20	8.4	9.8	97.1
	Daily	6	2.5	2.9	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Perceptions of the Influence of Other Field Office Data Selection Decisions

Two environmental independent variables, *other field office data source* and *other field office data newness* measure U.S. Fish & Wildlife Service field office perceptions of the influence of data selection procedures of other field offices on their own data adoption decisions. These two independent variables were used to test the following environmental hypotheses, which were informed by diffusion theory literature pertaining to the likelihood of adopting a particular innovation being tied to mimicking the adoption procedures of others (Berry & Berry, 1990; Meyer & Scott, 1992; Scott, 1991; Walker, 1969). Additionally, the selection of biological data sets by natural resource field offices within the state of North Carolina has been linked to the data adoption procedures of surrounding offices (Gerlach, 2005).

- ***H_{8a}*: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.**

- ***H_{8b}*: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.**

U.S. Fish & Wildlife Service field office perceptions of the influence of data sources and newness of data used by other field offices in making biodiversity management decisions were measured by the following survey item.

- "The adoption of data is important in making biodiversity management decisions. When your field office is adopting data, how influential are each of the following?"

Respondents were asked to assess the influence of "data sources" and the "newness of data" used by other U.S. Fish & Wildlife Service field offices on a ten-point scale, with 1 representing "Not Influential" and 10 representing "Very Influential." Some 63% of field offices assigned data sources used by other U.S. Fish & Wildlife Service field offices an influence rating of 8 or higher on the aforementioned ten-point scale, as depicted in Figure 5.1. On a separate ten-point scale, 62% of field offices assigned the newness of data used by other field offices an influence rating of 8 or higher, as shown in Figure 5.2. The two variables, *other field office data source* and *other field office data newness*, were not rated against one another.

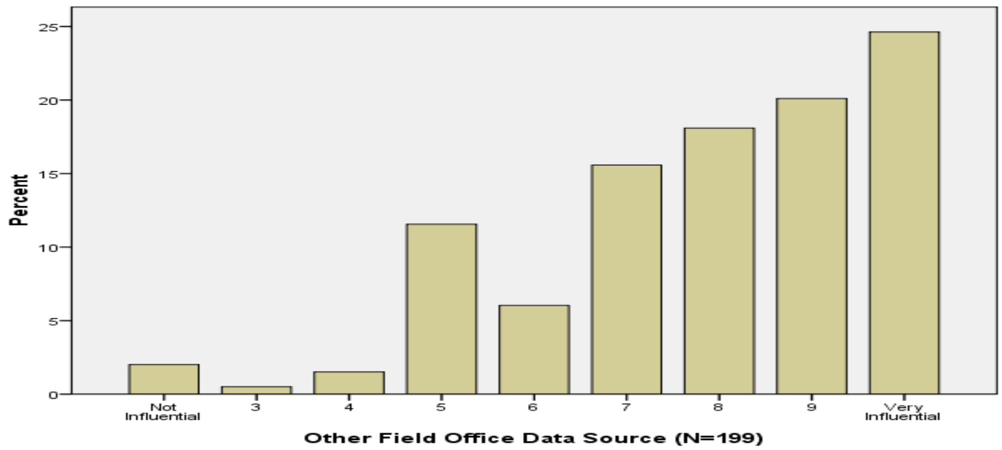

Figure 5.1: Perception of the Influence of Data Sources Used by Other Field Offices on Data Adoption

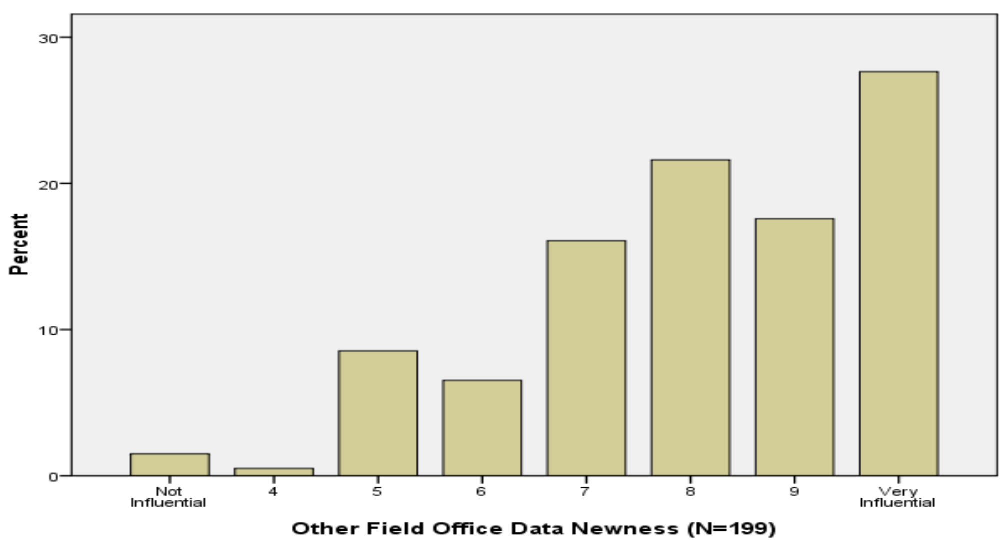

Figure 5.2: Perception of the Influence of the Newness of Data Used by Other Field Offices on Data Adoption

As noted in Table 3.5 of chapter three, the environmental independent variables *other field office data source* and *other field office data newness* were recoded to allow for more meaningful multivariate analysis (Not Influential = original choices 1-5; Somewhat

Influential = original choices 6-9; Very Influential = original choice 10). The recoded frequency distributions of these two variables are shown in Tables 5.4 and 5.5.

Table 5.4: Perception of the Influence of Data Sources Used by Other Field Offices on Data Adoption (recoded)

Other Field Office Data Source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	31	13.0	15.6	15.6
	Somewhat Influential	119	50.0	59.8	75.4
	Very Influential	49	20.6	24.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Table 5.5: Perception of the Influence of the Newness of Data Used by Other Field Offices on Data Adoption (recoded)

Other Field Office Data Newness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	21	8.8	10.6	10.6
	Somewhat Influential	123	51.7	61.8	72.4
	Very Influential	55	23.1	27.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

As depicted in Table 5.4, a mere 16% of U.S. Fish & Wildlife Service field offices do not believe the sources of data used by other field offices are influential in their own data adoption decisions. As shown in Table 5.5, only 11% of field offices are not influenced by the newness of data used by other field offices in making biodiversity management decisions when adopting their own data. While field offices reported varying perceptions of the influence of other field offices' data selection decisions, bivariate and multivariate analyses were necessary to ascertain whether or not this influence affects data selection on a statistically significant level.

Public Involvement Intensity

The intensity of public involvement in the biodiversity management decision-making process was assessed by two survey items. The first item, measuring *public participation frequency*, asked, "How frequently does your field office receive information relevant to biodiversity management decisions from individual members of the general public (not organized interest groups)?" Respondents were asked to select from the following choices.

- Daily
- Weekly
- Monthly
- Quarterly
- Annually
- Rarely
- Never

The second survey item, measuring *public participation intensity*, asked, "When your field office receives such information from individual members of the general public (not organized interest groups) how many citizens, on average, offer information?" Respondents selected from the following choices.

- 1 – 5
- 6 – 10
- 11 – 15
- 16 – 20
- Over 20
- Individual members of the general public never offer information.

These measures of public involvement intensity were used to test the following environmental hypotheses.

- ***H_{9a}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data.***

- ***H_{9b}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***

Survey results show little public participation in making biodiversity management decisions at the field office level. While 53% of U.S. Fish & Wildlife Service field offices rarely experience public participation in making such decisions and 12% never do, only 3% of field offices experience public participation weekly. Survey results also indicate that public participation numbers are low when it exists at all. Some 75% of field offices reported that, when the public does participate, only between one and five individuals offer information during the biodiversity management decision-making process. These results suggest that public involvement in the policy-making process is far less intense at the field office level than previous research indicates (Gerlach, 2005). Tables 5.6 and 5.7 show original frequency distributions associated with responses pertaining to *public participation frequency* and *public participation intensity*, respectively.

Table 5.6: Frequency of Public Participation in the Biodiversity Management Decision-Making Process

Public Participation Frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	24	10.1	11.8	11.8
	Rarely	107	45.0	52.5	64.2
	Annually	24	10.1	11.8	76.0
	Quarterly	20	8.4	9.8	85.8
	Monthly	22	9.2	10.8	96.6
	Weekly	7	2.9	3.4	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Table 5.7: Intensity of Public Participation in the Biodiversity Management Decision-Making Process

Public Participation Intensity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individual members of the general public never offer information.	27	11.3	13.4	13.4
	1-5	152	63.9	75.2	88.6
	6-10	12	5.0	5.9	94.6
	11-15	4	1.7	2.0	96.5
	Over 20	7	2.9	3.5	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Public Data Use Preference

Public data use preference was measured by a survey item which asked, "On average, which data source do individual members of the general public (not organized interest groups) encourage your field office to use when making biodiversity management decisions?" U.S. Fish & Wildlife Service field offices were allowed to choose from the following responses.

- Federal Data
- State or Local Data
- Non-governmental Data
- A combination of the above
- Individual members of the general public do not express a preference.

Table 5.8 shows the frequency distribution of responses to the survey item measuring the environmental independent variable *public data use preference*.

Table 5.8: Data Use Preferences of the General Public for Use in Making Biodiversity Management Decisions

Public Data Use Preference

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individual members of the general public do not express a preference.	119	50.0	58.9	58.9
	Federal Data	7	2.9	3.5	62.4
	State or Local Data	4	1.7	2.0	64.4
	Non-governmental Data	23	9.7	11.4	75.7
	A combination of data sources	49	20.6	24.3	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

As Table 5.8 indicates, 59% of U.S. Fish & Wildlife Service field offices reported that the general public does not express a data use preference with regard to making biodiversity management decisions. Hypothesis 9c asserts that field office perceptions that the general public desires for a particular data source to be used in the decision-making process are positively related to the selection of data from that source.

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***

An examination of the descriptive statistics associated with the environmental independent variable *public data use preference* indicated the public very rarely lobbies for the sole use of federal (4% response), state or local (2%), or non-governmental (11%) data sources when making biodiversity management decisions. However, to further test hypothesis 9c, *public data use preference* could not be recoded, as stated in chapter three, and, specifically, Table 3.5. Recoding the variable would have disallowed any possible multivariate testing of the hypothesis by collapsing responses into categories that do not address the three data sources explored in this study. Therefore, the variable was included in MANCOVA model 9c in its original format, though responses were not as evenly distributed as would be desired.

Summary of Descriptive Statistics Findings

The descriptive statistics of environmental independent variables offered initial insight into those variables used to test environmental hypotheses. Table 5.9 summarizes the interesting findings offered by environmental independent variable descriptive statistics. As is the case and was noted with regard to organizational hypotheses in chapter four, the descriptive statistics associated with environmental independent variables could not be used to fully evaluate the environmental hypotheses examined in this study. Bivariate and multivariate analyses were conducted to more thoroughly test these hypotheses. The sections to follow detail those procedures and their results.

Table 5.9: Summary of Substantive Findings Based on Descriptive Statistics Associated with Environmental Independent Variables

Environmental Hypotheses	Substantive Findings Based on Descriptive Statistics of Environmental Independent Variables
H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.	• *No substantive findings based on the descriptive statistics of environmental independent variables.*
H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.	• 20 % of U.S. Fish & Wildlife Service field offices confer with nonprofit organizations at least monthly for the purpose of making biodiversity management decisions • 16% of U.S. Fish & Wildlife Service field offices confer with private sector businesses at least monthly for the purpose of making biodiversity management decisions • 37% of U.S. Fish & Wildlife Service field offices confer with academic institutions at least monthly for the purpose of making biodiversity management decisions
H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.	• 63% of U.S. Fish & Wildlife Service field offices assigned the data sources used by other field offices an influence rating of 8 or higher on a ten-point scale whereby 1 represented “Not Influential” and 10 represented “Very Influential”
H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.	• 62% of U.S. Fish & Wildlife Service field offices assigned the newness of data used by other field offices an influence rating of 8 or higher on a ten-point scale whereby 1 represented “Not Influential” and 10 represented “Very Influential”

Table 5.9: Continued

H_{9a}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data. *H_{9b}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.*	• 53% of U.S. Fish & Wildlife Service field offices reported "rarely" having experienced public participation in the biodiversity decision-making process o 12% of field offices reported having "never" experienced public participation of this type • 75% of U.S. Fish & Wildlife Service field offices reported that, when the general public does participate in biodiversity decision making, that public participation only consists of between one and five individuals
H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.	• 59% of U.S. Fish & Wildlife Service field offices reported that the general public has "no preference" with regard to the source of data a field office uses in making biodiversity management decisions

BIVARIATE CORRELATIONS

This section details significant bivariate Pearson correlations among environmental independent variables and the dependent variables used in this study. Chapter four highlights bivariate correlations among organizational independent and dependent variables. Therefore, those relationships are not discussed further in this chapter. Correlations among independent variables (organizational and environmental), dependent variables, and those involving control variables are also detailed in chapter four, as are potential threats of multicollinearity and singularity. The sections to follow present and discuss significant bivariate Pearson correlations involving the environmental independent variables examined in this chapter and data selection and data newness dependent variables.

Environmental Independent Variables and Data Selection Dependent Variables

Several environmental independent variables showed significant Pearson correlations with data selection dependents. Table 5.10 illustrates these correlations and their corresponding levels of significance. The full correlations matrix which includes statistics for significant and non-significant correlations among all variables is included as Appendix F of this dissertation. The discussion following Table 5.10 highlights some of the more interesting correlations portrayed in the table.

Table 5.10: Significant Bivariate Pearson Correlations Among Environmental Independent and Data Selection Dependent Variables

	Data Selection Dependent Variables					
Environmental Independent Variables	*Federal Data Importance*	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
State or Local Agency Data Marketing Efforts	-	-	-	.160*	.214**	-
Non-governmental Data Marketing Efforts	-	-	-	-	-	.163*
Confer w/ Nonprofit Organizations	.151*	.257**	.285**	.379**	.488**	.536**
Confer w/ Private Sector Businesses	-	-	.162*	.410**	.497**	.452**
Confer w/ Academic Institutions	-	.251**	.286**	.356**	.528**	.512**
Other Field Office Data Source	.328**	.304**	-	.148*	.186**	-
Other Field Office Data Newness	.290**	.367**	.182*	-	.203**	.145*
Public Participation Frequency	-	-	-	.216**	.181**	.199**
Public Data Use Preference	.194*	.170*	-	-	.191**	-

**Correlation is significant at the .01 level (two-tailed, N=238).
*Correlation is significant at the .05 level (two-tailed, N=238).

Survey results indicate that a U.S. Fish & Wildlife Service field office relationship with an interest or advocacy group correlates to field office data selection. The highest correlation involving these variables exists between the frequency with which a field office confers with nonprofit organizations and the frequency with which it uses non-governmental data (Pearson correlation=.536, p=.000). However, the environmental independent variable *confer w/ nonprofit organizations* also correlates highly to frequency of federal (Pearson correlation=.379, p=.000) and state or local (Pearson correlation=.488, p=.000) data use. Additionally, the frequency with which a field office confers with private sector businesses when making biodiversity management decisions correlates highly to frequency of federal (Pearson correlation=.410, p=.000), state or local (Pearson correlation=.497, p=.000), and non-governmental (Pearson correlation=.452, p=.000) data use. Finally, the frequency with which a field office confers with academic institutions highly correlates to frequency of federal (Pearson correlation=.356, p=.000), state or local (Pearson correlation=.528, p=.000), and non-governmental (Pearson correlation=.512, p=.000) data use. These significant and relatively high correlations suggest a relationship between working with interest or advocacy groups and data selection.

The perceived influence the data sources used by other field offices has on data selection procedures within a responding field office was shown to be significantly related to data selection. U.S. Fish & Wildlife Service field offices which attached higher levels of influence to the data sources selected by other field offices also attached higher levels of importance to federal (Pearson correlation=.328, p=.000) and state or local (Pearson correlation=.304, p=.000) data sources. Field offices which attached a higher level of influence to the data sources selected by other field offices were also shown to use federal (Pearson correlation=.148, p=.040) and state or local (Pearson correlation=.186, p=.010) data more frequently. These results indicate a possible relationship between the data selection procedures of other U.S. Fish & Wildlife Service field offices and the data selection procedures reported by a responding field office. These findings were of particular interest with regard to hypothesis 8a, though multivariate analysis was necessary to fully test the hypothesis.

Another significant correlation of interest exists between the perceived influence of the newness of data used by other field offices on data selection procedures within a responding field office and actual data selection. U.S. Fish & Wildlife Service field offices which attached higher levels of influence to the newness of data used by other field offices also attached higher levels of importance to federal (Pearson correlation=.290, p=.000), state or local (Pearson correlation=.367, p=.000), and non-governmental (Pearson correlation=.182, p=.011) data sources. Field offices which attached a higher level of influence to the newness of data used by other field offices were also shown to use state or local (Pearson correlation=.203, p=.005) and non-governmental (Pearson correlation=.145, p=.045) data more frequently. Though hypothesis 8b compares the perceived influence of the newness of data used by other field offices to the newness of data selected by a responding field office, the aforementioned findings are interesting and somewhat unexpected. Bivariate Pearson correlations suggest the greater the influence of age of data used by surrounding U.S. Fish & Wildlife Service field offices on the data selection procedures of a particular field office, the more apt that field office is to select federal or state or local data for use in making biodiversity management decisions.

Environmental Independent Variables and Data Newness Dependent Variables

Table 5.11 shows significant bivariate Pearson correlations between environmental independent variables and data newness dependent variables, as well as their corresponding levels of significance. The full correlation matrix is included as Appendix F of this dissertation. Based on hypothesis 8b, significant correlations with data newness dependents were expected for the environmental independent variable *other field office data newness*. However, as depicted in Table 5.11, the only two significant correlations among environmental independent and data newness dependent variables were unexpected ones.

Table 5.11: Significant Bivariate Pearson Correlations Among Environmental Independent and Data Newness Dependent Variables

	Data Newness Dependent Variables	
Environmental Independent Variables	*Year of Last Update (Data Set Most Relied Upon)*	*Year of Establishment (Data Set Most Relied Upon)*
Confer w/ Private Sector Businesses	-.196*	-
Public Participation Intensity	-.257*	-

**Correlation is significant at the .01 level (two-tailed, N=238).
*Correlation is significant at the .05 level (two-tailed, N=238).

Bivariate Pearson correlations indicated negative relationships between the environmental independent variables *confer w/ private sector businesses* and *public participation intensity* and the data newness dependent variable *year of last update of data set most relied upon*. Survey results indicate the more frequently a U.S. Fish & Wildlife Service field office confers with private sector businesses when making biodiversity management decisions, the more time has passed since the last update of the data set most relied upon by that particular field office (Pearson correlation=-.196, p=.015). Additionally, the greater the number of citizens which participate in aiding a field office when making biodiversity management decisions, the less likely that field office is to most rely upon a data set which was recently updated (Pearson correlation=-.257, p=.002). While the theories tested in this study do not offer a reason for these findings, they are indeed worthy of reporting and potential future research efforts.

Though Bivariate Pearson correlations offered insight into relationships among the variables used to test this study's environmental hypotheses, multivariate analysis was needed to make decisions on their acceptance or rejection. As previously stated, while bivariate correlations can be revealing, they can also be misleading. Multivariate analysis may reveal some seemingly significant bivariate correlations to be spurious when other variables are controlled. Multivariate analysis can also reveal some seemingly non-significant relationships to have been suppressed by control variables and to actually be significant. The following section details the multivariate analysis procedures employed in this study.

ANALYSIS OF ENVIRONMENTAL FACTORS USING MANCOVA

Environmental hypotheses were tested using MANCOVA procedures. The variables used in these models are detailed in Table 3.2 of this dissertation. By testing environmental hypotheses grounded in diffusion theory, environmental research questions (also contained in Table 3.2) were answered and components of the research model are either confirmed or rejected. The discussion of MANCOVA results in the sections to follow examines each research question and related hypothesis associated with potential environmental factors which influence data selection. A determination is made whether or not to confirm or reject each hypothesis based on these analyses.

Environmental Research Questions and Hypotheses

Research Question 6

The sixth research question explored in this study examined the effect of data marketing efforts on data selection. Hypothesis 6 was tested by a MANCOVA model which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* as well as the environmental independent variables *federal agency data marketing efforts, state or local agency data marketing efforts,* and *non-governmental data marketing efforts*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in the model.

- ***H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.***

MANCOVA Model 6

A six-way MANCOVA model was run to test hypothesis 6. The Box's M test was non-significant (p = .327). Therefore, the assumption of equality of covariance matrices was met (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed a violation of the homogeneity of variance assumption for the dependent variables *federal data importance* (p = .000), *state or local data importance* (p = .001), *federal data frequency of use* (p = .046), *state or local data frequency of use* (p = .010), and *non-governmental data frequency of use* (p = .003). According to Tabachnick & Fidell (2001), MANCOVA is generally robust in the face of such a violation, especially when sample sizes are relatively equal and there are no ouliers. However, Allaire (2009) suggests reporting Pillai's Trace multivariate test results when either of the two aforementioned assumptions is violated. As with the multivariate analysis of organizational factors, this suggestion was followed in the analysis of environmental factors as well. Table 5.12 shows the main and interaction effects on the data selection dependent variables used in this model.

Table 5.12: Main and Interaction Effects for MANCOVA Model 6

Source of Variation	Pillai's Trace *F*	Sig.	Partial Eta-Squared	Power
Federal Agency Data Marketing Efforts	1.844	.005	.094	N/A
State or Local Agency Data Marketing Efforts	1.659	.016	.086	N/A
Non-governmental Data Marketing Efforts	1.645	.018	.085	N/A
*Federal Agency Data Marketing Efforts * State or Local Agency Data Marketing Efforts*	1.257	.099	.105	.998
*Federal Agency Data Marketing Efforts * Non-governmental Data Marketing Efforts*	1.086	.296	.117	.998

Table 5.12: Continued

*State or Local Agency Data Marketing Efforts * Non-governmental Data Marketing Efforts*	.977	.537	.106	.995
*Federal Agency Data Marketing Efforts * State or Local Agency Data Marketing Efforts * Non-governmental Data Marketing Efforts*	.800	.737	.044	.687

Tests of univariate between-subjects effects were conducted to further analyze the impact of the environmental independent variables on individual data selection dependent variables. Significant relationships are detailed in Table 5.13.

Table 5.13: Significant Between-Subjects Effects for MANCOVA Model 6

Dependent Variable	Source of Variation	df	*F*	Sig.	Partial Eta-Squared
Federal Data Importance	*Federal Agency Data Marketing Efforts*	5	3.840	.003	.152
Federal Data Frequency of Use	*Federal Agency Data Marketing Efforts*	5	3.280	.009	.133
State or Local Data Frequency of Use	*Federal Agency Data Marketing Efforts*	5	2.311	.049	.097
	Non-governmental Data Marketing Efforts	5	2.445	.039	.103

With regard to hypothesis 6, the between-subjects tests showed that federal agency data marketing efforts are positively associated with the selection of federal data sources. Such efforts account for 15.2% of the variance in the dependent variable *federal data importance* and 13.3% of the variance in the dependent variable *federal data frequency of use* when controlling for other variables in the model. Federal agency data marketing efforts were also shown to account for 9.7% of the variance in the dependent variable *state or local data frequency of use* when controlling for other variables in the model, an unexpected finding of this study. Another unexpected finding is that the data marketing efforts of non-governmental organizations accounts for 10.3% of the variance in the dependent variable *state or local data frequency of use* when controlling for other variables in the model. The results included in Table 5.13 indicate that federal agency data marketing efforts do indeed influence data selection, making U.S. Fish & Wildlife Service field offices more apt to select federal data sources for use in making biodiversity management decisions. These significant relationships were further examined using Bonferroni and LSD post-hoc tests.

Tests of univariate between-subjects effects did not show state or local agency data marketing efforts to influence the selection of state or local data sources, nor did they show non-governmental data marketing efforts to influence the selection of non-governmental data. Tests of univariate between-subjects effects failed to conclude a relationship between state or local agency data marketing efforts and field office perceptions of state or local data importance (p = .237, power = .472) and frequency of state or local data use (p = .076, power = .666), though post-hoc tests indicated otherwise. Between-subjects tests failed to conclude a relationship between non-governmental data marketing efforts and field office perceptions of non-governmental data importance (p = .865, power = .144) and frequency of non-governmental data use (p = .160, power = .547).

Post-hoc Tests

Bonferroni post-hoc tests were initially conducted to further examine the significant main effects and univariate between-subjects relationships among the independent variables used in MANCOVA model 6 and data selection dependent variables. However, the Bonferroni tests showed no level of *federal agency data marketing efforts* to be statistically different from another in predicting *federal data importance* or *federal data frequency of use*. Bonferroni tests did not show any level of *state or local agency data marketing efforts* to be statistically different from another in predicting *state or local data importance* or *state or local data frequency of use*. Additionally, Bonferroni post-hoc tests did not reveal a statistical difference among levels of the independent variable *non-governmental data marketing efforts* in predicting *non-governmental data importance* or *non-governmental data frequency of use*. Therefore, the more liberal LSD post-hoc tests were conducted. According to Garson (2008), the LSD post-hoc test is more appropriate for use when the independent variables contain several levels to be compared.

LSD post-hoc tests revealed no statistically significant difference among levels of the independent variable *federal agency data marketing efforts* in predicting the dependent variables *federal data importance* or *federal data frequency of use*. However, LSD tests did reveal that U.S. Fish & Wildlife Service field offices which are the targets of state or local agency data marketing efforts on a "weekly" basis use state or local agency data more frequently than field offices which entertain such marketing efforts "quarterly," (mean difference = 1.98, p = .040) or "annually" (mean difference = 2.28, p =.015). Field offices which experience state or local agency data marketing efforts as infrequently as "monthly" were shown to use state or local data more frequently than field offices which are "rarely" (mean difference = 1.13, p = .040) or "never" (mean difference = 1.48, p = .009) the targets of such marketing efforts. With regard to hypothesis 6, the results of post-hoc tests suggest that state or local data marketing efforts do indeed affect the selection of state or local data sources for use in making biodiversity management decisions.

LSD post-hoc tests also revealed that U.S. Fish & Wildlife Service field offices which are the targets of non-governmental data marketing efforts on a "weekly" basis attach *lower* levels of importance to non-governmental data than field offices which are targeted by such marketing efforts "annually" (mean difference = -.6759, p = .049) or "rarely" (mean difference = -.7506, p = .022). These results were unexpected with regard to hypothesis 6, representing the opposite of what was predicted. These post-hoc tests hint at a possible saturation effect, whereby excessive non-governmental data marketing might negatively affect field office perceptions of non-governmental data. These results are worthy of exploration through future research.

Hypothesis 6 Decision

Using the customary significance criterion ($p < .05$), hypothesis 6 was partially confirmed. Based on the significant main effects of all three independent variables (though exhibiting small overall partial eta-squared effects), significant univariate between-subjects tests, and subsequent post-hoc tests, hypothesis 6 was partially supported.

- ***H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.***

- Hypothesis 6: Partially Supported

Based on MANCOVA model 6, it was concluded that positive relationships exist between federal data agency marketing efforts and the selection of federal data as well as state or local agency data marketing efforts and the selection of state or local data. Literature pertaining to group pressures or marketing efforts was the basis for hypothesis 6 (Lackey, 2007, Scott et al., 2007). Previous research also suggests the importance of data marketing efforts to data selection procedures (Gerlach, 2005). This study partially confirmed the previous research findings by showing that federal and state or local agency data marketing efforts positively impact the selection of those respective data sources. The implications of these findings are further discussed in chapter six of this dissertation.

Research Question 7

The seventh research question examined the effect of interest or advocacy group relationships on data selection. Hypothesis 7 was tested by a MANCOVA model which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* and the environmental independent variables *confer w/ nonprofit organizations, confer w/ private sector businesses,* and *confer w/ academic institutions*. The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates in the model as well.

- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***

MANCOVA Model 7

A six-way MANCOVA model was run to test hypothesis 7. The Box's M test was non-significant (p = .388). Therefore, the assumption of equality of covariance matrices was met (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). However, the Levene's test of equality of error variances showed the homogeneity of variance assumption to be violated for all six of the data selection dependent variables used in the model.

- *federal data importance* (p = .000)
- *state or local data importance* (p = .001)
- *non-governmental data importance* (p = .037)
- *federal data frequency of use* (p = .002)
- *state or local data frequency of use* (p = .002)
- *non-governmental data frequency of use* (p = .000)

Due to the violation of this assumption, main and interaction effects are reported using Pillai's Trace, which is more robust in the face of such a violation when there are no outliers (Allaire, 2009).

The Pillai's Trace multivariate tests of overall differences were statistically non-significant for all three environmental independent variables.

- *confer w/ nonprofit organizations*, $F(5, 110) = 1.107$, p = .320, power = .918
- *confer w/ private sector businesses*, $F(5, 110) = .925$, p = .584, power = .842
- *confer w/ academic institutions*, $F(5, 110) = 1.212$, p = .205, power = .946

Each of the observed power statistics associated with the three independent variables was above the .80 threshold necessary to conclude that Type II error was not a problem (Garson, 2008). Therefore, the null assumption that these relationships do not exist was accepted.

Pillai's Trace multivariate tests of overall differences among groups revealed two significant interaction effects among independent variables. The Pillai's Trace multivariate test was statistically significant for the interaction between *confer w/ nonprofit organizations* and *confer w/ private sector businesses*, $F(17, 110) = 1.306$, $p = .031$, partial eta-squared = .172. Additionally, the Pillai's Trace multivariate test was significant for the interaction between *confer w/ private sector businesses* and *confer w/ academic institutions,* $F(14, 110) = 1.384$, $p = .018$, partial eta-squared = .153. The results of these tests indicate that the interaction between *confer w/ nonprofit organizations* and *confer w/ private sector businesses* accounts for 17.2% of the difference among groups, while the interaction between *confer w/ private sector businesses* and *confer w/ academic institutions* accounts for 15.3% of the difference among groups when controlling for other variables in the model. Though significant, these relationships were only of moderate strength.

Univariate between-subjects tests showed that the frequency with which a U.S. Fish & Wildlife Service field office confers with nonprofit organizations when making biodiversity management decisions was significantly and moderately related to frequency of non-governmental data use ($p = .028$, partial eta-squared = .110). With regard to hypothesis 7, these results indicate that a close working relationship with a non-governmental data producer does, in part, impact the selection of non-governmental data sources for use in the decision-making process. This significant relationship was examined further using Bonferroni post-hoc tests.

Univariate between-subjects tests revealed two other significant relationships. The frequency with which a U.S. Fish & Wildlife Service field office confers with private sector businesses was shown to be significantly and moderately related to frequency of federal data use ($p = .047$, partial eta-squared = .098). Univariate between-subjects tests also revealed a significant relationship between the interaction of the independent variables *confer w/ private sector businesses* and *confer w/ academic institutions* and the dependent variable *state or local data importance* (p = .013, partial eta-squared = .221). This relationship was a relatively strong one, accounting for 22.1% of the variance in field office perceptions of the importance of state or local data when controlling for other variables in the model. This relationship was further examined using Bonferroni post-hoc tests as well.

The univariate between-subjects tests conducted in this study failed to find several relationships suggested in hypothesis 7. The frequency with which a U.S. Fish & Wildlife Service field office confers with private sector businesses showed non-significant relationships with field office perceptions of non-governmental data importance ($F(5, 110)$ = .278, p = .924, power = .116) and frequency of non-governmental data use, ($F(5, 110)$ = 1.422, p = .222, power = .484). The frequency with which field offices confer with academic institutions was also shown not to be significantly related to perceptions of non-governmental data importance ($F(5, 110)$ = .474, p = .795, power = .173) and frequency of non-governmental data use ($F(5, 110)$ = .192, p = .965, power = .094). Though significance tests failed to reject the null assumption that these relationships do not exist, there was insufficient power to claim that the relationships are indeed zero. Therefore, this study simply failed to conclude that the aforementioned relationships exist. With regard to hypothesis 7, relationships with private sector businesses and academic institutions do not appear to impact the selection of non-governmental data for use in making biodiversity management decisions based on univariate between-subjects tests.

Bonferroni Post-hoc Tests

Bonferroni post-hoc tests were conducted to further examine the significant relationships between the independent variables used in MANCOVA model 7 and data selection dependent variables. In reference to hypothesis 7, post-hoc tests revealed that U.S. Fish & Wildlife Service field offices that confer with nonprofit organizations "weekly" when making biodiversity management decisions use non-governmental data more frequently than those which confer with nonprofit organizations "quarterly" (mean difference = 1.45, p = .003). Field offices which confer with nonprofit organizations "weekly" also use non-governmental data more frequently than those which confer with nonprofit organizations "annually" (mean difference = 2.08, p = .000), "rarely" (mean difference = 2.53, p = .000), and "never" (mean difference = 3.56, p = .000). Additionally, field offices which confer with nonprofit organizations merely on an annual basis reported using non-governmental data more frequently than those which "never" confer with nonprofit organizations (mean difference = 1.47, p = .017).

Bonferroni post-hoc tests revealed similar results for the relationship between the independent variable *confer w/ nonprofit organizations* and field office perceptions of non-governmental data importance. U.S. Fish & Wildlife Service field offices which confer with nonprofit organizations "weekly" are more likely to perceive non-governmental data as important than those which confer with nonprofit organizations "annually" (mean difference = .5983, p = .018). Field offices which confer with nonprofit organizations "weekly" are also more likely to perceive non-governmental data sources as important than field offices which "rarely" confer with nonprofit organizations (mean difference = .6566, p = .002) and those which “never” confer with nonprofits (mean difference = 1.0278, p = .000). These results indicate that not only do field offices which confer with nonprofit organizations use non-governmental data more frequently, but they also attach a higher importance rating to the use of non-governmental data sources when making biodiversity management decisions. These findings partially confirmed hypothesis 7.

Bonferroni post-hoc tests were also used to explain the significant univariate relationship between the interaction among independent variables *confer w/ private sector businesses* and *confer w/ academic institutions* and the dependent variable *state or local data importance.* The strength of this relationship was found in the fact that U.S. Fish & Wildlife Service field offices which confer with academic institutions “weekly” are more likely to perceive state or local data as important than field offices which “rarely” confer with academic institutions (mean difference = .6364, p = .007). Additionally, field offices which confer with academic institutions “monthly” are also more likely to perceive state or local data as important than those which confer with academic institutions “rarely” (mean difference = .6136, p = .003). Though these results do not apply to hypothesis 7, they do warrant future research consideration.

Hypothesis 7 Decision

Using the customary significance criterion ($p < .05$), hypothesis 7 was partially confirmed.

- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***
    - Hypothesis 7: Partially Supported

Based on MANCOVA model 7, it was concluded that a close working relationship with a nonprofit organization is positively related to the selection of non-governmental data sources. Research on the role of interest groups in the diffusion of innovations indicates a positive relationship between advocacy and the adoption of innovative policies (Daley, 2007; Martin, 2001; Mintrom & Vergari, 1998; Sapat, 2004). The results of this study suggest that such a relationship exists between conferring with nonprofit organizations and the selection of non-governmental data sources for use in making biodiversity management decisions. The implications of this finding and its effect on the research model examined in this study are discussed further in chapter six.

Research Question 8

The eighth research question explored by this study examined the effect of other field offices on data selection. Hypotheses 8a and 8b were tested by two separate MANCOVA models. MANCOVA model 8a included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use* as well as the independent variable *other field office data source.* MANCOVA model 8b included the two data newness dependent variables *year of last update of data set most relied upon* and *decade of establishment of data set most relied upon* and the independent variable *other field office data newness.* The control variables *Service region*, *tenure w/ FWS*, and *employees in field office* served as covariates in both models.

- ***H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.***

- ***H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.***

MANCOVA Model 8a

A three-way MANCOVA model was run to test hypothesis 8a. The Box's M test was significant (p = .006), indicating that the assumption of equality of covariance matrices was violated (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was violated for the data selection dependent variables *federal data importance* (p = .000) and *non-governmental data importance* (p = .016). Therefore, main effects are reported using Pillai's Trace due to its robust nature in the face of such violations when there are no outliers (Allaire, 2009).

The Pillai's Trace multivariate test of overall differences among groups was statistically significant (p = .000). The independent variable *other field office data source* was shown to have a significant main effect on the group of dependent variables, $F(2, 174)$ = 4.146, p = .000, partial eta-squared = .130. The partial eta-squared statistic revealed this relationship to be a moderate one at best, with field office perceptions of the influence of data used by other field offices on data selection procedures accounting for 13% of the variance in the dependent variable group when controlling for other variables in the model.

Tests of univariate between-subjects effects were conducted to further analyze the impact of the independent variable *other field office data source* on individual independent variables. U.S. Fish & Wildlife Service field office perceptions of the influence of data used by other field offices on data selection procedures was significantly and moderately related to the following data selection dependent variables.

- *federal data importance,* $F(2, 174) = 15.778$, $p = .000$, partial eta-squared = .156
- *state or local data importance,* $F(2, 174) = 10.627$, $p = .000$, partial eta-squared = .111
- *non-governmental data importance,* $F(2, 174) = 4.915$, $p = .008$, partial eta-squared = .054
- *state or local data frequency of use,* $F(2, 174) = 3.215$, $p = .043$, partial eta-squared = .036

These results indicate that the independent variable *other field office data source* is responsible for 15.6% of the variance in the dependent variable *federal data importance* and 11.1% of the variance in the dependent variable *state or local data importance* when controlling for other variables in the model. These significant relationships, while moderate at best, suggest that U.S. Fish & Wildlife Service field offices which are influenced by the data selection decisions of other field offices attach a higher level of importance to federal and state or local data sources when making biodiversity management decisions. The other two significant relationships are very weak, with *other field office data source* accounting for only 5.4% of the variance in *non-governmental data importance* and 3.6% of the variance in *state or local data frequency of use* when controlling for other variables in the model. These significant relationships were further examined through Bonferroni post-hoc tests.

The independent variable *other field office data source* showed non-significant relationships with dependent variables *federal data frequency of use* ($F(2, 174) = 3.031$, $p = .051$, power = .581) and *non-governmental data frequency of use* ($F(2, 174) = 1.720$, $p = .182$, power = .358). The power statistics associated with these two non-significant relationships failed to reach the .80 threshold (Garson, 2008). Therefore, even though significance tests failed to reject the null assumption that these relationships do not exist, there was inadequate power to accept the null hypothesis that the strength of these relationships is indeed zero. This study simply failed to find statistically significant relationships involving the independent variable *other field office data source* and the dependent variables *federal data frequency of use* and *non-governmental data frequency of use*.

<u>Bonferroni Post-hoc Tests</u>

Bonferroni post-hoc tests were conducted to identify specific differences among levels of the independent variable *other field office data source* and data selection dependent variables. These tests showed that U.S. Fish & Wildlife Service field offices which believe the data selection decisions of other field offices to be “very influential” with regard to their own data selection decisions attached a higher level of importance to federal data sources than field offices which believe surrounding field office data selection to be “somewhat influential” (mean difference = .4911, $p = .000$) or “not influential” (mean difference = .5417, $p = .000$). Field offices which responded “very influential” also attached a higher level of importance to state or local data than those which responded “somewhat influential” (mean difference = .4583, p = .000) and “not influential” (mean difference = .5417, p = .001). Additionally, field offices which responded “very influential” attached a higher level of importance to non-governmental data sources than field offices which responded “somewhat influential” (mean difference = .3423, p = .011). These results suggest that the more influential a U.S. Fish & Wildlife Service field office perceives the data selection decisions of other field offices to be on their own data selection procedures, the more likely that field office is to attach a higher level of importance to federal, state or local, and non-governmental data sources. Future research is necessary to further examine field office perceptions of the selection of specific data sources by other field offices and the impact of these perceptions on data selection decisions.

Similar relationships exist between levels of the independent variable *other field office data source* and the dependent variables *federal data frequency of use* and *state or local data frequency of use.* U.S. Fish & Wildlife Service field offices which perceive the data selection decisions of other field offices to be “somewhat influential” with regard to their own data selection decisions use federal data more frequently than field offices which believe the data selection decisions of surrounding field offices are “not influential” (mean difference = .86, p = .025). Additionally, field offices which believe the data selection procedures of other field offices to be “very influential” use state or local data with greater frequency than do field offices which responded “not influential” (mean difference = .93, p = .024). These results indicate that the greater the perceived influence of other field office data selection over data selection decisions, the greater frequency with which a particular field office uses federal and state or local data sources. Again, further research is necessary to identify relationships between the perceived selection of specific data sources by other field offices and the selection of those specific sources for use in making biodiversity management decisions. However, with regard to hypothesis 8a, the results of Bonferroni post-hoc tests suggest that the perceived influence of other field office data selection decisions does indeed affect similar decisions within a particular U.S. Fish & Wildlife Service field office.

Hypothesis 8a Decision

Using the customary significance criterion ($p < .05$), hypothesis 8a was confirmed.

- ***H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.***
    - Hypothesis 8a: Supported

Based on the MANCOVA model, it was concluded a relationship exists between the perceived influence of other field office data selection decisions and data selection within a particular U.S. Fish & Wildlife Service field office. These findings serve to further validate the research of Walker (1969) regarding the likelihood of an innovation being adopted if others have already adopted the idea. These results and their implications and impact on the research model used in this study are further discussed in chapter six of this dissertation.

MANCOVA Model 8b

A three-way MANCOVA model was run to test hypothesis 8b which included the environmental independent variable *other field office data newness* and the dependent variables *year of last update of data set most relied upon* and *decade of establishment of data* *set most relied upon*. The Box's M test was non-significant (p = .132), indicating that the assumption of equality of covariance matrices was satisfied (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was met for both data newness dependent variables. Therefore, main effects are reported using Wilk's Lambda (Alliare, 2009).

The Wilk's Lambda test of overall differences among groups was statistically non-significant, $F(2, 124) = .427$, $p = .789$. The Wilk's Lambda observed power statistic was .149. Though the significance test failed to reject the null assumption that there is no difference among groups, there was insufficient power to claim that these differences do not exist. Therefore, this study simply failed to conclude a relationship between the independent variable *other field office data newness* and the group of data newness dependent variables.

Univariate between-subjects tests showed non-significance as well. The relationship between *other field office data newness* and the dependent variable *year of last update of data set most relied upon* was shown to be non-significant, $F(2, 124) = .641$, $p = .529$, power = .155. The relationship between *other field office data newness* and the dependent variable *decade of establishment of data set most relied upon* was also revealed to be non-significant, $F(1, 124) = .203$, $p = .813$, power = .082. However, the observed power statistics associated with these two non-significant relationships were not above the .80 threshold (Garson, 2008). Therefore, there was insufficient power to accept the null hypothesis that the strength of these relationships is indeed zero. Rather, this study failed to conclude that these relationships exist.

Hypothesis 8b Decision

Using the customary significance criterion ($p < .05$), hypothesis 8b was not confirmed.

- ***H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.***
    - Hypothesis 8b: Not Supported

MANCOVA model 8b did not confirm a relationship between U.S. Fish & Wildlife Service field office perceptions of the influence of the newness of data being used by other field offices and data selection decisions. When conducting previous research, U.S. Fish & Wildlife Service biologists working in North Carolina indicated that data newness is a potential driving force in selecting a particular source of biological information (Gerlach, 2005). This study did not substantiate that finding across the entire U.S. Fish & Wildlife Service.

Research Question 9

The ninth and final research question examined the effect of public involvement in the biodiversity management decision-making process on data selection. Hypotheses 9a, 9b, and 9c were tested by two separate MANCOVA models, each of which included the six data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use.* MANCOVA model 9a-b, which corresponds to hypotheses 9a and 9b, used the independent variables *public participation* *frequency* and *public participation intensity*. MANCOVA model 9c, which corresponds to hypothesis 9c, used the independent variable *public data use preference.* The control variables *Service region*, *tenure w/ FWS*, and *employees in field office* served as covariates in both models.

- ***H_{9a}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data.***

- ***H_{9b}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***

MANCOVA Model 9a-b

A three-way MANCOVA model was run to test hypotheses 9a and 9b. The Box's M test was significant (p = .030), indicating that the assumption of equality of covariance matrices was violated for this model (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). However, MANCOVA is robust in the face of a significant Box's M statistic when sample sizes are relatively equal and there are no outliers, as was the case in this model (Allaire, 2009). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was violated for the dependent variable *federal data importance* (p = .048). Therefore, main effects are reported using Pillai's Trace because of its robust nature when such assumptions are violated and there are no outliers present (Allaire, 2009).

All tests of multivariate main and interaction effects showed non-significance for the independent variables used in this model. The Pillai's Trace tests of overall differences among groups indicated non-significant main effects for the independent variables *public participation frequency* (F(5, 166) = .904, p = .617, power = .838) and *public participation intensity* (F(2, 166) = 1.100, p = .360, power = .635). A Pillai's Trace test of overall differences among groups also showed non-significance for the interaction between the two independent variables used in the model, F(6, 166) = .776, p = .827, power = .816. The Pillai's Trace observed power statistics for the main effect of *public participation frequency* and the interaction effect involving both independent variables were both above the .80 threshold to indicate acceptance of the null assumption that those relationships with the group of dependent variables do not exist. However, there was insufficient power to accept the null hypothesis that the relationship between *public participation intensity* and the group of dependents does not exist. Rather, this study simply failed to conclude a main effect of *public participation intensity* on the group of dependent variables used in the model.

Tests of univariate between-subjects effects were conducted to further analyze the impact of independent variables and their interactions on individual dependent variables. All of these relationships were revealed to be statistically non-significant. Table 5.14 shows the results of the univariate between-subjects tests.

Table 5.14: Between-Subjects Effects for MANCOVA Model 9a-b

Dependent Variable	Potential Source of Variation	df	*F*	Sig.	Power
Federal Data Importance	*Public Participation Frequency*	5	.985	.429	.346
	Public Participation Intensity	2	.758	.470	.177
	*Public Participation Frequency * Public Participation Intensity*	6	.410	.872	.167
State or Local Data Importance	*Public Participation Frequency*	5	.887	.491	.312
	Public Participation Intensity	2	.350	.705	.105
	*Public Participation Frequency * Public Participation Intensity*	6	.595	.734	.233
Non-governmental Data Importance	*Public Participation Frequency*	5	.442	.819	.165
	Public Participation Intensity	2	1.735	.180	.360
	*Public Participation Frequency * Public Participation Intensity*	6	.510	.800	.202
Federal Data Frequency of Use	*Public Participation Frequency*	5	.749	.588	.265
	Public Participation Intensity	2	.247	.781	.088
	*Public Participation Frequency * Public Participation Intensity*	6	1.327	.248	.510
State or Local Data Frequency of Use	*Public Participation Frequency*	5	.429	.828	.162

Table 5.14: Continued

	Public Participation Intensity	2	.191	.826	.079
	*Public Participation Frequency * Public Participation Intensity*	6	1.265	.276	.487
Non-governmental Data Frequency of Use	*Public Participation Frequency*	5	.936	.459	.329
	Public Participation Intensity	2	.638	.530	.156
	*Public Participation Frequency * Public Participation Intensity*	6	.309	.931	.134

With regard to hypotheses 9a and 9b, Table 5.14 indicates that higher levels of public involvement in the biodiversity management decision-making process were not positively related to the selection of state or local or non-governmental data sources. It should be noted that none of the observed power statistics reported in Table 5.14 surpassed the .80 threshold (Garson, 2008). Though significance tests failed to reject the null assumption that these relationships do not exist, there was inadequate power to accept the null hypothesis that the strength of these relationships is indeed zero. Therefore, this study simply failed to find statistically significant relationships involving the independent variables *public participation frequency* and *public participation intensity* and data selection dependent variables.

Hypotheses 9a and 9b Decisions

Using the customary significance criterion ($p < .05$), hypotheses 9a and 9b were not confirmed.

- ***H_{9a}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data.***
    - Hypothesis 9a: Not Supported
- ***H_{9b}: High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***
    - Hypothesis 9b: Not Supported

Based on the MANCOVA model, it was concluded that higher levels of public involvement in the biodiversity management decision-making process are not significantly related to the selection of state or local or non-governmental data. Though public involvement in making natural resource policy is a growing trend (Brunner et al., 2005; Clark, 2002) and diffusion theory research shows that public support may significantly influence the adoption of certain innovations (Elazar, 1972), this study did not find the results of previous research to be salient in explaining data selection among U.S. Fish & Wildlife Service field offices. These findings and their implications are discussed further in chapter six of this dissertation, and the research model is altered to reflect the rejection of hypotheses 9a and 9b.

MANCOVA Model 9c

A two-way MANCOVA model was run to test hypothesis 9c which included the environmental independent variable *public data use preference* and the data selection dependent variables *federal data importance, state or local data importance, non-governmental data importance*, *federal data frequency of use, state or local data frequency of use,* and *non-governmental data frequency of use*. The Box's M test was non-significant

(p = .187), indicating that the assumption of equality of covariance matrices was satisfied (Field, 2005; Garson, 2008; Tabachnick & Fidell, 2001). The Levene's test of equality of error variances showed that the homogeneity of variance assumption was met for all six data selection dependent variables. Due to meeting these two assumptions, main effects are reported using Wilk's Lambda (Alliare, 2009).

The main effect of *public data use preference* on the group of dependent variables was revealed to be non-significant. The Wilk's Lambda multivariate test of overall differences among groups showed non-significance, $F(4, 175) = .938$, $p = .549$. The Wilk's Lambda observed power statistic was .706. This statistic did not cross the .80 threshold (Garson, 2008). Therefore, there was insufficient power to claim that a relationship between the independent variable and the group of dependent variables does not exist. Rather, this study failed to conclude there is a main effect of *public data use preference* on the group of dependent variables.

All univariate between-subjects tests showed non-significance. The independent variable *public data use preference* was not proven to be significantly related to the following six data selection dependent variables.

- *federal data importance,* $F(4, 175) = 1.701$, $p = .152$, power = .514
- *state or local data importance,* $F(4, 175) = 1.561$, $p = .187$, power = .476
- *non-governmental data importance,* $F(4, 175) = .640$, $p = .634$, power = .207
- *federal data frequency of use,* $F(4, 175) = .204$, $p = .936$, power = .093
- *state or local data frequency of use,* $F(4, 175) = 1.178$, $p = .322$, power = .365
- *non-governmental data frequency of use,* $F(4, 175) = .123$, $p = .974$, power = .075

Significance tests failed to reject the null assumption that the strength of these relationships is zero. However, there was insufficient power to go further and accept the null hypothesis that the relationships do not exist. Therefore, this study simply failed to conclude that these relationships exist.

Hypothesis 9c Decision

Using the customary significance criterion ($p < .05$), hypothesis 9c was not confirmed.

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***
    - Hypothesis 9c: Not Supported

Based on the results of MANCOVA model 9c, this study failed to conclude a significant relationship between public input regarding the type of data that should be used in making a biodiversity management decision and U.S. Fish & Wildlife Service field office selection of data from a particular source. Though previous research (Gerlach, 2005) suggests that public data use preferences may impact field office data selection, this study did not substantiate those findings across the entire U.S. Fish & Wildlife Service. As was noted in chapter two, little is known about the impact of public input regarding data selection and its influence on the use of biological information when making biodiversity management decisions. Unfortunately, the results of this study add little to that already meager body of knowledge with the exception of having failed to identify a significant relationship between public data use preferences and data selection. Future research is warranted to explore this subject matter in greater detail.

Controlling for Organizational Independent Variables

The environmental MANCOVA models discussed in this chapter only tested environmental independent variables. This was, in part, by design, but also out of necessity. The environmental research questions examined through the testing of related hypotheses sought to isolate elements of diffusion theory in an effort to determine their explanatory value with regard to data selection in the natural resource policy process. As discussed in chapter four, an omnibus MANCOVA model consisting of all organizational and environmental independent variables was attempted in this study to assess the significance of all independent variables when controlling for others. Ideally, the results of this omnibus model would have been compared to the results of the MANCOVA models which tested each environmental hypothesis. However, there was insufficient sample adequacy to run such a model. A sample size of 204 cases (respondents who completed the survey) falls well short of what is necessary to run a MANCOVA model with 22 multi-leveled independent variables. Therefore, the omnibus model violated a major MANCOVA assumption. Garson (2008) states, "Small samples may have lower power. At a minimum, every cell must have more cases than there are dependent variables." It is also recommended that no fewer than 80% of cells have less than five cases, with no cells containing zero cases (Garson, 2008).

While the omnibus MANCOVA model proved inappropriate due to a small sample size, a smaller MANCOVA model was run which included the organizational independent variables *parent agency influence* and *information exchange w/ non-governmental organizations* and the environmental independent variables *confer w/ nonprofit organizations* and *other field office data source.* This MANCOVA model included the same data selection dependent variables used in previous models (*federal data importance, state or local data importance, non-governmental data importance, federal data frequency of use*, *state or local data frequency of use*, and *non-governmental data frequency of use*). The control variables *Service region, tenure w/ FWS,* and *employees in field office* served as covariates. The independent variables used in this MANCOVA model represent the most important findings discussed in the previous and current chapters with regard to data selection. Other significant findings seem more intuitive, as discussed in chapter six. While an omnibus MANCOVA model containing all 22 independent variables is preferred to this model, this smaller MANCOVA model examined the robustness of previous significant results while satisfying the MANCOVA assumption of an adequate sample size. The results of previous MANCOVA models containing the independent variables *parent agency influence*, *information exchange w/ non-governmental organizations*, *confer w/ nonprofit organizations*, and *other field office data source* were proven to be robust when examining these four organizational and environmental independent variables together in the same model. While these results seem to indicate the robustness of this study's most significant findings, future research efforts which examine a larger sample of natural resource agency field offices are necessary to include more multi-leveled independent variables in an omnibus MANCOVA model.

SUMMARY OF ENVIRONMENTAL HYPOTHESES AND DECISIONS

Based on the MANCOVA models run to test the environmental hypotheses in this study, some aspects of diffusion theory and biodiversity conservation literature are more salient than others in explaining data selection for use in making biodiversity management decisions. Table 5.15 summarizes the decisions made regarding environmental hypotheses tested, with more detailed commentary to follow.

Table 5.15: Environmental Hypotheses and Decisions

Hypothesis	Decision	Concept(s) from the Literature Tested
H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.	Partially Confirmed	Previous research • North Carolina Gap Analysis Program (GAP) GAP marketing efforts
H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.	Partially Confirmed	Diffusion theory • Advocacy and the diffusion of innovations Impact of interest groups Policy networks
H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.	Confirmed	Institutional isomorphism Diffusion theory • Adoption by others • Success of innovations elsewhere • Entity-to-entity diffusion of innovations
H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.	Not Confirmed	Institutional isomorphism Diffusion theory • Adoption by others • Success of innovations elsewhere • Entity-to-entity diffusion of innovations

Table 5.15: Continued

H_{9a}: High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data.	Not Confirmed	Diffusion theory • Public influence on adoption Public involvement Previous research • North Carolina GAP
H_{9b}: Higher levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.	Not Confirmed	Diffusion theory • Public influence on adoption Public involvement Previous research • North Carolina GAP
H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.	Not Confirmed	Diffusion theory • Public influence on adoption Public involvement Previous research • North Carolina GAP Advocacy in natural resource Policy

After testing the environmental hypotheses examined in this study, it is evident that some aspects of diffusion theory and biodiversity conservation literature aid in explaining data selection decisions within the U.S. Fish & Wildlife Service while others do not. With regard to hypothesis 6, previous research on GAP in the state of North Carolina (Gerlach, 2005) suggests that higher levels of data marketing have a positive impact on the selection of certain sources of data for use in making biodiversity management decisions. Statistical analysis confirmed this to be true for federal and state or local data sources. Higher marketing efforts by federal and state or local agencies are positively associated with the selection of those respective data sources. This study also confirmed that field office relationships with nonprofit organizations are positively associated with the selection of non-governmental data sources. Whereas literature pertaining to interest or advocacy group relationships (Daley, 2007; Godwin & Schroedel, 2000; Nicholson-Crotty & Nicholson-Crotty, 2004) suggests that field office relationships with any interest or advocacy group (nonprofits, private sector businesses, academic institutions) are positively associated with non-governmental data selection, this study only confirmed a relationship between nonprofit organizations and such data selection decisions. Therefore, hypothesis 7 was partially confirmed and research pertaining to policy networks (Mintrom & Vergari, 1998), interest or advocacy group relationships, and the impact of interest groups on data selection was proven to be partially salient in explaining data selection.

Aspects of diffusion theory were proven to be salient in explaining data selection with regard to hypothesis 8a, but not hypothesis 8b. Aspects of neo-institutional theory were once again validated by testing hypothesis 8a as well. Literature pertaining to the impact of the successful adoption of an innovation by an entrepreneurial office or organization (Berry & Berry, 1990; Brown & Cox, 1971; Elazar, 1972; Walker, 1969) on the diffusion of that innovation suggests that the data selection decisions of other U.S. Fish & Wildlife Service field offices have an impact on data selection. Scholarly literature also suggests the potential for mimetic and normative isomorphic tendencies with regard to data selection (Meyer & Scott, 1992; Scott, 1991). These explanations were proven to be valid with regard to the influence of other field office data sources (hypothesis 8a), but not the newness of data used by other field offices for making biodiversity management decisions (hypothesis 8b). Therefore, a major finding of this study is that aspects of core diffusion theory literature pertaining to the entity-to-entity diffusion of innovations were proven to be salient in explaining data selection within the U.S. Fish & Wildlife Service. Additionally, in testing hypothesis 8a, the concepts of mimetic and normative isomorphism were once again proven salient. The sources of data used by surrounding field offices do indeed influence data selection decisions within the agency. However, this study failed to find a relationship between the newness of data used by surrounding field offices and the newness of data selected for use in making biodiversity management decisions.

Public involvement in the policy-making process was not proven to be a relevant factor in the data selection decisions of U.S. Fish & Wildlife Service field offices. Hypotheses 9a, 9b, and 9c were not confirmed through statistical analysis. Whereas previous research (Gerlach, 2005) on the impact of public input during the biodiversity management decision-making process suggests that higher levels of public involvement are positively associated with the selection of more locally produced data sources, this study failed to confirm that relationship. This study also failed to confirm a relationship between the data use preferences of the general public and field office data selection. Though research pertaining to public involvement in the natural resource policy-making process exists (Brunner et al., 2005; Clark, 2002), this study failed to make a connection between public involvement and data selection within U.S. Fish & Wildlife Service field offices.

The theoretical and practical implications of findings related to the organizational hypotheses examined in chapter four and the environmental hypotheses tested in this chapter are discussed in greater detail in chapter six to follow. There, the research model tested in this dissertation is revisited and adjusted in accordance with the results of this study. The adjusted research model includes only the aspects of neo-institutional theory, diffusion theory, and biodiversity conservation literature proven to be salient in explaining data selection within the U.S. Fish & Wildlife Service. The dissertation concludes with a summary of major findings, discussion of study limitations, and suggestions for future research.

CHAPTER 6: CONCLUSIONS AND DISCUSSION

This chapter discusses the results of this research, addressing the implications of the study's findings. The chapter is organized in five main sections. First, the research questions are answered by the confirmation or rejection of related hypotheses. The research model is adjusted to account for study results. Second, the theoretical and practical implications of this research are outlined. Third, study limitations are discussed. Fourth, directions for future research are presented. Finally, the dissertation concludes with a summary of what was learned as a result of this work.

RESEARCH QUESTIONS AND HYPOTHESES

Organizational Research Questions

The organizational research questions examined in this study are grounded in neo-institutional theory and the biodiversity conservation literature. To answer these research questions, a series of organizational hypotheses were tested. These hypotheses were informed by specific aspects of neo-institutional theory and biodiversity conservation research. The following subsections detail the organizational research questions and highlight the decisions made regarding the acceptance or rejection of organizational hypotheses.

Research Question 1

The first research question examined the effect of field office age on data selection. Results of the survey indicate a fairly even distribution of U.S. Fish & Wildlife Service field offices which opened in the 1960s, 1970s, 1980s, and 1990s. However, only seven field offices reported opening in the 2000s. This research question sought to examine institutional embeddedness and aspects of sociological institutionalism (Hall & Taylor, 1996; McAdam et al., 1997; Zucker, 1991) as they pertain to the selection of data for use in the natural resource policy-making process. Sociological institutionalism emphasizes embeddedness in multiple relationships, such as culture, society, and organizational identity (Hall & Taylor, 1996). Research question 1 sought to identify whether or not data selection decisions are embeddeded into the organizational identity of older U.S. Fish & Wildlife Service field offices. Hypothesis 1 was tested to answer research question 1, and it was determined that institutional embeddedness and sociological institutionalism are not salient aspects in explaining data selection.

- ***H_1: The age of a field office is positively associated with its selection of federal government agency data.***
    - Hypothesis 1: Not Supported

In examining research question 1, this study found that the selection of federal government agency data is not embeddeded into the institutional norms of older U.S. Fish & Wildlife Service field offices. It does not appear that the selection of federal data sources plays an integral part in a field office's quest for social legitimacy and acceptance within the agency or natural resource community. Rather, the selection of federal data sources does not intensify with field office age.

Research Question 2

The second research question examined the effect of parent agency pressures on data selection. Survey results indicate that very few U.S. Fish & Wildlife Service field offices believe parent agency influence to be a factor in data selection decisions, with 46% of field offices believing parent agency pressures make no difference at all. This research question explored the concept of coercive isomorphism (DiMaggio & Powell, 1991) as it pertains to data selection procedures within the U.S. Fish & Wildlife Service. Hypothesis 2 was tested to answer research question 2. Results of the multivariate analysis indicated that the higher the field office perception that the parent agency rewards using a "combination of data sources" in decision making, the more importance a field office attaches to non-governmental data. Therefore, it appears that parent agency pressures may lead to the selection of non-governmental data, though a positive relationship was shown for the *non-governmental data importance* dependent variable only and not for the *non-governmental data frequency of use* dependent variable.

- ***H_2: The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source.***
    - Hypothesis 2: Partially Supported

By answering research question 2, this study found that perhaps the U.S. Fish & Wildlife Service seeks a comprehensive approach to using data in making biodiversity management decisions. It could be that non-governmental data sources are viewed as more important by those field offices which believe they stand to gain by using "a combination of data sources" because they perceive non-governmental data to be a necessary supplement to government data sources. These findings cause one to ask whether or not field offices begin their decision-making processes using federal and/or state or local data sources and turn to non-governmental data sources when they feel pressure from their parent agency? Further exploration is needed to fully examine the timeline of data selection when multiple sources or data sets are used in the biodiversity management decision-making process. However, this study indicates that non-governmental data is important when used in conjunction with government data sources, and that the U.S. Fish & Wildlife Service encourages this approach to decision-making.

Research Question 3

The third research question examined the effect of field office management practices on data selection. Survey results indicate that field offices attach varying levels of importance to collaboration with other field offices, other federal natural resource agencies, state or local natural resource agencies, and non-governmental organizations when making biodiversity management decisions. Survey results also indicate that while most U.S. Fish & Wildlife Service field offices engage in ecosystem-level biodiversity management, field offices employ a broad range of management approaches along the spectrum of “exclusively species-level” to “exclusively ecosystem-level” management. Research question 3 examined the concept of normative isomorphism (Meyer & Rowan, 1991; Meyer & Scott, 1992) and biodiversity conservation literature pertaining to ecosystem-level management practices (Thomas, 2003) with regard to data selection decisions. Hypotheses 3a and 3b were tested to answer research question 3. This study found normative isomorphism to be salient with regard to the selection of non-governmental data sources, but did not find a relationship between ecosystem-level management procedures and the selection of federal government agency data.

- ***H_{3a}: Collaboration with federal, state or local, or non-governmental natural resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions.***
    - Hypothesis 3a: Partially Supported
- ***H_{3b}: Ecosystem-level management practices are positively associated with the selection of federal government agency data.***

    Hypothesis 3b: Not Supported

In answering research question 3, this study found that the selection of non-governmental data sources increases as levels of collaboration with non-governmental natural resource organizations increase. As stated in chapter two, normative isomorphism is often a product of certain practices or decision-making processes being thought of as acceptable protocol within a particular community (Meyer & Scott, 1992). This study found that the more acceptable collaboration with a non-governmental natural resource organization is within the U.S. Fish & Wildlife Service, the more likely field offices are to use non-governmental data in their decision-making processes. As field offices engage in such collaboration, they use non-governmental data with more regularity.

Research Question 4

The fourth research question examined the effect of past data use experiences on data selection. Survey results indicate that U.S. Fish & Wildlife Service field offices have experienced varying degrees of satisfaction using federal, state or local, and non-governmental data sources. However, federal agency data received the highest "positive experiences" rating, followed by state or local agency data and non-governmental data, respectively. Research question 4 sought to determine the salience of the neo-institutional theory tenet of path dependency (Duit, 2007; Pierson, 2000; Pierson & Skocpol, 2002) as well as literature pertaining to repetitive momentum (Baum, 1996) in explaining data selection procedures. Research question 4 was answered by testing hypothesis 4. This study confirmed a relationship between positive data use experiences and the current day selection of particular data sources for use in making biodiversity management decisions. Path dependency and repetitive momentum appear to be salient concepts in explaining data selection with the U.S. Fish & Wildlife Service.

- ***H_4*: Past positive experiences in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source.**
    - Hypothesis 4: Supported

By answering research question 4, this study proved that U.S. Fish & Wildlife Service field offices will repeat successful data selection decisions. From a practical standpoint, these results may seem rather intuitive. However, path dependent and repetitive tendencies may cause a field office not to explore alternative data sources which may better meet their policy-making needs. Pierson (2002) asserts that path dependent behaviors make it difficult and sometimes costly for an organization to change course. Baum (1996) believes that repetitive momentum describes the tendency of an organization to maintain direction and emphasis on prior actions. With so many data sources available to field offices today (NBII, 2007), perhaps a strict adherence to what has worked in the past leaves more appropriate and higher quality data sources untapped. Though field offices appear to stick to data sources which have served them well in the past, there could be a danger in doing so.

Research Question 5

The fifth and final organizational research question examined the effect of information technology capabilities on data selection. Survey results indicate that 49% of U.S. Fish & Wildlife Service field offices use the newest available version of ArcView software (9.2). However, many field offices do not have access to ArcView 9.2 and therefore lack some GIS viewing capabilities. Research question 5 examined path dependency (Duit, 2007; Pierson, 2000; Pierson & Skocpol, 2002) as it relates to the selection of newer data for use in making biodiversity management decisions. Research question 5 also sought to validate the suggestions of U.S. Fish & Wildlife Service biologists interviewed during previous research (Gerlach, 2005) that a lack of access to newer ArcView software prevents the selection of newer, more recently updated data sets. Hypothesis 5 was tested to answer research question 5. This study failed to conclude a significant relationship between access to more up-to-date versions of ArcView and the selection of newer data for use in making biodiversity management decisions. Therefore, path dependency was not shown to be salient in explaining the selection of newer, more recently updated data sets. Additionally, the suggestions of U.S. Fish & Wildlife Service biologists interviewed during a previous study were not validated.

- ***H_5: A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets.***
    - Hypothesis 5: Not Supported

In answering research question 5, this study found that the selection of newer, more recently updated data sets is not tied to access to newer versions of GIS software within U.S. Fish & Wildlife Service field offices. Rather, data sets are updated quite regularly regardless of GIS viewing capabilities. While a disparity in access to the newest version of ArcView software does exist within the U.S. Fish & Wildlife Service, it does not impact the overall use of freshly updated data sets for making biodiversity management decisions. This could be due to data set updates being compatible with older versions of ArcView software, or may be attributed to the availability of alternate methods by which to evaluate recently updated data sets. The disconnect between the widespread use of newer, more recently updated data and the lack of access to the newest version of ArcView software within the U.S. Fish & Wildlife Service warrants further exploration.

Environmental Research Questions

The environmental research questions are grounded in diffusion theory. To answer these research questions, a series of environmental hypotheses were tested. These hypotheses were informed by specific aspects of diffusion theory. The following subsections detail the environmental research questions answered by this study and once again highlight the decisions made regarding the acceptance or rejection of environmental hypotheses.

Research Question 6

The sixth research question explored in this study examines the effect of data marketing efforts on data selection. Survey results indicate data marketing is a tactic employed by producers of federal, state or local, and non-governmental data. U.S. Fish & Wildlife Service field offices reported federal agency data marketing efforts to be most frequent, closely followed by non-governmental organizations and state or local agencies, respectively. Biodiversity conservation literature suggests that data marketing efforts may have a significant effect on the policy-making process (Lackey, 2007; Scott et al., 2007). Previous research (Gerlach, 2005) also suggests that data marketing efforts may positively influence data selection decisions within field offices. Research question 6 examined whether or not these suggestions are valid across the entire U.S. Fish & Wildlife Service. Hypothesis 6 tested research question 6, and this study concluded that positive relationships exist between federal agency data marketing efforts and the selection of federal data sources as well as between state or local agency data marketing efforts and the selection of state or local data. Multivariate tests concluded a *negative* relationship between non-governmental data marketing efforts and the selection of non-governmental data.

- ***H_6: High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions.***
    - Hypothesis 6: Partially Supported

By answering research question 6, this study found that data marketing efforts of federal and state or local agencies are often fruitful. While these findings seem intuitive, results of this research also indicate the data marketing efforts of non-governmental organizations have a negative impact on the selection of data from non-governmental sources. This finding warrants further research to ascertain why non-governmental data marketing efforts to U.S. Fish & Wildlife Service field offices do not achieve positive results. Previous research indicates that field offices may not have established the same level of trust with non-governmental data producers as they have with federal and state or local data producers (Gerlach, 2005). Perhaps U.S. Fish & Wildlife Service field offices are skeptical of the motives of non-governmental data producers. Scholarly literature indicates that a large number of practitioners do not believe that data marketing by non-governmental producers, many of which are termed *interest* or *advocacy groups*, can or should have a place in making objective, value-free policy decisions (Lackey, 2007; Martin, 2006; Scott et al., 2007). While further research is needed to explore this negative relationship in greater detail, this study found that non-governmental data marketing efforts do not equate to the same positive results with regard to data selection as marketing efforts by federal and state or local data producers.

Research Question 7

The seventh research question examined the effect of interest or advocacy group relationships on data selection. U.S. Fish & Wildlife Service field offices reported the strongest relationships with academic institutions, followed by nonprofit organizations and private sector businesses, respectively. Research question 7 sought to determine whether these relationships impact data selection decisions. Diffusion theory literature pertaining to advocacy and the diffusion of innovations suggests that such relationships and involvement in a policy network may positively affect the adoption of a particular innovation (Daley, 2007; Martin, 2001; Mintrom & Vergari, 1998; Sapat, 2004). Hypothesis 7 was tested in an effort to answer research question 7. This study found that a close working relationship with a nonprofit organization is positively associated with the selection of non-governmental data sources. These results indicate that diffusion theory, particularly advocacy and its impact on the adoption of an innovation, is salient with regard to explaining non-governmental data selection.

- ***H_7: A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions.***
    - Hypothesis 7: Partially Supported

In answering research question 7, this study found that field offices which work closely with a non-governmental natural resource organization are more likely to select non-governmental data. The establishment of such trust appears to be important to the selection of non-governmental data. Whereas the data marketing efforts of non-governmental organizations alone do not lead to non-governmental data selection, U.S. Fish & Wildlife Service field offices are more likely to select non-governmental data when they work closely with non-governmental data producers in making biodiversity management decisions. These findings suggest that non-governmental data producers are better served to establish a working relationship with field offices than to simply market their data products if the end goal is to see their data impact policy decisions.

Research Question 8

The eighth research question explored by this study examined the effect of other field offices on data selection. This research question is grounded in diffusion theory literature pertaining to state-to-state policy diffusion, particularly the adoption of innovations that show success in nearby states (Berry & Berry, 1990; Brown & Cox, 1971; Buckley & Westerland, 2004; Clemens, 1998; Daley, 2007; Daley & Garand, 2005; Elazar, 1972; Gianakis & McCue, 1997; Grossback et al., 2004; Soule & Zylan, 1997; Walker, 1969). Survey results indicate that U.S. Fish & Wildlife Service field offices vary in their perceptions of how influential the data sources and newness of data used by other field offices are when making their own data selection decisions, with approximately half of all field offices identifying each as "somewhat influential" in their data selection procedures. Field offices believe the newness of data used by other field offices to be slightly more influential on their own data selection decisions than the source of data used by other field offices. Hypotheses 8a and 8b were tested to answer research question 8. The multivariate analysis used to test hypothesis 8a confirmed relationships between the perceived influence of the source of data used by other U.S. Fish & Wildlife Service field offices and the selection of all three data sources under examination (federal, state or local, and non-governmental). However, hypothesis 8b was rejected, as this study failed to conclude a relationship between the perceived influence of the newness of data used by other field offices and the newness of data selected by a particular U.S. Fish & Wildlife Service field office. The confirmation of hypothesis 8a and rejection of hypothesis 8b indicates that other field offices do indeed influence the selection of data for use in making biodiversity management decisions from the standpoint of data source, but not data newness.

- ***H_{8a}: Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions.***
    - Hypothesis 8a: Supported
- ***H_{8b}: The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office.***
    - Hypothesis 8b: Not Supported

By answering research question 8, this study found that the data selection decisions of other field offices are influential when a particular U.S. Fish & Wildlife Service field office is facing a similar decision. There appear to be elements of mimetic and normative isomorphism at play as well as the previously mentioned tenets of diffusion theory. Mimetic isomorphism occurs as organizations copy established decision-making patterns in an effort to reap similar rewards or profits, whereas normative isomorphism is often a product of certain practices or decision-making processes being thought of as acceptable protocol within a particular community (Meyer & Scott, 1992). This study suggests that field offices potentially seek to mimic the data selection decisions of other field offices, decisions which may be viewed as the accepted norm within the agency. Future research may examine mimetic and normative isomorphism with regard to the selection of particular data sets to assess its salience in finer detail.

Research Question 9

The final environmental research question examined the effect of public involvement in the biodiversity management decision-making process on data selection procedures. Survey results indicate that the general public (not organized interest groups) is not heavily involved in the biodiversity management process undertaken by U.S. Fish & Wildlife Service field offices. When the general public is involved, few citizens participate at one time and the public does not have a preference with regard to the data source(s) used for making decisions. However, based on the recent trend toward public involvement and community-based initiatives detailed in natural resource policy literature (Brunner et al., 2005; Clark, 2002) as well as diffusion theory research pertaining to public influence on the adoption of innovations (Elazar, 1972), research question 9 sought to explore the effect of public involvement on data selection. Hypotheses 9a, 9b, and 9c were tested to answer the ninth research question. All three hypotheses were rejected, and none of the aforementioned literature was shown to be salient in explaining data selection procedures among U.S. Fish & Wildlife Service field offices.

- ***H_{9a}*: *High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of state or local government agency data.***
    - Hypothesis 9a: Not Supported
- ***H_{9b}*: *High levels of public involvement in making biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data.***
    - Hypothesis 9b: Not Supported

- ***H_{9c}: Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source.***
    - Hypothesis 9c: Not Supported

In answering research question 9, this study found public involvement to be a non-factor in the data selection decisions of U.S. Fish & Wildlife Service field offices. Survey results show that the general public is not heavily involved in the biodiversity management decision-making process. When members of the general public do become involved, they rarely assert a data source preference for use in making such decisions. Survey results indicate that the general public is especially not involved in biodiversity management decision-making to the extent some scholars assert is preferred in other policy areas (Nalbandian, 1999; Pretty & Smith, 2004; Stivers, 1994). While public involvement has been proven effective in certain natural resource policy areas (Brunner et al., 2005), it appears that public involvement in everyday biodiversity management decision-making is not widespread enough to impact data selection at the natural resource agency field office level.

Research Model Adjustment

The research model informed by neo-institutional theory, diffusion theory, and biodiversity conservation literature is shown in Figure 6.1 (a repeat of Figure 1.1).

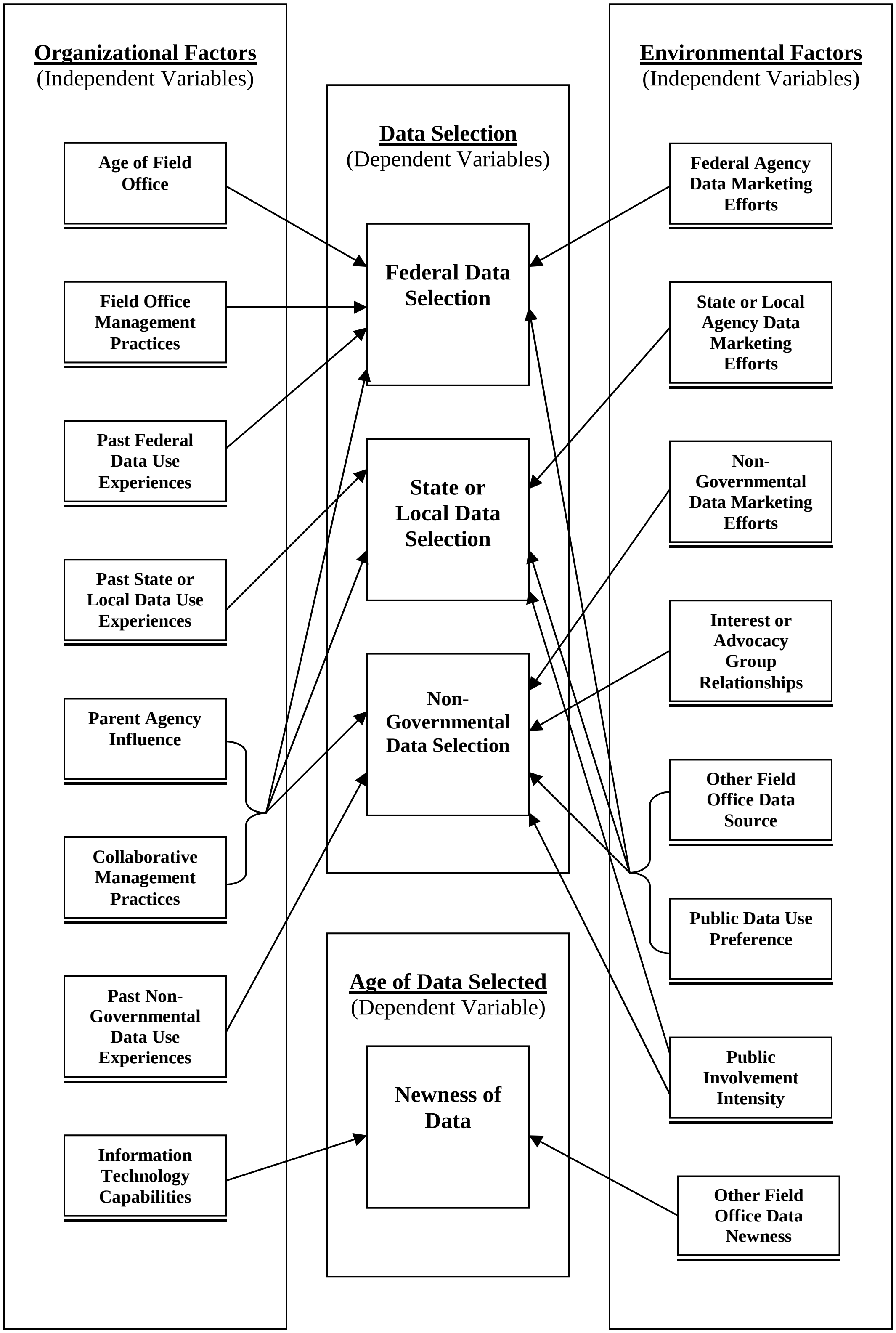

Figure 6.1: Research Model (repeat of Figure 1.1) (*arrows indicate hypothesized relationships)

The original research model shown in Figure 6.1 has been adjusted to reflect the confirmation or rejection of the organizational and environmental hypotheses tested in this study. The arrows shown in Figure 6.1 represent hypothesized significant relationships. The new model reflects the removal of arrows from Figure 6.1 based on either an inability to confirm a hypothesized relationship or proof that no significant relationship exists. Based on the findings of this study, the new model for explaining data selection for use in the natural resource policy process is depicted in Figure 6.2.

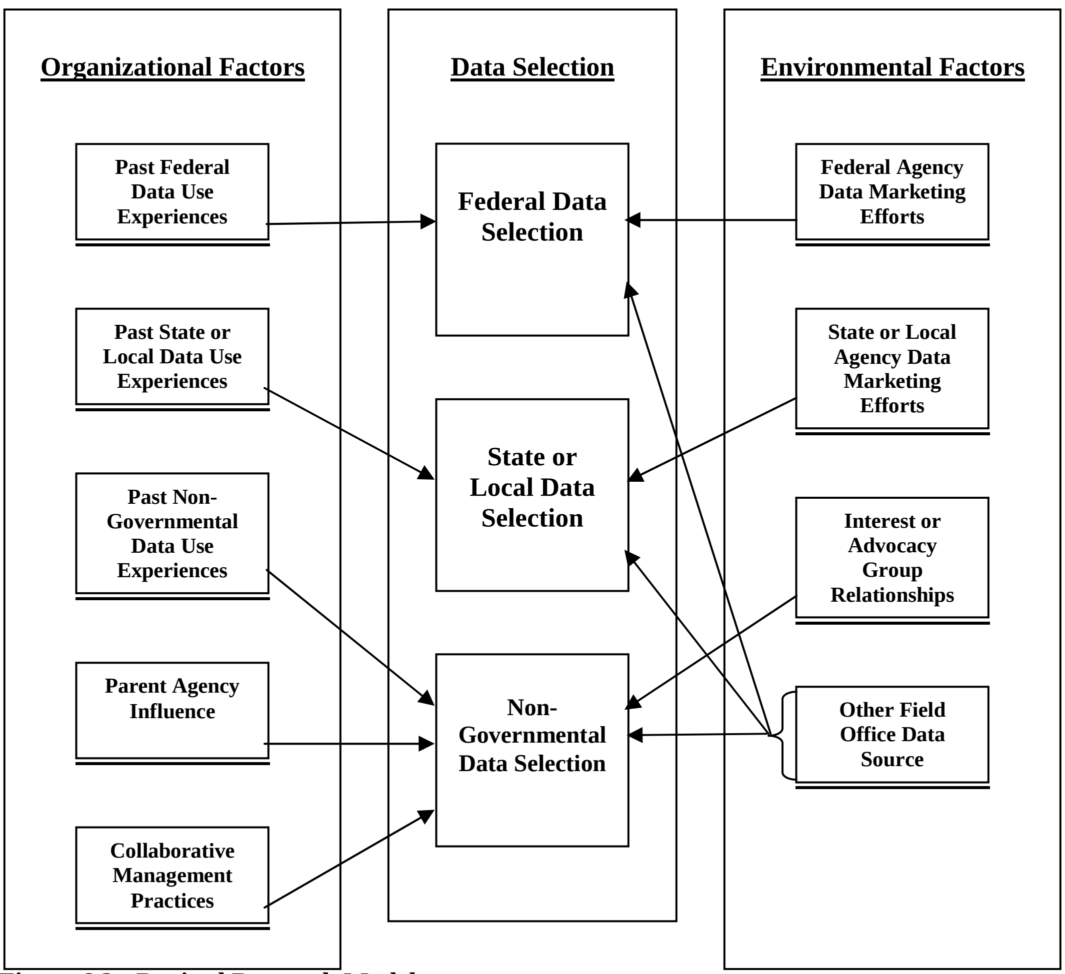

Figure 6.2: Revised Research Model (*arrows indicate **confirmed** relationships)

The confirmation of the significant relationships illustrated in Figure 6.2 provides for a more parsimonious research model. However, it is readily recognized that the adjusted research model should be tested in other areas of natural resource policy. Application to a different natural resource agency, such as the U.S. Forest Service, as well as a different unit of analysis, such as the individual natural resource agency employee, would allow for further validation or adjustment of the model depicted in Figure 6.2. As was discussed in chapter one, one of the main objectives of this study was to empirically test aspects of neo-institutional and diffusion theories as well as concepts within biodiversity conservation literature to provide a more parsimonious model for explaining data selection within natural resource agencies. The new model serves that purpose, but is ripe for further research, as is discussed in later sections of this chapter.

The model shown in Figure 6.2 does, however, illuminate some of the more significant findings of this study. While the effects of past data use experiences and federal and state or local data marketing efforts on data selection among U.S. Fish & Wildlife Service field offices may seem intuitive, the impacts of parent agency influence, collaborative management practices, and interest or advocacy group relationships are more surprising. These findings warrant further discussion.

Parent agency influence. The perception that a U.S. Fish & Wildlife Service field office stands to gain additional resources (funding, information technology capabilities, staffing) from the agency for using "a combination of data sources" when making biodiversity management decisions is positively related to the selection of non-governmental data. This finding suggests that the role of non-governmental data in the natural resource policy process may be to supplement governmental data. Using only governmental data when making biodiversity management decisions may be viewed by the U.S. Fish & Wildlife Service as potentially limiting. Therefore, the agency may perceive non-governmental data as important in providing additional insight when making policy decisions, and may pressure or even provide incentives for field offices to use non-governmental data sources. This study found this role of non-governmental data in the decision-making process to be plausible based on the existence of a significant relationship between the field office perception that using “a combination of data sources” is favorable to the parent agency and the selection of non-governmental data sources.

Collaborative management practices. This study found that field office collaboration with non-governmental natural resource organizations is positively related to the selection of non-governmental data sources. These results indicate that non-governmental organizations influence data selection when afforded the opportunity to exchange information with U.S. Fish & Wildlife Service field offices during the biodiversity management decision-making process. As previously mentioned, an explanation for this may be that U.S. Fish & Wildlife Service field offices seek to collaborate with non-governmental organizations in an attempt to supplement governmental data. The addition of non-governmental information may be viewed as preferable, and consequently rewarded, by the agency. Therefore, field offices may engage in collaborative management practices with non-governmental organizations as a means by which to make biodiversity management decisions based on a more comprehensive collection of data, thus pleasing the parent agency.

Interest or advocacy group relationships. This study found that a close working relationship with a natural resource nonprofit organization is positively related to the selection of non-governmental data. This finding serves to further underscore the aforementioned value of non-governmental organizations and their data to the biodiversity management decision-making process. This study suggests the U.S. Fish & Wildlife Service and its field offices realize the importance of non-governmental contributions to the natural resource policy-making process. Maintaining a close working relationship with one or more natural resource nonprofit organizations may be mutually beneficial to the U.S. Fish & Wildlife Service field office and the nonprofit organization. The field office stands to gain supplemental insight and data to be used in making biodiversity management decisions, which field offices perceive to be important to the parent agency. Nonprofit organizations can establish trust with field offices, a means by which to ensure their data products are used to impact natural resource policy.

The overall role of non-governmental data in making natural resource policy decisions appears to be an important one. While federal and state or local data sources are selected based on past experiences, marketing efforts, and the data selection choices of other field offices, non-governmental data appear to be selected on the basis of adding an element of comprehensiveness to the decision-making process. Based on the results of this study, U.S. Fish & Wildlife Service field offices select non-governmental data sources more often when they 1) perceive the parent agency desires for them to consult a combination of data sources in their decision-making processes, 2) collaborate with non-governmental organizations during the decision-making process, and 3) have a close working relationship with one or more natural resource nonprofit organizations. While non-governmental organization data marketing efforts show a negative impact on non-governmental data selection, building trust in the form of collaboration and sustained working relationships with U.S. Fish & Wildlife Service field offices appears to be the best avenue by which non-governmental data producers can assure their data products impact natural resource policy.

IMPLICATIONS OF THE STUDY

This study applied neo-institutional and diffusion theories as well as popular concepts from biodiversity conservation literature (related to the two aforementioned theories) to data selection procedures within the U.S. Fish & Wildlife Service in an effort to better understand such decisions. Due to the fact that accepted theories were empirically tested within natural resource policy-making, this study has both theoretical and practical implications. While neo-institutional theory has been tested within the arena of natural resource policy making, diffusion studies in this area of policy are scarce. Therefore, the theoretical implications of this study are more weighted toward diffusion theory, though the application of neo-institutional theory to data selection procedures produced some interesting results as well. This section details the theoretical and practical implications of this work.

Theoretical Implications

Neo-institutional Theory

This study suggests that data selection decisions are made within the U.S. Fish & Wildlife Service due to coercive isomorphism, but not necessarily because of institutional embeddedness. As mentioned, field offices are inclined to respond to parent agency pressure with regard to the selection of non-governmental data. The perception that a field office stands to gain resources by using a combination of data sources when making biodiversity management decisions helps explain the selection of non-governmental data sources. Conversely, the concept of institutional embeddedness was not shown to be salient in explaining data selection decisions. This study found that data selection decisions are no more embedded into the organizational norms of older field offices than they are younger field offices. A recommendation based on this study might be that coercive isomorphism should be studied in greater detail with regard to individual non-governmental data sets. Additionally, the concept of institutional embeddedness is not helpful in explaining data selection in the ever-changing landscape that defines the natural resource policy process.

This study found normative isomorphism to be salient in explaining the selection of non-governmental data sources. U.S. Fish & Wildlife Service field offices which value collaboration with non-governmental organizations were proven to value the use of non-governmental data sources in making biodiversity management decisions. Field offices were also proven to be influenced by other field offices in making their data selection decisions. However, normative isomorphism was not proven salient in explaining data selection by biodiversity management techniques (ecosystem- vs. species-level management). Though field offices may subscribe to the same management technique with similar levels of intensity, this study found no connection between such similarities and data selection decisions.

This study validated the neo-institutional concept of path dependency within the natural resource policy process. Path dependency predicted that U.S. Fish & Wildlife Service field offices make data selection decisions based on positive experiences using federal, state or local, and/or non-governmental data. This study found path dependency to be salient in explaining data selection decisions among field offices. Though path dependency has been studied in several arenas (Duit, 2007; Pierson, 2000; Pierson & Skocpol, 2002), many of which are related to public policy, the concept has not been explored in great detail as it applies to natural resource policy. This study adds to the knowledge base pertaining to path dependency a confirmation of its relevance in the natural resource policy process. In short, past data selection decisions which have yielded satisfactory results influence data selection among U.S. Fish & Wildlife Service field offices.

Diffusion Theory

Scholarly literature pertaining to diffusion theory suggests that interest or advocacy group relationships influence the adoption of innovations (Daley, 2007; Godwin & Schroedel, 2000; Nicholson-Crotty & Nicholson-Crotty, 2004). This study found this aspect of diffusion theory to be salient in explaining the selection of non-governmental data for use in making biodiversity management decisions. A U.S. Fish & Wildlife Service field office which values conferring with nonprofit organizations when making such decisions is more predisposed to select non-governmental data than those which do not confer with nonprofits. These results suggest that interest or advocacy groups (nonprofit organizations only) do indeed influence the adoption of non-governmental data.

This study suggests that other U.S. Fish & Wildlife Service field offices influence data selection by their own data selection decisions. Diffusion theory literature is rife with research pertaining to the impact of the successful adoption of an innovation elsewhere on the dissemination of that particular innovation (Berry & Berry, 1990; Brown & Cox, 1971; Elazar, 1972; Walker, 1969). The results of this study indicate that the data selection decisions of other field offices do indeed influence data selection for use in making biodiversity management decisions. The study of the influence of other entities, organizations, states, etc. on the adoption of natural resource policies, data, or decision-making processes has been minimal at best. This study offers insight into the salience of the adoption of an innovation by another natural resource agency field office in explaining data selection decisions. The results of this research suggest that a relationship does exist between the two variables.

This study produced a non-finding of note with regard to diffusion theory. Public involvement has been discussed in diffusion (Elazar, 1972), conservation (Brunner et al., 2005; Clark, 2002; Ostrom, 1990), and public administration (Nalbandian, 1999; Pretty & Smith, 2004; Stivers, 1994) literature as a positive force in adopting or making successful policy decisions. This study suggests that public involvement is not a significant factor in selecting data for use in making biodiversity management decisions at the natural resource agency field office level. While much of the aforementioned literature examines public involvement in a slightly different light (soliciting public input, etc.), this study examined public involvement from the standpoint of making ground-level natural resource policy decisions pertaining to biodiversity management and did not find public involvement to be a factor in determining which data are used in such decision-making processes. In applying public involvement to a different area of policy making, this study found that the public does not play a significant role in data selection.

Practical Implications

This study offers practical implications for both producers and users of biological data. The findings provide insight into the data selection process which may be valuable in adjusting how data products are marketed and employed in making biodiversity management decisions. As discussed in chapter one, the main objective of many data producers is to see their data sets impact policy. Therefore, these producers often look for more efficient avenues by which to get their data in the hands of policymakers. Decision-making agencies are charged by the EPA with making policy based on *best available science* (Sullivan et al., 2006). This study provides these agencies with increased knowledge of how their data selection decisions are made, perhaps allowing them to recognize any discrepancies in their protocol and the selection and use of what they may deem to satisfy the rather vague notion of *best available science* (Sullivan et al., 2006).

Implications for Data Producers

Federal Data Producers

As discussed in chapters one and two, several federal government programs produce biological data with hopes of impacting natural resource policy. The Gap Analysis Program (GAP) of the U.S. Geological Survey is one such program. This study suggests that programs such as GAP should continue to market their data products to natural resource agencies and their field offices. The results of this research indicate those marketing efforts are indeed effective. Federal data producers should also seek to establish or maintain relationships with existing users of their data products. This study suggests that positive experiences using federal agency data lead to the selection of federal data for use in making biodiversity management decisions. Analysis of control variables (discussed in chapter four) also suggests that U.S. Fish & Wildlife Service regions 1 (Pacific) and 3 (Great Lakes-Big Rivers) use federal data with greater frequency than other regions, as do field offices with greater than 30 employees.

State or Local Data Producers

State or local natural resource agencies which produce biological data would be well served to focus on the continued marketing of these data sets to other natural resource policy-making agencies such as the U.S. Fish & Wildlife Service. This study found that state or local agency data marketing efforts are significantly related to the selection of state or local data for making biodiversity management decision. Additionally, state or local data producers should continue producing quality data sets, as this study suggests that positive experiences using state or local data sources correspond to the selection of state or local data for use in the policy process. Analysis of control variables also suggests that newer (less tenured) U.S. Fish & Wildlife Service employees may be more open to selecting state or local data sources for use in making ground-level natural resource policy decisions.

Non-governmental Data Producers

This study defined *non-governmental* entities as nonprofit organizations, private sector businesses, and academic institutions. Results of this research indicate that collaboration efforts among U.S. Fish & Wildlife Service field offices and nonprofit organizations lead to the increased selection of non-governmental data. However, a negative effect was shown with regard to the amount of data marketing conducted by non-governmental organizations and the selection of non-governmental data. Field offices do not appear to respond favorably to increased non-governmental data marketing efforts when it comes time to choose data for use in making biodiversity management decisions. This study suggests that nonprofit organizations, in particular, can best realize the policy-making potential of their data products by involving their organizations in the biodiversity management decision-making process. The results of this research also indicate that non-governmental data producers should continue to provide field offices which have used their data in the past with high quality biological information. U.S. Fish & Wildlife Service field offices which have had positive experiences using nonprofit, private sector business, or academic data sources were shown to select non-governmental sources when making policy decisions.

Implications for Data Users

Choosing the "Best Available Science"

As mentioned in chapter one, the EPA requests the use of *best available science* in making many biodiversity management decisions, particularly those related to managing for threatened or endangered species and mitigating against harmful environmental impacts (Sullivan et al., 2006). This study suggests that relationships with nonprofit organizations make a natural resource agency field office more predisposed to select non-governmental data sources. This study also found that field offices select data with which they have had positive experiences and data that are being used by other field offices. These results suggest that perhaps natural resource agency field offices "satisfice" with regard to their identification of *best available science*. Herbert Simon (1947) indicated that humans lack the cognitive resources to make the best available choices, but will make decisions based on the information readily available to them. Simon (1947) asserted that decisions are made under heavy limitations – not knowing outcome probabilities, without reliable assessments of history, etc. This notion of *satisficing* appears to be at play in the data selection decisions of field offices. With regard to *best available science*, this study indicates that U.S. Fish & Wildlife Service field offices may believe that if other field offices or natural resource organizations consider data "best available" they should as well.

The factors which this study has shown to impact data selection also indicate that mimetic isomorphism may be at play in the identification of *best available science*. Mimetic isomorphism often occurs as a result of one organization copying the decisions of others in an effort to achieve similar results (Meyer & Scott, 1992; Scott, 1991). This study suggests that U.S. Fish & Wildlife Service field offices are highly influenced by the data selection decisions of other field offices and by non-governmental organizations with which they collaborate, in particular nonprofit organizations with which they work on a regular basis. There may be a level of uncertainty attached to the identification of *best available science* as a result of not being able to judge data quality until after using a data source. This uncertainty may lead to being influenced by the data selection decisions of other field offices or the suggestions of non-governmental organizations. This form of data selection could ultimately lead to homogeneity of what is considered *best available science* among field offices.

As a result of this study, it is recommended that data users evaluate their data selection decisions, paying particularly close attention to why data used for making biodiversity management decisions continue to be selected. A satisficing approach to data selection may be the cause of biodiversity management decisions being made without consulting the best available data with regard to the specific issue. While there is undoubtedly comfort and reassurance in using data sources which are highly regarded by other field offices or organizations, mimetic tendencies may simply lead to the selection of "what everyone else is using" rather than best available data. As mentioned in chapter one, there is a plethora of data available to natural resource agency field offices (NBII, 2007). While the EPA's notion of *best available science* may be ambiguous (Sullivan et al., 2006), each field office should choose data which will best inform the specific biodiversity management decisions with which they are faced.

A Better Understanding of Field Offices

This study offers natural resource agencies and the field offices that operate within them a better understanding of not only data selection decisions, but the impact of several commonly accepted practices and newer management trends. For example, entertaining data marketing efforts appears to be a common aspect of working within a U.S. Fish & Wildlife Service field office. This study indicates that these data marketing efforts have a significant impact on how science actually informs policy. Scholars continue to debate the appropriateness of such advocacy in the natural resource policy process. Many believe the role of science should be to provide non-biased, objective information for use in making biodiversity management decisions (Lackey, 2007; Martin, 2006; Scott et al., 2007). Others believe advocacy to be a positive force in the selection and use of biological information in the natural resource decision-making process (Meine & Meffe, 1996; Noss, 2007; Shrader-Frechette, 1996). Natural resource agency field offices should understand the impact that data marketing efforts have on their particular data selection decisions and evaluate whether or not this advocacy is interfering with the quality and appropriateness of data used in making biodiversity management decisions.

The trend toward collaborative and ecosystem-level management practices appears to be prominent within the U.S. Fish & Wildlife Service, but does not greatly impact data selection save for the positive relationship between non-governmental collaboration and non-governmental data selection. Based on the results of this study, it is recommended that natural resource agency field offices continually reassess their data selection decisions and their particular management practices. This study suggests that normative isomorphic pressures could be determining whether or not field offices engage in collaborative management practices. Meyer & Scott (1992) assert that normative isomorphism often occurs as the perception grows that established decision-making practices have become sanctioned by successful organizational leaders within a particular organizational community. While collaborative (Brunner et al., 2005; Thomas, 2003) and ecosystem-level (Clark, 2002) management practices represent a trend in natural resource policy making today, field offices should pay close attention to whether or not these practices are appropriate for their particular situations or whether they are engaging in these management approaches as a result of isomorphic tendencies. Though the relationship between field office management practices and data selection decisions is weak at best, it is recommended that field offices be aware of why they employ the management practices they do and how those management practices may influence the selection of data for use in making biodiversity management decisions, particularly the selection of non-governmental data.

STUDY LIMITATIONS

This study contained four main limitations that should be considered. First, only 557 U.S. Fish & Wildlife Service field offices were surveyed. Of those 557 field offices, the survey was completed by 204 for a response rate of 36.6%. Though the response rate was respectable for a web-based survey, a mere 204 cases made conducting complex MANCOVA models extremely difficult. MANCOVA requires a minimum of five cases in 80% of cells, with no cells containing zero cases (Garson, 2008). Therefore, the omnibus MANCOVA model discussed in chapters four and five was impossible to run due to its gross violation of the sample adequacy assumption. An adjustment was made to run a MANCOVA model using the two most important (based on findings) organizational and environmental independent variables to test their effects on data selection while controlling for one another. However, the relatively small sample size included in this study made more complex multivariate analysis impossible to conduct without violating a major MANCOVA assumption.

A second limitation to this study was the unit of analysis examined. It became apparent throughout the course of this research that some data selection decisions are indeed made by the individual U.S. Fish & Wildlife Service field biologist. While there is significant value in understanding data selection decisions made by the entire field office, this study is the poorer for not examining the data selection procedures of individual employees within the U.S. Fish & Wildlife Service. Future research should examine the *individual* as the unit of analysis and perhaps apply the research model depicted in Figure 6.1 to how individual data selection decisions are made to determine if a similar, more parsimonious model (Figure 6.2) would be achieved.

A third limitation to this study is the overall generalizability of findings. The combination of a small sample size and only surveying one natural resource agency (the U.S. Fish & Wildlife Service) makes the results of this study difficult to generalize to other federal or state or local natural resource agencies. Though some policy issues faced are similar across agencies, many differ as does agency structure, norms, and relationships. Again, future research should apply the original research model depicted in Figure 6.1 to other natural resource agencies to determine whether some of the hypothesized relationships included in that model manifest themselves in the manner in which they did in this study. Perhaps hypothesized relationships that were disproven by this research may prove to be significant when studying other agencies as well.

A final study limitation has to do with some of the assumptions made based on previous research involving the U.S. Fish & Wildlife Service (Gerlach, 2005). Previous research indicated that data selection decisions are routinely made at the field office level and that specific data sources often satisfy many policy-making needs within the field office (Gerlach, 2005). However, approximately ten respondents found it difficult to answer the survey due to the fact that they 1) deal with several management issues and use different data sets for most, 2) found the "federal," "state or local," and "non-governmental" data source categories to be far too broad, or 3) use field office-generated data almost exclusively. While future research should examine the selection and use of biological information at the data *set* level rather than the data *source* level, this study was designed to begin a research agenda which examines how data are used in the natural resource policy process, and it serves that purpose. It is acknowledged that not taking into account the variation in tasks and uses of data across U.S. Fish & Wildlife Service field offices constitutes a significant limitation to the current study, and future research will be focused in more precise areas of data selection and use.

Though this study was bound by the aforementioned limitations, significant relationships were identified between certain organizational and environmental factors and data selection decisions among U.S. Fish & Wildlife Service field offices. These findings offer important insight into the salience of neo-institutional and diffusion theories in explaining data selection. Improving upon the limitations of this study should confirm the results of this research while adding finer details to the study's findings. The limitations of this study present ample opportunity for expanding upon the significant relationships identified in future research endeavors.

FUTURE RESEARCH

This study as well as the aforementioned feedback from U.S. Fish & Wildlife Service employees suggests three key directions for future research. First, an exploration of how organizational and environmental factors affect the selection and use of individual data *sets* is warranted. While the current study examined the selection of data *sources*, examining how individual data *sets* are selected and used for policy making is a separate issue. U.S. Fish & Wildlife Service biologists indicated in e-mail comments regarding this research that different data sets from the same data source are often used in a variety of different decision-making capacities.

A second direction for future research is to conduct a study on data selection using the individual U.S. Fish & Wildlife Service biologist as the unit of analysis. It might be of particular interest to test the research model employed in this study (Figure 6.1) to determine which hypothesized relationships are significant or non-significant using the individual employee as the unit of analysis. A study of this nature might even explore the effects of rational choice theory or bounded rationality on individual data selection procedures.

A third direction for future research may be focused on applying the research model shown in Figure 6.1 to other natural resource agencies. For example, the U.S. Forest Service would be an interesting candidate for a study of this nature. The U.S. Forest Service is similar in organization and approach to the U.S. Fish & Wildlife Service, yet shows marked differences in policy areas addressed. A study which applies the research model shown in Figure 6.1 to the U.S. Forest Service in an effort to determine the robustness of the adjusted model shown in Figure 6.2 would provide further insight into the factors which affect data selection among natural resource agencies. A similar study of the U.S. Forest Service would also provide the opportunity to compare and contrast data selection within the two agencies. Similar studies may be conducted across state environmental and natural resource departments as well, which would provide a comparison of factors that explain data selection at the state level across the United States.

SUMMARY

As a result of this study, several organizational and environmental factors were identified that explain data selection for use in the natural resource policy process. Table 6.1 details the research questions examined in this study, related hypotheses, and their answers.

Table 6.1: Study Research Questions, Related Hypotheses, and Answers

Research Questions	Related Hypotheses	Answers
RQ1: *What is the effect of field office age on data selection?*	***H_1:*** The age of a field office is positively associated with its selection of federal government agency data. **Decision:** Not Supported	• This study showed no significant effect of field office age on data selection.
RQ2: *What is the effect of parent agency pressures influence data selection?*	***H_2:*** The perception that a field office stands to gain the favor of agency headquarters, financially or otherwise, by selecting a certain source of data is positively associated with the selection of that particular data source. **Decision:** Partially Supported	• U.S. Fish & Wildlife Service field offices which reported that they stand to gain the favor of agency headquarters for using a “combination of data sources” were more likely to perceive non-

Table 6.1: Continued

		governmental data as "important."
***RQ3:** What is the effect of field office management practices on data selection?*	***H_{3a}:*** Collaboration with federal, state or local, or non-governmental nature resource agencies or organizations is positively associated with the selection of those respective data sources for making biodiversity management decisions. **Decision:** Partially Supported ***H_{3b}:*** Ecosystem-level management practices are positively associated with the selection of federal government agency data. **Decision:** Not Supported	• Field office collaboration with non-governmental natural resource organizations is significantly related to the selection of non-governmental data sources. • Field office collaboration with federal and state or local natural resource agencies was not shown to explain data selection. • Ecosystem-level management practices do not explain the selection of federal data.
***RQ4:** What is the effect of past data use experiences on data selection?*	***H_4:*** Past positive experience in using data from a particular source for natural resource policy making is positively associated with the present day selection of data from that same source. **Decision:** Supported	• Past positive experiences using federal, state or local, and non-governmental data sources are significantly related to the modern day selection of those data sources.
***RQ5:** What is the effect of field office information technology capabilities on data selection?*	***H_5:*** A lack of access to more up-to-date versions of GIS software, such as ArcView 9.2, is negatively associated with the selection of newer, more recently updated data sets. **Decision:** Not Supported	• This study found no significant relationship between access to more up-to-date GIS software and the selection of newer data sets.

Table 6.1: Continued

***RQ6:** How do data marketing efforts affect data selection?*	***H_6:*** High levels of data marketing are positively associated with the selection of a particular source of data for use in making biodiversity management decisions. **Decision:** Partially Supported	• More frequent data marketing efforts of federal and state or local agencies leads to the increased selection of data from those respective sources. • Higher levels of non-governmental data marketing were shown to negatively impact the selection of non-governmental data.
***RQ7:** What effects do interest or advocacy groups have on data selection?*	***H_7:*** A close working relationship with a non-governmental data producer (interest or advocacy group) is positively associated with the selection of non-governmental data for use in making biodiversity management decisions. **Decision:** Partially Supported	• Nonprofit organizations have a significant effect on the selection of non-governmental data. • Private sector businesses and academic institutions were not show to have a significant effect on the selection of non-governmental data.
***RQ8:** How do other field offices affect data selection?*	***H_{8a}:*** Field office data selection is positively associated with the perceived source of data other field offices are using in making their own biodiversity management decisions. **Decision:** Supported ***H_{8b}:*** The perception that other field offices are using newer, more innovative data sets to inform biodiversity management decisions is positively associated with the selection of newer, more innovative data sets by a particular field office. **Decision:** Not Supported	• The perception that other field offices are using data from a particular source is significantly related to selection of data from that source. • The perception that other field offices are using newer, more recently updated data sets was not shown to explain the selection of newer, more recently updated data.

Table 6.1: Continued

RQ9: *How does public involvement affect data selection?*	***H*$_{9a}$*:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of state and local government agency data. **Decision:** Not Supported ***H*$_{9b}$*:*** High levels of public involvement in biodiversity management decisions at the field office level are positively associated with the selection of non-governmental data. **Decision:** Not Supported ***H*$_{9c}$*:*** Field office perception that the public desires for biodiversity management decisions to be informed by a particular source of data is positively associated with the selection of data from that source. **Decision:** Not Supported	• Public participation was not shown to affect data selection within U.S. Fish & Wildlife Service field offices.

This study determined that data selection decisions at the U.S. Fish & Wildlife Service field office level can be explained by the following organizational factors.

- Past data use experiences
- Collaboration with non-governmental organizations when making biodiversity management decisions
- Parent agency influence to use a combination of data sources when making biodiversity management decisions

Data selection can be explained by the following environmental factors.

- Federal agency data marketing efforts
- State or local agency data marketing efforts
- A working relationship with a nonprofit organization

- The perceived source of data used by other U.S. Fish & Wildlife Service field offices

This study failed to identify any factors which explain the newness of data selected by U.S. Fish & Wildlife Service field offices, as depicted in the post-analysis model shown in Figure 6.2.

From the standpoint of neo-institutional and diffusion theories, this study did not identify one as more salient with regard to explaining data selection than the other. Rather, aspects of both theories help explain data selection. Institutional isomorphism and path dependency are salient aspects of neo-institutional theory in explaining field office data selection, while advocacy and field office-to-field office diffusion are explanatory aspects of diffusion theory. Further research is required to ascertain how explanatory these theories are when examining data selection at the individual U.S. Fish & Wildlife Service employee level as well as the selection of data *sets* rather than data *sources*. However, this study provides a better understanding of these theories as they apply to the field of natural resource policy.

From a practical standpoint, this study aids data producers and users in bridging the gap between the voluminous amount of biological information available and the actual use of data in the biodiversity management decision-making process. As stated in chapter one, the main goal of biological data is to impact policy. This study helps facilitate that process by bringing to light the explanatory value of neo-institutional and diffusion theories as well as offering practical suggestions for selecting data that best inform sound natural resource policies. Field offices should continually evaluate:

- Data quality
- Relationships with data producers

- Reasons for selecting data from a particular source
- Whether or not non-governmental data can effectively supplement governmental sources
- The appropriateness of data used to inform biodiversity management decisions
- The appropriateness of biodiversity management approaches

Through understanding the factors which influence data selection decisions and paying careful attention to data quality, field offices can select data sources which best inform natural resource policy decisions. Through that same attention paid to data quality as well as establishing collaborative working relationships with field offices, data producers can ensure their data products impact policy in a positive manner. This level of vigilance and cooperation can lead to quality data playing an even more important role in the natural resource policy process.

REFERENCES

Allaire, J.C. (2009). MANOVA. [Power Point class presentation]. Department of Psychology, North Carolina State University.

Anderson, S.E., & Gansneder, B.M. (1995). Using electronic mail surveys and computer-monitored data for studying computer-mediated communication systems. *Social Science Computer Review*, *13*(1), 33-46.

Andrews, R.N.L. (1999). *Managing the environment, managing ourselves: A history of American environmental policy*. London: Yale University Press.

Appalachian Voices. (2004). Mountain top removal coal mining. [Online]. Available URL: http://www.appvoices.org/mtr/default.asp. Accessed: 27 September 2005.

Arch Coal. (2005). [Online]. Available URL: http://www.archcoal.com. Accessed: 27 September 2005.

Aronson, E. (2003). The rationalizing animal. In B.M. Staw (Ed.), *Psychological dimensions of organizational behavior* (3rd ed., 131-138). Upper Saddle River, NJ: Prentice Hall.

Baum, J.A. (1996). Organizational ecology. In Clegg, S.R., Hardy, C., & Nord, W.R. (Eds.), *Handbook of Organizational Studie* (77-115). London: Sage Publications.

Baum, J.A., & Oliver, C. (1992). Instutional embeddedness and the dynamics of organizational populations. *American Sociological Review*, *57*, 540-559.

Bendor, J., Moe, T.M., & Shotts, K.W. (2001). Recycling the garbage can: An assessment of the research program. *American Political Science Review, 95*(1), 169-190.

Berman, D. (2004, April 1). Judge orders USDA to search again for info on planning regs. *Greenwire, 10*(9). Available URL: http://www.lib.ncsu:3863/ Greenwire/2004/04/01/#7. Accessed: 27 February 2005.

Berry, F. S., & Berry, W. D. (1990). State lottery adoptions as policy innovations: An event history analysis. *The American Political Science Review*, *84*(2), 395-415.

Berry, F.S., & Berry, W.D. (1999). Innovation and diffusion models in policy research. In Sabatier, P.A. (Ed.), *Theories of the policy process* (169-200). Boulder, CO: Westview Press.

Blockstein, D.E. (2002). How to lose your political virginity while keeping your scientific credibility. *Bioscience, 52*(1), 91-96.

Brown, L. A., & Cox, K. (1971). Empirical regularities in the diffusion of innovation. *Annals of the Association of American Geographers, 61*(3), 551-559.

Brunner, R.D., Steelman, T.A., Coe-Juell, L., Cromley, C.M., Edwards, C.M., & Tucker, D.W. (2005). *Adaptive governance: Integrating science, policy, and decision making.* New York: Columbia University Press.

Brussard, P.F., & Tull, J.C. (2007). Conservation biology and four types of advocacy. *Conservation Biology, 21*(1), 21-24.

Buckley, J., & Westerland, C. (2004). Duration dependence, functional form, and correct standard errors: Improving EHA models of state policy diffusion. *State Politics and Policy Quarterly, 4*(1), 94-113.

Carden, K. (2006). Bridging the divide: The role of science in species conservation law. *Harvard Environmental Law Review, 30*(1), 165-259.

Carson, R. (1962). *Silent spring.* Boston: Houghton Mifflin Company.

Clark, T.W. (2002). *The policy process: A practical guide for natural resource professionals.* London: Yale University Press.

Clarke, J.N., & McCool, D.C. (1996). *Staking out the terrain: Power and performance among natural resource agencies.* Albany, NY: SUNY Press.

Clemens, E.S. (1998). *The people's lobby: Organization innovation and the rise of interest group politics in the United States, 1890-1925.* Chicago: University of Chicago Press.

Cohen, M., March, J., & Olsen, J. (1972). A garbage can model of organizational choice. *Administrative Science Quarterly, 17*(March), 1-25.

Cook, T.D., & Campbell, D.T. (1979). *Quasi-experimentation: Design and analysis issues for field settings*. Boston: Houghton-Mifflin.

Cortner, H.J. (2000). Making science relevant to environmental policy. *Environmental Science and Policy, 3*, 21-30.

Daley, D.M. (2007). Voluntary approaches to environmental problems: Exploring the rise of nontraditional public policy. *Policy Studies Journal, 35*(2), 165-180.

Daley, D.M., & Garand, J.C. (2005). Horizontal diffusion, vertical diffusion, and internal pressure in state environmental policymaking, 1989-1998. *American Politics Research, 33*(5), 615-644.

Democratic Leadership Council & Penn, Schoen, & Berland Associates Survey. (2002). [Online]. Available URL: http://www.lib.ncsu.edu:4191/poll.htm. Accessed 15 February 2008 from the iPOLL Databank, The Roper Center for Public Opinion Research, University of Connecticut.

DiMaggio, P.J., & Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147-160.

DiMaggio, P.J., & Powell, W.W. (Eds.). (1991). *The new institutionalism in organizational analysis.* Chicago: University of Chicago Press.

Dombeck, M.P., Williams, J.E., & Wood, C.A. (2004). Wildfire policy and public lands: Integrating scientific understanding with social concerns across landscapes. *Conservation Biology, 18*(4), 883-889.

Duit, A. (2007). Path dependency and institutional change: The case of industrial emission control in Sweden. *Public Administration, 85*(4), 1097-1118.

Elazar, D. (1972). *American federalism.* New York: Thomas Crowell.

Eilperin, J. (2004, December 23). New rules issued for national forests: Some environmental protections eased. *The Washington Post*, p. A01.

ESRI: GIS and Mapping Software. (2007). ArcView: Desktop GIS for mapping, data integration, and analysis [Online]. Available URL: http://www.ersi.com/software/arcview/. Accessed: 01 November 2007.

Field, A. (2005). *Discovering statistics using SPSS* (2nd ed.). Sage Publications: London.

Forest Service Publishes Planning Rule for Better Management of National Forests and Grasslands; Environmental Management System Will Be Adopted. (2005, February 7). U.S. Forest Service news release. AScricbe, Inc. Newswire.

Frederickson, G.H., Johnson, G.A., & Wood, C. (2004). The changing structure of American cities: A study of the diffusion of innovation. *Public Administration Review, 64*(3), 320-330.

Gap Analysis Program. (2007). [Online]. Available URL: http://www.gapanalysis.nbii.gov. Accessed: 27 May 2007.

Garson, G.D. (2008). StatNotes [Online]. Available URL: http://www2.chass.ncsu.edu/garson/pa765/statnote.htm. First Accessed: 17 December 2006.

Gerlach, J.D. (2005). Proceedings from the Gap Analysis Program Conference and Research Symposium: *A Process Evaluation of NC-GAP: Examining the Use of GAP Data in the Biodiversity Conservation Policy Process.* Reno, NV.

Gerlach, J.D., & Jolley, G.J. (2007). The Gap Analysis Program: A proactive approach to biodiversity conservation. *Journal of Extension,* forthcoming.

Gianakis, G.A., & McCue, C.P. (1997). Administrative innovation among Ohio local government finance officers. *The American Review of Public Administration, 27*(3), 270-286.

Glass, G.C., & Hopkins, K. (1984). *Statistical methods in education and psychology*. Englewood Cliffs, NJ: Prentice Hall.

Godwin, M.L., & Schroedel, J.R. (2000). Policy diffusion and strategies for promoting change: Evidence from California local gun control ordinances. *Policy Studies Journal, 28*(4), 760-776.

Grossback, L.J., Nicholson-Crotty, S., & Peterson, D.A. (2004). Ideology and learning in policy diffusion. *American Politics Research, 32*(5), 521-545.

Hägerstrand, T. (1967). *Innovation diffusion as a spatial process.* Chicago: University of Chicago Press.

Hall, P., & Taylor, R. (1996). Political science and the three new institutionalisms. *Political Studies, 44*, 936-957.

Hannan, M.T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology, 82*(5), 929-964.

Hannan, M.T., & Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review, 49*, 149-164.

Hira, A., & Hira, R. (2000). The new institutionalism: Contradictory notions of change. *American Journal of Economics and Sociology, 59*(2), 267-282.

Immergut, E. (1998). The theoretical core of new institutionalism. *Politics and Society, 26*(1), 5-34.

Jepperson, R.L. (1991). Institutions, institutional effects, and institutionalism. In DiMaggio, P.J., & Powell, W.W. (Eds.), *The new institutionalism in organizational analysis* (143-163). Chicago: University of Chicago Press.

Karch, A. (2006). National intervention and the diffusion of policy innovations. *American Politics Research, 34*(4), 403-426.

Katz, D., & Kahn, R.L. (1966). *The social psychology of organizations.* New York: John Wiley.

Kiesler, S., & Sproull, L. (1986). Response rates in the electronic survey. *Public Opinion Quarterly, 50*, 402-413.

Kim, S.C. (2005). Nested institutions and the retardation of the adaptive process. *Systems Research and Behavioral Science, 22*(6), 483-495.

King, C.S., Feltey, K.M., Susel, B.O. (1998). The question of participation: Toward authentic public participation in public administration. *Public Administration Review, 58*, 317-326.

Kingdon, J.W. (1984). *Agendas, alternatives, and public policies*. Boston: Little, Brown & Company.

Klingman, D. (1980). Temporal and spatial diffusion in the comparative analysis of social change. *American Political Science Review, 74*, 123-137.

Knoke, D. (1982). The spread of municipal reform: Temporal, spatial, and social dynamics. *American Journal of Sociology, 86*(6), 1314-1339.

Koelble, T.A. (1995). Review article: The new institutionalism in political science and sociology. *Comparative Politics, 27*(1), 231-244.

Lackey, R.T. (2007). Science, scientists, and policy advocacy. *Conservation Biology, 21*(1), 12-17.

Leichter, H. M. (1983). The patterns and origins of policy diffusion: The case of the commonwealth. *Comparative Politics*, *15*(2), 223-233.

Levi, M. (1990). A logic of institutional change. In Cook, K.S., & Levi, M. (Eds.), *The limits of rationality* (402-418). Chicago: University of Chicago Press.

Levi, M. (1997). A model, a method, and a map: Rational choice in comparative and historical analysis. In Lichbach, M.I., & Zuckerman, A.S. (Eds.), *Comparative politics: Rationality, culture, and structure* (19-41). New York: Cambridge University Press.

Libby, L.W., & Clouser, R.L. (1990). Population and global economic patterns. In Sampson, R.N., & Hair, D. (Eds.), *Natural Resources for the 21st Century* (7-31). Washington, D.C.: Island Press.

Lowndes, V. (1996). Varieties of new institutionalism: A critical appraisal. *Public Administration*, *74*(2), 181-197.

March, J.G., & Olsen, J.P. (1989). *Rediscovering institutions.* New York: Free Press.

Martin, A. (2006). Advocacy dressed up as science: Response to Ramey et al., 2005. *Animal Conservation*, *9*(3), 248-249.

Martin, I. (2001). Dawn of the living wage: The diffusion of a redistributive municipal policy. *Urban Affairs Review*, *36*(4), 470-496.

McAdam, D., Tarrow, S., & Tilly, C. (1997). Toward an integrated perspective on social movements. In Lichbach, M.I, & Zuckerman, A.S. (Eds.), *Comparative politics: Rationality, culture, and structure* (142-173). New York: Cambridge University Press.

McVoy, E.C. (1940). Patterns of diffusion in the United States. *American Sociological Review, 5*(2), 219-227.

Meglino, B.M., & Korsgaard, A. (2004). Considering rational self-interest as a disposition: Organizational implications of other orientations. *Journal of Applied Psychology, 89*(6), 946-959.

Meine, C, & Meffe, G.K. (1996). Conservation values, conservation science: A healthy tension. *Conservation Biology, 10*(3), 916-917.

Menard, S. (1995). *Applied logistic regression analysis.* Sage university paper series on quantitative applications in the social sciences, 07-106. Thousand Oaks, CA: Sage.

Meyer, J.W., & Rowan, B. (1991). Institutional organizations: Formal structure as myth and ceremony. In DiMaggio, P.J., & Powell, W.W. (Eds.), *The new institutionalism in organizational analysis* (41-62). Chicago: University of Chicago Press.

Meyer, J.W., & Scott, R. (1992). *Organizational environments: Ritual and rationality.* London: Sage Publications.

Mintrom, M., & Vergari, S. (1998). Policy networks and innovation diffusion: The case of state education reforms. *The Journal of Politics, 60*(1), 126-148.

Mohr, L.B. (1969). Determinants of innovation in organizations. *The American Political Science Review, 63*(1), 111-126.

Myers, R. (1990). *Classical and modern regression with applications* (2nd ed.). Boston: Duxbury.

Nalbandian, J. (1999). Facilitation community, enabling democracy: New roles for local government managers. *Public Administration Review, 59*, 187-197.

National Biological Information Infrastructure. (2007). [Online]. Available URL: http://www.nbii.gov. Accessed: 14 June 2007.

Nicholson-Crotty, S., & Nicholson-Crotty, J. (2004). Interest group influence on managerial priorities in public organizations. *Journal of Public Administration Research and Theory, 14*(4), 571-583.

North, D.C. (1990). *Institutions, institutional change and economic performance.* Cambridge: Cambridge University Press.

Noss, R.F. (2007). Values are a good thing in conservation biology. *Conservation Biology, 21*(1), 18-20.

Olsen, J.P. (2001). Garbage cans, new institutionalism and the study of politics. *American Political Science Review, 95*(1), 191-198.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action.* Cambridge: Cambridge University Press.

Parker, L. (1992). Collecting data the e-mail way. *Training and Development, 46*(7), 52-54.

Patten, M.L. (2001). *Questionnaire research: A practical guide* (2nd ed.). Los Angeles: Pyrczak Publishing.

Patterson, T.E. (2008). *We the people: A concise introduction to American politics* (7th ed.). New York: McGraw-Hill.

Peng, S.S. (2000). Mountaintop removal controversy: Environmental issues and research associated with MTR mining in West Virginia. *Mining Engineering, 52*(9), 53-58.

Pierson, P. (2000). The limits of design: Explaining institutional origins and change. *Governance: An International Journal of Policy and Administration, 13*, 475-499.

Pierson, P., & Skocpol, T. (2002). Historical institutionalism in contemporary political science. In Katznelson, I., & Milner, H.V. (Eds.), *Political science: The state of the discipline* (693-721). New York: Norton APSA.

Pilkey-Jarvis, L., & Pilkey, O.H. (2008). Useless arithmetic: Ten points to ponder when using mathematical models in environmental decision making. *Public Administration Review, 68*(3), 470-479.

Pouyat, R.V. (1999). Science and environmental policy: Making them compatible. *BioScience, 49*, 281-286.

Pretty, J., & Smith, D. (2004). Social capital in biodiversity conservation and management. *Conservation Biology*, *18*(3), 631-635.

Robinson, S.E., & Meier, K.J. (2006). Path dependence and organizational behavior: Bureaucracy and social promotion. *American Review of Public Administration, 36*(3), 241-260.

Rogers, E. M. (1962). *Diffusion of innovations* (1st ed.). New York: Free Press. 5th ed., 2003. New York: Simon & Shuster.

Rogers, M.K. (2006). Explaining performance measurement utilization and benefits: An examination of performance measurement practices in local governments (Doctoral dissertation, North Carolina State University, 2006). [Online]. Available URL: http://www.lib.ncsu.edu/ETD-db/ETD-browse/browse?first_letter=R. Accessed 21 October 2007 from the North Carolina State University Electronic Theses and Dissertations Database.

Rykiel, E.J. (2001). Scientific objectivity, value systems, and policymaking. *BioScience*, *51*(6), 433-436.

Sabatier, P.A., Focht, W., Lubell, M., Trachtenbert, Z., Veditz, A., & Matlock, M. (Eds.). (2004). *Swimming upstream: Collaborative approaches to watershed management.* Boston: MIT Press.

Sapat, A. (2004). Devolution and innovation: The adoption of state environmental policy innovations by administrative agencies. *Public Administration Review, 64*(2), 141-151.

Sarewitz, D. (2004). How science makes environmental controversies worse. *Environmental Science and Policy, 7*, 385-403.

Scott, M.J., Rachlow, J.L., Lackey, R.T., Pidgorna, A.B., Aycrigg, J.L., Feldman, G.R., Svancara, L.K., Rupp, D.A., Stanish, D.I., & Steinhorst, R.K. (2007). Policy advocacy in science: Prevalence, perspectives, and implications for conservation biologists. *Conservation Biology, 21*(1), 29-35.

Scott, R. (1991). Unpacking institutional arguments. In DiMaggio, P.J., & Powell, W.W. (Eds.), *The new institutionalism in organizational analysis* (164-182). Chicago: University of Chicago Press.

Shrader-Frechette, K. (1996). Throwing out the bathwater of positivism, keeping the baby of objectivity: relativism and advocacy in conservation biology. *Conservation Biology, 10,* 912–914.

Sierra Club. (2005). Tell the Bush administration not to bury our streams and wetlands with waste. [Online]. Available URL: http://www.sierraclub.org/wetlands/mining.asp. Accessed: 25 September 2005.

Simon, H. (1947). *Administrative behavior: A study of decision-making processes in administrative organizations*. New York: Free Press.

Soule, S.A., & Zylan, Y. (1997). Runaway train? The diffusion of state-level reform in ADC/AFDC eligibility requirements, 1950-1967. *The American Journal of Sociology, 103*(3), 733-762.

Spector, P.E. (2006). *Industrial and organizational psychology: Research and practice* (4th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Sproull, L. (1986). Using electronic mail for data collection in organizational research. *Academy of Management Journal, 29*(1), 159-169.

Stevens, J.P. (2002). *Applied multivariate statistics for the social sciences* (4th ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Stivers, C. (1994). The listening bureaucrat: Responsiveness in public administration. *Public Administration Review, 54*(4), 364-369.

Strang, D., & Meyer, J.W. (1993). Institutional conditions for diffusion. *Theory and Society, 22*(4), 487-511.

Stroup, R.L., & Baden, J.A. (1983). *Natural resources: Bureaucratic myths and environmental management.* Cambridge, MA: Ballinger Publishing Company.

Sullivan, P.J., Acheson, J.M., Angermeier, P.L., Faast, T., Flemma, J., Jones, C.M., Knudsen, E.E., Minello, T.J., Secor, D.H., Wunderlich, R., & Zanetell, B.A. (2006). Defining and implementing: Best available science for fisheries and environmental science, policy, and management. *Fisheries, 31*(9), 460-465.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn & Bacon.

Taylor, F.W. (1895). A piece-rate system. *American Society of Mechanical Engineers.*

Thomas, C. (2003). *Bureaucratic landscapes: Interagency cooperation and the preservation of biodiversity*. Boston: MIT Press.

Thomas, J.G., & Griffin, R.W. (2003). The power of social information in the workplace. In B.M. Staw (Ed.), *Psychological dimensions of organizational behavior* (3rd ed., 172-180). Upper Saddle River, NJ: Prentice Hall.

Thompson, J. (1967). *Organizations in action*. New York: McGraw Hill.

Tolbert, P.S., & Zucker, L.G. (1983). Institutional sources of change in formal organizations: The diffusion of civil service reform, 1880-1935. *Administrative Science Quarterly, 28*, 22-39.

Townley, B. (1997). The institutional logic of performance appraisal. *Organization Studies, 18*(2), 261-285.

U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Interior's Office of Surface Mining and Fish and Wildlife Service, & West Virginia Department of Environmental Protection. (2003). *Programmatic environmental impact statement (EIS) on mountaintop mining and valley fill.* [Online]. Available URL: http://www.pbs.org/now/science/coalupdate.html. Accessed: 03 November 2005.

U.S. Environmental Protection Agency. (2002). Corps and EPA clarify Clean Water Act definition: New environmental improvements also to be made in Appalachian mining rules. *EPA news release*. [Online]. Available URL: http://yosemite.epa/gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/f0aa42a6.htm. Accessed: 31 October 2005.

U.S. Environmental Protection Agency. (2004). FY 2004 annual plan: Goal 8: Sound science, improved understanding of environmental risks and greater innovation to address environmental problems. [Online]. Available URL: http://www.epa.gov/cfo/budget/2004/2004ap/goal8.pdf. Accessed: 11 October 2007.

U.S. Fish & Wildlife Service. (2007). [Online]. Available URL: http://www.fws.gov. Accessed: 16 May 2007.

Vig, N.J., & Kraft, M.E. (2006). *Environmental policy: New directions for the twenty-first century* (6th ed.). Washington, D.C.: CQ Press.

Walker, J.L. (1969). The diffusion of innovations among the American states. *American Political Science Review, 63*(3), 880-899.

Walker, J.L. (1973). Comment: Problems in research on the diffusion of policy innovations. *The American Political Science Review, 67*(4), 1186-1191.

Weir, M. (1992). Ideas and politics of bounded innovation. In Steinmo, S., Thelen, K., & Longstreth, F. (Eds.), *Structuring politics: Historical institutionalism in comparative analysis* (188-216). New York: Cambridge University Press.

Yin, R.K. (1981). Life histories of innovations: How new practices become routinized. *Public Administration Review, 41*(1), 21-28.

Zucker, L.G. (1991). The role of institutionalization in cultural persistence. In DiMaggio, P.J., & Powell, W.W. (Eds.), *The new institutionalism in organizational analysis* (83-107). Chicago: University of Chicago Press.

APPENDICES

Appendix A: Survey Instrument

U.S. Fish & Wildlife Service survey

1. Introduction and Page 1 of 4

INTRODUCTION

This is a survey about the selection of data sources by U.S. Fish & Wildlife Service field offices for use in making biodiversity management and conservation decisions. You have been selected to participate because of your work with scientific data in making such decisions. I have worked to select one potential respondent from each U.S. Fish & Wildlife Service national wildlife refuge, ecological services field office, national fish hatchery, fisheries resource office, and fish and wildlife resource office across all regions of the agency. Where possible, I have tried to contact biologists. If you feel that a biologist in your office would be better suited to answer this survey, please forward it to them. Your answers will remain strictly confidential at all times, and data will not be shared outside of reporting overall results related to my doctoral research. This study will bring to light the process by which data are selected for use within the Service and will serve to help all interested in biodiversity management and conservation further understand how data sources may be more useful to the decision-making process in the future. This survey will take you approximately 10-12 minutes to complete and will hopefully lead to data more effectively impacting policy in the future. The results of this study will be made available to you via e-mail contact or a URL provided for examination at your convenience. Thank you for your assistance. Should you have any questions, please contact me at (314) 495-9512 or my dissertation committee chairperson at NC State University, Dr. Dennis Daley, either by e-mail at Dennis_Daley@ncsu.edu or by phone at (919) 515-3740.

John D. Gerlach, II
Dept. of Public Administration
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1. How important are the following data sources to your field office?

	1 (Unimportant)	2	3	4	5	6	7	8	9	10 (Important)
Federal Data										
State or Local Data										
Non-governmental Data										

2. How frequently does your field office use the following data sources in making biodiversity management decisions?

	Daily	Weekly	Monthly	Quarterly	Annually	Rarely	Never
Federal Data							
State or Local Data							
Non-governmental Data							

3. What is the name of the data set your field office relies on most?

4. In approximately what year was this data set last updated?

5. In approximately what year (or decade if year is unknown) was this data set established?

U.S. Fish & Wildlife Service survey

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6. On average, my field office has had positive experiences using the following data sources in making biodiversity management decisions.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Federal Data					
State or Local Data					
Non-governmental Data					

7. Please rank the following data sources with respect to average positive experiences in making biodiversity management decisions.

	1 (Most Satisfied)	2	3 (Least Satisfied)
Federal Data			
State or Local Data			
Non-governmental Data			

8. Which of the following choices makes this statement most true?

"My office receives additional resources (funding, information technology capabilities, staffing) from the U.S. Fish & Wildlife Service for using ____________ in making biodiversity management decisions."

- Federal Data
- State or Local Data
- Non-governmental Data
- A combination of the above
- Doesn't make a difference

9. In general, how frequently do the following market their data products to your field office?

	Weekly	Monthly	Quarterly	Annually	Rarely	Never
Federal Government Agencies						
State or Local Government Agencies						
Non-governmental Organizations						

U.S. Fish & Wildlife Service survey

10. How often does your field office confer with the following when making biodiversity management decisions?

	Daily	Weekly	Monthly	Quarterly	Annually	Rarely	Never
NONPROFIT ORGANIZATIONS (Defenders of Wildlife, Sierra Club, American Fisheries Society, etc.)	○	○	○	○	○	○	○
PRIVATE SECTOR BUSINESSES (engineering firms, power plants, manufacturing, etc.)	○	○	○	○	○	○	○
ACADEMIC INSTITUTIONS (university research centers, academic departments, faculty members, etc.)	○	○	○	○	○	○	○

U.S. Fish & Wildlife Service survey

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11. How frequently does your field office receive information relevant to biodiversity management decisions from individual members of the general public (not organized interest groups)?

- Daily
- Weekly
- Monthly
- Quarterly
- Annually
- Rarely
- Never

12. When your field office receives such information from individual members of the general public (not organized interest groups), how many citizens, on average, offer information?

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- Over 20
- Individual members of the general public never offer information.

13. On average, which data source do individual members of the general public (not organized interest groups) encourage your field office to use when making biodiversity management decisions?

- Federal Data
- State or Local Data
- Non-governmental Data
- A combination of the above
- Individual members of the general public do not express a preference.

14. Please rate your field office's overall approach to biodiversity management.

- 1 (Exclusively Species-level)
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 (Exclusively Ecosystem-level)

15. How important is the exchange of information relevant to making biodiversity management decisions with the following?

	1 (Unimportant)	2	3	4	5	6	7	8	9	10 (Important)
Other U.S. Fish & Wildlife Service field offices										
Other Federal natural resource agencies										
State or Local natural resource agencies										
Non-governmental organizations										

U.S. Fish & Wildlife Service survey

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16. The adoption of data is important in making biodiversity management decisions. When your field office is adopting data, how influential are each of the following?

	1 (Not Influential)	2	3	4	5	6	7	8	9	10 (Very Influential)
Data sources used by other U.S. Fish & Wildlife Service field offices	○	○	○	○	○	○	○	○	○	○
The **newness (recency of update) of data** used by other U.S. Fish & Wildlife Service field offices	○	○	○	○	○	○	○	○	○	○

17. What is the most up-to-date version of ArcView software available in your field office?

- ○ 3.x
- ○ 8.x
- ○ 9.1
- ○ 9.2
- ○ Other
- ○ My field office does not use ArcView software.

18. To which region of the U.S. Fish & Wildlife Service does your field office belong?

- ○ Region 1 (Pacific)
- ○ Region 2 (Southwest)
- ○ Region 3 (Great Lakes - Big Rivers)
- ○ Region 4 (Southeast)
- ○ Region 5 (Northeast)
- ○ Region 6 (Mountain-Prairie)
- ○ Region 7 (Alaska)
- ○ Region 8 (California and Nevada)

19. In approximately what year did your field office open?

20. Approximately how many people does your field office employ full-time?

21. Approximately how many people does your field office employ part-time?

22. Approximately how long have you been working for the U.S. Fish & Wildlife Service?

Appendix B: Informed Consent Form

North Carolina State University
INFORMED CONSENT FORM for RESEARCH

Title of Study: An Examination of Factors that Explain the Use of Data in the Natural Resource Policy Process

Principal Investigator: John D. Gerlach, II Faculty Sponsor: Dr. Dennis Daley

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What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher (principal investigator) named above.

What is the purpose of this study?
The purpose of this study is to identify the factors which influence the selection of data by natural resource agency field offices for use in the natural resource policy-making process. Organizational and environmental factors are being assessed in hopes of developing a model for predicting data selection. This study constitutes my doctoral dissertation research, which is being done in partial fulfillment of the requirements necessary for me to earn my Ph.D. in public administration from NC State University.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to participate in an online survey by accessing the URL provided in a Survey Monkey e-mail to follow. The survey will take approximately 10-12 minutes to complete. The survey is entirely web-based. The use of U.S. Mail or telephone questioning is not necessary, and you will not be contacted in those manners regarding this study.

Risks
There are no known risks associated with your participation in this study.

Benefits
This study will add to the knowledge of natural resource professionals and academicians a better understanding of why certain data sources are selected for use in the biodiversity management and conservation decision-making process. This research also provides a better understanding of the organizational and environmental factors influencing data selection decisions.

Confidentiality
The information in the study records will be kept strictly confidential. Data will be stored securely in a personal flash drive and laptop, which is accessible only by the principal investigator. The data collected for this study will not be shared at any point in time. No reference will be made in oral or written reports which could link you to the study. Your identity and that of your field office will be kept strictly confidential. Data will not be shared with any other party outside of the dissemination and potential publication of broad results.

Compensation
You will not receive anything for participating in this study. However, your participation will help enhance our understanding of the subject matter and is greatly appreciated. You will also be provided with descriptive statistics and study results.

What if you have questions about this study?
If you have questions at any time about the study or the procedures, you may contact the researcher, John D. Gerlach, II, by e-mail at jdgerlac@ncsu.edu, or by phone at (314) 495-9512.

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. David Kaber, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/515-3086) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148)

Consent To Participate
"I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may withdraw at any time. I understand that my decision to take the online survey implies my consent to participate in the study."

Appendix C: Survey Codebook

1. How important are the following data sources to your field office?
    a. Federal Data (*FDimp*)
    b. State or Local Data (*SLDimp*)
    c. Non-governmental Data (*NGDimp*)

1=Unimportant to 10=Important

RECODED (*FDimp1, SLDimp1, NGDimp1*): (1-5, 6-9, 10)
1=Unimportant
2=Somewhat Important
3=Very Important

2. How frequently does your field office use the following data sources in making biodiversity management decisions?
    a. Federal Data (*FDfreq*)
    b. State or Local Data (*SLDfreq*)
    c. Non-governmental Data (*NGDfreq*)

1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly
7=Daily

3. What is the name of the data set your field office relies on most?

1=Internal Data
2=State Data
3=Federal Data Other Than FWS
4=Aerial/Satellite Imagery
5=Seabird/Oceanic Data
6=University Data
7=Non-governmental Data
8=Combination Databases
9=Don't Know

4. In approximately what year was this data set last update? (*DataSetUpd*)

Numeric responses

RECODED (*DataSetUpd1*):
1=2008
2=2007
3=2006
4=2005
5=2004
6=2003
7=2002
8=2001
9=2000
10=Before 2000

RECODED (*DataSetUpd2*): (1, 2, 3-10)
1=2008
2=2007
3=Before 2007

5. In approximately what year (or decade if year is unknown) was this data set established?

Numeric responses

RECODED into decades (*DataSetEst*):
1=2000s
2=1990s
3=1980s
4=1970s
5=1960s
6=1950s
7=1940s
8=1930s
9=Before 1930
10=Don't Know

RECODED (*DataSetEst1*): (1, 2, 3, 4, 5, 6-9, 10)
1=2000s
2=1990s
3=1980s
4=1970s
5=1960s
6=Before 1960
7=Don't Know

6. On average, my field office has had positive experiences using the following data sources in making biodiversity management decisions.
    a. Federal Data (*FDexp*)
    b. State or Local Data (*SLDexp*)
    c. Non-governmental Data (*NGDexp*)

1=Strongly Disagree
2=Disagree
3=Neutral
4=Agree
5=Strongly Agree

RECODED (*FDexp1*, *SLDexp1*, *NGDexp1*): (1-3, 4, 5)
1=Do Not Agree
2=Agree
3=Strongly Agree

7. Please rank the following data sources with respect to average positive experiences in making biodiversity management decisions.
    a. Federal Data
    b. State or Local Data
    c. Non-governmental Data

1=Most Satisfied
2
3=Least Satisfied

8. Which of the following choices makes this statement most true? (*add_fund*)

   "My office receives additional resources (funding, information technology capabilities, staffing) from the U.S. Fish & Wildlife Service for using ______________ in making biodiversity management decisions.

1=Federal Data
2=State or Local Data
3=Non-governmental Data
4=A combination of the above
5=Doesn't make a difference

9. In general, how frequently do the following market their data products to your field office?
   a. Federal Government Agencies (*FD_market*)
   b. State or Local Government Agencies (*SLD_market*)
   c. Non-governmental Organizations (*NG_market*)

1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly

10. How often does your field office confer with the following when making biodiversity management decisions?
    a. Nonprofit Organizations (*confer_NPO*)
    b. Private Sector Businesses (*confer_PrivSec*)
    c. Academic Institutions (*confer_Acad*)

1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly
7=Daily

RECODED (*confer_NPO1, confer_PrivSec1, confer_Acad1*): (1, 2, 3, 4, 5, 6-7)
1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly

11. How frequently does your field office receive information relevant to biodiversity management decisions from individual members of the general public (not organized interest groups)? (*pub_inform*)

1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly
7=Daily

RECODED (*pub_inform1*): (1, 2, 3, 4, 5, 6-7)
1=Never
2=Rarely
3=Annually
4=Quarterly
5=Monthly
6=Weekly

12. When your field office receives such information from individual members of the general public (not organized interest groups), how many citizens, on average, offer information? (*pub_numbers*)

1=Individual members of the general public never offer information.
2= 1–5
3= 6-10
4= 11–15
5= 16-20
6= Over 20

RECODED (*pub_numbers1*): (1, 2, 3-6)
1=Individual members of the general public never offer information.
2= 1–5
3=Over 5

13. On average, which data source do individual members of the general public (not organized interest groups) encourage your field office to use when making biodiversity management decisions? (*pub_datapref*)

1=Individual members of the general public do not express a preference.
2=Federal Data
3=State or Local Data
4=Non-governmental Data
5=A combination of the above

14. Please rate your field office's overall approach to biodiversity management. (*bio_mgmt*)

1=Exclusively Species-level to 10=Exclusively Ecosystem-level

15. How important is the exchange of information relevant to making biodiversity management decisions with the following?
    a. Other U.S. Fish & Wildlife Service field offices (*info_FWS*)
    b. Other Federal natural resource agencies (*info_Fed*)
    c. State or Local natural resource agencies (*info_SL*)
    d. Non-governmental organizations (*info_NG*)

1=Unimportant to 10=Important

RECODED (*info_FWS1, info_Fed1, info_SL1, info_NG1*): (1-5, 6-9, 10)
1=Unimportant
2=Somewhat Important
3=Very Important

16. The adoption of data is important in making biodiversity management decisions. When your field office is adopting data, how influential are each of the following?
    a. Data sources used by other U.S. Fish & Wildlife Service field offices (*data_infl*)
    b. The newness (recency of update) of data used by other U.S. Fish & Wildlife Service field offices (*new_infl*)

1=Not Influential to 10=Very Influential

RECODED (*data_infl1, new_infl1*): (1-5, 6-9, 10)
1=Not Influential
2=Somewhat Influential
3=Very Influential

17. What is the most up-to-date version of ArcView software available in your field office? (*ArcView*)

1=My field office does not use ArcView software.
2=3.x
3=8.x
4=9.1
5=9.2
6=Other

RECODED (*ArcView1*): (1, 2-4 & 6, 5)
1=My field office does not use ArcView software.
2=Earlier Version
3=Version 9.2

18. To which region of the U.S. Fish & Wildlife Service does your field office belong? (*region*)

1=Region 1 (Pacific)
2=Region 2 (Southwest)
3=Region 3 (Great Lakes – Big Rivers)
4=Region 4 (Southeast)
5=Region 5 (Northeast)
6=Region 6 (Mountain-Prairie)
7=Region 7 (Alaska)
8=Region 8 (California and Nevada)

19. In approximately what year did your field office open? (*FO_open*)

Numeric responses

RECODED (*FO_open1*)

1=2000s
2=1990s
3=1980s
4=1970s
5=1960s
6=Before 1960

20. Approximately how many people does your field office employee full-time? (*emp_FT*)

Numeric responses

21. Approximately how many people does your field office employ part-time? (*emp_PT*)

Numeric responses

COMPUTE VARIABLE: *FTE* = emp_FT + (emp_PT / 2)

22. Approximately how long have you been working for the U.S. Fish & Wildlife Service? (*tenure*)

Numeric responses (measured in years)

Appendix D: Original Frequency Distributions

Federal Data Importance (FDimp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	2	.8	.9	.9
	2	3	1.3	1.3	2.1
	4	2	.8	.9	3.0
	5	6	2.5	2.6	5.6
	6	4	1.7	1.7	7.3
	7	14	5.9	6.0	13.3
	8	31	13.0	13.3	26.6
	9	40	16.8	17.2	43.8
	Important	131	55.0	56.2	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

State or Local Data Importance (SLDimp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	3	1.3	1.3	1.3
	2	3	1.3	1.3	2.6
	3	5	2.1	2.1	4.7
	4	3	1.3	1.3	6.0
	5	10	4.2	4.3	10.3
	6	8	3.4	3.4	13.7
	7	17	7.1	7.3	21.0
	8	40	16.8	17.2	38.2
	9	39	16.4	16.7	54.9
	Important	105	44.1	45.1	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

Non-governmental Data Importance (NGDimp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	4	1.7	1.7	1.7
	2	4	1.7	1.7	3.4
	3	3	1.3	1.3	4.7
	4	3	1.3	1.3	6.0
	5	20	8.4	8.6	14.7
	6	18	7.6	7.8	22.4
	7	27	11.3	11.6	34.1
	8	35	14.7	15.1	49.1
	9	32	13.4	13.8	62.9
	Important	86	36.1	37.1	100.0
	Total	232	97.5	100.0	
Missing	System	6	2.5		
Total		238	100.0		

Federal Data Frequency of Use (FDfreq)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	1.7	1.8	1.8
	Rarely	16	6.7	7.1	8.8
	Annually	38	16.0	16.8	25.7
	Quarterly	29	12.2	12.8	38.5
	Monthly	45	18.9	19.9	58.4
	Weekly	50	21.0	22.1	80.5
	Daily	44	18.5	19.5	100.0
	Total	226	95.0	100.0	
Missing	System	12	5.0		
Total		238	100.0		

State or Local Data Frequency of Use (SLDfreq)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	4	1.7	1.8	1.8
	Rarely	17	7.1	7.6	9.3
	Annually	48	20.2	21.3	30.7
	Quarterly	43	18.1	19.1	49.8
	Monthly	49	20.6	21.8	71.6
	Weekly	38	16.0	16.9	88.4
	Daily	26	10.9	11.6	100.0
	Total	225	94.5	100.0	
Missing	System	13	5.5		
Total		238	100.0		

Non-governmental Data Frequency of Use (NGDfreq)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	2.1	2.2	2.2
	Rarely	37	15.5	16.6	18.8
	Annually	55	23.1	24.7	43.5
	Quarterly	31	13.0	13.9	57.4
	Monthly	44	18.5	19.7	77.1
	Weekly	34	14.3	15.2	92.4
	Daily	17	7.1	7.6	100.0
	Total	223	93.7	100.0	
Missing	System	15	6.3		
Total		238	100.0		

Parent Agency Influence (add_fund)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Federal Data	15	6.3	7.5	7.5
	State or Local Data	4	1.7	2.0	9.5
	Non-governmental Data	5	2.1	2.5	12.1
	A combination of data sources	66	27.7	33.2	45.2
	Doesn't make a difference	109	45.8	54.8	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Field Office Management Practices (bio_mgmt)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Exclusively Species-level	3	1.3	1.5	1.5
	2	8	3.4	3.9	5.4
	3	17	7.1	8.3	13.7
	4	14	5.9	6.9	20.6
	5	44	18.5	21.6	42.2
	6	30	12.6	14.7	56.9
	7	43	18.1	21.1	77.9
	8	31	13.0	15.2	93.1
	9	10	4.2	4.9	98.0
	Exclusively Ecosystem-level	4	1.7	2.0	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Information Exchange w/ Other FWS Field Offices (info_FWS)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	2	.8	1.0	1.0
	2	2	.8	1.0	2.0
	3	1	.4	.5	2.4
	5	4	1.7	2.0	4.4
	6	10	4.2	4.9	9.3
	7	12	5.0	5.9	15.1
	8	29	12.2	14.1	29.3
	9	43	18.1	21.0	50.2
	Important	102	42.9	49.8	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Information Exchange w/ Other Federal Agencies (info_Fed)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	2	.8	1.0	1.0
	2	2	.8	1.0	2.0
	3	1	.4	.5	2.5
	4	4	1.7	2.0	4.4
	5	14	5.9	6.9	11.3
	6	9	3.8	4.4	15.7
	7	23	9.7	11.3	27.0
	8	49	20.6	24.0	51.0
	9	39	16.4	19.1	70.1
	Important	61	25.6	29.9	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Information Exchange w/ State or Local Agencies (info_SL)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	2	.8	1.0	1.0
	3	1	.4	.5	1.5
	4	2	.8	1.0	2.5
	5	6	2.5	2.9	5.4
	6	10	4.2	4.9	10.3
	7	19	8.0	9.3	19.6
	8	46	19.3	22.5	42.2
	9	42	17.6	20.6	62.7
	Important	76	31.9	37.3	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Information Exchange w/ Non-governmental Organizations (info_NG)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	2	.8	1.0	1.0
	2	6	2.5	2.9	3.9
	3	3	1.3	1.5	5.4
	4	5	2.1	2.5	7.8
	5	20	8.4	9.8	17.6
	6	21	8.8	10.3	27.9
	7	29	12.2	14.2	42.2
	8	45	18.9	22.1	64.2
	9	27	11.3	13.2	77.5
	Important	46	19.3	22.5	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Past Federal Data Use Experiences (FDexp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	.8	1.0	1.0
	Disagree	1	.4	.5	1.5
	Neutral	27	11.3	13.3	14.8
	Agree	110	46.2	54.2	69.0
	Strongly Agree	63	26.5	31.0	100.0
	Total	203	85.3	100.0	
Missing	System	35	14.7		
Total		238	100.0		

Past State or Local Data Use Experiences (SLDexp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	1.3	1.5	1.5
	Disagree	4	1.7	2.0	3.4
	Neutral	29	12.2	14.3	17.7
	Agree	119	50.0	58.6	76.4
	Strongly Agree	48	20.2	23.6	100.0
	Total	203	85.3	100.0	
Missing	System	35	14.7		
Total		238	100.0		

Past Non-governmental Data Use Experiences (NGDexp)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	.8	1.0	1.0
	Disagree	4	1.7	2.0	3.0
	Neutral	55	23.1	27.2	30.2
	Agree	96	40.3	47.5	77.7
	Strongly Agree	45	18.9	22.3	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Information Technology Capabilities (ArcView)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	My field office does not use ArcView software.	31	13.0	15.7	15.7
	3.x	5	2.1	2.5	18.3
	8.x	9	3.8	4.6	22.8
	9.1	33	13.9	16.8	39.6
	9.2	116	48.7	58.9	98.5
	Other	3	1.3	1.5	100.0
	Total	197	82.8	100.0	
Missing	System	41	17.2		
Total		238	100.0		

Federal Agency Data Marketing Efforts (FD_market)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	43	18.1	21.6	21.6
	Rarely	50	21.0	25.1	46.7
	Annually	51	21.4	25.6	72.4
	Quarterly	18	7.6	9.0	81.4
	Monthly	28	11.8	14.1	95.5
	Weekly	9	3.8	4.5	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

State or Local Agency Data Marketing Efforts (SLD_market)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	47	19.7	23.5	23.5
	Rarely	76	31.9	38.0	61.5
	Annually	43	18.1	21.5	83.0
	Quarterly	19	8.0	9.5	92.5
	Monthly	12	5.0	6.0	98.5
	Weekly	3	1.3	1.5	100.0
	Total	200	84.0	100.0	
Missing	System	38	16.0		
Total		238	100.0		

Non-governmental Data Marketing Efforts (NG_market)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	40	16.8	20.2	20.2
	Rarely	82	34.5	41.4	61.6
	Annually	31	13.0	15.7	77.3
	Quarterly	26	10.9	13.1	90.4
	Monthly	14	5.9	7.1	97.5
	Weekly	5	2.1	2.5	100.0
	Total	198	83.2	100.0	
Missing	System	40	16.8		
Total		238	100.0		

Confer w/ Nonprofit Organizations (confer_NPO)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	12	5.0	5.9	5.9
	Rarely	70	29.4	34.3	40.2
	Annually	40	16.8	19.6	59.8
	Quarterly	42	17.6	20.6	80.4
	Monthly	22	9.2	10.8	91.2
	Weekly	13	5.5	6.4	97.5
	Daily	5	2.1	2.5	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Confer w/ Private Sector Businesses (confer_PrivSec)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	29	12.2	14.1	14.1
	Rarely	95	39.9	46.3	60.5
	Annually	29	12.2	14.1	74.6
	Quarterly	20	8.4	9.8	84.4
	Monthly	14	5.9	6.8	91.2
	Weekly	14	5.9	6.8	98.0
	Daily	4	1.7	2.0	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Confer w/ Academic Institutions (confer_Acad)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	.8	1.0	1.0
	Rarely	23	9.7	11.2	12.2
	Annually	56	23.5	27.3	39.5
	Quarterly	49	20.6	23.9	63.4
	Monthly	49	20.6	23.9	87.3
	Weekly	20	8.4	9.8	97.1
	Daily	6	2.5	2.9	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Other Field Office Data Source (data _infl)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	4	1.7	2.0	2.0
	3	1	.4	.5	2.5
	4	3	1.3	1.5	4.0
	5	23	9.7	11.6	15.6
	6	12	5.0	6.0	21.6
	7	31	13.0	15.6	37.2
	8	36	15.1	18.1	55.3
	9	40	16.8	20.1	75.4
	Very Influential	49	20.6	24.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Other Field Office Data Newness (new_infl)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	3	1.3	1.5	1.5
	4	1	.4	.5	2.0
	5	17	7.1	8.5	10.6
	6	13	5.5	6.5	17.1
	7	32	13.4	16.1	33.2
	8	43	18.1	21.6	54.8
	9	35	14.7	17.6	72.4
	Very Influential	55	23.1	27.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Public Participation Frequency (pub_inform)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	24	10.1	11.8	11.8
	Rarely	107	45.0	52.5	64.2
	Annually	24	10.1	11.8	76.0
	Quarterly	20	8.4	9.8	85.8
	Monthly	22	9.2	10.8	96.6
	Weekly	7	2.9	3.4	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Public Participation Intensity (pub_numbers)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individual members of the general public never offer information.	27	11.3	13.4	13.4
	1-5	152	63.9	75.2	88.6
	6-10	12	5.0	5.9	94.6
	11-15	4	1.7	2.0	96.5
	Over 20	7	2.9	3.5	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Public Data Use Preference (pub_datapref)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individual members of the general public do not express a preference.	119	50.0	58.9	58.9
	Federal Data	7	2.9	3.5	62.4
	State or Local Data	4	1.7	2.0	64.4
	Non-governmental Data	23	9.7	11.4	75.7
	A combination of data sources	49	20.6	24.3	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Service Region (region)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Region 1 (Pacific)	22	9.2	10.8	10.8
	Region 2 (Southwest)	25	10.5	12.3	23.0
	Region 3 (Great Lakes - Big Rivers)	35	14.7	17.2	40.2
	Region 4 (Southeast)	43	18.1	21.1	61.3
	Region 5 (Northeast)	32	13.4	15.7	77.0
	Region 6 (Mountain-Prairie)	22	9.2	10.8	87.7
	Region 7 (Alaska)	10	4.2	4.9	92.6
	Region 8 (California and Nevada)	15	6.3	7.4	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Appendix E: Recoded Frequency Distributions

Federal Data Importance RECODED (FDimp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	13	5.5	5.6	5.6
	Somewhat Important	89	37.4	38.2	43.8
	Very Important	131	55.0	56.2	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

State or Local Data Importance RECODED (SLDimp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	24	10.1	10.3	10.3
	Somewhat Important	104	43.7	44.6	54.9
	Very Important	105	44.1	45.1	100.0
	Total	233	97.9	100.0	
Missing	System	5	2.1		
Total		238	100.0		

Non-governmental Data Importance RECODED (NGDimp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	34	14.3	14.7	14.7
	Somewhat Important	112	47.1	48.3	62.9
	Very Important	86	36.1	37.1	100.0
	Total	232	97.5	100.0	
Missing	System	6	2.5		
Total		238	100.0		

Year of Last Update of Data Set Most Relied Upon (DataSetUpd2) (RECODED from continuous variable)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2008	109	45.8	68.6	68.6
	2007	34	14.3	21.4	89.9
	Before 2007	16	6.7	10.1	100.0
	Total	159	66.8	100.0	
Missing	System	79	33.2		
Total		238	100.0		

Decade of Establishment of Data Set Most Relied Upon (DataSetEst1)
(RECODED from continuous variable)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2000s	39	16.4	23.6	23.6
	1990s	26	10.9	15.8	39.4
	1980s	24	10.1	14.5	53.9
	1970s	14	5.9	8.5	62.4
	1960s	12	5.0	7.3	69.7
	Before 1960	15	6.3	9.1	78.8
	Don't Know	35	14.7	21.2	100.0
	Total	165	69.3	100.0	
Missing	System	73	30.7		
Total		238	100.0		

Age of Field Office (FO_open1)
(RECODED from continuous variable)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2000s	7	2.9	3.6	3.6
	1990s	36	15.1	18.6	22.2
	1980s	31	13.0	16.0	38.1
	1970s	25	10.5	12.9	51.0
	1960s	24	10.1	12.4	63.4
	Before 1960	71	29.8	36.6	100.0
	Total	194	81.5	100.0	
Missing	System	44	18.5		
Total		238	100.0		

Information Exchange w/ Other FWS Field Office RECODED (info_FWS1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	9	3.8	4.4	4.4
	Somewhat Important	94	39.5	45.9	50.2
	Very Important	102	42.9	49.8	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Information Exchange w/ Other Federal Agencies RECODED (Info_Fed1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	23	9.7	11.3	11.3
	Somewhat Important	120	50.4	58.8	70.1
	Very Important	61	25.6	29.9	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Information Exchange w/ State or Local Agencies RECODED (info_SL1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	11	4.6	5.4	5.4
	Somewhat Important	117	49.2	57.4	62.7
	Very Important	76	31.9	37.3	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Information Exchange w/ Non-governmental Organizations RECODED (info_NG1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant	36	15.1	17.6	17.6
	Somewhat Important	122	51.3	59.8	77.5
	Very Important	46	19.3	22.5	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Past State or Local Data Use Experiences RECODED (SLDexp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do Not Agree	36	15.1	17.7	17.7
	Agree	119	50.0	58.6	76.4
	Strongly Agree	48	20.2	23.6	100.0
	Total	203	85.3	100.0	
Missing	System	35	14.7		
Total		238	100.0		

Past Federal Data Use Experiences RECODED (FDexp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do Not Agree	30	12.6	14.8	14.8
	Agree	110	46.2	54.2	69.0
	Strongly Agree	63	26.5	31.0	100.0
	Total	203	85.3	100.0	
Missing	System	35	14.7		
Total		238	100.0		

Past Non-governmental Data Use Experiences RECODED (NGDexp1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do Not Agree	61	25.6	30.2	30.2
	Agree	96	40.3	47.5	77.7
	Strongly Agree	45	18.9	22.3	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Information Technology Capabilities RECODED (ArcView1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	My office does not use ArcView software.	31	13.0	13.0	13.0
	Earlier version	91	38.2	38.2	51.3
	Version 9.2	116	48.7	48.7	100.0
	Total	238	100.0	100.0	

Confer w/ Nonprofit Organizations RECODED (confer_NPO1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	12	5.0	5.9	5.9
	Rarely	70	29.4	34.3	40.2
	Annually	40	16.8	19.6	59.8
	Quarterly	42	17.6	20.6	80.4
	Monthly	22	9.2	10.8	91.2
	Weekly	18	7.6	8.8	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Confer w/ Private Sector Businesses RECODED (confer_PrivSec1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	29	12.2	14.1	14.1
	Rarely	95	39.9	46.3	60.5
	Annually	29	12.2	14.1	74.6
	Quarterly	20	8.4	9.8	84.4
	Monthly	14	5.9	6.8	91.2
	Weekly	18	7.6	8.8	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Confer w/ Academic Institutions RECODED (confer_Acad1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	.8	1.0	1.0
	Rarely	23	9.7	11.2	12.2
	Annually	56	23.5	27.3	39.5
	Quarterly	49	20.6	23.9	63.4
	Monthly	49	20.6	23.9	87.3
	Weekly	26	10.9	12.7	100.0
	Total	205	86.1	100.0	
Missing	System	33	13.9		
Total		238	100.0		

Other Field Office Data Source RECODED (data_infl1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	31	13.0	15.6	15.6
	Somewhat Influential	119	50.0	59.8	75.4
	Very Influential	49	20.6	24.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Other Field Office Data Newness RECODED (new_infl1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Influential	21	8.8	10.6	10.6
	Somewhat Influential	123	51.7	61.8	72.4
	Very Influential	55	23.1	27.6	100.0
	Total	199	83.6	100.0	
Missing	System	39	16.4		
Total		238	100.0		

Public Participation Frequency RECODED (pub_inform1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	24	10.1	11.8	11.8
	Rarely	107	45.0	52.5	64.2
	Annually	24	10.1	11.8	76.0
	Quarterly	20	8.4	9.8	85.8
	Monthly	22	9.2	10.8	96.6
	Weekly	7	2.9	3.4	100.0
	Total	204	85.7	100.0	
Missing	System	34	14.3		
Total		238	100.0		

Public Participation Intensity RECODED (pub_numbers1)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Individual members of the general public never offer information.	27	11.3	13.4	13.4
	1-5	152	63.9	75.2	88.6
	Over 5	23	9.7	11.4	100.0
	Total	202	84.9	100.0	
Missing	System	36	15.1		
Total		238	100.0		

Appendix F: Bivariate Pearson Correlations Matrix (N=238)

	Federal Data Importance	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
Federal Data Importance	1	.622**	.532**	.275**	.236**	.217**
State or Local Data Importance	.622**	1	.701**	.224**	.400**	.288**
Non-governmental Data Importance	.532**	.701**	1	.110	.221**	.437**
Federal Data Frequency of Use	.275**	.224**	.110	1	.791**	.648**
State or Local Data Frequency of Use	.236**	.400**	.221**	.791**	1	.722**
Non-governmental Data Frequency of Use	.217**	.288**	.437**	.648**	.722**	1
Year of Last Update of Data Set Most Relied Upon	-.021	-.071	-.118	-.105	-.046	-.157
Decade of Establishment of Data Set Most Relied Upon	.072	-.027	.027	.045	.076	.102
Age of Field Office	.084	.019	.081	.037	.010	.055
Parent Agency Influence	-.050	.010	-.084	-.109	-.027	-.076

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Year of Last Update of Data Set Most Relied Upon	*Decade of Establishment of Data Set Most Relied Upon*	*Age of Field Office*	*Parent Agency Influence*	*Field Office Management Practices*	*Information Exchange w/ Other FWS Field Offices*
Federal Data Importance	-.021	.072	.084	-.050	.057	.280**
State or Local Data Importance	-.071	-.027	.019	.010	.066	.225**
Non-governmental Data Importance	-.118	.027	.081	-.084	.148*	.125
Federal Data Frequency of Use	-.105	.045	.037	-.109	-.010	.082
State or Local Data Frequency of Use	-.046	.076	.010	-.027	.008	.146*
Non-governmental Data Frequency of Use	-.157	.102	.055	-.076	.054	.127
Year of Last Update of Data Set Most Relied Upon	1	-.189*	-.132	.089	.119	.010
Decade of Establishment of Data Set Most Relied Upon	-.189*	1	.142	.002	.046	.174*
Age of Field Office	-.132	.142	1	-.052	.035	.015
Parent Agency Influence	.089	.002	-.052	1	-.022	.017

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Exchange w/ Other Federal Agencies	*Information Exchange w/ State or Local Agencies*	*Information Exchange w/ Non-governmental Organizations*	*Past Federal Data Use Experiences*	*Past State or Local Data Use Experiences*	*Past Non-governmental Data Use Experiences*
Federal Data Importance	.314**	.319**	.258**	.271**	.258**	.127
State or Local Data Importance	.353**	.375**	.247**	.193**	.372**	.211**
Non-governmental Data Importance	.229**	.197**	.351**	.133**	.218**	.391**
Federal Data Frequency of Use	.155*	.174*	-.003	.398**	.303**	.165*
State or Local Data Frequency of Use	.246**	.298**	.096	.243**	.323**	.159*
Non-governmental Data Frequency of Use	.276**	.256**	.258**	.185**	.209**	.417**
Year of Last Update of Data Set Most Relied Upon	-.094	-.002	-.029	-.094	.003	-.109
Decade of Establishment of Data Set Most Relied Upon	.077	.176*	.194*	-.059	-.046	-.044
Age of Field Office	.003	-.036	.114	-.004	-.040	.051
Parent Agency Influence	.042	.029	-.085	-.030	.068	-.050

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Technology Capabilities (ArcView)	*Federal Agency Data Marketing Efforts*	*State or Local Agency Data Marketing Efforts*	*Non-governmental Data Marketing Efforts*	*Confer w/ Nonprofit Organizations*	*Confer w/ Private Sector Businesses*
Federal Data Importance	.020	-.068	-.039	-.125	.151*	.053
State or Local Data Importance	.023	.028	.101	-.019	.257**	.131
Non-governmental Data Importance	.117	-.057	-.075	-.033	.285**	.162*
Federal Data Frequency of Use	.223**	.108	.160*	.107	.379**	.410**
State or Local Data Frequency of Use	.186**	.103	.214**	.131	.488**	.497**
Non-governmental Data Frequency of Use	.162*	.049	.067	.163*	.536**	.452**
Year of Last Update of Data Set Most Relied Upon	-.036	-.021	.087	-.031	.018	-.196*
Decade of Establishment of Data Set Most Relied Upon	.019	-.131	-.134	-.117	.006	-.037
Age of Field Office	-.100	.070	.029	.051	-.056	-.040
Parent Agency Influence	-.006	-.034	-.042	-.201**	.007	-.029

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Confer w/ Academic Institutions	*Other Field Office Data Source*	*Other Field Office Data Newness*	*Public Participation Frequency*	*Public Participation Intensity*	*Public Data Use Preference*
Federal Data Importance	.086	.328**	.290**	-.085	.008	.194**
State or Local Data Importance	.251**	.304**	.367**	-.027	.031	.170*
Non-governmental Data Importance	.286**	.119	.182*	.014	.125	.094
Federal Data Frequency of Use	.356**	.148*	.103	.216**	.114	.122
State or Local Data Frequency of Use	.528**	.186**	.203**	.181*	.132	.191**
Non-governmental Data Frequency of Use	.512**	.141	.145*	.199**	.069	.081
Year of Last Update of Data Set Most Relied Upon	-.033	-.011	.064	-.077	-.257**	-.084
Decade of Establishment of Data Set Most Relied Upon	.055	-.040	.049	-.069	-.048	-.018
Age of Field Office	.023	.103	.067	-.011	-.120	.055
Parent Agency Influence	-.046	-.075	-.016	-.123	-.073	-.078

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Employees in Field Office	*Service Region*	*Tenure w/ FWS*
Federal Data Importance	.101	.081	-.051
State or Local Data Importance	.096	.053	-.045
Non-governmental Data Importance	.101	.121	-.013
Federal Data Frequency of Use	.199**	-.221**	-.138
State or Local Data Frequency of Use	.195**	-.156*	-.163*
Non-governmental Data Frequency of Use	.212**	-.135	-.084
Year of Last Update of Data Set Most Relied Upon	-.114	.015	.028
Decade of Establishment of Data Set Most Relied Upon	-.044	.020	-.130
Age of Field Office	.155*	.082	.067
Parent Agency Influence	-.050	.074	.062

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Federal Data Importance	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
Field Office Management Practices	.057	.066	.148*	-.010	.008	.054
Information Exchange w/ Other FWS Field Offices	.280**	.225**	.125	.082	.146*	.127
Information Exchange w/ Other Federal Agencies	.314**	.353**	.229**	.155*	.246**	.276**
Information Exchange w/ State or Local Agencies	.319**	.375**	.197**	.174*	.298**	.256**
Information Exchange w/ Non-governmental Organizations	.258**	.247**	.351**	-.003	.096	.258**
Past Federal Data Use Experiences	.271**	.193**	.133	.398**	.243**	.185**
Past State or Local Data Use Experiences	.258**	.372**	.218**	.303**	.323**	.209**
Past Non-governmental Data Use Experiences	.127	.211**	.391**	.165*	.159*	.417**
Information Technology Capabilities (ArcView)	.020	.023	.117	.223**	.186**	.162*
Federal Agency Data Marketing Efforts	-.068	.028	-.057	.108	.103	.049

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Year of Last Update of Data Set Most Relied Upon	*Decade of Establishment of Data Set Most Relied Upon*	*Age of Field Office*	*Parent Agency Influence*	*Field Office Management Practices*	*Information Exchange w/ Other FWS Field Offices*
Field Office Management Practices	.119	.046	.035	-.022	1	.025
Information Exchange w/ Other FWS Field Offices	.010	.174*	.015	.017	.025	1
Information Exchange w/ Other Federal Agencies	-.094	.077	.003	.042	.053	.604**
Information Exchange w/ State or Local Agencies	-.002	.176*	-.036	.029	.016	.589**
Information Exchange w/ Non-governmental Organizations	-.029	.194*	.114	-.085	.117	.462**
Past Federal Data Use Experiences	-.094	-.059	-.004	-.030	-.058	.071
Past State or Local Data Use Experiences	.003	-.046	-.040	.068	-.001	.127
Past Non-governmental Data Use Experiences	-.109	-.044	.051	-.050	.109	.087
Information Technology Capabilities (ArcView)	-.036	.019	-.100	-.006	.118	-.127
Federal Agency Data Marketing Efforts	-.021	-.131	.070	-.034	.056	.030

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Exchange w/ Other Federal Agencies	*Information Exchange w/ State or Local Agencies*	*Information Exchange w/ Non-governmental Organizations*	*Past Federal Data Use Experiences*	*Past State or Local Data Use Experiences*	*Past Non-governmental Data Use Experiences*
Field Office Management Practices	.053	.016	.117	-.058	-.001	.109
Information Exchange w/ Other FWS Field Offices	.604**	.589**	.462**	.071	.127	.087
Information Exchange w/ Other Federal Agencies	1	.769**	.494**	.063	.074	-.026
Information Exchange w/ State or Local Agencies	.769**	1	.582**	.022	.125	-.003
Information Exchange w/ Non-governmental Organizations	.494**	.582**	1	-.078	-.007	.182**
Past Federal Data Use Experiences	.063	.022	-.078	1	.726**	.528**
Past State or Local Data Use Experiences	.074	.125	-.007	.726**	1	.578**
Past Non-governmental Data Use Experiences	-.026	-.003	.182**	.528**	.578**	1
Information Technology Capabilities (ArcView)	-.126	-.044	-.075	.139*	.116	.125
Federal Agency Data Marketing Efforts	.051	-.002	-.023	.068	.022	-.019

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Technology Capabilities (ArcView)	*Federal Agency Data Marketing Efforts*	*State or Local Agency Data Marketing Efforts*	*Non-governmental Data Marketing Efforts*	*Confer w/ Nonprofit Organizations*	*Confer w/ Private Sector Businesses*
Field Office Management Practices	-.188	.056	.010	.066	.010	-.084
Information Exchange w/ Other FWS Field Offices	.127	.030	.069	-.069	.062	.064
Information Exchange w/ Other Federal Agencies	.126	.051	.089	-.014	.146*	.187**
Information Exchange w/ State or Local Agencies	.044	-.002	.062	-.038	.211**	.100
Information Exchange w/ Non-governmental Organizations	.075	-.023	-.047	.051	.374**	.098
Past Federal Data Use Experiences	-.139*	.068	.077	.002	.146*	.178*
Past State or Local Data Use Experiences	-.116	.022	.094	-.018	.196**	.144*
Past Non-governmental Data Use Experiences	-.125	-.019	-.075	.098	.236**	.052
Information Technology Capabilities	1	-.085	-.053	-.027	.167*	.131
Federal Agency Data Marketing Efforts	.085	1	.765**	.526**	.107	.035

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Confer w/ Academic Institutions	*Other Field Office Data Source*	*Other Field Office Data Newness*	*Public Participation Frequency*	*Public Participation Intensity*	*Public Data Use Preference*
Field Office Management Practices	.011	-.007	-.016	-.123	-.115	.014
Information Exchange w/ Other FWS Field Offices	.001	.381**	.454**	-.104	.031	-.020
Information Exchange w/ Other Federal Agencies	.097	.347**	.462**	-.062	-.037	.091
Information Exchange w/ State or Local Agencies	.130	.324**	.414**	-.006	-.030	.027
Information Exchange w/ Non-governmental Organizations	.188**	.125	.294**	.032	.050	.049
Past Federal Data Use Experiences	.136	.122	.112	-.014	.054	.022
Past State or Local Data Use Experiences	.127	.125	.095	.035	.082	-.006
Past Non-governmental Data Use Experiences	.178*	.074	.055	.009	.039	-.110
Information Technology Capabilities (ArcView)	.111	-.112	-.068	.114	.131	-.062
Federal Agency Data Marketing Efforts	.190**	-.011	.133	.095	-.053	.160*

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Employees in Field Office	*Service Region*	*Tenure w/ FWS*
Field Office Management Practices	-.063	.017	.110
Information Exchange w/ Other FWS Field Offices	-.154*	-.142*	-.077
Information Exchange w/ Other Federal Agencies	.000	-.122	-.061
Information Exchange w/ State or Local Agencies	.015	-.109	-.083
Information Exchange w/ Non-governmental Organizations	.073	-.064	.023
Past Federal Data Use Experiences	.046	-.109	.002
Past State or Local Data Use Experiences	.029	-.157*	.001
Past Non-governmental Data Use Experiences	.041	-.085	.038
Information Technology Capabilities (ArcView)	.207**	-.008	-.168*
Federal Agency Data Marketing Efforts	.083	-.155*	.075

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Federal Data Importance	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
State or Local Agency Data Marketing Efforts	-.039	.101	-.075	.160*	.214**	.067
Non-governmental Data Marketing Efforts	-.125	-.019	-.033	.107	.131	.163*
Confer w/ Nonprofit Organizations	.151*	.257**	.285**	.379**	.488**	.536**
Confer w/ Private Sector Businesses	.053	.131	.162*	.410**	.497**	.452**
Confer w/ Academic Institutions	.086	.251**	.286**	.356**	.528**	.512**
Other Field Office Data Source	.328**	.304**	.119	.148*	.186**	.141
Other Field Office Data Newness	.290**	.367**	.182*	.103	.203**	.145*
Public Participation Frequency	-.085	-.027	.014	.216**	.181*	.199**
Public Participation Intensity	.008	.031	.125	.114	.132	.069

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Year of Last Update of Data Set Most Relied Upon	*Decade of Establishment of Data Set Most Relied Upon*	*Age of Field Office*	*Parent Agency Influence*	*Field Office Management Practices*	*Information Exchange w/ Other FWS Field Offices*
State or Local Agency Data Marketing Efforts	.087	-.134	.029	-.042	.010	.069
Non-governmental Data Marketing Efforts	-.031	-.117	.051	-.201**	.066	-.069
Confer w/ Nonprofit Organizations	.018	.006	-.056	.007	.010	.062
Confer w/ Private Sector Businesses	-.196*	-.037	-.040	-.029	-.084	.064
Confer w/ Academic Institutions	-.033	.055	.023	-.046	.011	.001
Other Field Office Data Source	-.011	-.040	.103	-.075	-.007	.381**
Other Field Office Data Newness	.064	.049	.067	-.016	-.016	.454**
Public Participation Frequency	-.077	-.069	-.011	.056	-.123	-.104
Public Participation Intensity	-.257**	-.048	-.120	-.073	-.115	.031

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Exchange w/ Other Federal Agencies	*Information Exchange w/ State or Local Agencies*	*Information Exchange w/ Non-governmental Organizations*	*Past Federal Data Use Experiences*	*Past State or Local Data Use Experiences*	*Past Non-governmental Data Use Experiences*
State or Local Agency Data Marketing Efforts	.089	.062	-.047	.077	.094	-.075
Non-governmental Data Marketing Efforts	-.014	-.038	.051	.002	-.018	.098
Confer w/ Nonprofit Organizations	.146*	.211**	.374**	.146*	.196**	.236**
Confer w/ Private Sector Businesses	.187**	.100	.098	.178*	.144*	.052
Confer w/ Academic Institutions	.097	.130	.188**	.136	.127	.178*
Other Field Office Data Source	.347**	.324**	.125	.122	.125	.074
Other Field Office Data Newness	.462**	.414**	.294**	.112	.095	.055
Public Participation Frequency	-.062	-.006	.032	-.014	.035	.009
Public Participation Intensity	-.037	-.030	.050	.054	.082	.039

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Technology Capabilities (ArcView)	*Federal Agency Data Marketing Efforts*	*State or Local Agency Data Marketing Efforts*	*Non-governmental Data Marketing Efforts*	*Confer w/ Nonprofit Organizations*	*Confer w/ Private Sector Businesses*
State or Local Agency Data Marketing Efforts	-.053	.765**	1	.543**	.182*	.127
Non-governmental Data Marketing Efforts	-.027	.526**	.543**	1	.269**	.133
Confer w/ Nonprofit Organizations	.167*	.107	.182*	.269**	1	.490**
Confer w/ Private Sector Businesses	.131	.035	.127	.133	.490**	1
Confer w/ Academic Institutions	.111	.190**	.253**	.256**	.569**	.548**
Other Field Office Data Source	-.112	-.011	.096	.004	.000	.035
Other Field Office Data Newness	-.068	.133	.202**	.022	.093	.065
Public Participation Frequency	.114	.095	.044	.183**	.225**	.192**
Public Participation Intensity	.131	-.053	.022	-.011	.026	.178*

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Confer w/ Academic Institutions	*Other Field Office Data Source*	*Other Field Office Data Newness*	*Public Participation Frequency*	*Public Participation Intensity*	*Public Data Use Preference*
State or Local Agency Data Marketing Efforts	.253**	.096	.202**	.044	.022	.162*
Non-governmental Data Marketing Efforts	.256**	.004	.022	.183**	-.011	.161*
Confer w/ Nonprofit Organizations	.569**	.000	.093	.225**	.026	.116
Confer w/ Private Sector Businesses	.548**	.035	.065	.192**	.178*	.233**
Confer w/ Academic Institutions	1	.004	.095	.186**	.119	.173*
Other Field Office Data Source	.004	1	.579**	-.082	-.062	.215**
Other Field Office Data Newness	.095	.579**	1	-.119	-.149*	.078
Public Participation Frequency	.186**	-.082	-.119	1	.452**	.107
Public Participation Intensity	.119	-.062	-.149*	.452**	1	.230**

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Employees in Field Office	*Service Region*	*Tenure w/ FWS*
State or Local Agency Data Marketing Efforts	.060	-.161*	.108
Non-governmental Data Marketing Efforts	.062	-.144*	-.007
Confer w/ Nonprofit Organizations	.128	-.069	-.003
Confer w/ Private Sector Businesses	.181*	-.042	-.123
Confer w/ Academic Institutions	.153*	-.091	-.097
Other Field Office Data Source	-.022	-.044	-.039
Other Field Office Data Newness	-.053	-.110	-.055
Public Participation Frequency	.041	-.070	-.039
Public Participation Intensity	.158*	.032	-.044

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Federal Data Importance	*State or Local Data Importance*	*Non-governmental Data Importance*	*Federal Data Frequency of Use*	*State or Local Data Frequency of Use*	*Non-governmental Data Frequency of Use*
Public Data Use Preference	.194**	.170*	.094	.122	.191**	.081
Employees in Field Office	.101	.096	.101	.199**	.195**	.212**
Service Region	.081	.053	.121	-.221**	-.156*	-.135
Tenure w/ FWS	-.051	-.045	-.013	-.138	-.163*	-.084

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Year of Last Update of Data Set Most Relied Upon	*Decade of Establishment of Data Set Most Relied Upon*	*Age of Field Office*	*Parent Agency Influence*	*Field Office Management Practices*	*Information Exchange w/ Other FWS Field Offices*
Public Data Use Preference	-.084	-.018	.055	-.078	.014	-.020
Employees in Field Office	-.114	-.044	.155*	-.050	-.063	-.154*
Service Region	.015	.020	.082	.074	.017	-.142*
Tenure w/ FWS	.028	-.130	.067	.062	.110	-.077

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Exchange w/ Other Federal Agencies	*Information Exchange w/ State or Local Agencies*	*Information Exchange w/ Non-governmental Organizations*	*Past Federal Data Use Experiences*	*Past State or Local Data Use Experiences*	*Past Non-governmental Data Use Experiences*
Public Data Use Preference	.091	.027	.049	.022	-.006	-.110
Employees in Field Office	.000	.015	.073	.046	.029	.041
Service Region	-.122	-.109	-.064	-.109	-.157*	-.085
Tenure w/ FWS	-.061	-.083	.023	.002	.001	.038

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Information Technology Capabilities (ArcView)	*Federal Agency Data Marketing Efforts*	*State or Local Agency Data Marketing Efforts*	*Non-governmental Data Marketing Efforts*	*Confer w/ Nonprofit Organizations*	*Confer w/ Private Sector Businesses*
Public Data Use Preference	-.062	.160*	.162*	.161*	.116	.233**
Employees in Field Office	.207**	.083	.060	.062	.128	.181*
Service Region	-.008	-.155*	-.161*	-.144*	-.069	-.042
Tenure w/ FWS	-.168*	.075	.108	-.007	-.003	-.123

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Confer w/ Academic Institutions	*Other Field Office Data Source*	*Other Field Office Data Newness*	*Public Participation Frequency*	*Public Participation Intensity*	*Public Data Use Preference*
Public Data Use Preference	.173*	.215**	.078	.107	.230**	1
Employees in Field Office	.153*	-.022	-.053	.041	.158*	.094
Service Region	-.091	-.044	-.110	-.070	.032	-.045
Tenure w/ FWS	-.097	-.039	-.055	-.039	-.044	-.013

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).

	Employees in Field Office	*Service Region*	*Tenure w/ FWS*
Public Data Use Preference	.094	-.045	-.013
Employees in Field Office	1	.083	.030
Service Region	.083	1	.033
Tenure w/ FWS	.030	.033	1

**Correlation is significant at the .01 level (two-tailed).
*Correlation is significant at the .05 level (two-tailed).