THE EFFECTS OF CONTRACTING COSTS, BUREAUCRATIC COSTS, AND CONSTITUENCIES ON STATE WILDLIFE AGENCY BUDGETS

by

Dominic Paul Parker

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master's of Science

in

Applied Economics

MONTANA STATE UNIVERSITY-BOZEMAN
Bozeman, Montana

May 2001

APPROVAL

of a thesis submitted by

Dominic Paul Parker

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

Dean Lueck _____ _____
(Signature) Date

Approved for the Department of Agricultural Economics and Economics

Myles Watts _____ _____
(Signature) Date

Approved for the College of Graduate Studies

Bruce McLeod _____ _____
(Signature) Date

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a master's degree at Montana State University-Bozeman, I agree that the Library shall make it available to borrowers under the rules of the Library.

If I have indicated my intention to copyright this thesis by including a copyright notice page, copying is allowable only for scholarly purposes, consistent with "fair-use" as prescribed by U.S. Copyright Law. Requests for extended quotation from or reproduction of this thesis in whole or in parts may be granted only to the copyright holder.

Signature _____

Date _____

ACKNOWLEDGEMENTS

I wish to thank several individuals for assisting me throughout the development of this thesis. First, I wish to thank my committee members: Dean Lueck, Terry Anderson, and Rob Fleck. Dean introduced me to the topic of wildlife economics and openly shared with me his knowledge of the subject. He diligently reviewed all of my drafts, kept me motivated and focused, and expressed confidence in me throughout the process. Terry provided insights into explaining the most perplexing issues that surfaced. His comments reminded (and taught) me how to think like an economist. Rob helped me move towards progress several times when I felt stuck. He helped me model problems and to better understand the constraints that an academic researcher faces.

This thesis is enhanced in several dimensions because of the useful input I received during a three-month fellowship at PERC. I wish to thank the entire staff at PERC, specifically Dan Benjamin, David Gerard, Don Leal, and Rick Stroup, for taking an active interest in my research.

I wish to thank the Department of Economics, especially Randy Rucker, for providing financial assistance, support, and a great office to write this thesis. I also wish thank Dave Buschena for his informal suggestions and comments. I regret not asking Dave to serve as a fourth committee member. Finally, I wish to thank my fellow graduate students for challenging me throughout this endeavor.

TABLE OF CONTENTS

TABLE OF CONTENTS – Continued

Page

TABLE OF CONTENTS – Continued

Page

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

In the United States, management of wildlife resources is primarily conducted by private landowners and state wildlife agencies. Landowners must establish and enforce contracts in order to capture the value of wildlife populations that inhabit tracts of land beyond their property boundaries. Bureaucratic agencies have little incentive to maximize the net value of wildlife and their performance is limited by political constraints, employee shirking, and conflict among competing professionals. This thesis examines the role that these costs have in affecting the size of state wildlife agency budgets and allocations of budgets to nongame. The general hypothesis is that budget size and budget allocations to nongame respond to changes in the relative costs of each institution in ways consistent with wealth maximization. Two models are developed to derive a narrower set of hypotheses. The first seeks to explain the determinants of agency budget size. The second seeks to explain the determinants of the percentage of budgets allocated to nongame. Five predictions result. First, increases in private contracting costs will increase agency budget size and decrease nongame allocations. Second, increases in bureaucratic costs will decrease agency budget size. Third, increases in the costs of nongame management to agencies and politicians will decrease budget allocation towards nongame. Fourth, increases in game and nongame demand will increase agency budget size. Fifth, increases in the demand for nongame relative to game will increase budget allocations to nongame. For the empirical tests of each model I use data from a cross-section of U.S. states. Land-use and land ownership data proxy private contracting costs and agency organization and funding variables proxy bureaucratic costs. Agency organization and funding variables are also used to proxy nongame management costs to agencies and politicians. Hunting, fishing, and wildlife-watching data are used to proxy demand for game and nongame. The regression analysis supports all five of the predictions listed above.

CHAPTER 1

INTRODUCTION

The actions, incentives, and costs of government bureaucracies are of great interest to economists. In many respects, the study of bureaucracy began when Niskanen (1971) and Stigler (1971) formally recognized that bureaucrats have imperfect incentives to maximize public welfare. Since then, scholars in many disciplines have dedicated their careers towards explaining what government agencies do and why they do it. Much has been learned about the objectives and incentives of individual bureaucrats (Wilson 1989 and Dewatripont et.al. 1999), the tendency of agencies to act as interest groups (Johnson and Libecap 1994), and the role of politicians and interest groups in limiting agency discretion (McCubbins et. al. 1987 and Peltzman 1976). Despite impressive gains in the understanding of bureaucracy, several questions are left conspicuously unanswered. How does the position of an agency on the government hierarchy or the scope of its jurisdiction affect agency incentives, costs, and behavior? How do the incentives, costs, and behavior of an agency funded entirely by user fees differ from an agency that is also funded through general appropriations?

This thesis aims to address these questions by examining the determinants of state fish and wildlife agency budget size and budget allocations. To some, state wildlife agencies may seem like an obscure case study for such broad and important subject matter. Wildlife agencies are small relative to other state agencies with budgets

accounting for less than two percent of state government spending in all states. Yet state wildlife agencies are an ideal case study for two reasons. First, the organization and funding schemes of wildlife agencies are changing and vary considerably across U.S states. These differences provide a rich cross-section of data that can be used to examine the effects of each in influencing bureaucratic incentives and behavior. Second, wildlife agencies are currently at the center of a debate concerning how they should be funded and organized. This study will shed light on the debate and will useful to those with stakes in wildlife policy.

Since their inception in the late 19th century, state wildlife agencies have served a similar set of constituents and have shared many organizational features. This is especially true in the middle of the 20th century when most agencies had adopted the prototype Model State Game and Fish Administrative Law but had not yet began to receive pressure from emerging groups interested in nongame species (Robertson and Bolen 1989). During this period agencies were funded almost entirely by hunters and anglers. Most wildlife agencies were organized independent of other natural resource agencies and were designed to serve their narrow constituencies.

But the constituencies of state wildlife agencies have changed dramatically since the middle of the 20th century. In recent years, interest in nongame wildlife (species not valued specifically for hunting or fishing) has grown and nongame users and wildlife groups less interested in game species have gained leverage. These groups are demanding that a greater emphasis be given to the management of nongame species such as bats, wolves, lizards and songbirds – species that account for 86 percent of all wildlife

but are the recipients of less than 10 percent of state wildlife agency spending (Richie 1999).

Concurrent with changing constituencies, the organizational features of many wildlife agencies have also changed. While hunters and anglers are still the primary revenue source in most states, some state agencies now receive a significant portion of their budgets from state general funds (WCFA 1996). Some wildlife agencies have broadened the scope of their jurisdiction to encompass other natural resource issues such as environmental management, parks, and forestry (Cannemela and Warren 1999, Roberston and Bolen 1989). In addition, many wildlife agencies have been placed below other natural resource agencies on the governmental hierarchy (WMI 1997, WMI 1968).

The reliance on license fees for funding is often cited as the primary reason for the apparent neglect of nongame species (Richie and Holmes 2000, Richie 1999, Scott, Hansen, and Mosher 1999). Over the past 20 years, conservation groups and the International Association of Fish and Wildlife Agencies (IAFWA) have lobbied for nongame funding from both federal and state sources. In the 1990's, the Teaming With Wildlife (TWW) proposal sought to create a consistent source of funding for nongame wildlife through an excise tax on backpacks, binoculars, and other camping equipment. The TWW initiative has faded out and conservation groups are now endorsing the Conservation and Reinvestment Act (CARA) which could add more than $350 million to state wildlife agency budgets. CARA is endorsed by sportsman groups (e.g., Ducks Unlimited and the Rocky Mountain Elk Foundation) as well as groups primarily interested in nongame (e.g., Defenders of Wildlife and the Audubon Society). On the

state level, some conservation groups, such as the Izaack Walton League of America (IWLA), contend that state agencies should switch from a primary reliance on hunting and fishing license sales to a primary reliance on state general funds (Scott, Hansen, and Mosher 1999). According to the IWLA, general fund dollars will give wildlife managers the resources to tend to the needs of neglected species before they become endangered.

Conservation groups and the IAFWA are paying less attention to the affect of organizational structure, such as hierarchy placement and jurisdiction, on agency behavior. A few ecologists, however, seem to recognize the importance of agency organization. Cannemela and Warren (1999, 1059) argue the following. "Considering the breadth of the natural resource management profession, an administrative structure that separates some wildlife management and environmental protection programs may be less efficient than having them combined." The crux of their argument is that wildlife management cannot be administered effectively without integrating the management of complementary agencies. Although it is not entirely clear, they seem to measure efficiency with the costs of improving amenities such as habitat and water quality.

The lobbying efforts of conservation groups and the comments of Cannemela and Warren (1999) begin to illuminate the importance of funding sources and organizational features. Yet the conclusions made by each seem premature. Conservation groups assume that less of a funding reliance on hunters and anglers will lead to increased spending on nongame. General fund dollars, however, have not been primarily directed

at nongame species in the past (O'Toole 1995).[1] Cannemela and Warren (1999) argue that combined administration of natural resource agencies will be more cost effective than separate management but they provide no empirical test to support their conclusion.

Indeed, no systematic explanation of the affects of funding sources and organization on wildlife agency behavior exists in either the economics or the wildlife management literature. In a broad sense, this study will help to illuminate the affects of agency organization on agency behavior. In a more narrow sense, this study will illuminate the affects of wildlife agency organization, funding sources, constituencies, and private contracting costs on wildlife agency budget sizes and budget allocations towards nongame.

Methodology and Key Questions

An analytical impediment exists in modeling agency budget size and allocations to nongame because neither is explicitly chosen by any one institution. State legislators, private landowners, the federal government, and wildlife agency bureaucrats all influence each.[2] To circumvent this impediment I assume that these institutions act together in an effort to maximize the net value of wildlife. Their ability to do so, however, is hindered

[1] General funds in North Carolina were not dedicated to nongame or any other program. The North Carolina Wildlife Commission could spend general funds at their discretion. In Louisiana, general funds helped the agency support boater access, aquatic plant control, marine fisheries research, and wildlife management areas. Missouri received over $60 million in general fund dollars in 1995 but nongame received less than 5 percent of this revenue (O'Toole 1995).

[2] Legislatures determine license pricing and whether or not to grant general funds. Private landowners decide whether or not to manage land as wildlife habitat and control much of the access to hunting and fishing. The federal government, through the Endangered Species Act, claims jurisdiction over certain species and their habitat. State wildlife agency bureaucrats administer and enforce regulations, distribute information about wildlife, and research, monitor, and restock the populations of many species.

by bureaucratic constraints and private contracting costs. Within this framework, a focus on the incentives, constraints, and discretion of bureaucracies becomes paramount. The framework will appeal to the bureaucracy (e.g., Niskanen 1971,Wilson 1989, Peltzman 1976, Becker 1983) and public choice literature (e.g., Weingast, McCubbins, and Noll 1987) for many of its underlying assumptions. I also employ a contracting cost approach (Lueck 1989) to account for the influence of changes in the costs of private wildlife management.

The organizational structure and funding schemes of wildlife agencies vary considerably across states. These differences provide a cross-section of data that will be used to test the effects of each in influencing bureaucratic costs and incentives, and ultimately, behavior. The size and strength of game and nongame constituencies also varies considerably across states and will be used to test the affects of changes in demand conditions on budget sizes and nongame allocations. In addition, land ownership patterns and land usage varies across states. These data will be used to test the validity of a contracting cost framework (Lueck 1989) as a determinant of agency budget size and nongame allocations.

Land holding characteristics (e.g., size, use, and productivity) are shown to influence various hunting regulations as well as season lengths (Lueck 1989). But many questions remain unanswered that will be empirically addressed in this thesis. Does an increase in contracting costs among landowners increase the size of an agency's budget or the percentage of the budget allocated to nongame? Does an increase in an agency's reliance on general funds increase the size of its budget? Do agencies near the top of the

hierarchy have larger budgets than agencies near the bottom? Do agencies with broad jurisdiction have larger budgets than agencies with narrow jurisdiction? Does an increase in the reliance of general funds lead to a more spending on nongame? Does an agency's placement on the hierarchy or the scope of its jurisdiction bias wildlife policy in favor of game or nongame users? Does an increase in the demand for nongame increase budget size or budget allocations to nongame?

Thesis Organization

Understanding the nature of these questions requires a working knowledge of wildlife agencies. Chapter 2 will discuss early conservation efforts and give a rationale for the creation of state game agencies. The chapter describes the evolution from the early game department to the modern wildlife agency and explains the federal government's role in this development. The structure of the modern agency will be described in detail and special emphasis will be placed on the constituencies, organizational structure, budget sizes, funding sources, and the nongame management practices of agencies. Maps are used to highlight differences between states in each of these features.

A working knowledge of the objectives, incentives, and constraints of bureaucrats is an integral component of understanding how wildlife agencies respond to different constituencies and funding sources. Chapter 3 will briefly review the bureaucracy literature that is relevant to this study and examine the implications in a wildlife agency setting. While none of the bureaucracy models that are reviewed provide an explicit

approach to modeling wildlife agency behavior, some provide fundamental ideas that I employ in each of my wildlife policy models.

The size of agency budgets and the percentage of budgets allocated to nongame are both influenced by enough of the same forces to warrant their examination in one study (this thesis). Yet both are influenced by enough different forces to preclude them from being analyzed by one single model. For this reason, the determinants of agency budget size and nongame budget allocations are modeled in separate chapters.

Chapter 4 develops and tests a model of wildlife agency budget determinants. The model begins with a discussion of a first-best outcome. This outcome is used as an analytical benchmark to examine how much wildlife management effort (public and private) is exerted under different demand and cost conditions. The assumptions underlying the first-best outcome are relaxed in the subsequent model. First, positive contracting costs are allowed to influence the cost of private wildlife management effort (Lueck 1989). Next, bureaucratic constraints such as an agency's placement on the hierarchy and the scope of its jurisdiction are allowed to influence the costs of agency wildlife management (Wilson 1989, Dewatripont et al. 1999, Peltzman 1976). Along with traditional demand and cost conditions, contracting and bureaucratic costs are hypothesized to affect the size of wildlife agency budgets in predictable ways. Chapter 4 ends with an empirical analysis of the model. The empirical section introduces the variables and provides empirical tests of the propositions derived from the budget determinant model. Chapter 4 concludes with a presentation and explanation of the

coefficient results derived using ordinary least squares (OLS) and a two-stage least squares (2SLS) procedures.

Chapter 5 examines and models the factors that influence how much of an agency's budget is allocated towards nongame species. The model developed in this chapter borrows ideas from a number of bureaucracy models including Wilson (1989), Niskanen (1971), and Peltzman (1976). The extension of these models in a wildlife agency setting is limited, however, so the model assumes its own identity. The basics of the model are first introduced and a first-best outcome is explained. Next, funding sources, agency placement on the hierarchy, and agency jurisdiction are introduced into the model as separate constraints. Testable implications are derived from these constraints. The last section of Chapter 5 provides an empirical analysis. This section explains the empirical variables that I use to proxy the parameters of the model and concludes with a presentation and explanation of the coefficient estimates derived using OLS and 2SLS procedures.

Chapter 6 summarizes the findings and outlines the conclusions. This chapter evaluates the significance of the findings in terms of the economics of bureaucracy and assesses their wildlife policy implications in light of the current debate. Weaknesses in the data set and econometric procedures are discussed and caveats in interpreting the findings are explained. Suggestions for future research, that would add credibility to the findings of the thesis, are given. The chapter concludes with a discussion of other bureaucratic agencies and peripheral wildlife policy issues that could be examined using the framework developed in the thesis.

CHAPTER 2

WILDLIFE MANAGEMENT IN THE UNITED STATES

In the U.S., state wildlife agencies administer the management of fish and wildlife species but several institutions have stakes in wildlife policy. Over time, state legislatures, private landowners, the federal government, wildlife users, along with wildlife agencies have helped shape wildlife policy. Their affect on wildlife management is marked with landmark legislation as well as more subtle changes in the structure and management emphasis of wildlife agencies.

The purpose of this chapter is to explain how wildlife management has evolved and where it is today. This chapter is organized in two broad sections. The first section describes early game laws, the onset of the federal government's involvement in wildlife policy, and the rationale for the creation of the state game departments. The second section describes the organizational structure, constituencies, funding sources, and management practices of modern wildlife agencies. While many of these features are common among all state agencies, others vary considerably across states. These differences are highlighted near the end of the chapter.

Early Wildlife Management

When European settlers first arrived in North America they were amazed by the abundance and variety of wildlife (Harrington 1991, Tober 1981). Early settlers and

explorers observed that in Georgia the "woods abound with deer, and the trees with swarms of bees and singing birds.... There is a great number of wild fowl.....and the greatest variety of fish in the world." In Virginia, two hundred deer "in one herd have usually been observed." In Massachusetts, "I have seen pigeons.... that to my thinking had neither beginning or ending, length of breadth, and so thick I could see no sun" (Tober 1981, 1). Animals typically associated with the American West were actually once present near the Atlantic coast from New York to Georgia. Bison roamed east of the Appalachians until 1801. Elk herds could be found as far east as Pennsylvania until around 1867. In addition, jaguars, black bears, grizzly bears, mountain lions, bobcats, wolves, martens, fishers, river otters, and lynxes were all in abundance in eastern regions during the colonial times (Harrington 1991).

Accounts of the abundance of wildlife were repeated as white explorers moved west on the frontier. In Kentucky, an ornithologist observed a flock of passenger pigeons that he estimated to contain 2.3 billion birds (Tober 1981). Enormous herds of bison and pronghorn antelope roamed in the prairie states west of the Mississippi. In 1804, explorer Meriwhether Lewis wrote in his journal "....immence herds of Buffaloe deer Elk and antelopes which we saw in every direction feeding on the hills and plains. I do not think I exagerate when I estimated the number of Buffaloe which could be comprehended at one view to amount to 30,000" (Ambrose 1997, 168). Animals such as prairie dogs, prairie chickens, and mule deer were also found in vast quantities. In the western rivers trout were commonplace and salmon were so abundant in the Columbia River that 19th

century explorers claimed that the river could be crossed "on the backs of salmon" (Clark 1995).

Despite the impressive quantities of native wildlife, by the early 1900's the stock of most American wildlife species had been severely reduced (Harrington 1991).[3] The white-tailed deer population had dwindled from estimates of 34 million at the time of Christopher Columbus to less than half a million by 1900. The last passenger pigeon died at the Cincinnati Zoo in 1914 (Belanger 1988). Wild bison populations on the United States plains were reduced from numbers exceeding 10 million in 1870 to about 300 in 1889 (Tober 1981). Salmon populations, which fluctuated erratically around the turn of the 19th century, began their unmistakable and drastic decline in 1918 (Harrington 1991).

The severe decline in wildlife populations resulted, primarily, from the overexploitation of wildlife by market hunters and fishermen (Harrington 1991, Tober 1981, Belanger 1988).[4] The underlying cause for the overexploitation was the open-access nature of wildlife resources. Wildlife was generally available to all on a first-come, first-served basis. The abundance of wildlife in America meant, at least initially, that it was unnecessary to establish property rights to wildlife. Some early observers, however, began to notice the affects of hunting on wildlife populations and legislators began to introduce laws to protect valuable wildlife (Harrington 1991).

---

[3] Much of the wildlife depletion occurred in the latter half of the 19th century. This time period is referred to by many scholars as the "age of extermination" (Belanger 1988).

[4] Other causes included the systematic destruction of predators, loss of habitat, and the introduction of harmful exotic species (Harrington 1991).

Game Laws

Laws to regulate hunting in America existed as early as the colonial period and slowly evolved over the years. Game laws were enacted to protect valuable species from overharvest, and in some cases, to encourage the harvesting of troublesome species such as wolves, foxes, and skunks (Leopold 1933). Other than bag limits and hunting licenses, many of the modern regulations used to prevent overharvest were first imposed in colonial times. By the time of the revolution, twelve of the thirteen colonies had closed seasons for certain species. Several had also prohibited certain methods of "taking" and the export sale of deerskins (Leopold 1933). Maryland banned the killing of deer by firelight in 1730. Sunday hunting was first banned in Delaware in 1795 with many states adding the regulation shortly after (Belanger 1988).

By 1880 all states had game laws. The first resident hunting license was required in NewYork in 1864 (Leopold 1933) and the first non-resident license was imposed in New Jersey in 1873 (Belanger 1988). The first bag limit for game animals was enacted in Iowa in 1878 limiting the taking of prairie chickens. The first bag limit for trout was set in Oregon in 1901 at 125 per day (Belanger 1988).

The growing prevalence of game laws required enforcement. The first game wardens appeared in Massachusetts and New Hampshire around 1740 (Belanger 1988). Early wardens were usually politically appointed, had little or no training for their work, and lacked authority. Instead of receiving salaries, early wardens were typically paid a commission of the fines they levied. This type of compensation led to vigorous enforcement and sometimes violent conflict between poachers and game wardens (Lueck

2000). Also, because early wardens were usually politically appointed, they learned which violators to avoid apprehending (Belanger 1988). In short, early law enforcement was inconsistent and unprofessional.

The Evolution of the Game Agency

The early game laws had only limited success in curbing overexploitation. During the 19th century, game laws were becoming more and more complex but were generally weak as they did not grant clear and full ownership rights to the states (Tober 1981). Moreover, the laws were seldom enforced. As wildlife populations continued to plummet there was recognition for a need to consolidate property rights to wildlife and enforcement authority into a single entity. "The logical mechanism.... was a state-level administrative agency that might develop the necessary scientific expertise for wildlife management, enforce existing law by deploying agents in the field, and advocate the cause of wildlife before legislature and the public" (Tober 1981). The state-run game department, still intact today, is the institution that emerged. The first state game agencies were established in California and New Hampshire in 1878. By 1900, seventeen states had game departments.[5]

The game agency system of wildlife management that developed in the U.S. was quite different than the landowner based system used in Great Britain. Lueck (1989) argues that the difference in the two systems reflects the disparity between the size of privately owned tracts and wildlife habitat requirements. In Great Britain nearly all of

[5] The agencies began to organize almost immediately. The International Association of Wildlife Agencies (IAFWA) was formed in 1902 when commissioners of eight states met in Yellowstone National Park to discuss wildlife management issues (Belanger 1988).

the land was (and is) privately owned and held in relatively large parcels. The territorial requirements of wildlife in Britain were often contained in a single landholding. A British landowner was more likely to capture the value of resident wildlife because he did not have to engage in costly negotiations with neighbors who also provided habitat for the same wildlife population. He had incentives to enforce hunting regulations and foster wildlife habitat. This is in contrast with 19th century America where private property rights over wildlife were costly to establish and enforce. U.S. land ownership, at that time, consisted primarily of small privately held parcels amidst large holdings of public land. The territorial requirements of many species were simply larger than most single landholdings could accommodate. Many species of migratory birds annually migrated across the continent, fish populations inhabited rivers that flowed for hundreds of miles, and big game species required thousands of acres to roam. In such an environment contracting between several parties (private and governmental) was prohibitively costly. The game department emerged as an institution that lowered the cost of establishing and enforcing property rights to wildlife. Under such a regime, rights to wildlife may be enforced at a lower cost because explicit agreement among all landowners is not required for the agency to act.

Federal-State Relationships

The federal government began its official involvement in wildlife policy with the passage of the Lacey Act in 1900. The Act made it a federal crime to cross state lines with wildlife killed in violation of state law. It also made any dead wildlife brought into a state subject to the laws of the state in which it was brought (Harrington 1991). The

legislation was heavily supported by sportsman interest groups and there was little opposition. The states supported the Lacey Act because it helped them enforce state wildlife laws but it did not interfere with state ownership of wildlife (Tober 1981). Upcoming federal wildlife legislation, however, would pose a threat to the state ownership doctrine. The passage of the Weeks-McLean Act in 1913, which placed migratory birds under federal custody, stirred conflict between the states and the federal government. States challenged the Act and it was first declared unconstitutional in federal district courts in Arkansas and Kansas. Finally, in the 1920 case *Missouri v. Holland,* the Supreme Court reaffirmed the authority of federal wildlife regulation (Harrington 1991) and the federal legislation began a federal migratory bird program.

Federal legislation that was instrumental in shaping state game management was yet to come. In 1937, the Federal Aid and Wildlife Restoration Act (more commonly known as the Pittman-Robertson Act after its congressional sponsors) was signed into law. Under the Act, state wildlife agencies receive federal funds to be used for the selection, restoration, rehabilitation and improvement of wildlife habitat and wildlife management research. The allowable uses of the federal funding are broad and include the acquisition of wildlife habitat, hiring of personnel, and research that will aid in wildlife restoration. The funds are derived from an 11 percent federal excise tax on sporting arms and ammunition and are apportioned to the States in an amount determined by a formula that considers the total area, the number of licensed hunters, and state

population.[6] The Act is a stipulates that all states eligible for the federal funds must prohibit the diversion of license fees paid by hunters for any purpose other than the administration of the state's wildlife department (16 U.S.C. §§ 669-669). Similar provisions for fishing enhancement were enacted under the Dingell-Johnson Act of 1950. This law provides grants to states, derived from an excise tax on fishing tackle, for the enhancement and restoration of fish populations. The Act was amended in 1984 extending the tax to include boats and is now known as the Wallop-Breaux Act (16 U.S.C. §§ 777).

These Acts had a tremendous impact on state wildlife agencies in addition to providing additional revenues. Prior to the passage of the Pittman-Robertson Act, state politicians often distributed license fee revenues to other government programs, such as highway maintenance and schools (Lund 1980), and wildlife agencies had little incentive to increase wildlife related revenues (O'Toole 1995). The new authority to keep license revenues may have increased agency incentives to improve the quality of hunting and fishing and reduced some of the peripheral political interest in wildlife policy. Perhaps because of this pay-for-use funding scheme, Wilson (1989) notes that state wildlife departments managed to acquire a good deal of autonomy from legislative control.

[6] Under the original Act and its later amendments items such as rifles, ammunition, pistols, revolvers, bows, and arrows are taxed. One-half of the revenues accrued from the tax on pistols, revolvers, bows, and arrows must be apportioned to the states based on population. Of the remaining funds, one-half must be apportioned to the states based on geographic size and the other based on the number of paid-license holders in each state. Apportionments are adjusted so that no state receives less than one-half of one percent or more than 5 percent of the total amount apportioned (16 U.S.C. §§ 669-669c).

Modern Wildlife Management

To some extent, all modern agencies are involved in the following activities: (1) setting season closures, (2) setting bag limits, (3) administrating the sale of hunting and fishing licenses, (4) restricting the methods by which wildlife can be taken, (5) enforcing game laws, (6) researching and monitoring populations, (7) managing habitat for wildlife, (8) protecting nongame and endangered species, (9) administering education programs. Each agency is governed by a board of commissioners who are usually appointed by the governor and often ratified by the legislature.

The size and requirements of commissioners vary from state to state. Most states have 5 to 10 commissioners but New York has 42. Many states require that the commissioners on the board represent each geographic region of the state. States may also require that their commissioners have current hunting and fishing licenses, belong to sportsman organizations, or hold college degrees in natural resource fields (WMI 1997). The following detailed example of typical commissioner requirements is taken from the Idaho Fish and Game Commission (http://www2.state.id.us/fishgame/commish.htm#co1).

> "The Idaho Fish and Game Commission was created by public initiative in 1938. Commissioners are appointed by the Governor (no more than four may be from the same political party) for staggered four-year terms. Each commissioner is confirmed by the Idaho State Senate. The seven commissioners, each representing a different region of the state, are responsible for administering the fish and game policy of the state: to preserve, protect, perpetuate and manage all wildlife. To be appointed, commissioners must be a bona fide resident of the region from which they are appointed, and be well informed and interested in wildlife conservation and restoration."

An agency director conducts the day-to-day operations of the wildlife agency. The director is typically chosen through the civil service system and is usually an experienced wildlife management professional. Many states require that the agency director hold a degree in wildlife management or a related field. The staff underneath the agency director is usually composed of wildlife biologists, technicians, conservation officers (wardens), and administrative personnel.

The state wildlife agency bureaucrats are directly responsible for managing wildlife but their ability to set policy is limited. The authority to enact a specific wildlife policy may be granted to either the legislature, the wildlife commission, or the wildlife agency director. The agency commission has the formal authority to set bag limits and season lengths, initiate landowner access programs, and advise on budget priorities (WMI 1997). In practice, however, the commission often ratifies the recommendations of the agency director on these matters. The agency director is generally responsible for law enforcement, researching and monitoring the population of wildlife species, and managing land as wildlife habitat. The authority to set hunting and fishing license fees is usually vested in the legislature (WMI 1997).[7] Other policies, such as the total size of state agency budgets and how much to allocate toward nongame, are not explicitly chosen by either the legislature or the agency but are affected by both.

[7] The commission or director may even have limited ability to influence license prices. In Idaho, for example, according to the Department of Fish and Game's website, resident fishing license fees have not been raised since 1991. Since then agency efforts to increase resident hunting and fishing licenses have been unsuccessful. Idaho residents will now vote on comprehensive fee increase proposal in 2000. Their options as described by the Department of Fish and Game are (1) support resident fee increases or (2) accept further reductions in wildlife management programs.

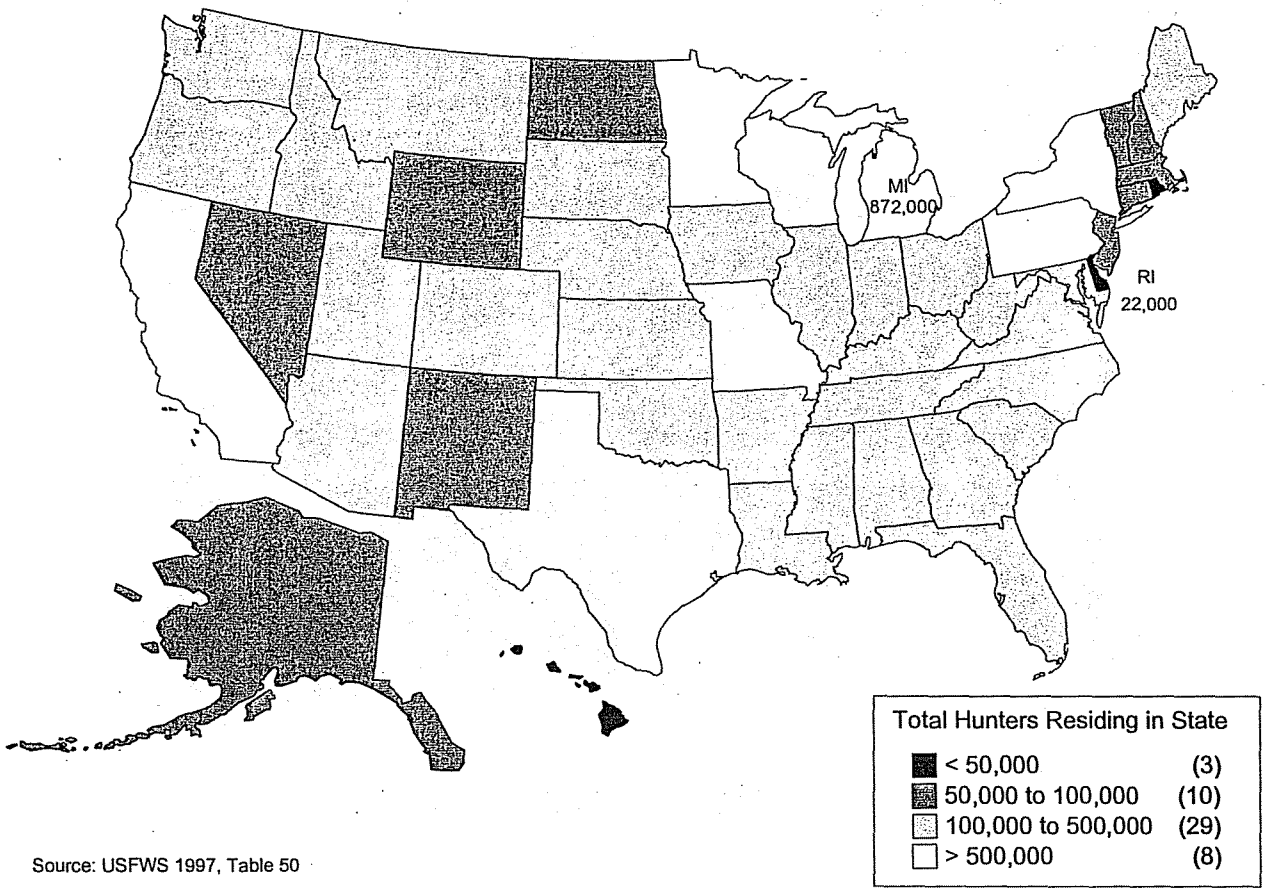
Many agency characteristics vary considerably across states, including state wildlife constituencies, agency budget sizes, agency budget allocations to nongame species, agency funding sources, agency jurisdiction, and agency placement on the state government hierarchy. The distinctions between states in these features are examined in the next sections.

Agency Constituents

Historically, the core constituencies involved in the creation of game laws and game agencies were recreational hunters and fisherman (Tober 1981). These constituencies are still dominant but their strength varies across states and is no longer exclusive. The average number of state residents that hunted in 1996 was 278,740, which approximately the number of hunters in Oregon and Oklahoma, and ranged from a high of 872,000 in Michigan to a low of 22,000 in Rhode Island. The average number of residents that fished in 1996 was 704,780, which is approximately the number of anglers in Tennessee and Alabama, and ranges from a high of 2.7 million in California to a low of 87,000 in Vermont.[8] Figures 2.1 and 2.2 show the total number of hunters and anglers by state. These figures indicate that the number of resident hunters and anglers is positively correlated with state population. The correlation between the number of hunters and population is $\rho = 0.66$ and the correlation between the number of anglers and population is $\rho = 0.93$ as shown in Appendix B.

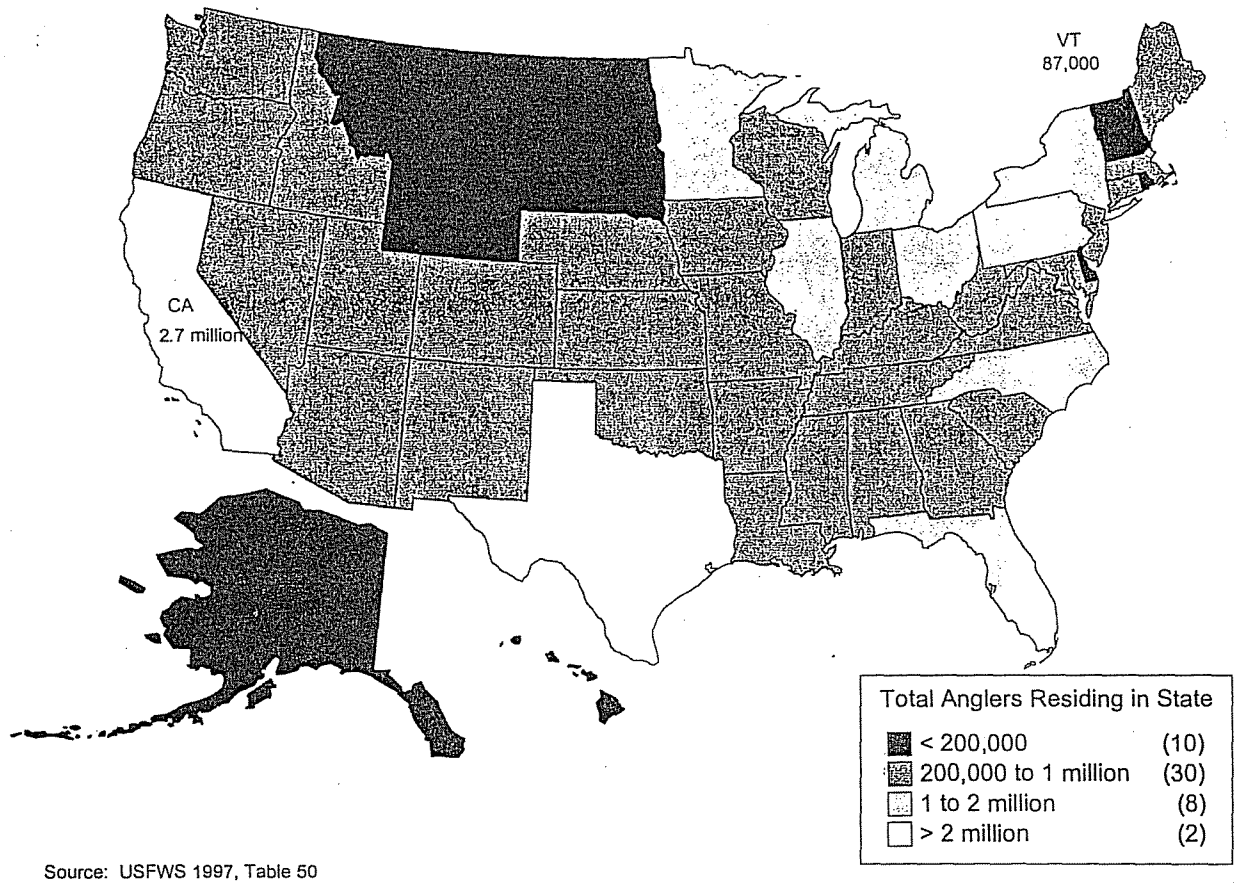
[8] On a per-capita basis, the average percentage of residents who hunted was 7.3 percent ranging from a high of 16.2 percent in Montana to a low of 1.1 percent in New Jersey. Per-capita, the average proportion of residents who fished was 15.3 percent ranging from a high of 29 percent in Alaska to a low of 8.2 percent in New York. Figures B.1 and B.2 in Appendix B show the per-capita numbers in each state.

Figure 2.1: Total Hunters



Source: USFWS 1997, Table 50

Figure 2.2: Total Anglers



Source: USFWS 1997, Table 50

Non-resident hunters and anglers are important constituents of wildlife agencies. Nonresidents tend to be wealthier and are more apt to hire guides and to hunt or fish on private land. From the perspective of agencies, guides, and landowners, nonresident sportsmen are an important source of revenue. From the perspective of resident sportsmen, nonresidents are often competitors for prime hunting and fishing access. The total number of 1996 nonresident hunters averaged 46,764, which is approximately the number of nonresident hunters in Tennessee and Maine, and ranged from a low of 230 in Hawaii to a high of 217,000 in Colorado. The number of 1996 nonresident anglers averaged 227,780, which is approximately the number of nonresident anglers in Colorado and Georgia, and ranged from a low of 22,000 in North Dakota to a high of 986,000 in Florida. Figures 2.3 and 2.4 show the number of nonresident hunters and anglers in each state. Notice that the number of nonresident hunters tends to be high in the rocky mountain region which harbors unique big game such as elk, antelope, and big horn sheep. Notice also that the number of nonresident anglers tends to be high in coastal states.

The constituencies of state wildlife agencies are no longer primarily hunters and anglers. According to several indicators, demand for nongame wildlife is substantial and increasing rapidly. In 1996, nearly 63 million Americans 16 years or older reported observing, photographing, or feeding wildlife compared to about 40 million Americans who either hunted or fished (USFWS, 1997). Participation in birdwatching rose from 21 to 54 million Americans from 1983 to 1995 (Richie, 1999) but the total number of individual hunting license holders peaked in 1982 (USFWS, 1997). Membership in the

National Audubon Society has grown 77 percent since 1980 (from 311,000 to 550,000). During the same time period membership in the Defenders of Wildlife has risen from 44,000 to almost 382,000 – a 760 percent increase. Since 1995 alone, Defenders of Wildlife membership has more than tripled.[9]

The relative strength of nongame constituencies across states may be gauged by comparing the number of residents that participate in wildlife-watching activitites. Wildlife-watching activity is defined by the USFWS as "individuals engaged in an activity primarily for the purpose of feeding, photographing, or observing wildlife."[10] The number of 1996 wildlife watchers in each state averaged 1.2 million, which is a approximately the number of wildlife watchers in Colorado and Maryland, ranging from a high of 5.9 million in California to a low of 112,000 in North Dakota. The number of wildlife watchers as a percentage of population averaged 25.1 percent and ranges from a high 36.7 percent in Vermont to a low of 10.3 percent in Hawaii. Figure 2.5 shows the total number of wildlife watchers per state.[11] As was the case with resident hunters and anglers, the number of wildlife watchers is highly correlated with state population (ρ = 0.96).

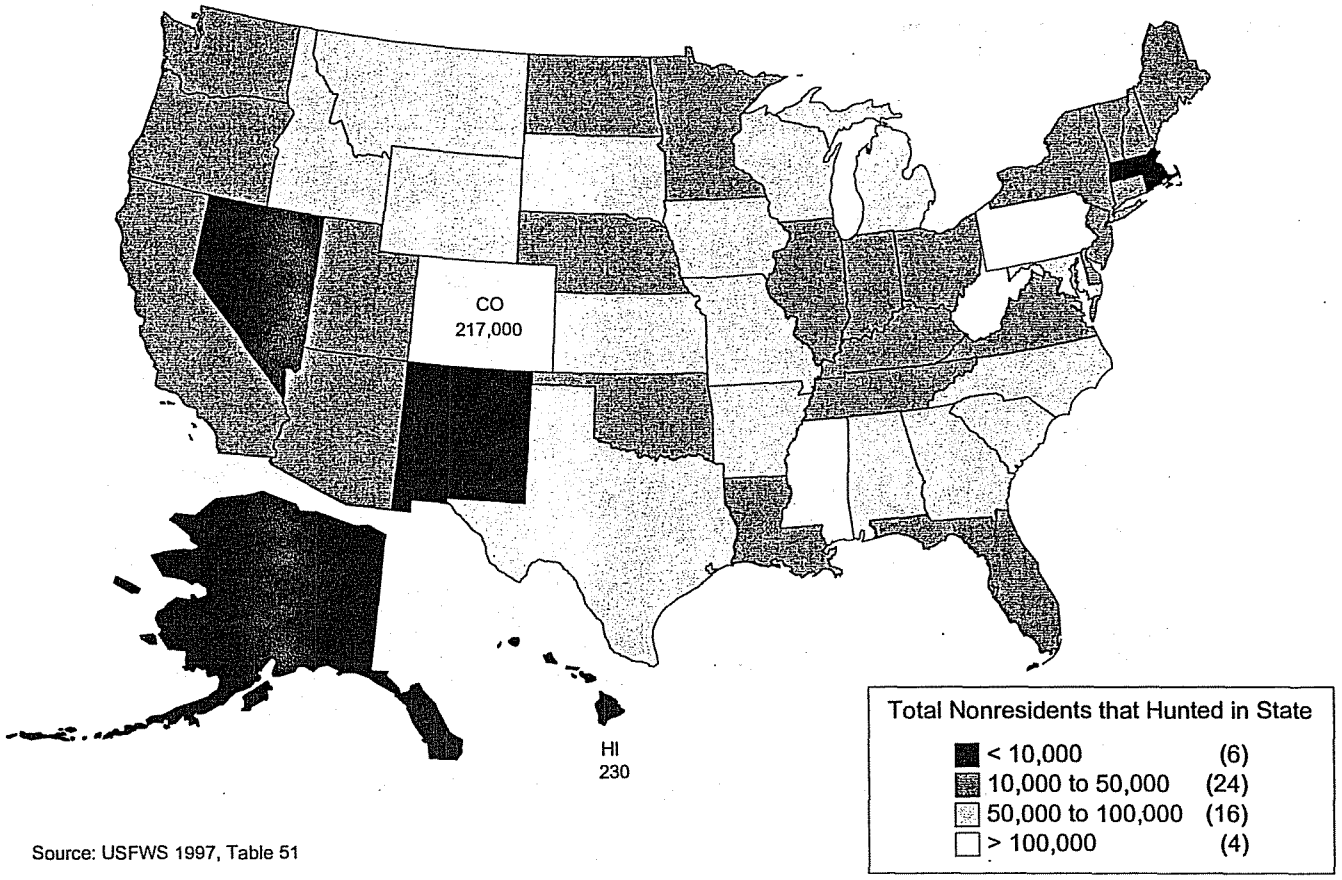
---

[9] This information comes from the websites of the National Audubon Society and the Defenders of Wildlife, and Tober (1989) Table 2:3, page 38.

[10] USFWS (1997), appendix A, page A-4.

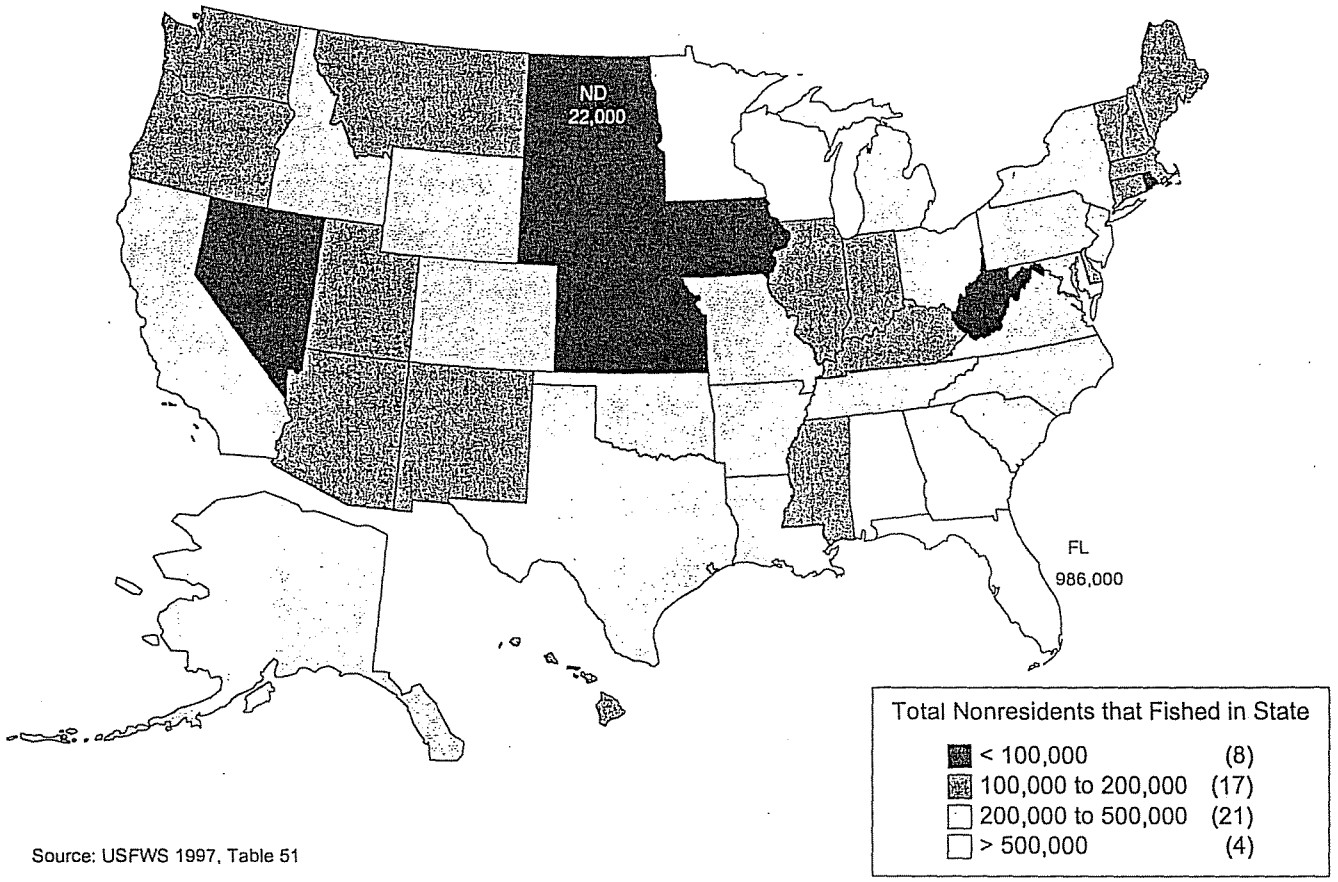
[11] See Appendix B for an illustration of wildlife watchers per-capita in each state.

Figure 2.3: Total Nonresident Hunters



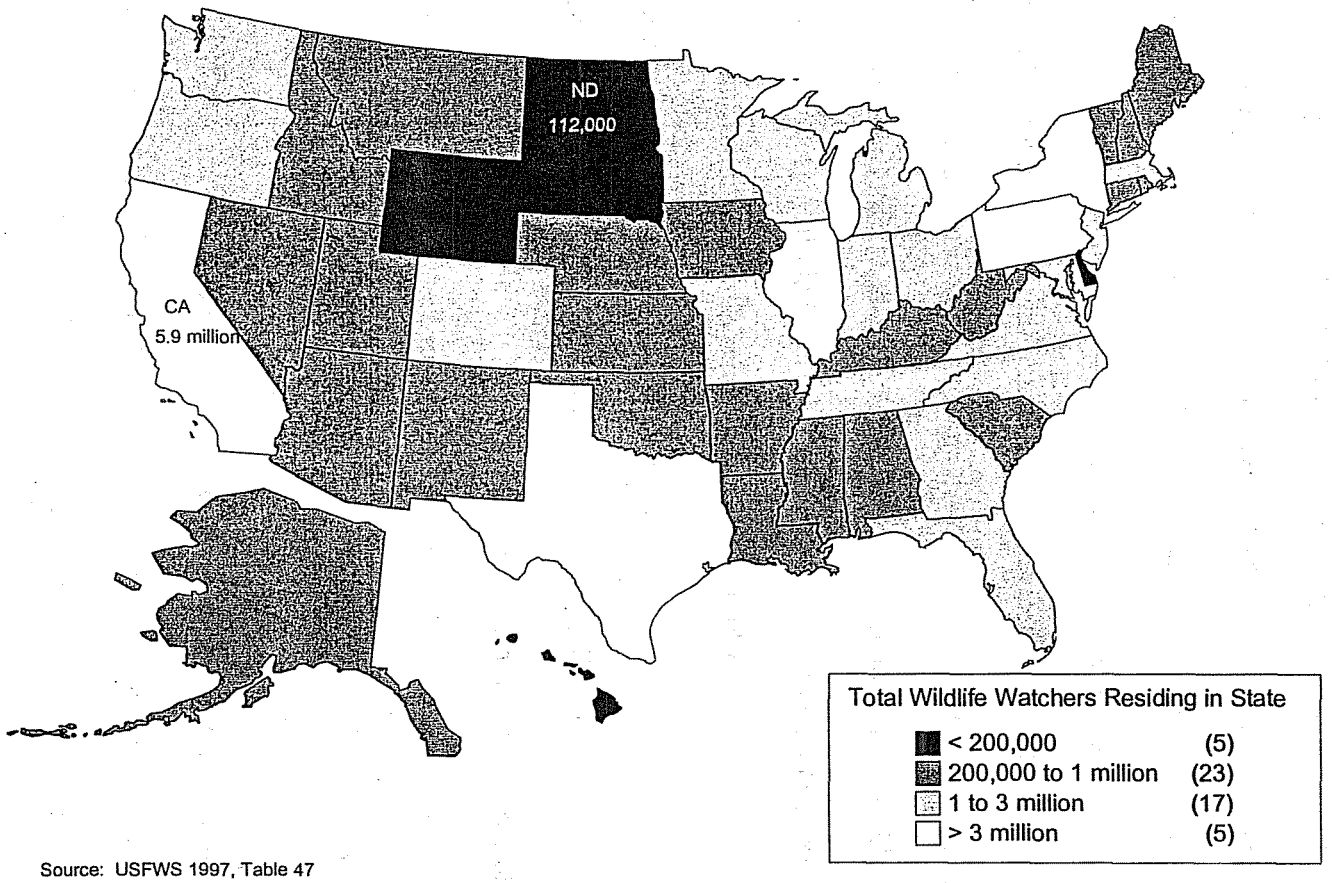
Source: USFWS 1997, Table 51

Figure 2.4: Total Nonresident Anglers



Source: USFWS 1997, Table 51

Figure 2.5: Total Wildlife Watching Participants



Source: USFWS 1997, Table 47

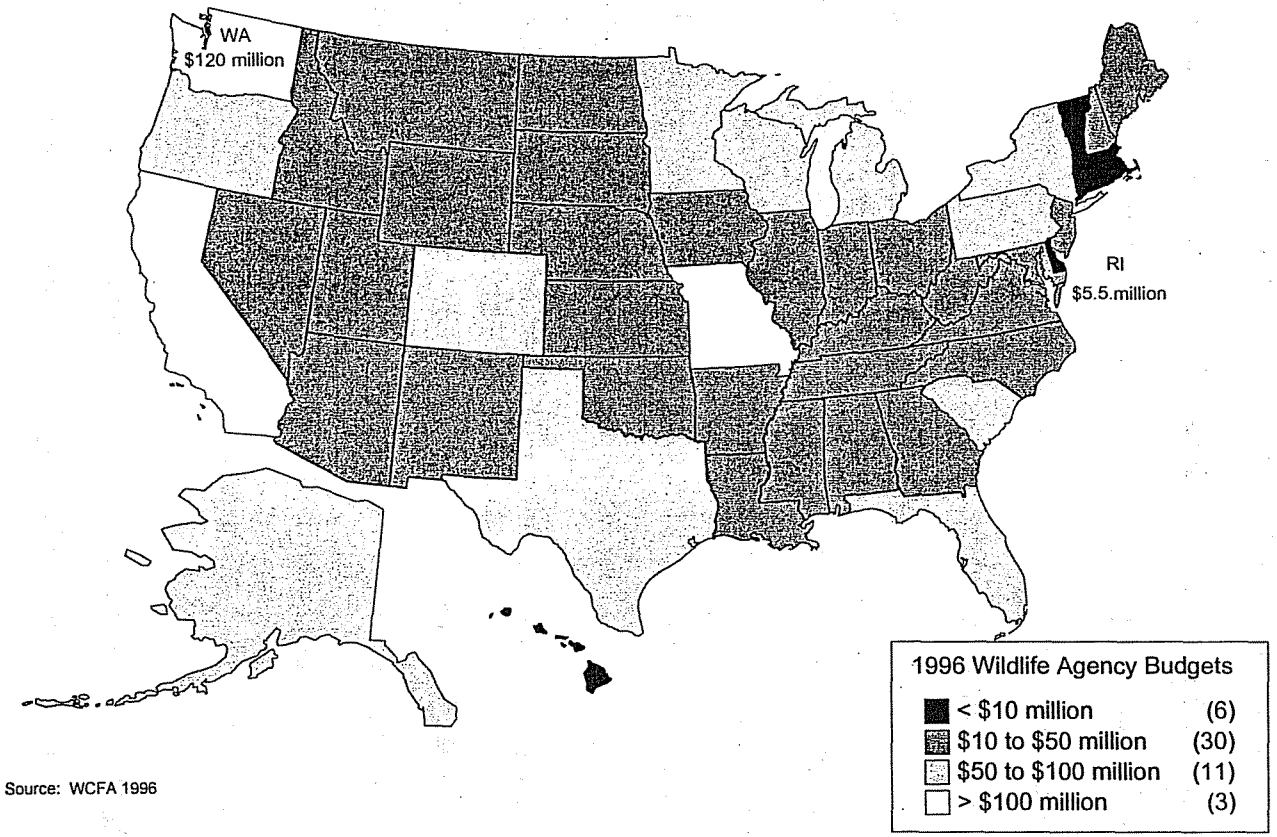
Agency Budgets and Funding Sources

The total budget of all wildlife agencies in 1996 was over $2 billion (WCFA 1996) which is dwarfed by the overall spending of state governments of about $917 billion (U.S. Census Bureau 1998). The budget size of individual state agencies varied considerably ranging from a high of $120 million in Washington to a low of $5.5 million in Rhode Island. The average budget size was $40.6 million, which is comparable to the budgets of Ohio, Idaho, and Arizona. As a percentage of overall government spending, wildlife agency budgets were greatest in Alaska (1.68 percent) and Wyoming (1.40 percent) indicating the relative importance of wildlife resources in those states. Figure 2.6 shows the distribution of wildlife agency budgets across states in 1996. Notice that there is not a dominate correlation between budget size and population ($\rho = 0.52$).

State wildlife budgets are comprised of federal and in-state monies. Federal dollars account for about 24 percent of total state agency budgets (WCFA 1996). Seventy-three percent of these dollars come from Pittman-Robertson and Wallop-Breaux appropriations. The additional federal funds are administered to the states through a variety of small grant programs such as the Coastal Wetlands Conservation, Partners for Wildlife, and through Section 6 of the Endangered Species Act.[12] In terms of total dollars of federal appropriations, Washington and Oregon received the most combined funding through these programs in 1996 (WCFA 1996).

[12] The types and amount of funding states receive through the Endangered Species Act will be described in greater detail later in this chapter.

Figure 2.6: Wildlife Agency Budgets



Source: WCFA 1996

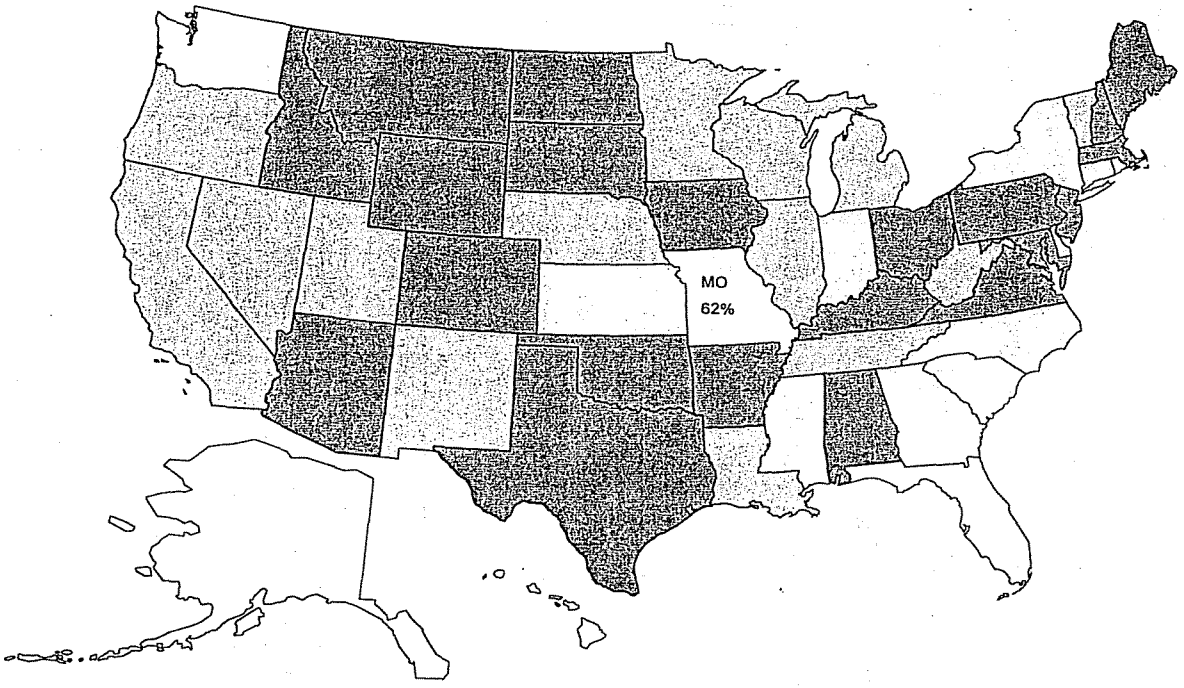
In most states, the prevalent non-federal revenue source is and always has been hunting and fishing license sales (Harrington 1991, WCFA 1996). License sales make up more than half of agency budgets in 27 states with the highest proportions in Colorado (76 percent) and Illinois (74 percent) (WCFA 1996). Additional in-state funding sources include income tax check-off programs, wildlife license plate fees, merchandise sales, private donations, and general funds.

In recent years, state general funds - earmarked sales taxes, lotteries, and general appropriations - are becoming more important revenue sources. In 1996, 30 states received general funding compared to 22 in 1979 (WCFA 1996). But appropriations in most states are relatively small – general funds accounted for only 12 percent of all agency budgets in 1996. Still, these funds make up a substantial proportion of agency budgets in a few states, most notably Missouri (62 percent), Florida (34 percent), and Washington (32 percent) (Scott, Hansen and Mosher 1999). Figure 2.7 shows the general funding received in each state as a percentage of the agency's total budget. Note that Missouri is a clear outlier. Since 1976, its agency has been constitutionally guaranteed 1/8 of 1 percent of state sales tax revenue.

Agency Jurisdiction and Hierarchy Placement

In some states, wildlife agencies are also responsible for managing other natural resource commodities such as state forests or state parks. The jurisdiction of such wildlife agencies is considered broad because of its extension into other natural resource issues. South Dakota's Department of Game, Fish and Parks has broad jurisdiction as does Hawaii's Division of Forestry and Wildlife. Other state agencies, such as

Figure 2.7: General Funds as a Percentage of Budgets



Sources: Scott, Hansen and Mosher 1999 and WCFA 1996

General Funds as a % of Total Budget

- 0% (21)
- 0% to 10% (14)
- 10% to 30% (9)
- 30% to 62% (6)

Vermont's Department of Wildlife and Ohio's Division of Wildlife, are solely responsible for the management of wildlife. The jurisdiction of these agencies is considered narrow because it is confined to wildlife matters.

In some states, wildlife agencies are considered independent organizations. The authority of these agencies is granted directly from the executive and legislative branches of state government. Another type of agency is considered subordinate because it is a subdivision of a larger natural resource agency within state government. The chief administrator of wildlife in these states is located further down the hierarchy of state government than the chief administrator of independent agencies. The Wildlife Department in Washington is considered independent while Georgia's Division of Wildlife Resources is considered subordinate. Figures 2.8 and 2.9 illustrate these basic organizational distinctions.

Figure 2.8: Washington State Government

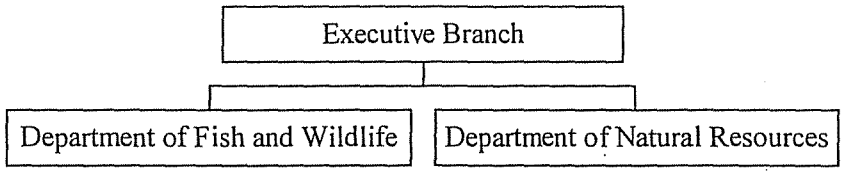


Figure 2.9: Georgia State Government

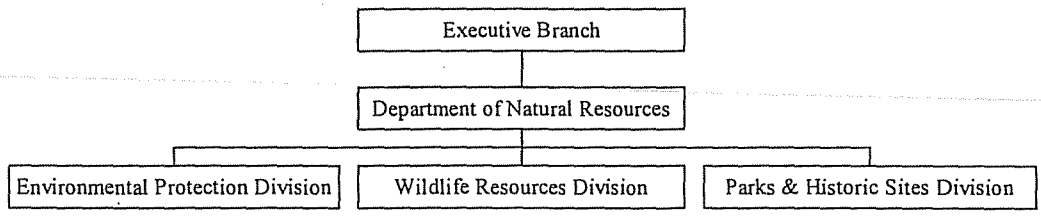


Table 2.1 shows a cross-tabulation of agency jurisdiction and hierarchy placement. Until recently, wildlife agencies tended to have narrow jurisdiction and were independent on the hierarchy (WMI 1997, 1968). The trend over the past thirty years, however, has been towards broadening jurisdiction and subordinate hierarchy placement. Only 19 wildlife agencies have narrow jurisdiction and are independent on the hierarchy today.

Table 2.1: Cross Tabulation of Jurisdiction and Hierarchy Placement

	Independent Agencies	**Subordinate Agencies**	**Jurisdiction Total**
Narrow (Wildlife only)	1	3	4
Narrow (Wildlife and Fish)	18	18	36
Broad (Fish, Wildlife and Other Natural Resource)	8	2	10
Hierarchy Placement Total	27	23	50

Nongame Management

In the 100 year or so history of state wildlife agencies, nongame management is a relatively new. Early wildlife agency managers focused on managing game species – primarily grazing animals such as deer, elk, moose, and antelope (Anderson 1991). The basic management practices used to control populations included hunting restrictions, predator control, reservation of game lands as wildlife refuges, restocking and game farming, and controlling food supplies and disease (Leopold 1933). Any benefits to nongame species from these management techniques were indirect. Some practices, such

as predator control programs, were directly harmful to nongame species such as wolves and certain birds of prey.

In recent years, nongame and endangered species management has become more prevalent and environmental groups, less interested in game species, have become more influential. The influence of these groups began to manifest itself in the late 1960's with the passage of the Endangered Species Act (ESA) in 1973. The said purpose of the ESA is to conserve "the ecosystems upon which endangered and threatened species depend." Under the law, "endangered" means that an animal is in danger of extinction throughout all or a significant portion of its range. "Threatened" is intended to indicate that a species is likely to become endangered in the future (16 U.S.C. §§ 2-4). Federal listing takes a species out of state jurisdiction and places it under federal control. Under section 6 of the ESA, states can receive federal funding "to assist in the development of programs for the conservation of endangered and threatened species or to assist in monitoring the status of candidate species" (16 U.S.C. §§ 6). This is a grant program that requires that state agencies submit a proposal to the U.S. Wildlife Service and offer matching funds.[13]

Since the passage of the ESA, the number of nongame users has grown tremendously (USFWS 1997, Richie 1999). The membership in many prominent environmental groups has also grown (Tober 1989). These constituent forces, as well as the ESA, seem to be pushing wildlife agencies to expend more management effort on nongame species such as wolves, songbirds, bats, and lizards. By 1989, according to the

[13] State wildlife agencies may view federal listings with mixed feelings. On one hand, federal listings often impose restrictive land use regulations. This may give the agency an incentive to preempt federal listing by spending more on nongame species that are candidates for listing. On the other hand, federal listing means that an agency is more likely to receive federal funding through Section 6.

International Association of Wildlife Agencies (IAFWA), all state agencies had established a program specifically dedicated to nongame wildlife (Edelson, 1994).

The specific terms used to describe the programs varies from state to state but include the following: nongame wildlife, watchable wildlife, endangered species, biodiversity, wildlife diversity, and natural heritage programs. The output from these programs also varies considerably across states. For example, Alabama's Nongame Wildlife Program lauds the releasing of 91 bald eagles and 66 ospreys as its primary accomplishment. The program was also responsible for initiating a monitoring program to conserve Alabama's songbirds and the construction of more than 10,000 bluebird nest boxes. Idaho's Nongame Wildlife program is responsible for the research and monitoring of species such as wolverines, trumpeter swans, and the Coeur d' Alene salamander. Aggregate spending on these types of nongame programs in all states rose from $66.3 million in 1992 to $134.3 million in 1998 (Richie and Holmes 2000).

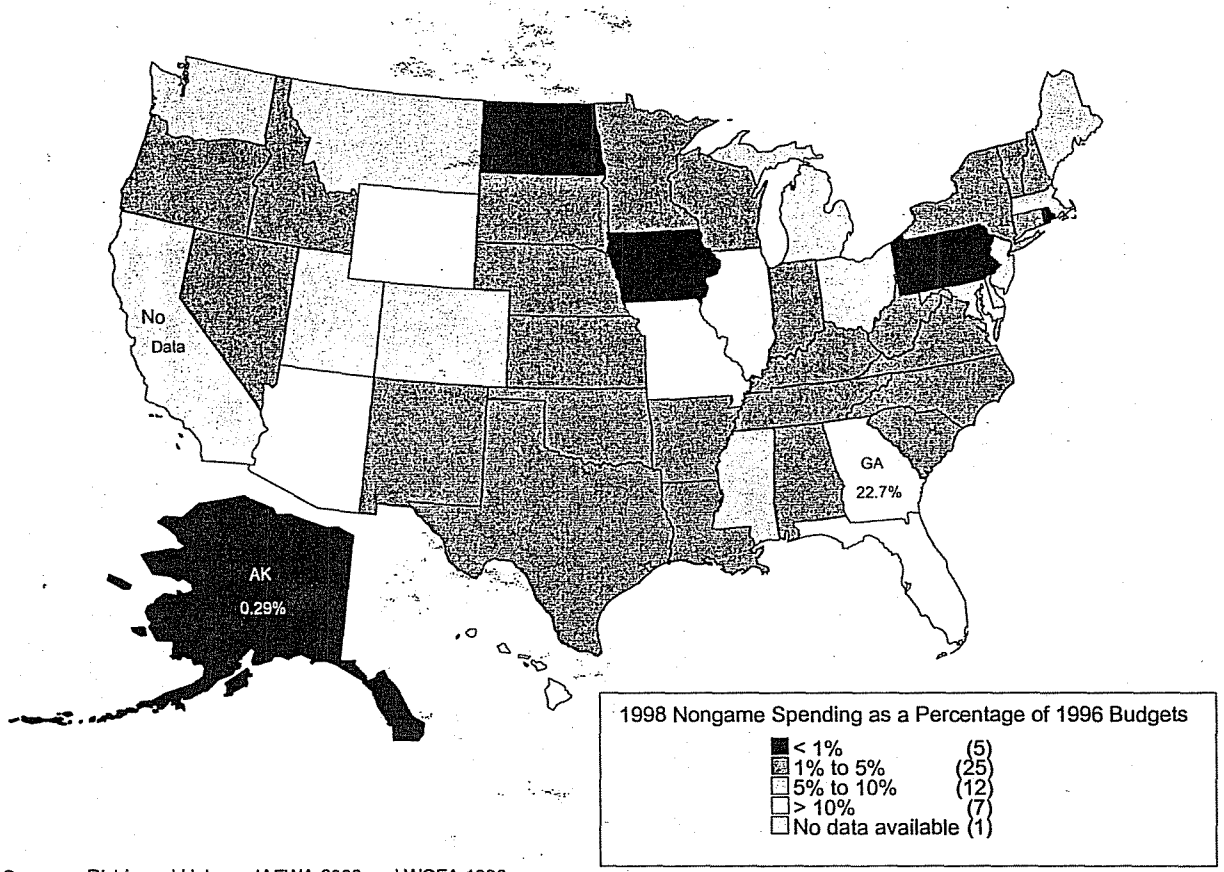
In spite of the increased emphasis on nongame management, many conservation groups contend that agency nongame management efforts are far from adequate. According to *Saving Biodiversity*, a 1998 Defenders of Wildlife report, no state has an "outstanding" program to protect species, habitat, and biodiversity. The analysis rated states on several criteria including predator and damage control activities, state agency management for biodiversity, and endangered species management. Forty-four states received failing grades. Another study, conducted by the International Association of Wildlife Agencies (IAFWA), estimates that expenditures on nongame wildlife programs

accounted for only 8.8 percent of the total expenditures on wildlife by state agencies in 1998 (Richie 1999).

The amount of money currently spent on nongame programs varies widely from state to state. The average agency spent $2.07 million on nongame in 1998 ranging from a high of $11.2 million in Missouri to a low of $51,999 in Rhode Island. As a percentage of 1996 budgets, nongame spending averaged 5.2 percent, which is approximately the percentage spent by agencies in Utah and New Jersey, ranging from a high of 22.7 percent in Georgia to a low of 0.3 percent in Alaska. Figure 2.12 compares the states in terms of nongame spending as a percentage of budgets.[14]

[14] The nongame spending data comes from the *State Wildlife Diversity Program Funding: A 1998 Survey* (Richie and Holmes 2000). California did not respond to the survey. The original numbers reported by Nevada, Maine, and Illinois were not reliable. I adjusted their responses after 2001 phone conversations with nongame biologists at each of the three agencies. Sources are Neel (2001), Hickman (2001), and McCullogh (2001).

Figure 2.10: Nongame Spending as a Percentage of Agency Budgets



Sources: Richie and Holmes, IAFWA 2000 and WCFA 1996

CHAPTER 3

WILDLIFE AGENCY INCENTIVES AND COSTS

The purpose of this chapter is to provide a preliminary framework for understanding the ways in which wildlife agency incentives and costs will vary under different bureaucratic organizational regimes. This chapter is organized into four sections. The first section provides a general review of the bureaucracy literature. The second section pushes the framework of Wilson (1989), Niskanen (1971), and Dewatripont et al. (1999) for implications regarding how agency funding, agency jurisdiction, and agency hierarchy placement will affect the costs of managing wildlife. The third section pushes the framework of Niskanen (1971), Wilson (1989), Peltzman (1976), and Becker (1983) for implications about how agency funding, jurisdiction, and hierarchy placement will affect the costs of implementing nongame programs. The fourth section briefly summarizes all of the implications.

Bureaucracy Literature Review

The actions and incentives of government agencies are the source of extensive debate among economists. Broadly speaking, the debate has focused on the objectives of agencies, the amount of discretion in pursuing those objectives, and the role of individual employee incentives in affecting outcomes. Despite the wealth of scholarly attention to each of these subjects, a lack of consensus remains. Another important issue, the

structural organization of government agencies, is relatively underdeveloped in the bureaucracy literature.

The Bureau's Objective

Prior to Niskanen (1971) there were few attempts to model bureaucracy based on purposive behavior. Previous models had considered the preferences of bureaucrats only as subordinate to the state. Niskanen was the first to formally identify the bureaucrat as a chooser and a maximizer instead of just a role player. A rational bureaucrat will maximize his utility. Suppose that the director of a bureau's utility depends on his salary, reputation, power, patronage, output, ease of making changes, and ease of managing the bureau. Niskanen claims that these variables, with the exception of the last two, are positively correlated with the agency's budget size. While the problems of making changes and managing the bureau may be negatively correlated with budget size, an increase in the budget reduces these burdens. From this premise, Niskanen asserts that rational government agencies will try to maximize the size of their budgets.

Many scholars (e.g, Johnson and Libecap 1994, Wilson 1989, Blais and Dion 1991) have challenged the budget-maximization assertion. Johnson and Libecap (1994), for example, do not find a strong link between federal bureaucrats' salaries and the size of the agency.[15] Without this link, the incentive for bureaucrats to pursue growth is weakened. Wilson (1989) considers the budget-maximization assertion an

[15] Johnson and Libecap used data for all white-collar federal GS workers as well as a sample of only top-level, senior bureaucrats. Both specifications produced only a weak correlation between salaries and agency size.

oversimplification. He emphasizes the importance a bureaucrat places on the ease and freedom of making changes (autonomy). High autonomy means the agency will have a supportive constituency and a strong, shared sense of mission. He argues that the belief that agencies want to maximize budgets ignores the tradeoff between bigger budgets and agency autonomy. "Autonomy is valued at least as much as resources, because autonomy determines the degree to which it is costly to acquire and use resources" (Wilson 1989, 191).

Agency Discretion

It is not possible to directly test whether an agency seeks to maximize the size of its budget or any other objective. Testable implications may emerge from these assertions, but any such predictions depend critically on how much discretion the agency is assumed to have. Separate theories exist where an agency's discretion in setting policy is expansive (Niskanen 1971), moderate (Wilson 1989), or limited (McCubbins et. al 1987, Becker 1983, Peltzman 1976).

In Niskanen's model, a bureau receives at least part of its funding from a sponsor (legislature or an executive branch of government) through budget appropriations. The bureau is able to estimate the sponsor's willingness-to-pay for its services "quite easily" from recent budget reviews and constituent influences. But because the sponsor usually services many bureaus, it lacks the time and incentive to gain much information about bureau costs. As a result, the legislature does not know the minimum budget that would be sufficient for the bureau to supply a given level of output. The budget-maximizing bureau has the ability and incentive to exploit this by exaggerating the demand for its

output as well as its internal costs. If the sponsor refuses its budget request, the agency as a monopoly provider of its output, can threaten to shut down its most essential services. This much discretion, combined with a budget-maximizing objective will result in a "run-away agency": an agency that is always bigger than what is socially optimal.

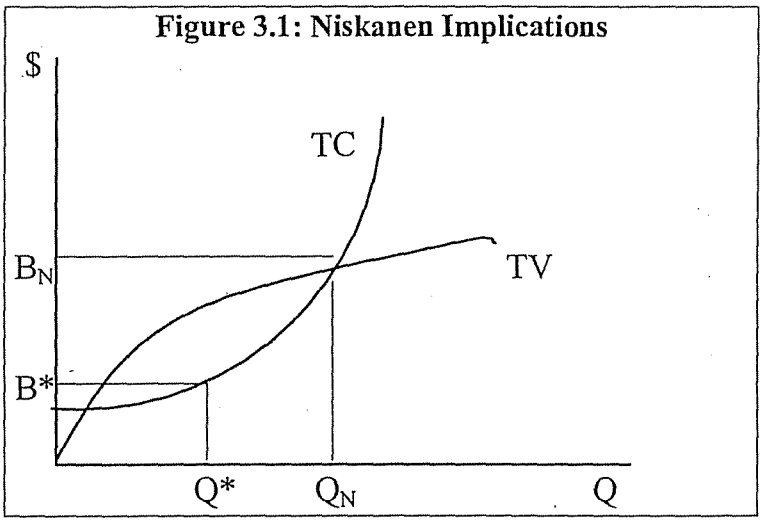
Wilson (1989) offers a water-downed view of agency discretion that is not entirely inconsistent with Niskanen. He does not contend that all information is in the domain of the bureau but he does argue that, under certain circumstances, agencies will enjoy considerable leeway from congressional oversight. Agencies will be on a longer political leash when they engage in tasks that are hard to specify and difficult to measure or when they operate in a conflict-ridden political environment (Wilson 1989). These circumstances make monitoring the agency more costly and provide the bureau some insulation from political punishment.

Other scholars (e.g., McCubbins et. al. 1989 and Moe 1985) have criticized Niskanen's model for treating the role of legislature as subordinate. They view the bureaucracy as ultimately subservient to Congress and the president. Politicians gain control of bureaucrats through informal oversight and administrative procedures (Moe 1985) and especially through the appointment process of top-level agency officials (McCubbins et. al. 1989). In other words, politicians have *ex post* oversight over agency actions and *ex ante* control over agency agendas. In such an environment, bureaucratic agencies will only enjoy a minor bit of discretion.

Some of these arguments are contrasted graphically in figure 3.1. First, assume the agency wishes to maximize its budget. Second, assume that Niskanen's assumptions

about agency discretion hold. The total value of a bureau's output (to the sponsor), is represented by TV and is known perfectly by the agency. The total cost of producing a given output is represented by TC, which is known only to the agency. The agency has the freedom to pick any level of output as long as $TC \leq TV$.[16] The budget-maximizing agency will produce at Q_N. The agency's output and budget (B_N) will be too large relative to the social optimum of Q* and B*. Note that all social surplus is completely exhausted when the agency has complete discretion and a budget-maximizing objective.[17]

Figure 3.1: Niskanen Implications



Presumably, politicians can benefit from redistributing surplus among constituents. If the legislature has even limited control over agency output decisions then

[16] Niskanen concedes that output and budgets are eventually constrained by total costs.

[17] This outcome is identical to an open access outcome where a resource is harvested until there is complete dissipation. Niskanen argues that the net value of agency goods and services is zero because of a similar type of "over-harvest".

it will not allow complete dissipation to occur. The legislature can keep agency production at a level less than Q_N.

The empirical evidence on bureaucratic discretion is scant. The fundamental prediction of Niskanen's model, that agencies overproduce, is difficult to test because agency output is generally hard to measure and the concept of efficiency is not empirically refutable. Some attempts at testing have been made, however, and the evidence is mixed. Much of this evidence does not support the idea that agencies can "runaway" (e.g., Weingast and Moran 1983, Blais and Dion 1991), but there are exceptions (e.g, McChesney 1992, Bierhanzl and Downing 1998).[18]

Interest Group and Capture Models

Interest group models (e.g., Stigler 1971, Becker 1983, Peltzman 1976) focus on the demand from interest groups for political favors. In these analyses, interest

[18] Weingast and Moran (1983) use data drawn from the regulatory policymaking of the Federal Trade Commission (FTC) to evalauate agency discretion. In 1979, Congress intervened to stop "regulatory abuses" of the FTC. Over the next couple of years, under vigilant Congressional oversight, the "abuses" were halted. Prior to 1979, the FTC could be viewed as a Niskanen-type runaway agency. Weingast and Moran argued, however, that this phenonemon was instead the result of changing political control (principals) which gave the FTC (agent) slack in making regulatory policy. This hypothesis was tested by looking at the change in the composition of Congress from 1976 to 1979. This time period was marked with unusually high turnover in membership after a decade of virtually no change. By 1979, congressional power had shifted to a new conservative coalition which began to stop the expansion of the FTC. Weingast and Moran conclude from these observations that the FTC was hardly a runaway agency.

McChesney (1992) studied the budget-maximization assertion by looking at the behavior of the Bureau of Indian Affairs (BIA) during the land allotment era from 1887 to 1934. McChesney argued that, during this period, the BIA acted as a special interest group that oscillated its support for alottment legislation in order to secure larger budgets. They did this by first supporting land alottment (the selling of individual parcels of BIA land to families) legislation because it temporarily increased the demand for BIA services. Over time however, more land sales (and less BIA land) meant less demand for BIA services. The BIA recognized this and lobbyed successfully behind legislation that ended allottments in1934. McChesney claims that the evidence, namely that the BIA budget increased in 1887 and again in 1934, supports the budget-maximization hypothesis.

groups control agency decision-making. Stigler (1971) first proposed that regulatory agencies are essentially captured by the industry in which they regulate. Peltzman (1976) and Becker (1983) modified his theory to account for the fact that competing consumer interest groups will also lobby for political favors. As Becker (1983) acknowledges, these models are simplified because politicians and bureaucrats are assumed to perfectly carry out the political allocations that result from interest group competition. A later model (Laffont and Tirole 1991) allows for possible collusion between interest groups and bureaus and thus incorporates the supply-side of public policy. According to this view, agency discretion is generally reduced when a regulated industry becomes better organized.

Agency Employees

The literature referred to so far typically assumes a bureau behaves as a single entity. The objectives of executives and "rank and file" employees are not distinguished from each other. Such treatment ignores the roles that career concerns (Dewatripont et. al. 1999, Wilson 1989) and bureaucracies as interest groups (Johnson and Libecap 1994) have in affecting agency incentives and outcomes.

Civil service rules typically constrain the pecuniary incentives that can be used to increase employee effort within an agency. According to the career concern model (Dewatripont et. al. 1999), bureaucrats are motivated to improve performance in an effort to increase the market value of their human capital. This incentive is strongest when agency missions are narrow and well defined so that the market can infer the marginal product of workers from their job positions. Knowing this, bureaucrats within the agency

will promote well-defined agendas and work to "professionalize" their agency. To this end, bureaucrats will promote the hiring of like-minded individuals with similar work experience (Wilson 1989).

Bureaucrats within an agency may be able to organize and lobby for preferred policies. Peltzman (1976) and Becker (1983) assert that successful interest groups are typically small, well organized, and composed of individuals with similar objectives. Some agency bureaucrats may fit this profile remarkably well and lobby successfully for pecuniary and non-pecuniary gains. Federal civil service employees, for example, have been successful in keeping their salaries and benefits high relative to state and local bureaucrats and private sector employees (Johnson and Libecap 1994).

Although these theories touch on organizational matters, none explicitly address the effect of an agency's location in the bureaucratic hierarchy or the scope of its jurisdiction on agency incentives and costs.[19] Some authors suggest that departmental organization may be of little consequence: "Moving an agency into or out of a cabinet department is unlikely to have much effect on policy unless it falls under the jurisdiction of a different congressional committee" (McCubbins et. al. 1989, 607). But a deeper look into many of the theories discussed in this literature review implies that agency organization will have significant affects on agency incentives and costs.

[19] The neglect of organizational matters is noted by Wilson: "That bureaucracies may adopt different organizational arrangements with different consequences is still about as foreign a notion as the possibility that some businesses may act in ways not predicted by marginal cost analysis" (Wilson 1989, 23).

Agency Organization and Wildlife Management Costs

What are the implications of each bureaucracy model when put in a wildlife agency setting? Do any insights about the affects of agency organization on wildlife agency costs or budgets emerge? The following section will examine these questions and serve as a precursor to the chapter 4 model of wildlife agency budget determinants.

General Funding

Niskanen's model (1971) implies that agencies that receive general funding (mixed agencies) will have a greater information advantage over politicians than agencies that are funded only through user fees (self-supporting agencies). Mixed wildlife agencies will exploit their information advantage and produce more output than desired by politicians. There will be "fat" or "fluff" in a mixed agency and it will be positively correlated with the agency's reliance on general funds (the percentage of the budget that comes from general funds). The empirical implication is that mixed agencies will have larger budgets than self-supporting agencies when controlling for other factors.

Unfortunately, this empirical implication is not unique to Niskanen's model. There are other explanations for why budgets will grow with a greater reliance on general funds. The implications of Niskanen's model and the rationale for why these implications are not unique to Niskanen are described in greater detail in Appendix C. Because no unique, testable propositions about wildlife agency costs or budgets emerge from Niskanen's model, his propositions are not developed into the model in chapter 4.

Agency Jurisdiction

Some scholars (e.g., Wilson 1989, Dewatripont et. al. 1999) contend that bureaucratic agencies can lower their costs of production by narrowing their missions. Wilson (1989) defines a mission as a strong, shared sensed of culture. One rationale (Wilson 1989) is that installing a narrow mission will encourage a homogeneous and supportive environment within an agency. Another rationale contends that the employees of an agency will exert more effort when missions and output are narrow and well-defined (Dewatripont et. al. 1999).

Politicians that oversee the agencies with narrow missions will tend to be aligned with and supportive of the agency's mission (Wilson 1989). In addition, agencies with narrow missions will tend to be staffed by employees with similar qualifications and backgrounds. Conversely, politicians that oversee agencies with broad missions may disagree about agency priorities who must answer to several interest groups. Also, agencies with broad missions must employ a variety of different professionals to produce output. These professionals may dispute what the agency should be doing and expend valuable resources to promote their agenda priorities.[20] An implication is that agencies with broad missions are predisposed to conflicting forces that constrain their ability to

[20] The experience of the U.S. forest service in the 1960's and 1970's is a good example of professional conflict. Prior to the Multiple Use and Sustained Yield Act of 1964, the agency employed primarily foresters with similar backgrounds and leanings. The Act mandated new demands and the agency employed new occupational professional groups such as biologists, economists, and engineers. The addition of the new personnel weakened the ability of the agency to maintain a narrow and clear sense of mission. These groups disputed many things, such as the definition of "yield", and the forest service suffered unusually high turnover rates during the late 1970's and early 1980's (Wilson 1989). This is essentially a problem of open-access resources and rent-seeking behavior.. There is a dissipation of wealth as agency employees expend valuable resources to promote their agenda priorities.

implement policy and produce output. As a result, agencies with broad missions are subject to higher production costs relative to more specialized agencies.

Narrow wildlife agencies should enjoy more unified political support and have a more homogeneous staff of employees than agencies with broad jurisdiction for a couple of reasons. First, the commission of agencies with narrow jurisdiction usually consists of individuals whose primary interest (and expertise) lies in wildlife management issues. Second, the professional employees of agencies with narrow jurisdiction are primarily wildlife and fishery biologists, wildlife and fishery technicians, and conservation officers (WMI 1997). In contrast, the interests and expertise of commissioners of agencies with broad jurisdictions are necessarily broad. In addition to employing biologists, technicians, and conservation officers, agencies with broad jurisdiction may also be staffed with professional foresters, geologists, and water quality specialists (WMI 1997).

Even if a wildlife agency with broad jurisdiction is able to mitigate the problems of divided political support and conflict among its employees, it may have to deal with the problem of motivating its employees when career concern incentives are low. One study argues that these incentives are lowered when agency missions are broad or fuzzy (Dewatripont et al. 1999). Because bureaucrats are engaged in many tasks, it is difficult for the market (potential employers such as firms or other agencies) to infer what skills he or she has from agency work experience. Competent and diligent workers are not easily distinguished from slackers. As a result, bureaucrats will exert less effort than if agency tasks were narrow.

The relevance of this model to a wildlife agency is questionable for two reasons. First, the career concern incentive of many wildlife agency employees may be weak because there is a lack of alternative market opportunities for most of these professionals. Wildlife professionals, however, can and do move from state to state.[21] Second, individual job tasks may be well defined whether or not an agency's jurisdiction is broad. For example, a wildlife biologist's duties for the Kansas Department of Wildlife and Parks may be nearly the same as a biologist employed for the Oklahoma Department of Wildlife Conservation. On the other hand, the duties of conservation officers might differ significantly because of jurisdiction. A conservation officer in Kansas may have to enforce state park regulations in addition to game laws while an officer in Oklahoma specializes in enforcing game laws. If game law enforcement opportunities exist with other state agencies, then the career concern incentive will apply and the officer in Oklahoma will exert more effort because he is directly accountable for poaching incidents.

A proposition about wildlife agency management costs emerges from Wilson's (1989) and Dewatripont et. al. (1999) models. Because of professional conflict between personnel, divided political support, and a greater susceptibility to employee shirking, agencies with broad jurisdiction will have greater per-unit costs in managing wildlife than agencies with narrow jurisdictions. The budget implications of this proposition are developed into the model in chapter 4.

[21] In 1985, IAFWA member companies employed 90% of the professional wildlife biologists in the United States (Belanger 1988).

Agency Hierarchy Placement

As explained in detail in chapter 2, a wildlife agency may be an independent agency or a subdivision of a larger agency (subordinate). None of the bureaucracy theories referred to in the general literature review explicitly suggests how such a position on the governmental hierarchy will affect agency costs or budgets. Wilson (1989) implicitly suggests that these hierarchy features may affect agency performance by influencing the per-unit costs of agency management.

In one sense wildlife managers in independent agencies have more autonomy. They are free to implement policy without some of the constraints that hinder subordinate agencies. All government agencies are constrained in that they must serve goals that are not of their own choosing (Wilson 1989). This constraint should be more binding for subordinate wildlife agencies whose authority is under the direction of the chief administrator of the parent agency. For example, a wildlife agency might want to improve the number and quality of hunting opportunities for its residents. It may wish to achieve this by planting winter forage and burning underbrush. But suppose the agency is subordinate to a larger agency such as the state Environmental Protection Agency. The EPA's air and soil quality policies may prevent the burning of underbrush. Thus the goals of the subordinate agency are undermined by the goals of the larger agency.[22]

[22] It is true that a separate EPA can also try to undermine an independent wildlife agency's ability to take action in order to achieve its goals. If the EPA and the wildlife agency are placed laterally on the hierarchy, however, the authority of the EPA to regulate the wildlife agency may not be clear. Wilson (1989) notes that conflicts between agencies with lateral authority are often not settled without legal action. Independent wildlife agencies are often able to resist costly regulations from other agencies but subordinate wildlife agencies must comply with the regulations of their parent agency.

A proposition about wildlife agency budgets emerges from this discussion. Agencies that are subordinate to larger agencies will be bound by more administrative constraints and "red tape" than agencies at the top of a bureaucratic hierarchy. These constraints impede the ability of an agency to take action in order to achieve its goals. An implication is that it is more costly for a subordinate agency to produce output that wildlife users value than independent agencies. This proposition and its budget implications are developed into the chapter 4 model.

Agency Organization and Nongame Management Costs

What do the bureaucracy models imply about the costs of implementing nongame management programs? Do any of the models suggest how general funds, agency jurisdiction, and agency hierarchy placement will affect these costs? This section serves as a precursor to the chapter 5 model by examining these questions.

The Costs of Implementing Nongame Programs

Wilson (1989) argues that all bureaucratic agencies are resistant to new tasks, even when the new tasks are desired by external constituencies and politicians. New tasks are costly to bureaus for a few reasons. First, new tasks tend to threaten agency autonomy because they often require cooperation with other agencies (Wilson 1989). Second, new tasks, especially ones that require the aid of new kinds of professionals (such as nongame biologists), tend to threaten the control that like-minded professionals within the agency

have established (Wilson 1989). Together, these forces bias agencies towards the status quo. In the case of state wildlife agencies the status quo is managing game species.[23]

Because of this natural bias, it will be costly to induce the agency into spending more on nongame programs. These costs will be abated to some extent, however, when the agency has an incentive to increase nongame allocations. There are two general reasons why an agency might have such an incentive. First, increasing nongame spending might help an agency achieve its objectives. For example, a budget-maximizing agency may want to spend resources on nongame if it believes this is a good strategy for increasing its revenue (Niskanen 1971). Second, increasing nongame spending may help the agency avoid punishment from politicians that oversee the agency (McCubbins et. al 1987). Politicians will be more motivated to push the agency to spend resources on nongame when its nongame constituency is large and effective in controlling free riders (Peltzman 1976, Stigler 1971, Becker 1983). The strength of each of these incentives will vary depending on the amount of general funds the agency receives, the scope of its jurisdiction, and its hierarchy placement.

General Funding

First consider a self-supporting agency that is funded entirely by license fees and user taxes. Demand for nongame exists, but users lack a funding mechanism for the management of nongame species. Under these conditions, the legislature and agency can

[23] Nongame management programs are relatively new in the history of wildlife agencies. The onset of these programs is described in chapter 2.

choose to spend nothing on nongame management or finance nongame programs with hunting and fishing revenues.

According to Stigler's (1971), Peltzman (1976), and Becker (1983), politicians will have little desire to finance nongame expenditures with hunting and angling fees. Although Peltzman and Becker disagree with Stigler's idea that a regulatory agency will exclusively serve a single interest group, their models are similar in that each contends that political support maximizing politicians will grant political favors to the most effective interest groups. The political effectiveness of competing interest groups is largely a function of the ability to control free-riders (Peltzman 1976, Becker 1983). On this account, game users should have a substantial advantage over nongame groups because each hunter and angler contributes to the budget, but nongame users do not. These models imply that nongame groups will have difficulty inducing politicians to extract user fee revenues towards the allocation of nongame expenditures.

In addition to politicians lack of desire to increase nongame allocations when the agency does not receive general funds, the agency will not have much incentive to allocate user fee revenues to nongame. Consider an agency that values autonomy as well as a larger budget (Wilson 1989, Niskanen 1971). Such an agency will have two incentives to resist spending on nongame programs. First, increasing its nongame allocations will increase its involvement with peripheral agencies and constituencies. This may threaten the wildlife agency's autonomy. Second, because nongame

constituents are not a funding source, but game users are, increasing nongame allocations will likely reduce the size of the agency's budget.[24]

Next consider a mixed agency that is financed by state general funds as well as license fees and user taxes. Under this funding structure, the agency can choose to use general funds to finance only nongame management, finance both game and nongame activities, or spend all general fund revenue on the management of game species.

When agencies receive general funds, politicians are more likely to pressure the agency to spend more on nongame programs. Unlike the case of the self-supporting agency, there seems little reason to assume that sportsmen groups will have a comparative advantage in controlling free riders in the lobbying effort. Nongame groups, who lack a direct funding source, will focus much of their lobbying efforts on obtaining general funds. This lobbying investment increases the per-capita investment of nongame interest groups and decreases the chances that these groups will lose in the bid for resource allocations (Peltzman 1976, Becker 1983). On the other hand, it is conceivable that nongame users are disorganized, low-intensity users who have a lower per-capita stake in the allocation of general dollars than game users. In either case, politicians will not find it expedient to be captured by either competing interest when funding sources are

[24] This is a budget-maximizing implication as long as the agency does not consider general funds a *potential* revenue source. In the next section I will maintain this assumption as it is agreeable with some anecdotal data. Most states that received general funds in 1996, have received general funds in past years (WCFA 1996). If the agency does view general funds as a potential revenue source, however, it may wish to expand its nongame agenda in an effort to obtain these funds.

mixed. According to Peltzman (1976) and Becker (1983), they will try to maximize their political support by distributing general funds to both game and nongame users.[25]

A budget-maximizing agency (Niskanen 1971) will consider revenue tradeoffs when determining its preferable nongame and game budget allocations. Because nongame users are a revenue source in a mixed agency (at least indirectly through the legislature), the agency may want to stimulate more nongame demand by spending general funds and even license revenues on nongame programs.[26] A budget-maximizing agency is likely to pursue this strategy when greater appropriations are highly correlated with increases in nongame demand. An agency is less likely to pursue this strategy when general fund appropriations are fixed (such as earmarked taxes) or weakly correlated with increases in nongame demand.

In summary, political-support maximizing politicians (Peltzman 1976) have a greater incentive to pressure wildlife agencies into allocating more resources to nongame programs when general funds are granted to the agency. In addition, a budget-maximizing agency (Niskanen 1971) also has a greater incentive to spend more on nongame when the agency receives some general fund appropriations. Each of these models suggests that it will be less costly for nongame users to induce a mixed agency into allocating more resources to nongame programs than a self-supporting agency. This implication will be incorporated into the chapter 5 model.

---

[25] The proportion of the allocation of general funds, however, will favor the more effective lobbying group.

[26] Johnson (1985) pursued this line of argument in his analysis of the United States Forest Service (USFS). Johnson argues that the USFS acted to stimulate recreational demand in order to justify a broader agenda. A broader agenda allowed the USFS to secure larger budget appropriations from Congress.

Agency Jurisdiction

The extent of an agency's jurisdiction may influence the willingness and ability of politicians and agencies to increase the amount of resources spent on nongame. As jurisdiction becomes broader, more constituents will take an active interest in the policies of the agency. For example, politicians who oversee agencies with jurisdiction over state parks, such as South Dakota's Department of Game, Fish and Parks, must answer to constituents concerned about the quality of camping, hiking, swimming, and sightseeing in state parks. As a consequence of their jurisdiction, political pressure from these groups whose interests are peripheral to wildlife issues may have a positive influence on nongame allocations. In the specific case of a fish, wildlife, and parks agency, state park interest groups will compete with game and nongame interest groups for allocations from the agency. But the interests of park and nongame user may be more complementary than the interests of game and park users.[27] This is because park users will benefit from a healthy and abundant nongame population. Vote-maximizing politicians (Peltzman 1976) who oversee the broad agency have incentives to please both constituencies and a reduced desire to cater entirely to the demands of game users.

As noted in the introduction of this section, all agencies tend to resist new policies in favor of the status quo because change is costly for agency employees (Wilson 1989). When the professional culture (a patterned way of thinking about the central tasks of an organization) of an agency is mixed, there is less resistance to new policies because the

[27] Most state park users are primarily engaged in activities such as camping, hiking, swimming, boating, hiking, sightseeing, and fishing. With the exception of fishing, these activities mostly involve nongame use.

agency does not have a strong, congruous professional culture that can be threatened by the introduction of new policies and personnel. State wildlife agencies with broad jurisdictions employ a variety of professionals such as park rangers, foresters, and water quality specialists, in addition to wildlife biologists and conservation officers. As a result, an agency with broad jurisdiction is less likely to have established a strong sense of professional culture. An implication is that agencies with broad jurisdiction may more readily accept new tasks, such as an increased emphasis on nongame management, than agencies with narrow jurisdictions.

In summary, politicians will have a greater incentive to pressure wildlife agencies into allocating more resources to nongame programs when jurisdiction is broad (Peltzman 1976). In addition, agencies with broad jurisdiction will be less resistant to nongame programs than agencies with narrow jurisdiction (Wilson 1989). Each suggests that it will be less costly to induce an agency with broad jurisdiction into allocating more resources to nongame programs than an agency with narrow jurisdiction. This implication will be incorporated into the chapter 5 model.

Agency Hierarchy Placement

An agency's position on the hierarchy may influence the ability of the agency to resist the implementation of new, nongame programs. Wilson (1989) notes that an agency's desire for autonomy leads it to resist regulation from other agencies. This resistance often leads to heated agency conflict. If the conflict is between agencies with lateral authority, the contention may not be settled without time-consuming legal or legislative action (Wilson 1989). Subordinate agencies, however, must comply with the

regulations of independent agencies above them. So an uprising of resistance from a subordinate agency is easily quelled by the parent agency. For example, Connecticut's Department of Environmental Protection has the authority to regulate its Division of Wildlife. If the two agencies were both independent, as is the case with Arizona's Department of Environmental Quality and its Game and Fish Department, the authority to regulate would not be as clear. An implication is that it will be more costly to induce independent wildlife agencies into adopting new, nongame programs.

To illustrate this implication, consider how hierarchical position might affect the implementation of a new biodiversity program that seeks to conduct inventories of all plants and animals.[28] Such a program may call for a cooperative effort of several natural resource agencies along with the wildlife agency. But the wildlife agency may resist cooperation if it has other priorities that it considers more worthy of its resources or if it views any interagency agreement as a threat to its autonomy (Wilson 1989). Such an agency will not willingly expend any of its resources on the program. The legislature or governor may intervene to eventually force cooperation, but this process will take time and requires that politicians be motivated enough to offer strong support for the new program.

Summary

None of the bureaucracy models referred to in this chapter explicitly model the affect of changes in agency organization on wildlife agency costs. Some of the models,

[28] A similar program, called the Biodiversity Initiative, is currently being conducted by Delaware's Department of Natural Resources and Environmental Control (DNREC 2000).

however, implicitly suggest how agency jurisdiction, hierarchy placement, and general funding will influence the costs of wildlife agency management and the costs of implementing nongame management. The implications are summarized in table 3.1.

Table 3.1: Summary of Bureaucracy Model Implications for Agency Costs

	Affect on the costs of wildlife management	Affect on the costs of nongame management
Niskanen (1971)		
Jurisdiction goes from broad to narrow	?	?
Hierarchy placement goes from subordinate to independent	?	?
Agency relies more on general funds	?	-
Peltzman (1976)		
Jurisdiction goes from broad to narrow	?	+
Hierarchy placement goes from subordinate to independent	?	?
Agency relies more on general funds	?	-
Wilson (1989)		
Jurisdiction goes from broad to narrow	-	+
Hierarchy placement goes from subordinate to independent	-	+
Agency relies more on general funds	?	?
Dewatripont et. al. (1999)		
Jurisdiction goes from broad to narrow	-	?
Hierarchy placement goes from subordinate to independent	?	?
Agency relies more on general funds	?	?

CHAPTER 4

AGENCY BUDGET SIZE DETERMINANTS

The purpose of this chapter is to formulate and test a model of state wildlife agency budget size. The primary goal is to build a coherent framework based on a wildlife agency model (e.g., Lueck 1989) and the existing bureaucracy literature (see chapter 3) that can explain why the size of wildlife agency budgets varies from state to state. This chapter is organized in three sections. Section 1 explains the model and the theoretical propositions that fall from it. Section 2 empirically tests the theoretical propositions. Section 3 briefly summarizes the findings of the chapter.

A Model of Agency Budget Determinants

The model considers the relationship between private landowner management effort and wildlife agency budget size. The model examines how each responds to changes in wildlife demand, wildlife costs, contracting costs, general funding, and bureaucratic costs. I begin with an assumption of zero transaction costs. Under this assumption, a first-best outcome is achieved with either a private landowner or an agency regime. Next, I allow private contracting and bureaucratic costs to be positive and compare the second-best outcomes from a private landowner ownership regime and an agency ownership regime with the first-best benchmark. Finally, while continuing to allow contracting and bureaucratic costs to be positive, I compare outcomes from a mixed

regime where wildlife management is conducted by private landowners and agency managers, with the first-best outcome. From this framework, I derive refutable hypotheses about the affects of changes in contracting costs, agency funding, and bureaucratic costs on private and agency management effort. Because I lack the data to test the private management implications, I conclude the section by emphasizing the agency budget implications that I will test in section 2 of this chapter.

The Basic Model and First-Best Outcome

The total value (V) of wildlife management and the total cost of wildlife management (C) depend on wildlife management effort (w). Management effort can be thought of as a composite variable that includes management tools such as law enforcement, information and education, research, hunting access, and habitat manipulation. Effort is converted into commodities that wildlife users value but the marginal value falls as effort increases so that $V'(w) > 0$ and $V''(w) < 0$.[29] Marginal costs are positive and increasing so that $C'(w) > 0$ and $C''(w) > 0$.

The exogenous variable that influences the total value of wildlife management is the demand for both game and nongame (Φ). Increases in Φ will increase the marginal value of wildlife. The exogenous variables that influence the total cost of wildlife are the opportunity cost of alternative land use and wildlife damage to property (θ). Increases in θ will increase the marginal cost of wildlife.

[29] Hunters, for example, value information about the population migration patterns and habitat preferences of game that is gathered from research and monitoring. The value of each additional unit of research effort declines, however, as more information becomes available to hunters.

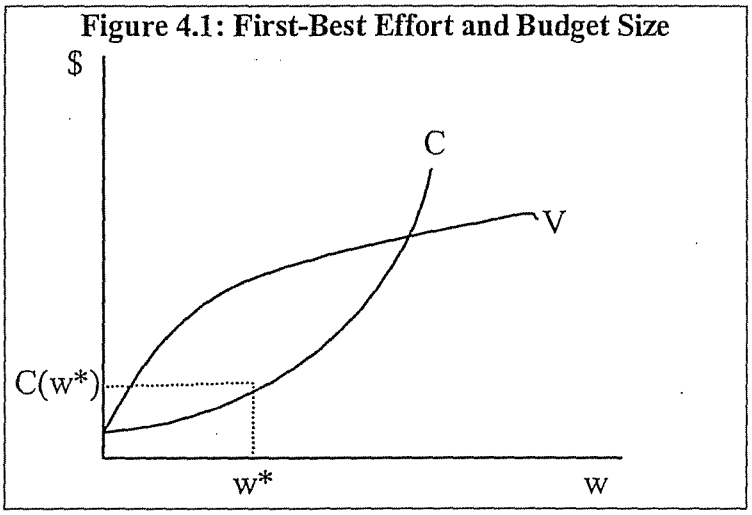
As an analytical benchmark, consider the first-best allocation of management effort. Solving (1) maximizes the net value of wildlife. The first-best solution is given by (2).

(1) $\max_{w} NV = V(w, \Phi) - C(w, \theta)$

(2) $V'(w, \Phi) = C'(w, \theta)$

The first-best outcome is found by choosing (w) so that the marginal value of wildlife is equal to the marginal cost of wildlife. This solution is illustrated by w* in figure 4.1. The first-best "budget" size is represented by the total costs of the optimal effort C(w*).

Figure 4.1: First-Best Effort and Budget Size



In order for the net value of wildlife to be maximized at w*, I must assume zero transaction costs. Under this assumption, as the Coase Theorem implies, a first-best solution will be attained regardless of which institution governs wildlife.

Second-Best Solutions

If private contracting and bureaucratic costs are positive, however, it will matter what institution governs wildlife (Coase 1960). In the United States, private landowners and the state wildlife agency jointly administer wildlife management and each institution is constrained by costs not yet incorporated into the model. In order to systematically model these cost constraints, I separately consider three management regimes. In the first regime, private landowners are the sole providers of wildlife management. In the second regime, a state wildlife agency is the sole provider of wildlife management. In the third regime, agencies and private landowners combine to provide wildlife management. I will show that none of the regimes can provide a first best solution. The combined regime, however, may be able to generate a greater net value from wildlife than either of the separate regimes can generate on their own.

A Private Landowner Regime. Because valuable wildlife species typically require larger tracts of land for habitat than a single landowner can accommodate, landowners must contract with each other in order to capture their value. For example, a landowner may wish to foster deer habitat on his and his neighbor's land so that he may profit from fee hunting. His neighbor may agree to allow access and manipulation of his land in exchange for payment. The terms of such an arrangement will be couched in a contract. Because the costs of establishing and enforcing contracts among landowners will be greater than zero, less management effort will be exerted and the net value derived from wildlife will be less than in a first-best outcome (Lueck 1989). Moreover, as the cost of contracting among landowners rises, wildlife management effort will

continue to decline. In the extreme case, private landowners will exert zero effort and full dissipation will occur.

The costs of contracting among landowners will be higher, *ceteris paribus*, when land use becomes more heterogeneous, as single landholdings become smaller, and when more land is under government control. When landuse is heterogeneous, different valuable attributes of adjacent land are exploited. One landowner may use his tract for agriculture while a neighbor uses his tract to develop a subdivision. Given these landuse decisions, it may be prohibitively costly for the two owners to negotiate a contract that captures any wildlife value. When private landholdings are small, landowners must contract with several parties in order to secure property rights over a tract of land large enough to encompass a stock of wildlife. The cost of negotiating and enforcing contracts will rise with the number of parties involved. In addition, the contracting costs of private landowners will be higher when they establish contracts with federal government agencies that allow the public open access.[30] Because of their open access policies, contracts made with these agencies will be costly to enforce.

A State Agency Regime. The ability of a state wildlife agency to maximize the net value of wildlife is limited by five general constraints.[31] First, because bureaucrats do not receive rents directly associated with the net value of wildlife, they may have imperfect incentives to maximize this objective. Second, politicians and interest groups may seek to influence agency output in ways inconsistent with wealth maximization (Stigler 1971,

[30] Such federal government agencies include the Bureau of Land Management and the Forest Service.

[31] For a more extensive explanation of these constraints refer to chapter 3 of this thesis.

Peltzman 1976, Becker 1983, Wilson 1989). Third, bureaucrats from different professions within the agency will try to implement their preferred policies (Wilson 1989). Fourth, because bureaucrats are never the principals, they are more inclined to shirk. Fifth, wildlife agencies must adhere to administrative rules that often undermine an agency's ability to produce output that wildlife users value without costly procedures (Wilson 1989).

Even if I assume that agencies want to maximize the net value of wildlife, the other four constraints will impose costs on the agency so that it cannot reach the first-best outcome. The existence of these bureaucratic constraints implies that each unit of wildlife management will be more costly than depicted by the total cost curve in figure 4.1. Moreover, certain organizational features of wildlife agencies will exacerbate the affects of these constraints on agency costs. When a wildlife agency has broad jurisdiction, constraints 2, 3, and 4 will be more pronounced. When a wildlife agency is subordinate on the government hierarchy, constraint 5 will be more pronounced. These organizational features act to further dissipate the net value of wildlife realized from a state agency regime.

A Private Landowner and State Agency Regime. In practice, wildlife management (w) is conducted by both private and agency managers. Because the performance of a combined management regime will be hindered by contracting and bureaucratic costs, it will not be able to attain a first-best outcome. The net-value of wildlife under a combined regime, however, can be greater than under the exclusive control of either one of the two institutions. The framework I develop assumes that these

institutions work together in an attempt to maximize the net value of wildlife. Within this framework, agency and private managers mitigate the total costs of managing wildlife by transferring wildlife management responsibility to the lower cost producer. Although I can make no claims about the overall efficiency of the two institutions, the model asserts that each institution responds to changes in the relative cost and value faced by each institution in ways consistent with maximizing the net value of wildlife.

Let (w_A) represent the effort of the agency and (w_P) represent the effort of private managers. The variable (w_A) is a composite variable that denotes several agency management inputs such as law enforcement, population monitoring, restocking populations, and habitat manipulation. The variable (w_P) is also a composite variable that denotes several private management inputs such as population monitoring and habitat manipulation. The total value of agency wildlife management (V_A) depends on w_A and and w_P. The total cost of agency wildlife management (C_A) depend on w_A. The total value of private wildlife management (V_P) depends on w_A and and w_P. The total cost of agency wildlife management (C_P) depends on private effort (w_P). Both w_A and w_P are converted into commodities that wildlife users value but the marginal value falls as effort increases so that $\partial V_A/\partial w_A$ (denoted by V_A') and $\partial V_P/\partial w_P$ (denoted by V_P') are >0 and V_A'' and V_P'' are < 0. Marginal costs are positive and increasing so C_A' and $C_P' >0$ and C_A'' and C_P'' are >0.

The exogenous variable that influences the value of agency management (V_A) is wildlife demand (Φ). An increase in Φ increases V_A'. The exogenous variables that influence the total cost of agency management (C_A), are the opportunity cost of

alternative land use and wildlife damage to property (θ) and bureaucratic costs (b). Increases in these variables increase C_A'. The exogenous variables that influence the total value of private management (V_P) are Φ and the portion of wildlife agency costs that is covered by the general fund (g). An increase in Φ increases V_P'. Increases in g decrease V_P' because there will be less demand for private landowner management when wildlife users are able to use agency management at a price below marginal cost. The exogenous variables that influence the total cost of private management (C_P) are (θ) and contracting costs (r). Increases in either of these variables increase C_P'.

The problem facing agency and private managers is given by (3) and the first order conditions for a second best solution are shown in (4) and (5).

(3) $\max_{w_A,\, w_P} NV = [V_A(w_A, w_P, \Phi) + V_P(w_A, w_P, \Phi, g)] - [C_A(w_A, \theta, b) + C_P(w_P, \theta, r)]$

(4) $V_A'(w_A, w_P, \Phi) = C_A'(w_A, \theta, b)$

(5) $V_P'(w_A, w_P, \Phi, g) = C_P'(w_P, \theta, r)$

Wildlife Management Effort Propositions

I make three critical assumptions that allow me to sign comparative statics. These assumptions are the second-order conditions for maximization. The first set of assumptions are given by $V_A'' - C_A'' < 0$ and $V_P'' - C_P'' < 0$. Second, I assume that w_A and w_P are substitutes.[32] This assumption allows me to sign $\partial V_A'/\partial w_P$ and $\partial V_P'/\partial w_A$ as

[32] I do not assert that these variables are perfect substitutes. State laws have precluded them from being so because hunters and fisherman are usually compelled to purchase licenses from the agency even when they hunt and fish on private land. Therefore an increase in the number of hunters or fisherman will necessarily increase the demand for agency management and may also increase the demand for private management. My assumption, however, recognizes that either private landowners or agency managers can conduct most wildlife management activities.

negative. In words, increases in private wildlife management effort decrease the marginal value of agency management effort and increases in agency management effort decrease the marginal value of private management effort. Finally, I assume that ($[V_A''- C_A'']\bullet([V_P''- C_P''])$ > $([\partial V_A'/\partial w_P]\bullet[\partial V_P'/\partial w_A])$. This assumption, while difficult to interpret, is a necessary condition for maximization. Taken together, these assumptions imply that (4) and (5) can be solved for the explicit choice functions (6) and (7).

(6) $w_A^* = w_A(\Phi, g, \theta, b, r)$
(7) $w_P^* = w_P(\Phi, g, \theta, b, r)$

Substituting (6) and (7) into (4) and (5) yields the first-order identities given in (8) and (9).

(8) $V_A'(w_A^*(\Phi, g, \theta, b, r), w_P^*(\Phi, g, \theta, b, r), \Phi) \equiv C_A'(w_A^*(\Phi, g, \theta, b, r), \theta, b)$
(9) $V_P'(w_A^*(\Phi, g, \theta, b, r), w_P^*(\Phi, g, \theta, b, r), \Phi, g) \equiv C_P'(w_P^*(\Phi, g, \theta, b, r), \theta, r)$

The model yields several comparative static results concerning how the optimal management effort of each institution responds to changes in the exogenous parameters. To obtain comparative static results I first differentiate the system (8) and (9) with respect to any parameter (α) to obtain the following Hessian matrix.

$$\left| Hessian = \begin{matrix} V_A'' - C_A'' & \partial V_A'/\partial w_P \\ \partial V_P'/\partial w_A & V_P'' - C_P'' \end{matrix} \right|$$

By the second-order conditions, the determinant of the Hessian (H) is > 0. I use Cramer's rule to solve for $\partial w_A^*/\partial\alpha$ and $\partial w_P^*/\partial\alpha$. The solutions for a few comparative statics

results are illustrated below. The remaining comparative statics are summarized in table 4.1 and explicitly derived in appendix A.

$$\frac{\partial w_A^*}{\partial r} = \frac{(-\partial C_P'/\partial r)(\partial V_A'/\partial w_P)}{H} > 0$$

$$\frac{\partial w_P^*}{\partial r} = \frac{(\partial C_P'/\partial r)(V_A'' - C_A'')}{H} < 0$$

$$\frac{\partial w_A^*}{\partial \Phi} = \frac{[(\partial V_A'/\partial \Phi)(V_P'' - C_P'')] - [(\partial V_P'/\partial \Phi)(\partial V_A'/\partial w_P)]}{H} <,>,= 0?$$

$$\frac{\partial w_P^*}{\partial \Phi} = \frac{[(\partial V_P'/\partial \Phi)(V_A'' - C_A'')] - [(\partial V_A'/\partial \Phi)(\partial V_P'/\partial w_A)]}{H} <,>,= 0?$$

These results are consistent with the *Conjugate Pairs Theorem* which states that refutable comparative statics are forthcoming only if the given parameter enters one and only one first-order condition (Silberberg 1990). Notice that I am able to sign $\partial w_A^*/\partial r$ and $\partial w_P^*/\partial r$ because I assume that w_A and w_P are substitutes. I am unable to sign $\partial w_A^*/\partial \Phi$ and $\partial w_P^*/\partial \Phi$, however, because no prior assumptions tell me whether $(\partial V_A'/\partial \Phi)(V_P'' - C_P'')$ is greater or less than $(\partial V_P'/\partial \Phi)(\partial V_A'/\partial w_P)$ or whether $(\partial V_P'/\partial \Phi)(V_A'' - C_A'')$ is greater or less than $(\partial V_A'/\partial \Phi)(\partial V_P'/\partial w_A)$.

The comparative statics make intuitive sense in light of competing forces. An increase in contracting costs (r) increases the per-unit cost of private management (w_P^*) thereby decreasing the per-unit cost of agency management (w_A^*) relative to w_P^*.

Because w_P and w_A are substitutes, the net-value maximizing response to an increase (decrease) in (r) is a decrease (increase) in w_P^* and an increase (decrease) in w_A^*. An increase in wildlife demand (Φ) increases the per-unit value of w_P^* and w_A^*. The effect on the per-unit value of w_A^* relative to w_P^*, however, is ambiguous because I make no assumptions about the magnitude of change in V_A' and V_P' that result from changes in Φ.

Table 4.1: Agency and Private Management Effort Comparative Statics

Variable	Definition	Agency Management Effort (w_A^*)	Private Management Effort (w_P^*)
Φ	Increase in wildlife demand	?	?
g	Increase in the percentage of agency costs covered by general funds	+	-
θ	Increase in opportunity cost of alternative land use and wildlife damage to property	?	?
r	Increase in private contracting costs	+	-
b	Increase in bureaucratic costs	-	+

Increases in demand for wildlife (game and nongame) will have ambiguous affects on private and agency management effort. An increase in the percentage of agency costs covered by general funds will decrease private management effort and increase agency management effort. An increase in the costs of managing wildlife, because of increases in the opportunity cost of alternative land use or because of increases in wildlife damage to property, will have ambiguous affects on private and agency management. An increase in private contracting costs will increase agency wildlife management effort and decrease private management effort. An increase in bureaucratic costs will decrease agency effort and increase private effort.

Agency Budget Propositions

The comparative static propositions listed in table 4.1 cannot be tested directly because private and public wildlife management effort is not directly observable or uniformly measurable across states. The testable hypotheses that emerge from the model are the agency budget implications derived from the agency effort (w_A) propositions. The agency's budget is represented by its total costs for the chosen amount of effort $C_A(w_A^*)$. Given the slope assumptions that characterize V_A and C_A, I can determine the direction of change in an agency's budget when its effort changes. When agency effort (w_A^*) goes down, the total costs (C_A) of effort must also fall. When (w_A^*) rises the total costs (C_A) of agency effort must rise. The testable implications of the model are summarized in table 4.2.

Table 4.2: Agency Budget Comparative Statics

Variable	Variable Definition	Agency Budget $C_A(w_A^*)$
Φ	Increase in wildlife demand	?
g	Increase in the percentage of agency costs covered by general funds	+
θ	Increase in opportunity cost of alternative land use and wildlife damage to property	?
r	Increase in private contracting costs	+
b	Increase in bureaucratic costs	-

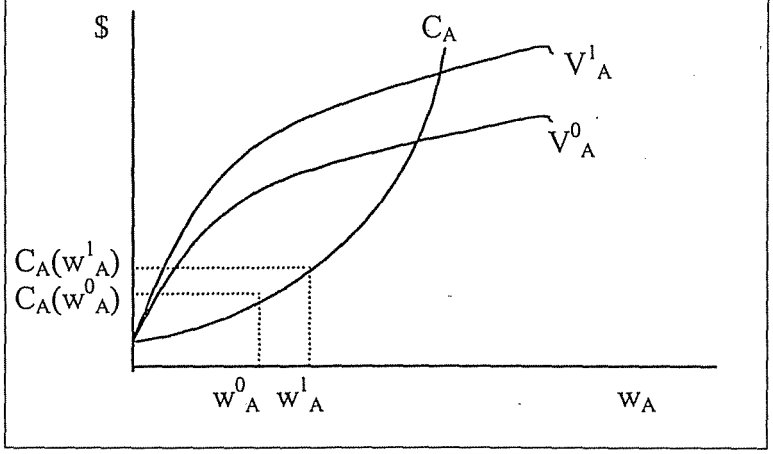
An increase in demand for wildlife (Φ) will have an ambiguous affect on a wildlife agency's budget.[33] Increases in the opportunity cost of land in alternative uses or an

[33] The sign of the comparative static $\partial C_A(w_A^*)/\partial\Phi$ is ambiguous in the theoretical section but some institutional details of wildlife agencies prompt me to adjust this prediction in the empirical section.

increase in wildlife damage to property (θ) will also have an ambiguous affect on agency budgets. An increase in the percentage of agency costs covered by the general fund will increase the agency's budget size. An increase in private contracting costs (r) will increase wildlife agency budgets. An increase in bureaucratic costs (b) will decrease agency budgets.

Figure 4.2 illustrates a budget proposition graphically. Suppose that private contracting costs (r) increase. This cause a shift from V^0_A to V^1_A. In response to this shift, the wildlife agency will increase its effort from (w^0_A) to (w^1_A). The optimal budget of the wildlife agency will increase from $C_A(w^0_A)$ to $C_A(w^1_A)$.

Figure 4.2: Agency Budget Size Propositions



Empirical Framework

The predictions from the model will be tested using cross-section data from U.S. states. The data set includes all fifty states but not the District of Columbia. The cross

section data, from 1996 and 1997, are compiled from several sources including the Wildlife Conservation Fund of America (WCFA), the U.S. Wildlife Service (USFWS), the U.S. Bureau of the Census, the Economic Research Service of the U.S. Department of Agriculture (ERS), the Wildlife Management Institute (WMI), and individual state wildlife agency websites.

Description of the State Data

I rely on certain variables, gathered from the sources listed above, to approximate the theoretical parameters of my model. The empirical variables are organized in the following categories: wildlife demand variables, contracting cost variables, bureaucratic cost variables, and funding variables. Variables in each category are described in detail below. A statistical summary is given in table 4.3. A correlation matrix of the variables is given in table B.1 in Appendix B.

Wildlife Agency Budgets. The ideal dependent variable would represent the minimum cost for a given level of agency output. The ideal budget variable would be a consistent measure of the costs of wildlife management effort even though the scope of agency jurisdictions vary. The empirical variable I use to proxy this ideal is budget data that comes from the *1996 Survey of State Wildlife Agency Revenue* conducted by the WCFA. Because the budgets are measured by revenue instead of costs, this variable falls short of the ideal. The revenue calculations, however, are generally consistent across states regardless of agency jurisdiction. For example, the revenue calculation from Montana Fish, Wildlife, and Parks is comparable with the revenue calculation from

Idaho's Department of Fish and Game because neither includes revenues from state parks. The revenue calculations, however, are somewhat inconsistent because some agencies administer commercial fisheries while others do not. For example, the revenue calculation for Maine's Department of Wildlife and Inland Fisheries does not include saltwater commercial fishing license revenue but Washington's Department of Fish and Wildlife revenue calculation does include commercial fishing revenues.

Wildlife Demand Variables. The data used to proxy demand for game and nongame come from the *1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* conducted by the U.S. Fish and Wildlife Service. The survey has been conducted since 1955 and is one of the most comprehensive continuing outdoor recreation surveys available (USFWS 1997).

The ideal measures of demand for game and nongame wildlife would be completely exogenous to wildlife agency expenditures and consistently measure resident and nonresident demand across states. The ideal exogenous demand variable would not be influenced by the price of licenses. Resident demand for game is measured with a variable that indicates the total number of state residents that hunted or fished in any U.S. state. For example, a resident of Alabama that hunted in Mississippi is considered an Alabama hunter. The number of non-resident hunters and non-resident anglers in each state is a proxy for non-resident or high value demand for game. The empirical variables used to measure demand for game are generally consistent across states and capture demand for game regardless of the species being pursued by hunters and anglers. These empirical variables, however, are less than ideal for three reasons. First, they are likely to

be endogenous to the amount of wildlife management effort exerted by the agency. Second, the variables are not a pure measure of exogenous demand because they are likely to be influenced by price. Third, the variables capture the number of game users but not the intensity of use.[34]

The ideal measure of nongame demand would isolate demand for wildlife that is not fished or hunted and would be completely exogenous to wildlife management effort. The variable used to proxy this ideal is the total number of days that state residents spent watching wildlife in 1996. Wildlife-watching activity is defined by the USFWS as "individuals engaged in an activity primarily for the purpose of feeding, photographing, or observing wildlife."[35] A wildlife-watching day is recorded if an individual spends any part of his or her day engaged in wildlife watching. My empirical measure of nongame demand is less than ideal because wildlife watchers often enjoy observing game species such as elk and moose as well as nongame species. In addition, the number of wildlife watching days is likely to be influenced by the amount of wildlife management effort exerted by the agency. Despite these shortcomings, this variable provides an empirical proxy for nongame demand that is consistently reported across the fifty states.

---

[34] A better variable to measure resident demand for game might be the total number of days spent hunting and fishing by residents. I choose not to use this variable for testing the budget predictions, however, because I lack a measure of nonresident hunting and fishing days that would be consistent with the definition of the resident variable. Using the total number of resident and nonresident hunters and fisherman allows me to compare the coefficients of the variables in a clear and meaningful manner.

[35] USFWS (1997), appendix A, page A-4.

Table 4.3: Variable Definitions and Summary Statistics

Variable Name	Definition	Minimum	Maximum	Mean	Standard Deviation
Dependent Variable					
BUDGET	Total budget (1996)	$5.50 M	$120.08 M	$40.60 M	$ 29.5 M
Wildlife Demand Variables					
HUNTERS	The number of state residents who hunted in any state (1996)	22,000	872,000	278,740	212,105
ANGLERS	The number of state residents who fished in any state (1996)	87,000	2,721,000	704,780	595,982
NONRESIDENT HUNTERS	The number of non-resident hunters (1996)	230	217,000	46,764	41,100
NONRESIDENT ANGLERS	The number of non-resident anglers (1996)	22,000	986,000	227,780	173,536
WILDLIFE WATCHING DAYS	The total number of days residents spent engaged in wildlife watching (1996)	422,000	16,765,000	5,722,543	4,267,983
Contracting Cost Variables					
PERCENT PUBLIC LAND	Percent of total land that is federally owned open access land (1996)	0.14%	81.82%	15.05%	19.93%
FARM SIZE	Average size of farm (in acres) (1997)	75	4,379	677	939
FARM VARIANCE	The standard deviation of the average farm size in each county (1997)	14.6	852.5	8,403.3	1,717.1
Agency Funding Variables					
GENERAL FUNDS SHARE	Total budget dollars from state general fund (1996)	0.00%	61.90%	9.41%	14.46%
GENERAL FUNDS DUMMY	=1 if the agency receives general funds, otherwise = 0 (1996)	0	1	0.60	0.52
Bureaucratic Cost Variables					
INDEPENDENT AGENCY	=1 if the agency is independent, otherwise = 0 (1997)	0.00	1.00	0.54	0.50
NARROW JURISDICTION	=1 if the agency's jurisdiction is narrow, otherwise = 0 (1997)	0.00	1.00	0.80	0.40
Control Variables					
POPULATION	Total population (1997)	480,907	32,666,550	5,395,508	5,937,650
AREA	Total area in square miles	1,045	570,374	70,725	85,804
INCOME	Per-capita income (1997)	$19,776	$37,338	$26,029	$3,777

Sources: see appendix B.

Contracting Cost Variables. The ideal measure of contracting costs would report the total cost required of landowners to establish and enforce property rights over a stock of wildlife. This type of data, of course, is unavailable. The costs of establishing and enforcing property rights should rise, however, as single land holdings become smaller, as land use becomes more heterogeneous, and as more land becomes open access (Lueck 1989). Proxies for these types of data are available.

I proxy the size of private landholdings with a variable that indicates the 1997 average size (in acres) of farms in each state. The data come from the *1997 Census of Agriculture* conducted by the USDA. The heterogeneity of land use is measured with a variable that proxies the standard deviation of farm sizes in each of the states. Homogenous land use tends to occur on tracts of land similar in size. For this reason, I assert that increases in the standard deviation of farm size increase the heterogeneity of land use and therefore, contracting costs. The variable I use to measure the extent of open access land holdings is the percentage of federally owned open access land in each state. Federally owned open access land includes Forest Service (USFS) and Bureau of Land Management (BLM) land holdings but excludes Park Service (USPS) and Bureau of Indian Affairs (BIA) land holdings. Wildlife recreational access on USFS and BLM land is generally available free of charge but access on USPS and BIA land is usually not free. As a result, private contracts that might capture the value of a stock of wildlife are difficult to establish and enforce on USFS and BLM land. Therefore, private contracting costs rise with increases in the percentage of land under open access policy.

These measures of private contracting costs have some shortcomings that should be noted. Ideally I would have measures of the size and variance of all private landholdings. The variables, however, exclude privately held tracts of land that are not used for agriculture. In a state like Alaska, where less than 1 percent of the land is used for agriculture, the farm size variable is probably a poor measure of the average size of all private landholdings. In other states, where most of land is used for agriculture, such as Kansas, Iowa, and Texas, the farm size variable should be a good measure of the average size of all private landholdings.

In comparison, however, the FARM VARIANCE is a less ideal variable because it is not a true measure of farm variance. This variable is a calculated by taking the standard deviation of the average farm size in each county of the state. Because the number and size of counties varies considerably in each state this measure of variation in farm size is biased. For example, in 1997 there were 5 counties in Alaska, 246 in Texas, and 118 in Kentucky. Without controlling for the size of counties, the FARM VARIANCE variable does not allow for a very meaningful comparison in farm size variance across these states. In recognition of this problem I limit the use of FARM VARIANCE to only a few specifications in my empirical analysis.

Bureaucratic Cost Variables. I assert that two agency organization variables are correlated with bureaucratic costs. The first variable is qualitative and indicates whether a wildlife agency's jurisdiction is broad or narrow. This variable is described in detail in chapter 2. Agencies with broad jurisdictions will have higher bureaucratic costs than agencies with narrow jurisdictions for three reasons. First, agencies with broad

jurisdiction are more predisposed to costly rent-seeking behavior (or professional conflict) among employees of different professions (Wilson 1989). Second, agencies with broad jurisdiction will have trouble implementing policy because they will tend to lack the unified political support enjoyed by agencies with narrow jurisdictions (Wilson 1989). Third, employees of agencies with broad jurisdictions may be more likely to shirk (Dewatripont et. al. 1999).

The second variable I use to proxy bureaucratic costs is also qualitative and indicates an agency's position on the hierarchy. Agencies on the top of the hierarchy are considered independent and agencies lower on the hierarchy are considered subordinate. This variable is discussed in greater detail in chapter 2. The bureaucratic costs of subordinate agencies are higher than the bureaucratic costs of independent agencies because subordinate agencies are subjected to more administrative constraints or "red tape" than independent agencies. These constraints make it more costly for a subordinate agency to produce output that wildlife users value.

Agency Funding Variables. The ideal empirical variable would indicate the portion of agency wildlife management costs that could be covered by user fees that are instead covered by general tax dollars. The ideal variable would be exogenous to the size of agency budgets. The variables I use to proxy this ideal is the percentage of the agency's budget that came from state general funds in 1996 and a dummy that indicates whether or not an agency received general funds in 1996. These variables are described in detail in chapter 2 and Figure 2.7 illustrates the percentage of an agency's budget that comes from general funds in each state.

These empirical proxies for the theoretical variable are less than ideal for two reasons. First, general fund dollars are not necessarily spent on programs that would otherwise be funded by user fees. General funds are often used for the production of nongame output that could not be supported by user fees. But some general funds almost always fund attributes of hunting and fishing that could be funded with user fees (O'Toole 1995). Therefore, I assume that the general fund variables are positively correlated to the amount of wildlife management services that are consumed by game users at a price lower than marginal cost. Second, general funds are likely to be endogenous to the size of agency budgets. I attempt to correct for this weakness in the econometrics.

Control Variables. I include variables to control for the influence of land area, population, and per-capita income. Pittman-Robertson and Dingell-Johnson appropriations are based on a formula that considers land area, the number of hunters and anglers, and population. Because of the administration of these federal funds, increases in land area and population should increase the size of agency budgets. The formula for Pittman-Robertson appropriations is explained in chapter 2. I also control for the influence of per-capita income. This variable is likely to influence the demand for game and nongame but may also directly influence the demand for wildlife management and therefore, agency budget size.

Empirical Predictions

Most of the empirical predictions listed below are the empirical counterparts to the theoretical comparative static results described in section 1. A few predictions are not formally obtained from the model, but are based on institutional details of wildlife agencies that are not accounted for in the model. For example, the model predicts that an increase in wildlife demand (game or nongame) will have an ambiguous affect on budget size ($\partial B_A^*/\partial \Phi <,>,$ or $= 0$?). Because hunters and fisherman must purchase licenses from the agency, however, increases in game users should increase budget size. Furthermore, because of the public good nature of nongame use, private managers will not be very responsive to increases in nongame users. If private landowners are unresponsive to nongame users, but overall wildlife management responds to increases in nongame demand in ways consistent with wealth maximization, then agency budgets should increase with increases in nongame demand.[36]

Wildlife Demand Predictions

- Increases in the number of hunters and anglers residing in each state will increase agency budgets.
- Increases in the number of non-resident hunters and non-resident anglers will increase agency budgets.
- Increases in the number of days spent wildlife watching by state residents will increase agency budgets.

Contracting Cost Predictions

- An increase in the percentage of federally owned open-access land will increase the size of agency budgets.
- An increase in the average farm size will decrease the size of agency budgets.
- An increase in the variance of farm size will increase the size of agency budgets.

[36] The comparative static $\partial w^*/\partial \Phi > 0$ can be formally derived from the model. This indicates that an increase in wildlife demand (game and nongame) increases overall management effort (w).

Bureaucratic Cost Predictions

- An agency with narrow jurisdiction will have a higher budget than an agency with broad jurisdiction.
- An independent agency will have a higher budget than a subordinate agency.

Agency Funding Predictions

- An increase in the percentage of an agency's budget that comes from general funds will increase the size of the state agency budget.

Control Variable Predictions

- An increase in the land area will increase agency budgets.
- An increase in the population will increase agency budgets.

Means Analysis of Agency Budgets

As a preliminary test of the predictions the mean values of agency budgets are grouped according to bureaucratic cost variables and agency funding variables. Table 4.4 shows the mean budgets for each subgroup and also shows the t-statistic for the null hypothesis that there is no difference between the mean budgets.

Table 4.4: Mean Values for Wildlife Agency Budgets

Independent Variable	States	Mean Budget	t-value
Agency Funding Variables			
Agency receives no general funds	20	$ 34.49 M	1.20
Agency receives some general funds	30	$ 44.67 M	
Bureaucratic Cost Variables			
Agency is independent on the hierarchy	27	$ 44.20 M	0.94
Agency is subordinate on the hierarchy	23	$ 36.36 M	
Agency has narrow jurisdiction	40	$ 41.66 M	0.51
Agency has broad jurisdiction	10	$ 36.34 M	

Note: * denotes t-values where the means are significantly different at least at the 10 percent level.

The model predicts that, *ceteris paribus*, agencies that are independent and agencies with narrow jurisdictions will have larger budgets than will subordinate agencies and agencies with broad jurisdiction respectively. The comparison of means offers some support for these predictions. Agencies with organizational independence have higher mean budgets ($44.20 million) than agencies that are subordinate ($36.36 million). In addition, agencies with narrow jurisdiction have higher mean budgets ($41.66 million) than their counterparts with broad jurisdiction ($36.34 million). These differences in means, however, are not statistically significant.

The model also predicts that an increase in an agency's reliance on general funds will lead to an increase in agency budgets. This prediction is supported to some extent by the results of the means test. The 20 state agencies that do not receive any general funds have a lower mean budget ($34.49 million) than the thirty agencies that do ($44.67 million). The difference in means, however, is only significant at the 77 percent level.

Econometric Analysis of Agency Budgets

The wildlife agency budget predictions will be tested using the Ordinary Least Squares (OLS) and Two Stage Least Squares (2SLS) procedures. A variety of specifications are used to evaluate the robustness of the hypothesis tests and to mitigate the problems of heteroscedasticity, endogenous right hand side variables, and outliers in the data set.[37] The regression analysis relies on several different specifications to estimate the generic model (10) below.

[37] Heteroscedasticity is common in regressions that rely on cross section data and usually causes OLS and 2SLS to underestimate the variances and the standard errors of coefficients (Johnston and DiNardo 1997). As a consequence, OLS estimates usually end up with higher t-statistics than would be obtained if the error

(10) Agency budget = $\alpha + \beta$(wildlife demand) + λ(contracting costs) + θ(agency funding) + Ω(bureaucratic costs) + σ(controls) + ε

The results of 8 different specifications are presented in tables 4.5 and 4.6. A summary of the results is presented in table 4.7. Four additional specifications are presented in Appendix B. In general, the results of the empirical tests offer strong support for the model.

Table 4.5. Table 4.5 shows OLS coefficient estimates for four different specifications of equation (10). Specifications 1 and 2 show the estimation results using the entire sample (all 50 observations) and specifications 3 and 4 show the estimation results from a sample of 49 observations with Alaska excluded. In specifications 2 and 4 all of the independent variables are included. FARM VARIANCE is excluded in specifications 1 and 3.

The differences in certain estimated coefficients and t-statistics between specifications 1 and 2 and specifications 3 and 4 suggest that Alaska, an outlier in some dimensions, has a strong influence on the OLS estimation results in table 4.5.[38] The exclusion of Alaska changes the signs of the coefficients on ANGLERS, NONRESIDENT ANGLERS, and FARM VARIANCE. Also noteworthy, the exclusion

terms were homoskedastic. Endogenous right hand side variables will render OLS coefficient estimates biased and inconsistent. Standard errors will also be biased making the OLS t-statistics less reliable and perhaps invalid (Studenmund and Cassidy 1987). A few outliers in the data set can disproportionately influence coefficient estimates as well as t-statistics.

[38] Alaska is most notably an outlier in terms of AREA. The land area of Alaska is more than twice as large as Texas which is the next largest state. Alaska is also on the fringe of being an outlier in terms of FARM SIZE (6th largest), FARM VARIANCE (2nd largest), and PERCENT PUBLIC LAND (5th largest).

of Alaska decreases the coefficient and reduces the t-statistic on PERCENT PUBLIC LAND, increases the coefficient and t-statistic on FARM SIZE, increases the coefficient and t-statistic on NARROW JURISDICTION, and increases the coefficient and t-statistic on AREA.

Including FARM VARIANCE in specifications 2 and 4 does not have much of an impact on the estimation results. The inclusion of FARM VARIANCE has its most noteworthy impacts on the coefficients of FARM SIZE in column 4 and the t-statistic on AREA in column 2. The impact of FARM VARIANCE on these variables is probably a result of the relatively high correlation between the three variables as illustrated in table B.1 in Appendix B.

According to White's Test, homoscedasticity cannot be rejected at a confidence level greater than 72 percent in any of the four specifications presented in table 4.5. Given these results, it is safe to assume that heteroscedasticity is not driving the coefficient and t-statistic estimates. A more significant problem might be that a right-hand side variable, GENERAL FUNDS SHARE, is highly endogenous with the size of agency budgets. In the extreme case, hypothesis tests based on the t-statistics given in table 4.5 may be rendered invalid because of this problem. The specifications presented in table 4.6 address the potential endogeneity problem.

Table 4.5: OLS Estimates of Wildlife Agency Budgets

Dependent variable = total budget

INDEPENDENT VARIABLES	Predicted Sign	(1)	(2)	(3) w/o Alaska	(4) w/o Alaska
CONSTANT		-29,824,068 (1.38)	-29,939,646 (1.35)	-49,090,239 (2.16)**	-48,848,305 (2.13)**
Wildlife Demand Variables					
HUNTERS	+	42.22 (2.03)**	42.22 (2.00)**	44.52 (2.23)**	44.85 (2.23)**
ANGLERS	+	2.57 (0.15)	2.53 (0.14)	-26.20 (1.21)	-29.21 (1.31)
NON-RESIDENT HUNTERS	+	143.53 (2.27)**	143.23 (2.21)**	118.29 (1.91)**	122.26 (1.95)**
NON-RESIDENT ANGLERS	+	-3.76 (0.23)	-3.75 (0.22)	12.70 (0.72)	14.95 (0.83)
WILDLIFE WATCHING DAYS	+	2.51 (2.39)**	2.52 (2.35)**	3.54 (3.14)***	3.60 (3.17)***
Contracting Cost Variables					
PERCENT PUBLIC LAND	+	400,163 (2.64)**	399,319 (2.64)**	201,997 (1.17)	196,007 (1.14)
FARM SIZE	-	-2,035 (0.67)	-1,927 (0.40)	-6,712 (1.80)**	-10,003 (1.70)*
FARM VARIANCE	+	--------	-99.38 (0.03)	--------	2,448 (0.72)
Agency Funding Variables					
GENERAL FUNDS SHARE	+	855,355 (5.21)***	855,863 (5.11)***	997,113 (5.78)***	1,000,008 (5.77)***
Bureaucratic Cost Variables					
INDEPENDENTAGENCY (=1 if independent)	+	13,992,480 (2.74)***	13,998,789 (2.70)***	14,017,702 (2.86)***	13,865,676 (2.80)***
NARROW JURISDICTION (=1 if narrow)	+	9,799,568 (1.58)*	9,818,377 (1.55)*	17,484,904 (2.48)**	18,060,971 (2.52)**
Control Variables					
POPULATION	+	-0.74 (0.53)	-0.75 (0.53)	-0.21 (0.16)	-0.11 (0.08)
AREA	+	83.79 (2.73)**	84.93 (1.73)**	307.81 (2.69)***	310.19 (2.69)***
INCOME	?	200.81 (0.29)	203.25 (0.28)	676.58 (0.96)	680.71 (0.95)
Adjusted R^2		.755	.748	.760	.757
F-Statistic		12.62	11.39	12.73	11.69
Observations		50	50	49	49
White's Test –Confidence level in rejecting homoscedasticity		60%	56%	72%	65%

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test.

Table 4.6. Table 4.6 shows 2SLS and OLS coefficient estimates for four different specifications of equation (6). Specifications 1 and 2 show estimation results using a 2SLS procedure where GENERAL FUNDS SHARE is estimated in the first stage and its estimated value is used as an instrumental variable in the second stage. Specification 2 differs from specification 1 because Alaska is excluded. Specifications 3 and 4 show estimation results using an OLS procedure, but are different from those presented in table 4.5 because GENERAL FUNDS DUMMY is used in place of GENERAL FUNDS SHARE. Specification 4 differs from 3 because Alaska is excluded. All four of the specifications are intended to mitigate the potential problems caused if GENERAL FUNDS SHARE is endogenous to agency budget size.

In the first stage of estimating the 2SLS coefficients, all of the independent variables (with the exception of GENERAL FUNDS SHARE) from the original equation plus a lagged variable, 1991 GENERAL FUNDS SHARE, are used to explain the variance in GENERAL FUNDS SHARE. In the second stage, the predicted value for GENERAL FUNDS SHARE replaces the original variable and is used to estimate the results presented in columns 1 and 2. There are no significant differences between the 2SLS results and the OLS results presented in columns 1 and 3 of table 4.5. This suggests that either their was not much of an endogeneity problem to begin with, or that the instruments used in the 2SLS process are just as endogenous to 1996 agency budget size as the original GENERAL FUNDS SHARE variable.

Table 4.6: 2SLS and OLS Estimates of Wildlife Agency Budgets

Dependent variable = total budget

INDEPENDENT VARIABLES	Predicted Sign	(1) 2SLS	(2) 2SLS w/o Alaska	(3) OLS w GF dummy	(4) OLS w GF dummy w/o Alaska
CONSTANT		-31,996,735 (1.47)	58,567,056 (2.47)**	-19,406,813 (0.70)	-23,449,708 (0.77)
Wildlife Demand Variables					
HUNTERS	+	43.09 (2.07)**	46.85 (2.29)**	29.76 (1.12)	29.64 (1.10)
ANGLERS	+	1.25 (0.07)	-36.49 (1.60)*	9.67 (0.44)	3.64 (0.13)
NON-RESIDENT HUNTERS	+	150.97 (2.36)**	126.45 (1.99)**	114.29 (1.40)*	109.17 (1.30)**
NON-RESIDENT ANGLERS	+	-5.54 (0.34)	13.53 (0.75)	12.33 (0.61)	16.41 (0.69)
WILDLIFE WATCHING DAYS	+	2.56 (2.43)**	3.90 (3.34)***	2.52 (1.86)**	2.76 (1.79)***
Contracting Cost Variables					
PERCENT PUBLIC LAND	+	397,942 (2.70)**	144,754 (0.81)	361,515 (1.90)**	315,947 (1.34)*
FARM SIZE	-	-1,759 (0.58)	-7,408 (1.94)**	-3,421 (0.88)	-4,429 (0.89)
Agency Funding Variables					
GENERAL FUNDS SHARE[a]	+	951,319 (5.03)***	1,238,000 (5.90)***	-------	-------
GENERAL FUNDS DUMMY	+	-------	-------	10,468,147 (1.72)**	11,198,899 (1.71)**
Bureaucratic Cost Variables					
INDEPENDENTAGENCY (=1 if independent)	+	14,560,800 (2.82)***	15,160,504 (3.00)***	11,882,661 (1.80)**	11,915,643 (1.78)**
NARROW JURISDICTION (=1 if narrow)	+	10,789,364 (1.71)**	21,511,339 (2.87)***	1,978,678 (0.25)	3,373,416 (0.38)
Control Variables					
POPULATION	+	-0.65 (0.46)	0.22 (0.15)	-1.45 (0.83)	-1.36 (0.75)
AREA	+	80.36 (2.59)**	360.64 (3.00)***	111.00 (2.90)***	159.54 (1.05)
INCOME	?	-208.36 (0.30)	818.45 (1.13)	134.13 (0.15)	233.09 (0.25)
Adjusted R^2		.752	.748	.603	.567
F-Statistic		12.38	12.34	6.72	5.85
Observations		50	49	50	49
White's Test –Confidence level in rejecting homoscedasticity		62%	74%	49%	48%

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test.

a: 1st stage IV's include all independent variables (with the exception of GENERAL FUNDS SHARE) and 1991 GENERAL FUNDS SHARE.

Another way to reduce the potential problems associated with the GENERAL FUNDS SHARE variable is to use a dummy variable in its place. In columns 3 and 4, GENERAL FUNDS DUMMY indicates whether or not an agency receives general funds. The sign of its coefficients are positive as predicted but are much less statistically significant than the coefficients on GENERAL FUNDS SHARE. Replacing GENERAL FUNDS SHARE with the dummy variable impacts the regression results in several other noteworthy ways. First, the adjusted R^2 and the F-statistic decrease. Second, the overall impact from excluding Alaska becomes less pronounced. Third, the signs of the coefficients on ANGLERS and NONRESIDENT ANGLERS all become positive. Fourth, the size of the coefficients and statistical significance of HUNTERS and NONRESIDENT HUNTERS both decrease. Fifth, the size of the coefficients and t-statistics on NARROW JURISDICTION dramatically decline.

Summary Table 4.7. The coefficient and t-statistic results from the 8 specifications are summarized in table 4.7. Of the 98 hypothesis tests, 77.6 percent are of the same sign as predicted and 60.2 percent of the coefficients are the same sign and statistically significant at least at the 90 percent level. Of the 14.2 percent of the coefficient estimates that are of the opposite sign as predicted, only 1 is statistically significant. The results from each category of variables are described in detail in the following subsections.[39]

[39] Because the dependent variable includes revenue from commercial fishing, I tested several specifications that also included a dummy variable indicating whether or not the agency administered commercial fishing licenses. The inclusion of this dummy did not significantly alter the hypothesis test results presented in this section.

Table 4.7: Summary of OLS and 2SLS Results for Budget Size Specifications

INDEPENDENT VARIABLES	Predicted Sign	# of specifications variable was used in	Coefficient range	# of specifications with positive coefficient	# of specifications with significant positive coefficient	# of specifications with negative coefficient	# of specifications with significant negative coefficient
Wildlife Demand Variables							
HUNTERS	+	8	29.64 to 46.85	8	6	0	0
ANGLERS	+	8	-36.49 to 9.67	5	0	3	1
NON-RESIDENT HUNTERS	+	8	109.17 to 150.97	8	8	0	0
NON-RESIDENT ANGLERS	+	8	-5.54 to 16.41	5	0	3	0
WILDLIFE WATCHING DAYS	+	8	2.51 to 3.90	8	8	0	0
Contracting Cost Variables							
PERCENT PUBLIC LAND	+	8	144,754 to 400,163	8	5	0	0
FARM SIZE	-	8	-1,759 to 10,003	0	0	8	3
FARM VARIANCE	+	2	-99.38 to 2,448	1	0	1	0
Agency Funding Variables							
GENERAL FUNDS SHARE	+	6	855,355 to 1,238,000	6	6	0	0
GENERAL FUNDS DUMMY	+	2	10,468,147 to 11,198,899	2	2	0	0
Bureaucratic Cost Variables							
INDEPENDENTAGENCY (=1 if independent)	+	8	11,882,661 to 15,160,504	8	8	0	0
NARROW JURISDICTION (=1 if narrow)	+	8	1,978,678 to 21,511,339	8	6	0	0
Control Variables							
POPULATION	+	8	-1.45 to 0.22	1	0	7	0
AREA	+	8	80.36 to 360.64	8	7	0	0
INCOME	?	8	-208.36 to 818.45	7	0	1	0

Note: Summarized results do not include logged specifications from table B.2 in Appendix B.

Wildlife Demand Variables. The coefficient and t-statistics on the wildlife demand variables suggest that hunting and wildlife watching activities have a more significant affect on agency budgets than fishing activities. The coefficients on HUNTERS, NONRESIDENT HUNTERS, and WILDLIFE WATCHING DAYS are positive and statistically significant in 92 percent of their occurrences. Furthermore, the coefficients on the hunting variables are consistently larger in magnitude then the positive coefficients on the fishing variables. In addition, the positive coefficients on the nonresident variables tend to be larger than the coefficients on the resident variables. Both results seem reasonable. Resident hunting license fees are almost always higher than resident fishing license fees and all of the state agencies price discriminate against nonresidents.

The magnitude of the affect of wildlife watching on agency budgets is an interesting, if not unexpected result. The coefficients mean that an increase of 1,000 wildlife watching days is correlated with a budget increase of as much as $3,900. These coefficients suggest agencies are quite responsive to nongame users who generally don't pay user fees.

The coefficients on NON-RESIDENT ANGLERS and ANGLERS are negative in 37 percent of the specifications in which they are used. This is a perplexing result that is inconsistent with my predictions. A rationale that might explain the negative coefficients is based on the presumption that residents and non-residents compete for fishing access. If the competition between them is extreme enough, increases in the number of nonresidents fisherman might reduce the number of resident anglers willing to

fish and vice versa. If this was the case, however, I would expect NONRESIDENT ANGLERS and ANGLERS to be negatively correlated. The correlation coefficient between these two variables, however, is positive and strong at 0.47 as illustrated in table B.1 in Appendix B.

The negative coefficients on the fishing variables may instead be explained by their correlation with other variables in the regressions. The fishing coefficients are all positive when GENERAL FUNDS DUMMY is used instead of GENERAL FUND SHARE (columns 3 and 4, table 4.6). This suggests that the interaction of GENERAL FUNDS SHARE and the fishing variables may be distorting their influence on agency budget size. In any case, the coefficients on both the resident and nonresident fishing variables are only negative and statistically significant in 1 of their combined 16 occurrences.

Contracting Cost Variables. The coefficients on PERCENT PUBLIC LAND, FARM SIZE, and FARM VARIANCE, have the same sign as predicted in 94 percent of their occurrences. The sign of the t-statistics are as predicted and statistically significant in 44 percent of their occurrences.

Of these variables, the coefficients on PERCENT PUBLIC LAND are the most consistent with the predictions – positive in all cases and statistically significant in 5 of the 8 specifications. The coefficients mean that a 10 percent increase in PERCENT PUBLIC LAND is correlated with as much as a $4 million increase in budget size. The magnitude of these coefficients, coupled with their statistical significance, support the

notion that federally owned land under open access policy has a marked impact on state wildlife agency budgets.[40]

In contrast, the signs and t-statistics on FARM SIZE and FARM VARIANCE are less robust than the signs and t-statistics on PERCENT PUBLIC LAND. While all of the coefficients on FARM SIZE are negative as predicted, the t-statistics are statistically significant in only 3 of the 8 specifications. All of the statistically significant coefficients on FARM SIZE occur when Alaska is excluded.[41] That the coefficients on FARM SIZE are more conforming to the model without Alaska can be explained statistically. Alaska has the 4th largest agency budget ($97.3 million) but also has the 5th largest average farm size at 1,608 acres. Because only 0.2 percent of Alaska is farmed (USDA 1997), however, the FARM SIZE variable is a particularly poor measure of the ideal variable for Alaska which would indicate the average size of all private land holdings.

The coefficients on FARM VARIANCE are also greatly affected by Alaska. The coefficient is positive, as predicted, only when Alaska is excluded. The t-statistic, however, is not statistically significant. Alaska has a significant affect on the sign of this coefficient because it has a large standard deviation in farm size (8,096 compared to a mean of 853). As described earlier in the empirical section, the FARM VARIANCE

---

[40] I also estimated similar specifications to test the effects of an increase in a square mile of public land versus an increase of a square mile of private land on agency budget size. The results did not contradict the finding presented in table 4.7. An increase in an acre of federally owned open access land increased agency budgets but an increase in privately owned land did not.

[41] In addition, the negative coefficients are largest when Alaska is excluded. For example, the coefficient on FARM SIZE in column 2 of table 4.5 means that an increase of 100 acres in average farm size is correlated with a budget decrease of $192,700 using all observations. When Alaska is dropped, as shown in column 4, an increase of 100 acres in average farm size is correlated with a $1 million decrease in budget size.

variable, as calculated, is far from an ideal contracting cost variable. This is why the variable is employed in only 2 of the 8 specifications.

Bureaucratic Cost Variables. The coefficient estimates on INDEPENDENT AGENCY and NARROW JURISDICTION are positive, as predicted, and statistically significant in 87.5 percent of their occurrences. In comparison, the coefficient estimates on INDEPENDENT AGENCY are more robust suggesting that an agency's location on the hierarchy has a relatively greater influence on agency budget size than does agency jurisdiction.

The coefficients on INDEPENDENT AGENCY are statistically significant in 8 of 8 specifications. The coefficients on NARROW JURISDICTION are statistically significant in 6 of 8 specifications. The wide range of coefficients on NARROW JURISDICTION (from $1.9 to $21.5 million) and t-statistics (from 0.25 to 2.87) indicates that the estimation results are highly sensitive to specification differences. In the 2 cases where the coefficients are not significant, GENERAL FUNDS DUMMY is used in place of GENERAL FUNDS SHARE (columns 3 and 4 in table 4.6). The coefficients on NARROW JURISDICTION are generally largest when Alaska is excluded from the data set.

Agency Funding Variables. The coefficients on GENERAL FUNDS SHARE and GENERAL FUNDS DUMMY are positive and statistically significant in 8 of 8 specifications. The coefficients on GENERAL FUNDS SHARE suggest that an increase in an agency's reliance on general funds of 10 percent is correlated with a budget size

increase of as much as $12 million. The coefficients on GENERAL FUNDS DUMMY suggest that an agency that receives some general funds will be as much as $11 million bigger in terms of budget size. These results are consistent with the notion that general fund dollars that are used to provide service to wildlife users at a price below marginal cost will crowd out private management and increase agency budget size.

Control Variables. The coefficient estimates on AREA are positive and statistically significant in 7 of 8 specifications. The coefficient results tend to be larger when Alaska is excluded. A possible explanation for this result lies in the formula of Pittman-Robertson appropriations. States receive monies positively correlated with land size. The appropriations, however, are capped so that no state can receive more than 5 percent of total appropriations. Because of its massive land area, Alaska always receives the capped limit of funding. If the cap were not in place, however, Alaska would receive more money based on land area. Because the OLS coefficient estimates control for the other variables, the estimates on AREA indicate that without the peculiar influences from Alaska, an additional square mile has a stronger influence on budget size.

Seven of the 8 coefficient estimates on POPULATION are negative. These are surprising results because population size directly enters the Pittman-Roberston formula.[42] In addition, POPULATION is positively and highly correlated with HUNTERS, ANGLERS, and WILDLIFE WATCHING DAYS – variables that tend to

[42] The formula is explained in chapter 2. A much smaller portion of appropriations is based on population than land area.

increase the size of the budget. None of the coefficients on POPULATION, however, are statistically significant.

Seven of the 8 coefficient estimates on INCOME are positive. These results suggest that demand for agency wildlife management increases with increases in income. This direct affect of changes in per-capita income on budget size appears to be small, however, given that none of the estimated coefficients are statistically significant.

Conclusion

The model and tests of budget determinants begin to illustrate some of the important influences accounting for the size of a modern wildlife agency's budget. The agency budget findings are generally consistent with the model, which built on Lueck (1989) and to a lesser extent, the ideas of Wilson (1989) and Dewatripont et. al. (1999). While some of the findings are elementary (e.g., that an increase in resident and non-resident hunters is correlated with an increase in the size of agency budgets), other results are less intuitive. The findings that agencies with narrow jurisdiction, agencies that are independent, and agencies in states with large public land holdings tend to have larger budgets are more interesting and unique contributions.[43] These results support the notion that wildlife agencies will adjust their management effort in response to changes in the relative costs of private and agency management. Furthermore, the empirical results

[43] One could cogently argue that agencies with broad jurisdictions and agencies subordinate to larger departments could increase their budget sizes by appealing to the interests of a broader range of constituents.

suggest that agencies will adjust their management effort in ways consistent with wealth maximization.

CHAPTER 5

NONGAME BUDGET ALLOCATION DETERMINANTS

In the previous chapter, I developed and tested a model of state wildlife agency budget size determinants. The purpose of this chapter is to examine the factors that influence how much of an agency's budget is allocated towards nongame species. The primary goal is to build a coherent framework, based on a conglomeration of bureaucracy models described in chapter 3 (e.g., Niskanen 1971, Peltzman 1976, Wilson 1989) and a contracting cost model (Lueck 1989), that can explain why the percentage of an agency's budget spent on nongame programs varies from state to state. This chapter is organized in three sections. In section 1, I explain the theoretical model and the propositions that fall from it. In section 2, I empirically test the predictions of the model. In section 3, I briefly summarize the findings of the chapter.

A Model of Nongame Budget Allocation Determinants

I begin the development of the model by describing its basic components and the key assumptions that will drive the comparative static results. Next, I describe a first-best outcome where the net value of agency wildlife management is maximized. Under the "perfect" assumptions that must hold to ensure a first-best outcome, agency organization will not affect the allocation of resources. Next, I relax the perfect assumptions and allow political and bureaucratic incentives and costs to be influenced by agency

organization (e.g, Peltzman 1976, Wilson 1989, Niskanen 1971), and I allow the value of agency nongame management to be affected by private contracting costs. Given these influences, I compare the second-best solutions that are obtained with the first-best analytical benchmark and derive refutable hypotheses.

Key Assumptions

I assume the agency is endowed a fixed amount of resources such as a total budget or a total number of employees to hire. Politicians and the agency choose how much of these resources to allocate towards nongame or game uses. In the previous chapter, w_A denoted the total effort of an agency. In this chapter, w_A is fixed but the allocation can be thought of as w_N/w_A where w_N = nongame management effort. I assume that $w_A - w_N = w_G$ so that game management effort (w_G) is implicitly chosen. This conveys the fundamental assumption underlying the model: game and nongame uses are competing.

This assumption requires some explicit justification. The division between nongame and game users is strong according to some wildlife management professionals. Ledford (1998) reports that "there is a very real us versus them mentality among some wildlifers with game species interests and others with nongame interests". But a hostile division between users is not a necessary condition for the model. Two conditions are necessary. First, an individual must be identified as primarily a game or nongame user. For example, a hunter who enjoys seeing bald eagles only while out on a hunt is primarily a game user. Second, expenditures made on nongame programs must primarily benefit nongame and expenditures made on game must primarily benefit game. For example, Missouri's Department of Conservation's Cave Life program, which researches

and studies the organisms associated with cave habitats, is for the primary benefit of nongame creatures such as bats, long-tailed salamanders and cave crayfish (Ashley and Elliot 2000).[44] Benefits to game species from programs like this are very indirect. As long as these conditions hold, it is valid to assume that nongame spending is costly to game users because the opportunity cost of those dollars are expenditures on programs that would more directly benefit game.

Model Basics

I begin the development of the model by assuming that game and nongame allocation decisions are made with the objective of maximizing the net value of wildlife management. The agency faces value and cost curves from game and nongame users. The total value of nongame management (V_N) and the total costs of nongame management (C_N) depend on nongame allocations (w_N). The total value of game management (V_G) and the total costs of game management (C_G) also depend on nongame allocations (w_N) because $w_A - w_N = w_G$. The function V_N has a positive but decreasing marginal product so that $V_N' > 0$ and $V_N'' < 0$ and the function C_N has a positive and increasing marginal cost so that $C_N' > 0$ and $C_N'' > 0$. The function V_G has a negative but increasing marginal product so that $V_G' < 0$ and $V_G'' > 0$ and the function C_G has a negative and decreasing marginal cost so that $C_G' < 0$ and $C_G'' < 0$.

The exogenous variable that affects the value of nongame management (V_N) is nongame demand (Φ_N). The exogenous variables that influence the costs of nongame management are nongame damage to property and the opportunity cost of using resources

[44] Other examples of state agency nongame programs are given in chapter 2.

for nongame purposes (θ_N). Increases in the variable Φ_N increase the per unit value of V_N. Increases in θ_N increase the per unit value of C_N. The exogenous variable that affects the value of game management (V_G) is demand for game (Φ_G). The exogenous variables that influence the costs of game management are game damage to property and the opportunity cost of using resources for game purposes (θ_G). Increases in the variable Φ_G increase the per unit value of V_G. Increases in θ_G increase the per unit value of C_G.

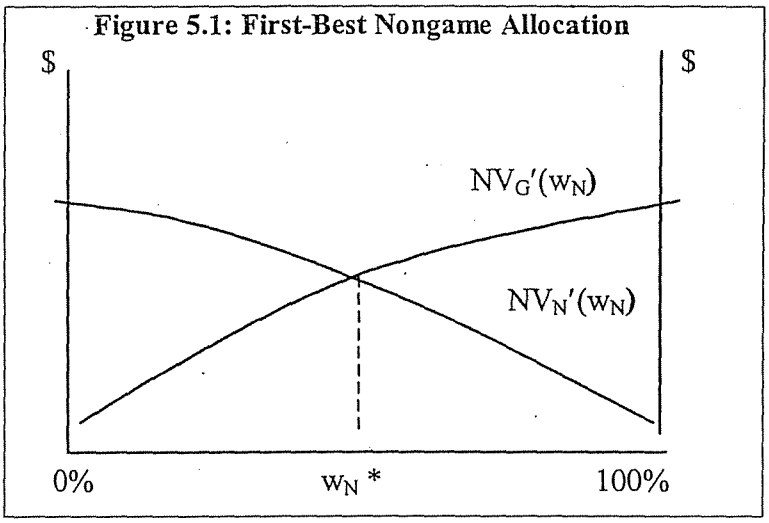
First-Best Outcome

Accordingly, the problem of state politicians and the agency is to maximize the net value of wildlife by choosing how much of their (fixed) resources to allocate towards nongame (w_N). The problem is given in (1) and the first-order condition for a first-best solution is shown in (2).

(1) $\max_{w_N} NV = [V_N (w_N,\Phi_N) + V_G (w_N, \Phi_G)] - [C_N (w_N, \theta_N) + C_G (w_N, \theta_G)]$

(2) $[V_N' (w_N,\Phi_N) - C_N' (w_N, \theta_N)] = [V_G' (w_N, \Phi_G) - C_G' (w_N, \theta_G)]$

The first-best outcome is found by choosing w_N so that the marginal net value of nongame equals the marginal net value of game. This solution is illustrated by w_N^* in figure 5.1.



Several assumptions must hold for the net value of wildlife to be maximized at w_N*. First, politicians or the agency must have perfect information about game and nongame wildlife values and costs. Second, agency customers must be able too perfectly and costlessly monitor agency bureaucrats. Third, politicians must also be monitored perfectly by agency customers. Fourth, private contracting costs must not influence the value of agency nongame management. Under these conditions, different funding schemes and organization structures will not affect the allocations to game and nongame species (Coase 1960).

Given the bureaucratic constraints described in chapter 3 and the existence of positive contracting costs (Lueck 1989), however, it is improbable that the above assumptions can hold and that w_N* can be attained. A more realistic model allows for organizational and funding constraints to influence the costs of nongame management and for private contracting costs to influence the value of agency nongame management.

Bringing these constraints into the model will allow for deviations from the first best outcome.

Second-Best Outcomes

Consider how changes in agency organization will influence nongame allocations when wildlife users cannot perfectly monitor politicians and agencies. Politicians may seek to maximize their political support (Peltzman 1976) and wildlife agencies are likely to be interested in larger budgets (Niskanen 1971) as well as autonomy (Wilson 1989). Because politicians have an interest in staying elected, I assume that increased nongame spending in the face of well-organized opposition from game users is costly to induce. Because new policies, such as more spending on nongame, tend to be resisted by agency employees (Wilson 1989), I assume that increased nongame spending in the face of agency resistance is costly to induce.

For reasons discussed in detail in section 3 of chapter 3, I make the following three assumptions. First, the per-unit costs (C'_N) of implementing nongame management (w_N), decrease (increase) with increases (decreases) in general fund appropriations (g). This assumption is consistent with Becker (1983), Peltzman (1976), and Niskanen (1971). Second, the per-unit costs of implementing nongame management decrease (increase) when an agency's jurisdiction (j) becomes more (less) broad. This assumption is consistent with Wilson (1989) and Peltzman (1976). Third, the per-unit costs of implementing nongame management decrease (increase) as an agency is placed further down (up) the government hierarchy (h). This last assumption is consistent with Wilson (1989).

I allow for private contracting costs to influence the relative value of agency game and nongame management. As private contracting costs decrease, landowners will have a greater incentive to exert wildlife management effort (Lueck 1989). But landowners will have a stronger incentive to increase game management effort because nongame use is more difficult to monitor and police. This implies that the value of agency management of nongame will increase (relative to the value of agency management of game) when private contracting costs decrease. Decreases in private contracting costs (r), will increase the per-unit value of (V'_N).

Given these organizational and contracting cost constraints, the problem facing politicians and agency managers is shown by (3). The first order condition for a second-best solution is shown in (4).

(3) $\max_{w_N} NV = [V_N(w_N, \Phi_N, r) + V_G(w_N, \Phi_G)] - [C_N(w_N, \theta_N, g, j, h) + C_G(w_N, \theta_G)]$

(4) $[V_N'(w_N, \Phi_N, r)) - C_N'(w_N, \theta_N, g, j, h)] = [V_G'(w_N, \Phi_G) - C_G'(w_N, \theta_G)]$

Nongame Allocation Propositions

The model yields several comparative static results concerning how the optimal allocation to nongame programs changes with respect to changes in the exogenous parameters. The comparative static results stem from the second-order conditions for maximization, namely $V_N'' - C_N'' < 0$ and $V_G'' - C_G'' > 0$. The second-order conditions imply that (4) can be solved for the explicit choice function (5).

(5) $w_N = w_N^*(\Phi, \theta, g, j, h, r)$

Where Φ is a vector of Φ_N and Φ_G and θ is a vector of θ_N and θ_G. Substituting (5) into (4) yields the first-order identity given in (6).

(6) $[V_N'(w_N^*(\Phi, \theta, g, j, h, r), \Phi_N, r) - C_N'(w_N^*(\Phi, \theta, g, j, h, r), \theta_N, g, j, h)] \equiv$
$[V_G'(w_N^*(\Phi, \theta, g, j, h, r), \Phi_G) - C_G'(w_N^*(\Phi, \theta, g, j, h, r), \theta_G)]$

To obtain comparative statics I differentiate (6) with respect to any parameter (α) and solve for $\partial w_N^*/\partial\alpha$. The solutions for a few comparative statics are illustrated below. The remaining comparative static results are summarized in table 5.1 below and explicitly derived in Appendix A.[45]

$$\frac{\partial w_N^*}{\partial \Phi_N} = \frac{\partial V_N'/\partial \Phi_N}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

$$\frac{\partial w_N^*}{\partial \Phi_G} = \frac{-\partial V_G'/\partial \Phi_G}{(V_N'' - C_N'') - (V_G'' - C_G'')} < 0$$

$$\frac{\partial w_N^*}{\partial g} = \frac{\partial C_N'/\partial g}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

Notice that the second order conditions and the assumed signs of each of the numerators allow me to sign each comparative static.

[45] I do not explicitly solve for $\partial w_G^*/\partial\alpha$. Because $w_G^* = w - w_N^*$, however, the comparative statics $\partial w_G^*/\partial\alpha$ are equal to $-(\partial w_N^*/\partial\alpha)$.

Table 5.1: Nongame Allocation Comparative Statics

Variable	Definition	Percentage of resources allocated to nongame (w_N^*)
Φ_N	Increase in nongame demand	+
Φ_G	Increase in game demand	-
θ_N	Increase in nongame damage to property or the opportunity cost of using resources for nongame.	-
θ_G	Increase in game damage to property or the opportunity cost of using resources for game.	+
g	Increase in agency reliance on general funds	+
j	Jurisdiction becomes more narrow	-
h	Hierarchy placement moves towards the top of the hierarchy	-
r	Increases in private contracting costs	-

Increases in nongame demand (Φ_N) will increase the proportion of total resources dedicated to nongame. Increases in game demand (Φ_G) will decrease the proportion of resources dedicated to nongame. Increase in nongame damage to property or the opportunity cost of using resources for nongame (θ_N) will decrease the proportion of resources dedicated to nongame. Increase in game damage to property or the opportunity cost of using resources for game (θ_G) will increase the proportion of resources dedicated to nongame. Increases in general funding dollars (g) will increase the proportion of resources dedicated to nongame. The proportion of agency resources spent on nongame will decrease as an agency's jurisdiction (j) becomes more narrow. The proportion of agency resources spent on nongame will decrease as an agency is placed further up the governmental hierarchy (h). Increases in private contracting costs (r) will decrease the proportion of agency resources dedicated to nongame.

Empirical Framework

The implications of the model will be tested with many of the same empirical variables used in chapter 4. Data that was not used in chapter 4 comes from the International Association of Wildlife Agencies (IAFWA) and the U.S. Wildlife Service (USFWS).

Description of the State Data

The empirical variables approximate the theoretical parameters of the model and are organized in the following categories: game and nongame demand variables, game and nongame cost variables, agency organization variables, contracting cost variables, and control variables. Variables in each category are described in detail below. A statistical summary of the variables that are used only in this chapter is given in table 5.2 and a correlation matrix is shown in Appendix B.

The Dependent Variable. The ideal dependent variable would be an agency's allocation of its management effort for the benefit of nongame users at the expense of game users (w_N/w_A in the theoretical section). The dependent variable I use to proxy this ideal is the expenditures used to fund nongame programs as a percentage of the agency's total budget. The nongame expenditure data comes from a 1998 survey conducted by the IAFWA entitled *State Wildlife Diversity Program Funding*. With the exception of California, all fifty states responded to the survey. This data is divided by the state

agency's 1996 budget. The budget data comes from the *1996 Survey of State Wildlife Agency Revenue* conducted by the WCFA.

Table 5.2: Variable Definitions and Summary Statistics

Variable Name	Definition	Minimum	Maximum	Mean	Standard Deviation
Dependent Variable					
NONGAME ALLOCATION	1998 nongame spending as a percentage of 1996 total budget	0.29%	22.69%	5.17%	5.18%
Game Demand Variables					
HUNTING DAYS	The total number of days residents hunted in any state (1996)	275,000	18,281,000	5,092,102	4,233,691
FISHING DAYS	The total number of days residents fished in any state (1996)	1,412,000	55,884,000	12,473,730	10,940,320
Nongame Demand Variables					
WILDLIFE WATCHING DAYS	The total numbers of days residents spent watching wildlife in any state (1996)	422,000	16,765,000	5,741,265	4,440,045
Cost Variables					
URBAN LAND	The percentage of state land defined as urban (1997)	0.12%	34.45%	6.35%	8.27%
Control Variables					
ENDANGERED SPECIES	The number of federally listed endangered or threatened animals and fish (1998)	6.00	87.00	22.53	16.40
ESA SECTION 6 FUNDS	The total dollars spent by states under the ESA Section 6 grant program	$0.00	$549,025	$93,605	$105,085
TAX CHECKOFF	=1 if the state has a tax checkoff for nongame, otherwise = 0 (1997)	0.00	1.00	0.71	0.45

Note: All variables exclude the observation California. A description of the sources is provided in Appendix B.

The empirical dependent variable matches up reasonably well with the ideal. An increase in the percentage of expenditures on nongame favors nongame users over game users. While game users are not directly harmed by spending on nongame programs, there is an opportunity cost to game users. The data, however, falls short of the ideal because there are inconsistencies in the methodology used by individual state agencies to report their expenditures. According to Richie and Holmes (1998, 2), "some states more narrowly defined their programs by expenditures directly related to nongame wildlife and endangered species. Other states included all funds they believed to benefit species not hunted or fished even when they were used in programs distinct from their nongame programs." I attempt to mitigate this problem by following up on 3 states whose responses were particularly odd (Illinois, Nevada, and Maine). These states were obvious outliers because each reports nongame spending as a percentage of its budget at a level substantially higher than the median of 3.3 percent. Nevada reported 82.7% percent, Illinois reported 62.8 percent, and Maine reported 30.4 percent. After extensive discussions with nongame biologists in each state, the data was re-reported in a manner more consistent with other states.[46]

Game and Nongame Demand Variables. The ideal empirical measures of game and nongame demand would be completely exogenous to game and nongame expenditures. The ideal measure of demand should reflect not only the number and types of wildlife users, but also the intensity of use. Because an avid fly fisherman demands

[46] After the modifications Illinois reported 17.4 percent, Maine reported 5.4 percent, and Nevada reported 4.2 percent.

more fish management than the weekend angler, measuring only the number of anglers understates the distinction between the intensity of use. Hence, the variable I use to measure demand for game is the number of days spent hunting or fishing by state residents who hunted or fished in *any* U.S. state. For example, if a resident of Alabama hunts 3 days in Louisiana and 2 days in Alabama the variable assesses 5 days of hunting towards the Alabama total. If any part of a day is spent hunting it is considered one day of hunting.[47] These measures of game demand are proxies for the theoretical variable (Φ_G).

The empirical variables used to measure demand for game are generally consistent across states and capture demand for game regardless of the species being pursued by hunters and fishermen. These empirical variable, however, are less than ideal because they are likely to be endogenous to the types of expenditures made by the wildlife agency. This endogeneity problem is lessened to some degree because each variable indicates the home state of the hunter and angler rather than the state where the hunting and fishing took place.

The ideal measure of nongame demand would isolate demand for wildlife species that are not fished or hunted and would be exogenous to nongame expenditures. The variable I use to measure nongame demand is the total number of days that state residents spent watching wildlife in 1996. As with hunting and fishing days, a wildlife-watching day is recorded if an individual spends any part of his or her day engaged in wildlife watching. This variable proxies (Φ_N) in the theoretical section.

[47] USFWS (1997), Appendix A, A-2.

The empirical measure of nongame demand is less than ideal because wildlife watchers often enjoy observing, photographing, or feeding game species such as elk and moose in addition to nongame species such as songbirds. In addition, wildlife-watching days may be influenced by nongame spending. Despite these shortcomings, this variable provides an empirical proxy for nongame demand that is consistently reported across the fifty states.

Cost Variables. An ideal empirical cost variable would measure the amount of game and nongame damage to property as well as the economic cost incurred to implement game and nongame management programs. This type of data is not available. Because game management generally requires less densely populated areas, however, I assert that the costs of managing land for game increases when more state land is urban. For example, it will be less costly to set up a birding trail with lookout stations in an urban park than to prepare the area for duck hunting. Thus, the empirical variable I use to proxy nongame costs is the percentage of land in urban areas. Urban areas are defined as "incorporated and unincorporated places of 2,500 population or more."

Agency Organization Variables. The model asserts that changes in general funding, agency jurisdiction, and agency hierarchy placement affect the costs of nongame management. The empirical measures of these variables were used in the previous chapter and are described in detail in chapter 2.

Contracting Cost Variables. I test for the influence of private contracting costs by including two variables, PERCENT PUBLIC LAND and FARM SIZE. These variables

are described in more detail in chapter 4. In brief, I assume that contracting costs rise with increases in PERCENT PUBLIC LAND and decreases in FARM SIZE.

Control Variables. I control for the influence of federally listed endangered species, the amount of funds granted to states through the ESA, funds donated for nongame programs through tax-checkoffs, population, and per-capita income.

An ideal variable to control for would be some measure of the total costs incurred by states as a result of federal ESA listings. If states are trying to avoid federal control, nongame allocations should increase positively with the costs incurred as a result of listing. One variable that I use to proxy the ideal is the number of federally listed endangered or threatened species in each state. Increases in the number of listed species should increase the costs borne by states. A second variable I use to proxy the ideal is the total amount spent by state agencies and the USFWS through Section 6 of the ESA.[48] This variable is closer to the ideal in that it is more indicative of how much a state is willing to spend to avoid federal listing. Unfortunately, this second variable is highly endogenous to nongame allocations. It may be more representative of a choice made by the agency than an exogenous cost imposed by the federal government.

Donations collected through voluntary tax checkoffs for nongame will also influence an agency's expenditures on nongame. I include a dummy variable that indicates whether or not the state has a tax checkoff program for nongame. In addition, I

[48] Through Section 6, states are eligible to receive matching federal funds for programs targeted at helping threatened or endangered species. This program is discussed in detail in chapter 2.

control for the influence of per-capita income and population. I include these variables as an attempt to eliminate statistical inference problems caused by omitted variables.

Empirical Predictions

Most of the empirical predictions are the empirical counterparts to the theoretical comparative static results summarized in table 5.1. A few additional predictions abound from the discussion of the affect of certain control variables on nongame allocations. All predictions are listed below.

Wildlife Demand Predictions

- Increases in the number of hunting days and fishing days will decrease the percentage of agency budgets allocated to nongame.
- Increases in the number of wildlife watching days will increase the percentage of agency budgets allocated to nongame.

Cost Predictions

- Increases in the percentage of land that is urban will increase the percentage of agency budgets allocated to nongame.

Agency Organization Predictions

- An increase in the percentage of an agency's budget that comes from general funds will increase the percentage of its budget allocated to nongame.
- An agency that receives general funds will allocate more of its budget to nongame than an agency that does not receive general funds.
- An agency with narrow jurisdiction will allocate less of its budget to nongame than an agency with broad jurisdiction.
- An agency that is independent on the hierarchy will allocate less of its budget to nongame than an agency that is subordinate.

Contracting Cost Predictions

- An increase in the average size of farms will increase the percentage of agency budgets allocated to nongame.
- An increase in the percentage of open access federal land will decrease the percentage of agency budgets allocated to nongame.

Control Variable Predictions

- An increase in the number of federally listed endangered and threatened species will increase the percentage of agency budgets allocated to nongame.
- An increase in the amount of funding granted to states under Section 6 of the ESA will increase the percentage of agency budget allocated to nongame.

Means Analysis of Budget Allocations to Nongame

As a preliminary test of some of the predictions of the model, the mean values of agency nongame expenditures as a percentage of budgets are grouped according to funding sources, jurisdiction, and hierarchy placement. The variables are segmented into groups, unequal in size, according to their qualitative definitions. Table 5.3 shows the mean values of the dependent variable for each subgroup and also shows the t-statistic for the null hypothesis that there is no difference between the mean nongame expenditures as a percentage of budgets.

The results shown in table 5.3 provide preliminary support for the predictions of the model. States that receive some general funding, are subordinate, and have broad jurisdiction allocate a greater percentage of their budgets to nongame species as reflected by the differences in means. None of these differences in mean allocations, however, are statistically significant at the 10 percent level.

Table 5.3: Mean Values of Nongame Allocations as a Percentage of Budget

Independent Variable	States	Mean Allocation to nongame as a Percentage of Budgets	t-value
Agency Organization Variables			
Agency receives no general funds	20	4.42%	0.84
Agency receives some general funds	29	5.69%	
Agency is independent on the hierarchy	27	4.43%	1.11
Agency is subordinate on the hierarchy	22	6.09%	
Agency has narrow jurisdiction	39	4.78%	1.09
Agency has broad jurisdiction	10	6.70%	

Note: * denotes t-values where the means are significantly different at least at the 10 percent level. Results exclude California.

Econometric Analysis of Budget Allocations to Nongame

I test the empirical predictions of the model using the Ordinary Least Squares (OLS) procedure and Two Stage Least Squares (2SLS) procedures. I use a variety of specifications to evaluate the robustness of the hypothesis tests and to mitigate the problem of endogenous right hand side variables. The regression analysis relies on several different specifications to estimate the generic model below:

(7) Nongame spending as % of budget = $\alpha + \beta$(game demand) + λ(nongame demand) + θ(nongame costs) + Ω(agency organization) + λ(contracting costs) + σ(controls) + ε

The results of 8 specifications are presented in tables 5.4 and 5.5. A summary of the results are presented in table 5.6. Four additional specifications are presented in Table B.3 of Appendix B.

Table 5.4. Table 5.4 shows the OLS coefficient estimates for four different specifications of equation (5) using different combinations of the independent variables. The dependent variable for each specification is the proportion of an agencies total budget that is spent on nongame. The range of the dependent variable is from 0.003 to 0.227. Specifications 1 and 2 include the cost variable URBAN LAND but exclude the contracting cost variables FARM SIZE and PERCENT PUBLIC LAND. Specifications 3 and 4 exclude URBAN LAND but include the contracting cost variables. Specifications 1 and 3 employ the variable ENDANGERED SPECIES and specifications 2 and 4 employ the variable ESA SECTION 6 FUNDS.

Substituting URBAN LAND, used in columns 1 and 2, with FARM SIZE and PERCENT PUBLIC LAND, used in columns 3 and 4, adds explanatory power to the regression but has only a minor affect on the coefficient and t-statistic estimates of other variables. Most notably, the absolute values of the t-statistics on NARROW JURISDICTION and INCOME drop slightly when the contracting cost variables are substituted for the cost variable.

Interchanging ENDANGERED SPECIES, used in columns 1 and 3, with ESA SECTION 6 FUNDS in columns 2 and 4 has a significant affect on the coefficient and t-statistic estimates of several other variables. Most notably, the substitution of ESA SECTION 6 FUNDS for ENDANGERED SPECIES decreases the coefficients and t-statistics on GENERAL FUNDS SHARE, INDEPENDENT AGENCY, and especially, NARROW JURISDICTION. In addition, the coefficients and t-statistics on POPULATION are much larger in columns 2 and 4.

Table 5.4: OLS Estimates of Nongame Budget Allocations

Dependent variable = nongame spending as a percentage of total budgets

INDEPENDENT VARIABLES	Predicted Sign	(1)	(2)	(3)	(4)
CONSTANT		0.178 (2.42)**	0.158 (2.09)**	0.141 (1.87)**	0.128 (1.72)**
Game Demand Variables					
HUNTING DAYS	-	-8.60E-09 (3.10)***	-8.78E-09 (3.19)***	-7.05E-09 (2.39)**	-8.71E-09 (2.78)***
FISHING DAYS	-	-2.18E-09 (1.52)*	-1.79E-09 (1.25)	-2.14E-09 (1.51)*	-1.96E-09 (1.42)*
Nongame Demand Variables					
WILDLIFE WATCHING DAYS	+	9.71E-09 (3.01)***	6.98E-09 (2.25)**	9.30E-09 (2.89)***	6.84E-09 (2.25)**
Cost Variables					
URBAN LAND	+	0.019 (0.22)	0.009 (0.11)	--------	--------
Agency Organization Variables					
GENERAL FUNDS SHARE	+	0.089 (1.91)**	0.068 (1.43)*	0.100 (2.20)**	0.071 (1.54)*
INDEPENDENTAGENCY (=1 if independent)	-	-0.030 (2.02)**	-0.022 (1.45)*	-0.030 (2.02)**	-0.024 (1.65)*
NARROW JURISDICTION (=1 if narrow)	-	-0.022 (1.34)*	-0.011 (0.70)	-0.034 (1.08)	-0.002 (0.15)
Contracting Cost Variables					
FARM SIZE	+	--------	--------	1.55E-05 (1.71)**	1.40E-05 (1.56)*
PERCENT PUBLIC LAND	-	--------	--------	-0.047 (1.14)	-0.077 (1.59)*
Control Variables					
INCOME	?	-4.37E-06 (1.88)**	-3.80E-06 (1.61)*	-3.18E-06 (1.33)*	-2.74E-06 (1.16)
ENDANGERED SPECIES	+	9.31E-04 (2.17)**	-------	1.02E-03 (2.39)**	-------
ESA SECTION 6 FUNDS	+	-------	1.56E-07 (2.32)**	-------	1.88E-07 (2.73)***
TAX CHECKOFF	?	-0.022 (1.22)	-0.018 (0.98)	-0.021 (1.32)*	-0.020 (1.23)
POPULATION	?	4.17E-09 (1.03)	6.54E-09 (1.71)*	3.08E-09 (0.77)	5.81E-09 (1.56)*
Adjusted R^2		.317	.333	.352	.378
F-Statistic		3.03	3.14	3.17	3.43
Observations		49	49	49	49

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test. Results exclude California.

Table 5.5. Table 5.5 shows 2SLS and OLS estimates for four different specifications of equation (7). These specifications are employed as an attempt to mitigate possible endogeneity problems associated with the GENERAL FUNDS SHARE variable. Specifications 1 and 2 are estimated using a 2SLS procedure where GENERAL FUNDS SHARE is estimated in the first stage and its estimated value is used as an instrumental variable in the second stage. Specification 1 and 2 differ in that ENDANGERED SPECIES and ESA SECTION 6 FUNDS are interchanged. Specifications 3 and 4 are estimated using an OLS procedure and differ from specifications 3 and 4 of table 5.4 because GENERAL FUNDS DUMMY is employed in place of GENERAL FUNDS SHARE.

In the first stage of estimating the 2SLS coefficients, all of the independent variables (with the exception of GENERAL FUNDS SHARE) from the original equation plus a lagged variable, 1991 GENERAL FUNDS SHARE, are used to explain the variance in GENERAL FUNDS SHARE. In the second stage, the predicted value for GENERAL FUNDS SHARE replaces the original variable and is used to estimate the results presented in columns 1 and 2. Note that the coefficient and t-statistic results are almost identical to the OLS results presented in columns 3 and 4 in table 5.4. The only noteworthy difference is that the coefficients and t-statistics on the GENERAL FUND SHARE variable are both reduced when estimated through the 2SLS procedure.

Table 5.5: 2SLS and OLS Estimates of Nongame Budget Allocation

Dependent variable = nongame spending as a percentage of total budgets

INDEPENDENT VARIABLES	Predicted Sign	(1) 2SLS	(2) 2SLS	(3) OLS w GF dummy	(4) OLS w GF dummy
CONSTANT		0.139 (1.84)**	0.128 (1.70)*	0.176 (2.34)**	0.142 (1.96)**
Game Demand Variables					
HUNTING DAYS	-	-7.03E-09 (2.39)**	-8.08E-09 (2.77)***	-8.71E-09 (2.84)***	-9.72E-09 (3.34)***
FISHING DAYS	-	-2.12E-09 (1.50)*	-1.96E-09 (1.42)*	-2.43E-09 (1.69)**	-2.14E-09 (1.58)*
Nongame Demand Variables					
WILDLIFE WATCHING DAYS	+	9.29E-09 (2.89)***	6.84E-09 (2.25)**	1.08E-08 (3.20)***	8.14E-09 (2.65)***
Agency Organization Variables					
GENERAL FUNDS SHARE	+	0.103 (2.00)**	0.072 (1.36)*	-------	-------
GENERAL FUNDS DUMMY	+	-------	-------	0.023 (1.69)**	0.023 (1.82)**
INDEPENDENT AGENCY (=1 if independent)	-	-0.034 (2.34)**	-0.024 (1.65)*	-0.035 (2.36)**	-0.022 (1.50)*
NARROW JURISDICTION (=1 if narrow)	-	-0.018 (1.07)	-0.002 (0.15)	-0.024 (1.45)*	-0.004 (0.27)
Contracting Cost Variables					
FARM SIZE	+	1.56E-05 (1.72)**	1.41E-05 (1.59)*	1.36E-05 (1.48)*	1.34E-05 (1.55)*
PERCENT PUBLIC LAND	-	-0.048 (1.14)	-0.077 (1.80)**	-0.054 (1.27)	-0.091 (2.13)**
Control Variables					
INCOME	?	-3.17E-06 (1.32)*	-2.74E-06 (1.16)	-4.11E-06 (1.66)*	-3.37E-06 (1.43)*
ENDANGERED SPECIES	+	1.01E-03 (2.39)**	-------	1.02E-03 (2.38)**	-------
ESA SECTION 6 FUNDS	+	-------	1.87E-07 (2.70)**	-------	2.15-07 (3.28)***
TAX CHECKOFF	?	-0.021 (1.27)	-0.019 (1.20)	-0.032 (1.98)**	-0.025 (1.65)*
POPULATION	?	3.04E-09 (0.76)	5.80E-09 (1.55)*	3.77E-09 (0.93)	6.18E-09 (1.69)*
Adjusted R^2		.352	.379	.319	.393
F-Statistic		3.11	3.39	2.87	3.59
Observations		49	49	49	49

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test. Results exclude California.

a: 1st stage IV's for specifications (1) and (2) include all independent variables (with the exception of GENERAL FUNDS SHARE) and 1991 GENERAL FUNDS SHARE.

Interchanging GENERAL FUNDS SHARE with GENERAL FUNDS DUMMY in columns 3 and 4 has only a minor affect on the coefficient and t-statistic estimates of a few variables. Most notably, the absolute value of the coefficients and t-statistics on INCOME and TAX CHECKOFF rise.

The fact that employing a lagged instrument or a dummy variable in place of GENERAL FUNDS SHARE does not alter the results much suggests that an endogenous relationship between GENERAL FUNDS SHARE and the dependent variable is not driving the results presented in table 5.4. This finding lends credence to the hypothesis testing results summarized in table 5.6.

Summary Table 5.6. The coefficient and t-statistics from the 8 specifications are summarized in table 5.6. Of the 70 hypothesis tests, 100 percent of the coefficients are of the same sign as predicted and 82.8 percent of all coefficients are of the predicted sign and statistically significant at least at the 90 percent level. The results for each category of variables are summarized in the following subsections.

Game Demand Variables. The coefficients on the hunting and fishing days variables are negative, as predicted, and statistically significant in 15 of 16 occurrences. The coefficients on HUNTING DAYS are statistically significant in all 8 occurrences while the coefficients on FISHING DAYS are statistically significant in 7 occurrences. The coefficients on the hunting variable are consistently larger (in absolute value) than the coefficients on the fishing variable. This result suggests that agencies and politicians are more responsive to hunting constituencies than fishing constituencies. This finding is

consistent with the regression analysis of chapter 4 where changes in the hunting variables were shown to have a more significant affect on agency budget size than fishing variables.

Nongame Demand Variable. The 8 coefficients on WILDLIFE WATCHING DAYS are all positive, as predicted, and statistically significant in every case. These results suggest that increases in wildlife watching use induce a greater budget allocation to nongame. The estimated magnitude of this affect, as illustrated by the range of coefficients, tends to be greater than the estimated affect of HUNTING DAYS on nongame budget allocations. This result suggests that nongame users may be more influential then game users in affecting budget allocations. This result is somewhat surprising because wildlife watchers do not typically pay user fees to the agency.

Cost Variable. In the 2 specifications in which URBAN LAND is employed, the coefficient estimates are positive. Neither is statistically significant. These results suggest that changes in the percentage of land considered urban has no affect on nongame allocations. It may be the case that URBAN LAND, as defined, is not a good proxy for the relative costs of game and nongame management. Or, it may be the case that politicians and agency managers are not sensitive to changes in cost conditions when choosing how much of the budget to allocate towards nongame.

Table 5.6: Summary of OLS and 2SLS Results for Nongame Budget Allocation Specifications

INDEPENDENT VARIABLES	Predicted Sign	# of specifications variable was used in	Coefficient range	# of specifications with positive coefficient	# of specifications with significant positive coefficient	# of specifications with negative coefficient	# of specifications with significant negative coefficient
Game Interest Variables							
HUNTING DAYS	-	8	-7.03E-09 to –9.72E-06	0	0	8	8
FISHING DAYS	-	8	-1.79E-09 to –2.43E-09	0	0	8	7
Nongame Interest Variables							
WILDLIFE WATCHING DAYS	+	8	6.84E-09 to 1.08E-08	8	8	0	0
Cost Variables							
URBAN LAND	+	2	0.009 to 0.019	2	0	0	0
Agency Organization Variables							
GENERAL FUNDS SHARE	+	6	0.068 to 0.103	6	6	0	0
GENERAL FUNDS DUMMY	+	2	0.023 to 0.023	2	2	0	0
INDEPENDENTAGENCY (=1 if independent)	-	8	-0.022 to -0.035	0	0	8	8
NARROW JURISDICTION (=1 if narrow)	-	8	-0.002 to -0.034	0	0	8	2
Contracting Cost Variables							
FARM SIZE	+	6	1.34E-05 to 1.56E-05	6	6	0	0
PERCENT PUBLIC LAND	-	6	-0.047 to -0.091	0	0	6	3
Control Variables							
INCOME	?	8	-2.74E-06 to -4.37E-06	0	0	8	6
ENDANGERED SPECIES	+	4	9.31E-04 to 1.02E-03	4	4	0	0
ESA SECTION 6 FUNDS	+	4	1.56E-07 to 2.15E-07	4	4	0	0
TAX CHECKOFF	?	8	-0.018 to -0.032	0	0	8	3
POPULATION	?	8	3.08E-09 to 6.54E-09	8	4	0	0

Note: Summarized results do not include logged specifications from table B.3 in Appendix B.

Agency Organization Variables. In all 24 estimates, the agency organization variables, GENERAL FUNDS SHARE, GENERAL FUNDS DUMMY, INDEPENDENT AGENCY, and NARROW JURISDICTION, have the same sign as predicted. In 75 percent of the estimates, the coefficients on these variables are statistically significant.

The coefficients on the general funding variables are positive and statistically significant in 8 of 8 occurrences. These results are consistent with the notion of the model – increases in general funds decrease the costs of increasing nongame budget allocations because politicians and the agency are more likely to endorse nongame spending.

The negative coefficient estimates for the qualitative variables INDEPENDENT AGENCY and NARROW JURISDICTION are statistically significant in 10 of 16 cases (62.5 percent). In comparison, the absolute coefficient values on INDEPENDENT AGENCY tend to be larger and are more often statistically significant. The coefficients on NARROW JURISDICTION are more sensitive to specification and less robust. These results suggest that an agency's location on the hierarchy has a relatively greater influence on nongame allocations than does agency jurisdiction. This finding is consistent with the chapter 4 empirical findings where hierarchy placement was found to have a more significant impact on budget size than jurisdiction.

Contracting Cost Variables. The 6 coefficient estimates for FARM SIZE are positive, as predicted, and statistically significant. The 6 coefficient estimates for PERCENT PUBLIC LAND are all negative, as predicted, and the estimates are

statistically significant in half of their occurrences. The estimated coefficients of these variables imply that decreases in private contracting costs are correlated with increases in the percentage of agency budgets allocated towards nongame. These results support the notion that declining contracting costs among private landowners leads to a greater relative demand for state agency provision of nongame.

Control Variables. The coefficient estimates on INCOME are negative and statistically significant in 6 of 8 occurrences. These results suggest that increases in income increase the demand for game more than nongame. On the other hand, the negative correlation may instead suggest that as income rises, game users are more effective than nongame users in lobbying politicians and agencies for budget allocations.

The coefficient estimates on ENDANGERED SPECIES and ESA SECTION 6 FUNDS are positive and statistically significant in 8 of their 8 occurrences. These results suggest that states agencies may be trying to avoid federal control by increasing spending when the risk of listed species is high or that agency constituents are more effective in lobbying for the well-being of endangered and threatened species than other nongame.

The coefficient estimates on TAX CHECKOFF are negative in all 8 specifications and statistically significant in 3. The coefficient results indicate that a state that has a tax-checkoff for nongame will allocate as much as .033 less of its total budget to nongame than a state that does not when controlling for other factors. This is a surprising result

that suggests that increases in voluntary contributions to nongame decreases the willingness of politicians and agencies to spend other revenues on nongame.[49]

Conclusion

In this chapter I examined the extent to which various factors affect how much of an agency's budget is allocated to nongame programs. In order to derive implications from the model, I assumed that game and nongame uses compete at the margin, and I asserted that general funding, agency jurisdiction, and an agency's hierarchical position affected the costs of implementing nongame allocations. I also asserted that changes in private contracting costs influence the relative demand for nongame and game. The first assumption states only that, if game and nongame users can be separately identified, there is an opportunity cost to each when expenditures are made on competing uses. The assumptions about how agency organizational features affect the costs of implementing nongame spending are based on an inspection of the implications that several bureaucracy models have in a wildlife agency setting (e.g., Peltzman 1976, Becker 1983, Niskanen 1971, and Wilson 1989). The assertion about the influence of contracting costs is based on Lueck (1989) and the public good attributes of nongame use.

In general, the empirical work supports the predictions of the model. First, the results imply that increases in the demand for game decrease nongame allocations and increases in the demand for nongame increase nongame allocations. Second, increases in

[49] State agencies that are granted nongame tax-checkoffs, however, are less likely to be granted state general funds. The correlation between GENERAL FUNDS SHARE and TAX CHECKOFF is negative (ρ=-0.28) (see Table B.1 in Appendix B).

general funding increase nongame allocations, and an agency independent on the hierarchy will allocate less to nongame than an agency subordinate on the hierarchy. To a lesser extent, the findings suggest that an agency with narrow jurisdiction will allocate less of its budget to nongame than a subordinate agency. These results suggest that organizational features affect the costs that politicians and agencies face in implementing nongame policies. Third, increases in the average farm size increase nongame allocations, and increases in open access federal land decrease nongame allocations. These findings support the notion that decreases in private contracting costs, which increase the demand for private management of game, will increase the relative demand for state wildlife agency provision of nongame.

CHAPTER 6

SUMMARY AND CONCLUSION

The broad objective of this thesis has been to gain a better understanding of the affects of agency organization and funding sources on agency behavior. In order to gain insight on these matters, the thesis examined the determinants of wildlife agency budget size and budget allocations to nongame. Budget size and budget allocations are of considerable importance to several parties with stakes in wildlife policy yet neither has been systematically studied in either the economics or wildlife management literature. The framework that was developed combines a contracting cost approach (Lueck 1989) with the ideas of several bureaucracy models, most notably Wilson (1989), Peltzman (1976), and Niskanen (1971).

Summary of Models and Findings

The hypothesis of the thesis is that agency organization, private contracting costs, and agency constituencies are key determinants of wildlife agency budget size and budget allocations to nongame. The budget size model in chapter 4 and the budget allocation model in chapter 5 each develop the broad hypothesis and generate a narrower set of testable implications. The models and findings are summarized in the next two sections.

Agency Budget Model and Findings

The model begins by considering the transaction costs that would prevent an exclusively private landowner management regime or an exclusively agency management regime from maximizing the net value of wildlife. Given positive transaction costs, the model assumes that private landowners and agencies act together in an attempt to maximize the net value of wildlife management. This implies that the mix of private and agency management changes in ways consistent with wealth maximization. The model also assumes that private and agency management are substitutes. This implies that an increase in the amount of effort exerted by one institution will decrease the value of effort exerted by the other. Several theoretical propositions are derived from the model. First, increases in private contracting costs increase agency budget size. Second, increases in bureaucratic costs decrease agency budget size. Third, increases in the amount of agency management provided to wildlife users at a price below marginal cost increase budget size. Fourth, increases in the strength of constituent demand for wildlife increases the size of agency budgets.

Data from a variety of sources are used to test these theoretical propositions. The average farm size in a state, the variation in average farm size, and the percentage of federally owned open access land in each state proxy private contracting costs. The scope of an agency's jurisdiction and an agency's placement on the hierarchy are used to proxy bureaucratic costs. An agency's reliance on general funds is used to proxy the amount of agency management provided to wildlife users at a price below marginal cost. The empirical variables used to proxy wildlife demand include the number of resident

hunters and anglers, nonresident hunters and anglers, and the number of days residents spent photographing, feeding, or observing wildlife.

OLS and 2SLS procedures are employed to test the propositions of the model. The econometric analysis relies on many different specifications used to evaluate the robustness of the independent variables affect on agency budget size. The most noteworthy findings are summarized below.

1. Increases in private contracting costs, as estimated by decreases in farm size and increases in the percentage of federal open access land in a state, increase agency budget size.

2. Increases in bureaucratic management costs, as estimated by the placement of an agency further down on the governmental hierarchy, decrease agency budget size.

3. Increases in bureaucratic management costs, as estimated by increases in the scope of an agency's jurisdiction, decrease agency budget size.

4. An increase in the amount of agency management provided at a price below marginal cost, as estimated by increases in an agency's budget reliance on the state general fund, increases agency budget size.

5. Increases in wildlife demand, as represented by increases in the number of resident and nonresident hunters and the number of days spent wildlife watching, increase agency budget size.

6. Increases in wildlife demand, as represented by increases in the number of resident and nonresident fishermen, do not affect agency budget size.

7. An increase in the area of a state increases agency budget size while increases in per-capita income and population do not affect agency budget size.

With the exception of (6), the findings offer strong support for the model. In comparison of the agency organization findings, (2) is more robust than (3).

Nongame Allocation Model and Findings

In the chapter 5 model, an agency is endowed a fixed budget. State politicians and agencies choose how much to allocate to nongame in an attempt to maximize the net value of wildlife management. Their ability to do so, however, is constrained by the agency's desire for autonomy and larger budgets (Wilson 1989, Niskanen 1971) and politicians desire for political support (Peltzman 1976).

It is costly to increase nongame allocations because bureaucratic agencies are naturally biased against implementing new programs (Wilson 1989) and because politicians will only push for increased spending when it increases their political support (Peltzman 1976). The costs of implementing nongame programs are exacerbated by certain agency organizational features and abated by others. When an agency relies more heavily on general funding it is less costly to increase nongame spending because politicians will have an incentive to pressure agencies into doing so (Peltzman 1976, Becker 1983). An agency concerned about increasing the size of its budget will also have an incentive to increase nongame spending (Niskanen 1971). As an agency's jurisdiction gets broader, it will be less costly to induce nongame spending because there will not be a strong and homogeneous professional culture in place to resist (Wilson 1989). Finally, as an agency moves higher up on the hierarchy, it will be more costly to induce nongame spending because the agency will be empowered with the authority to resist programs not of its choosing (Wilson 1989).

The relative value of agency game and nongame spending is influenced by private contracting costs among landowners. As private contracting costs decrease, landowners

will have a greater incentive to exert wildlife management effort (Lueck 1989). But this incentive to exert more wildlife management effort will be stronger for game than for nongame because nongame use is more difficult to monitor and police. As a result, the relative demand for agency spending on nongame increases with decreases in contracting costs.

Several theoretical propositions fall from the model. First, an increase in an agency's reliance on general funds decreases the percentage of its budget allocated to nongame. Second, an increase in the scope of an agency's jurisdiction increases the percentage of its budget allocated towards nongame. Third, as an agency is placed further up on the hierarchy, the percentage of the agency's budget allocated to nongame will decrease. Fourth, an increase in private contracting costs decreases the percentage of the agency's budget allocated towards nongame. Fifth, an increase in nongame demand relative to game demand will increase the percentage of an agency's budget allocated towards nongame. Sixth, an increase in game damage to property relative to nongame damage will decrease the percentage of an agency's budget allocated towards nongame.

Many of the empirical variables used to test the theoretical propositions were introduced explicitly in the model. These variables include an agency's reliance on general funds, the scope of its jurisdiction, and its hierarchical placement. The number of days state residents days spent in wildlife watching activity is used to proxy demand for game. The number of days state residents spent hunting and fishing is used to proxy demand for nongame. The average farm size and the percentage of public land in a state

are used to proxy private contracting costs. Finally, the percentage of land in urban use is used to proxy the relative damage to property caused by nongame relative to game.

OLS and 2SLS procedures are used to test the propositions of the model. The econometric analysis relies on several different specifications used to evaluate the robustness of the independent variables affect on agency budget size. The most noteworthy findings are summarized below.

1. Increases in an agency's reliance on general funds increases the percentage of the agency's budget allocated towards nongame.

2. Increases in the scope of an agency's jurisdiction, as approximated by a qualitative variable that indicates that an agency's jurisdiction is broad as opposed to narrow, increases the percentage of the agency's budget allocated towards nongame.

3. Increases in the hierarchical placement of an agency, as approximated by a qualitative variable that indicates that an agency's placement is independent as opposed to subordinate, decreases the percentage of the agency's budget allocated towards nongame.

4. Increases in nongame demand, as represented by increases in the number of resident days spent in wildlife watching activity, increases the percentage of the agency's budget allocated towards nongame.

5. Increases in game demand, as represented by increases in the number of resident days spent hunting and fishing, decreases the percentage of the agency's budget allocated towards nongame.

6. An increase in the damage and opportunity cost of managing game relative to nongame, as represented by increases in the percentage of land that is urban, does not affect the percentage of the agency's budget allocated towards nongame.

7. Increases in private contracting costs, as estimated by decreases in average farm size and increases in federal open access land, decreases the percentage of agency budgets allocated towards nongame.

In general, the findings offer strong support for the model. With the exception of (6), all of the findings are consistent with the predictions of the model. In comparison of the agency organizational variables, finding (3) is more robust than (2).

Key Conclusions

Recall that the hypothesis of the thesis is that agency organization, private contracting costs, and agency constituencies are key determinants of budget size and budget allocations to nongame. The findings of the thesis are summarized in the following four conclusions.

1. *Agency organizational structure is a key determinant of budget size and nongame budget allocations.* The amount of general funds an agency receives increases budget size and budget allocations to nongame. Agencies near the top of the hierarchy have larger budget sizes and allocate less of it to nongame than agencies near the bottom. Agencies with narrow jurisdictions have larger budgets and allocate less of it to nongame than agencies with broad jurisdiction. In comparison with each other, jurisdiction has the least relative impact on agency budget size and nongame allocations but is still a significant determinant of both.

2. *Private contracting costs are a key determinant of budget size and nongame budget allocations.* Increases in private contracting costs, as measured by increases in federal open access land and decreases in the average size of farms, increase agency budget size and decrease the percentage of the budget allocated towards nongame. In comparison, changes in federal open access land have a more significant impact on budget size but changes in farm size have a more significant impact on nongame budget allocations.

3. *Agency constituencies are a key determinant of budget size and nongame budget allocations.* Increases in resident and nonresident hunters increase budget size. Increases in resident hunting and fishing days decrease nongame budget allocations. Increases in wildlife watching days increase budget size and nongame allocations. In comparison of constituencies, hunters and wildlife watchers tend to have a much more significant impact on budget size and nongame budget allocations than fishing constituencies.

4. *Economic variables such as population and per-capita income are key determinants of nongame budget allocations but not budget size.* When controlling for the other variables, per-capita income and population have no affect on agency budget size. Increases in per-capita income decrease nongame budget allocations and increases in population increase nongame budget allocations.

Conclusions (1), (2), and (3) are consistent with the hypothesis of this thesis. Conclusion (3) indicates that agencies seem to be more responsive to hunting and nongame constituencies than to fishing constituencies. Hunters may be better organized than anglers and therefore more capable of leveraging agencies. This seems reasonable because hunters probably have a greater per-capita investment in agency policy given the higher cost of hunting equipment and licenses. It is more surprising, however, that nongame constituencies, who generally do not pay for their use, appear to be as influential as hunters and more influential than anglers. In contrast to agency organization and private contracting cost variables, conclusion (4) suggests that population and per-capita income are only mildly influential in affecting wildlife policy.

Relevance of Findings to Economics of Bureaucracy

The significance of conclusion (1) extends beyond wildlife agency behavior. This conclusion suggests that the placement of government agencies on the hierarchy and the scope of the jurisdiction of government agencies will affect the costs of agency output and the incentives of agencies to cater to a particular set of users or interest groups. In addition, conclusion (1) suggests that the composition of funding from user fees and general funds will affect the demand for agency output as well as the incentives of

agencies to cater to a particular set of users or interest groups. In a more general sense, conclusion (1) begins to illuminate the affects that bureaucratic organization have on agency behavior – a topic that seems underdeveloped in the bureaucracy literature.

Relevance of Findings to Wildlife Policy Debate

The key conclusions have relevance to the wildlife agency funding recommendations of the IWLA and the IAFWA that were discussed in the introduction. Recall that the IWLA has recommended that states agencies rely more on state general funds and the IAFWA has recommended that state agencies receive more funding from the U.S. Treasury (most recently through CARA legislation). Conclusion (1) suggests that an increased reliance on these funding sources will increase agency budget sizes and the amount of budgets allocated to nongame as argued by the IWLA and the IAFWA. Conclusion (3) suggests, however, that state agencies are responsive to nongame constituencies despite the lack of a nongame funding mechanism in most states. This finding suggests that nongame users are not politically impotent when they lack a dedicated funding source.

The conclusions also have relevance to the recommendations made by Cannemela and Warren (1999) that were discussed in the introduction. Recall that these ecologists argue that an administrative structure that combines wildlife management and environmental protection will be a more cost effective structure (relative to separate agencies) for improving amenities such as habitat and water quality, and reduced stream bank erosion. Conclusion (1) seems to somewhat affirm and somewhat contradict this claim. On one hand, the larger budgets of wildlife agencies near the top of the hierarchy

and agencies with narrow jurisdiction suggests that these agencies have a comparative advantage in the production of all wildlife amenities. On the other hand, the smaller nongame budget allocations of agencies near the top of the hierarchy and agencies with narrow jurisdiction suggests that these agencies have a comparative disadvantage in the production of nongame amenities.

Suggestions for Further Research

Advancing the empirical analysis would require refining the current data set, procuring more data, and perhaps expanding the number of observations. Advancing the theoretical analysis would require more thought on the interaction between agency organization and agency behavior. A more advanced theory might also explain the determinants of agency organization.

A more thorough test of the wildlife agency budget model requires a more consistent measure of budgets across states. The variable used to proxy agency budget size includes revenue from commercial license sales. But the inclusion of commercial revenues inflates the budgets of agencies that administer commercial fishing and deflates the budgets of agencies that do not. For this reason, commercial fishing revenues should be removed from the budget variable before further empirical analysis is undertaken.

An important variable that is missing from all specifications is the price of hunting and fishing licenses. This variable is likely to influence budget size as well as budget allocations to nongame. Unfortunately, however, an empirical variable for price that is consistent across all states is difficult to find. Many states offer hunting and fishing

license packages that are not comparable to those found in other states. Pricing may be for an individual species, such as deer, or a deer license may be packaged in with a license for other large game. Furthermore, the value of a certain species depends on the state in which it resides. In some states, for example, trout is the primary species sought by fisherman and in other states bass are primarily sought. While it is true that most states contain bass, it is not appropriate to compare the price of a bass fishing license in a state where it is the treasured game fish to the license price in a state where it is secondary to trout. If one could be found, a variable that proxies some measure of price that is consistent across states could improve the empirical analysis.

A complete empirical test of the chapter 4 model would require data that proxy private management effort. Such a variable might be gauged by looking at the revenues of guides or of fee-hunting landowners in each state. The current test of the chapter 4 and 5 models could also be improved with more refined contracting cost variables. Measures of the average size and variance of all private landholdings would be superior to the current measures of farm size and variance. In addition, the empirical analysis could be improved by adding more observations. More observations would increase the degrees of freedom and allow more flexibility in adding right hand side variables. A broader data set might be obtained by using a pooled data set of U.S. states or an expanded cross section that includes Canadian provinces.

The theoretical analysis may be improved with more thought about what links agency organization and agency behavior. Williamson (1999) may be a good resource for thinking about agency organization and transaction costs.

Finally, the theoretical and empirical analyses could be complemented with an examination of the determinants of agency organizational features such as funding sources, jurisdiction, and hierarchy placement. This thesis has treated these features as exogenous but attempting to explain their variance may lead to many fruitful insights. Such an endeavor could be as simple as running a series of probit regressions using the variables I have collected or it could be as complicated as developing a theory to explain each organizational feature and collecting data to test the theories.

While the framework developed in the thesis could be refined, it could also be generalized and used to examine other wildlife policies or the behavior of other government agencies. For example, the framework could be used to examine resident and nonresident license pricing and hunting season lengths, the number and types of personnel employed by wildlife agencies and the expenditures on fisheries versus wildlife. The framework could also be applied more generally and used to explain the budget size of any government agency or how agencies allocate resources to competing constituencies when funding sources and organizational structures vary.

LITERATURE CITED

Ambrose, Stephen E. 1997. *Undaunted Courage: Meriwhether Lewis, Thomas Jefferson, and the Opening of the American West.* New York: Simon and Schuster.

Anderson, Stanley H. 1991. *Managing our Wildlife Resources*. Englewood Cliffs, New Jersey: Prentice Hall.

Ashley, David C. and William Elliott. 2000. *Missouri Cave Life*. Missouri Department of Conservation. Available: http://www.conservation.state.mo.us/conmag/2000.

Becker, Gary S. 1983. "A Theory of Competition among Pressure Groups for Political Influence". *Quarterly Journal of Economics* 98(3): 371-400.

Belanger, Dion O. 1988. *Managing American Wildlife: A History of the International Association of Wildlife Agencies*. Amherst, MA: University of Massachusetts Press.

Bierhanzl, Edward J, and Paul B. Downing. 1998. "User Charges and Bureaucratic Inefficiency". *Atlantic Economic Journal* 26(2): 175-189.

Blais, Andre and Stephane Dion. eds. 1991. *The Budget-Maximizing Bureaucrat: Appraisals and Evidence.* Pittsburgh, PA: University of Pittsburgh Press.

Cannamela, Barden R. and Robert J. Warren. 1999. Should State Wildlife Management and Environmental Protection Programs be Combined?" *Wildlife Society Bulletin* 27(4): 1059-1063.

Clark, Robert. 1995. *River of the West: Stories from the Columbia River.* San Francisco: Harpers Collins West.

Coase, Ronald H. 1960. "The Problem of Social Cost." *Journal of Law and Economics* 3(1): 1-44.

Defenders of Wildlife. 1998. "Saving Biodiversity: A Status Report on State Laws, Policies and Programs." Biodiversity Center: Defenders of Wildlife.

Delaware Department of Natural Resources and Environmental Control (DNREC). *Biodiversity Initiative.* Available: http://www.dnrec.state.de.us/fw/fwwel.htm 2000.

Dewatripont, Mathias, Ian Jewitt, and Jean Tirole. 1999."The Economics of Career Concerns, Part II: Application to Missions and Accountability of Government Agencies" *Review of Economic Studies* 66: 199-217.

Edelson, Naomi. 1994. "State Wildlife Diversity Program Funding: A 1992 Survey". Washington D.C.: International Association of Wildlife Agencies.

Hickman, Tim. January 2001. Nongame Biologist, Illinois Department of Natural Resources, Springfield, IL. Personal Interview.

Johnson, Ronald N., and Gary D. Libecap. 1994. *The Federal Civil Service System and the Problem of Bureaucracy: The Economics and Politics on Institutional Change.* Chicago: University of Chicago Press.

Johnson, Ronald N. 1985. "U.S. Forest Service Policy and its Budget". In *Forestlands: Private and Public*, eds. Robert T. Deacon and M. Bruce Johnson. Cambridge, MA: Ballinger Publishing Company.

Johnston, Jack., and John DiNardo. 1997. *Econometric Methods*. New York: McGraw-Hill.

Laffont, Jean-Jacques and Jean Tirole. 1991. "The Politics of Government Decision-Making: A Theory of Regulatory Capture". *Quarterly Journal of Economics* 106(4): 1089-1126.

Ledford, David L. 1998. "Game or Nongame: A Challenge to see the Other Side." *Wildlife Society Bulletin* 26(3): 545.

Leopold, Aldo. 1933. *Game Management*. New York: C. Scribner's Sons.

Lueck, Dean. 1989. "The Economic Nature of Wildlife Law." *Journal of Legal Studies* 18(2): 291- 324.

Lueck, Dean. 1991. "Ownership and Regulation of Wildlife." *Economic Inquiry* 29(2): 249- 260.

Lueck, Dean. 2000. "An Economic Guide to State Wildlife Management." *PERC Research Study 00-2*, Bozeman, MT: Political Economy Research Study (PERC).

Lund, Thomas A. 1980. *American Wildlife Law*. Berkeley: University of California Press.

McChesney, Fred. 1990. "Government as Definer of Property Rights: Indian Lands, Ethnic Externalities, and Bureaucratic Budgets". *Journal of Legal Studies* 19(2): 297-335.

McCubbins, Mathew, Roger Noll, and Barry Weingast. 1987. "Administrative Procedures as Instruments of Political Control." *Journal of Law, Economics, and Organization* 3: 243-277.

McCubbins, Mathew, Randall Calvert, and Barry Weingast. 1989. "A Theory of Political Control and Agency Discretion". *American Journal of Political Science* 33(3): 588-611.

McCullogh, Mark. January 2001. Nongame Biologist, Maine Department of Inland Fisheries and Wildlife: Bangor, ME. Personal Interview.

Moe, Terry. 1985. "Control and Feedback in Economic Regulation: The case of the NLRB". *American Political Science Review* 79(4): 1094-1116.

Neel, Larry. January 2001. Nongame Biologist, Nevada Department of Fish and Game. Reno, NV.

Niskanen, William. 1971. *Bureaucracy and Representative Government.* Chicago: Aldine.

O'Toole, Randall. 1995. "State Land and Resources". *Different Drummer.* The Thoreau Institute.

Peltzman, Sam. 1976. "Toward a More General Theory of Regulation." *Journal of Law and Economics* 19(2): 211-240.

Richie, Deborah. 1999. "America's Wildlife at the Crossroads: The Case for Saving Species Before they Become Endangered by Fully Funding State Wildlife Conservation and Related Recreation and Education Programs." Washington D.C.: The International Association of Wildlife Agencies.

Richie, Deborah and Jennifer Holmes. 2000. "State Wildlife Diversity Programs Funding: A 1998 Survey". Washington D.C: International Association of Wildlife Agencies.

Robertson and Bolen. 1989. *Wildlife Ecology and Management.* New York: Collier MacMillan.

Scott, Ron with Paul Hansen and Jim Moshen. 1999. "Passing the Buck: A Comparison of State Wildlife Agency Funding and the Economic Value of Wildlife-Associated Recreation." Gaithersburg, MD: Izaak Walton League of America.

Silberberg, Eugene. 1990. *The Structure of Economics: A Mathematical Analysis.* New York: McGraw-Hill, Inc.

Stigler, George J. 1971. "The Economic Theory of Regulation". *Bell Journal of Economics* 2(1): 3-21.

Studemund, A.H. and Henry J. Cassidy. 1987. *Using Econometrics: A Practical Guide*: Boston: Little, Brown, and Company.

Tober, James. 1981. *Who Owns the Wildlife? The Political Economy of Conservation in Nineteenth Century America*. Westport, Connecticut: Greenwood Press.

Tober, James. 1989. *Wildlife and the Public Interest*: *Nonprofit Organizations and Federal Wildlife Policy*. New York: Praeger Publishers.

Waller, David. 1999. "Testimony Before The House Resources Committee on HR 701, The Conservation And Reinvestment Act,and HR 798, The Resources 2000 Act." Washington D.C: The International Association of Wildlife Agencies.

Weingast, Barry, and Mark Moran. 1983. "Bureaucratic Discretion or Congressional Control: Regulatory Policymaking by the Federal Trade Commission". *Journal of Political Economy* 91(5): 765-800.

The Wildlife Conservation Fund of America (WCFA). 1996. "1996 Survey of State Wildlife Agency Revenue". Columbus, OH: WCFA.

Wildlife Management Institute (WMI). 1997. "Organization, Authority and Programs of State Wildlife Agencies." Washington D.C: WMI.

Wildlife Management Institute (WMI). 1968. "Organization, Authority and Programs of State Wildlife Agencies." Washington D.C: WMI.

Williamson, Oliver E. 1999. "Public and Private Bureaucracies: A Transaction Cost Economics Perspective." *Journal of Law, Economics, and Organization* 15(1): 306-342

Wilson, James Q. 1989. *Bureaucracy*: *What Government Agencies Do and Why they Do it*. New York: Basic Books.

U.S. Department of Interior, Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1997. "1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation". Washington D.C.

APPENDICES

APPENDIX A

COMPARATIVE STATIC DERIVATIONS

COMPARATIVE STATIC DERIVATIONS

This appendix explicitly derives the comparative static results summarized in chapter 4 and chapter 5.

Chapter 4 Derivations

Given the assumptions described in chapter 4, the model yields several comparative static results. The results are summarized in table 4.1. Their derivations are presented in detail below.

The first-order conditions for the problem (1) are shown by (2) and (3).

(1) $\max_{w_A,\, w_P} NV = [V_A(w_A, w_P, \Phi) + V_P(w_A, w_P, \Phi, g)] - [C_A(w_A, \theta, b) + C_P(w_P, \theta, r)]$

(2) $V_A'(w_A, w_P, \Phi) = C_A'(w_A, \theta, b)$

(3) $V_P'(w_A, w_P, \Phi, g) = C_P'(w_P, \theta, r)$

The second-order conditions for maximization are given by (4), (5), and (6).

(4) $V_A'' - C_A'' < 0$

(5) $V_P'' - C_P'' < 0$

(6) $([V_A'' - C_A''] \cdot ([V_P'' - C_P'']) > ([\partial V_A'/\partial w_P] \cdot [\partial V_P'/\partial w_A])$

The second-order conditions imply, by the implicit function theorem, that (2) and (3) can be solved for the explicit choice functions (7) and (8).

(7) $w_A^* = w_A(\Phi, g, \theta, b, r)$

(8) $w_P^* = w_P(\Phi, g, \theta, b, r)$

Substituting (7) and (8) in for w_A and w_P in (2) and (3) yields the first-order identities (9) and (10).

(9) $V_A'(w_A^*(\Phi, g, \theta, b, r), w_P^*(\Phi, g, \theta, b, r), \Phi) \equiv C_A'(w_A^*(\Phi, g, \theta, b, r), \theta, b)$
(10) $V_P'(w_A^*(\Phi, g, \theta, b, r), w_P^*(\Phi, g, \theta, b, r), \Phi, g) \equiv C_P'(w_P^*(\Phi, g, \theta, b, r), \theta, r)$

To obtain comparative static results, I first differentiate this system (9 and 10) with respect to any parameter (α), to obtain the following Hessian matrix.

$$\left| Hessian = \begin{matrix} V_A'' - C_A'' & \partial V_A'/\partial w_P \\ \partial V_P'/\partial w_A & V_P'' - C_P'' \end{matrix} \right|$$

By the second-order conditions, the determinant of the Hessian (H) is > 0. Because I assume that w_A and w_P are substitutes, $\partial V_A'/\partial w_P$ and $\partial V_P'/\partial w_A$ are both < 0.

In order to obtain comparative statics, I use Cramer's rule to solve for $\partial w_A^*/\partial\alpha$ and $\partial w_P^*/\partial\alpha$. Using this methodology, the following comparative statics are obtained.

$$\frac{\partial w_A^*}{\partial \Phi} = \frac{[(\partial V_A'/\partial\Phi)(V_P'' - C_P'')] - [(\partial V_P'/\partial\Phi)(\partial V_A'/\partial w_P)]}{H} <,>,= 0?$$

$$\frac{\partial w_P^*}{\partial \Phi} = \frac{[(\partial V_P'/\partial\Phi)(V_A'' - C_A'')] - [(\partial V_A'/\partial\Phi)(\partial V_P'/\partial w_A)]}{H} <,>,= 0?$$

$$\frac{\partial w_A^*}{\partial \theta} = \frac{[(\partial C_A'/\partial\theta)(V_P'' - C_P'')] - [(\partial C_P'/\partial\theta)(\partial V_A'/\partial w_P)]}{H} <,>,= 0?$$

$$\frac{\partial w_P^*}{\partial \theta} = \frac{[(\partial C_P'/\partial\theta)(V_A'' - C_A'')] - [(\partial C_A'/\partial\theta)(\partial V_P'/\partial w_A)]}{H} <,>,= 0?$$

$$\frac{\partial w_A^*}{\partial r} = \frac{(-\partial C_P' / \partial r)(\partial V_A' / \partial w_P)}{H} > 0$$

$$\frac{\partial w_P^*}{\partial r} = \frac{(\partial C_P' / \partial r)(V_A'' - C_A'')}{H} < 0$$

$$\frac{\partial w_A^*}{\partial g} = \frac{-[(-\partial V_P' / \partial g)(\partial V_A' / \partial w_P)]}{H} > 0$$

$$\frac{\partial w_P^*}{\partial g} = \frac{(-\partial V_P' / \partial g)(V_A'' - C_A'')}{H} < 0$$

$$\frac{\partial w_A^*}{\partial b} = \frac{(\partial C_A' / \partial b)(V_P'' - C_P'')}{H} < 0$$

$$\frac{\partial w_P^*}{\partial b} = \frac{-[(\partial C_A' / \partial b)(\partial V_P' / \partial w_A)]}{H} > 0$$

Chapter 5 Derivations

Given the assumptions described in chapter 5, the model yields several comparative static results. The results are summarized in table 5.1. Their derivations are presented in detail below.

The first-order condition for the problem (1) is shown by (2).

(1) $\max_{w_N} NV = [V_N(w_N, \Phi_N, r) + V_G(w_N, \Phi_G)] - [C_N(w_N, \theta_N, g, j, h) + C_G(w_N, \theta_G)]$

(2) $[V_N'(w_N, \Phi_N, r)) - C_N'(w_N, \theta_N, g, j, h)] = [V_G'(w_N, \Phi_G) - C_G'(w_N, \theta_G)]$

The second-order conditions for maximization are given by (3) and (4).

(3) $V_N'' - C_N'' < 0$
(4) $V_G'' - C_G'' > 0$

The second-order conditions imply, by the implicit function theorem, that equation (2) can be solved for the explicit choice function (5).

(5) $w_N = w_N^*(\Phi, \theta, g, j, h, r)$

Substituting (5) in for w_N in (2) yields the first-order identity (6).

(6) $[V_N'(w_N^*(\Phi, \theta, g, j, h, r), \Phi_N, r) - C_N'(w_N^*(\Phi, \theta, g, j, h, r), \theta_N, g, j, h)] \equiv [V_G'(w_N^*(\Phi, \theta, g, j, h, r), \Phi_G) - C_G'(w_N^*(\Phi, \theta, g, j, h, r), \theta_G)]$

To obtain comparative static results, I differentiate (6) with respect to any parameter (α) and solve for $\partial w_N^*/\partial\alpha$. Using this methodology, the following comparative statics are obtained.

$$\frac{\partial w_N^*}{\partial \Phi_N} = \frac{\partial V_N' / \partial \Phi_N}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

$$\frac{\partial w_N^*}{\partial \Phi_G} = \frac{-\partial V_G' / \partial \Phi_G}{(V_N'' - C_N'') - (V_G'' - C_G'')} < 0$$

$$\frac{\partial w_N^*}{\partial g} = \frac{\partial C_N' / \partial g}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

$$\frac{\partial w_N^*}{\partial j} = \frac{\partial C_N' / \partial j}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

$$\frac{\partial w_N^*}{\partial h} = \frac{\partial C_N' / \partial h}{(V_N'' - C_N'') - (V_G'' - C_G'')} < 0$$

$$\frac{\partial w_N^*}{\partial r} = \frac{-\partial V_N' / \partial r}{(V_N'' - C_N'') - (V_G'' - C_G'')} < 0$$

$$\frac{\partial w_N^*}{\partial \theta_N} = \frac{\partial C_N' / \partial \theta_N}{(V_N'' - C_N'') - (V_G'' - C_G'')} < 0$$

$$\frac{\partial w_N^*}{\partial \theta_G} = \frac{-\partial C_N' / \partial \theta_G}{(V_N'' - C_N'') - (V_G'' - C_G'')} > 0$$

APPENDIX B

DATA

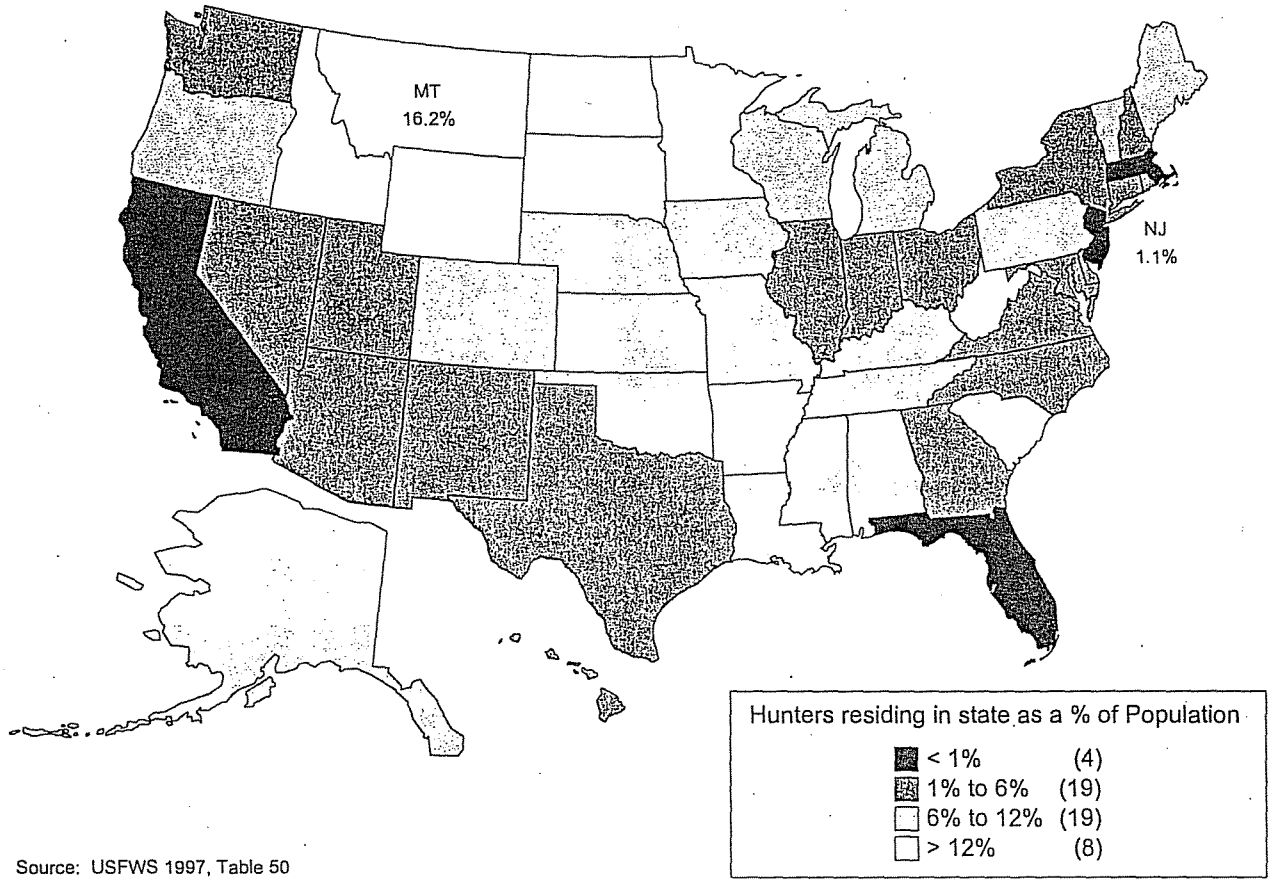
DATA

This appendix provides additional data relevant to the content of the thesis. The appendix is organized in three sections: Agency constituents per-capita, data sources and correlations, and logged empirical specifications.

Agency Consituents Per-Capita

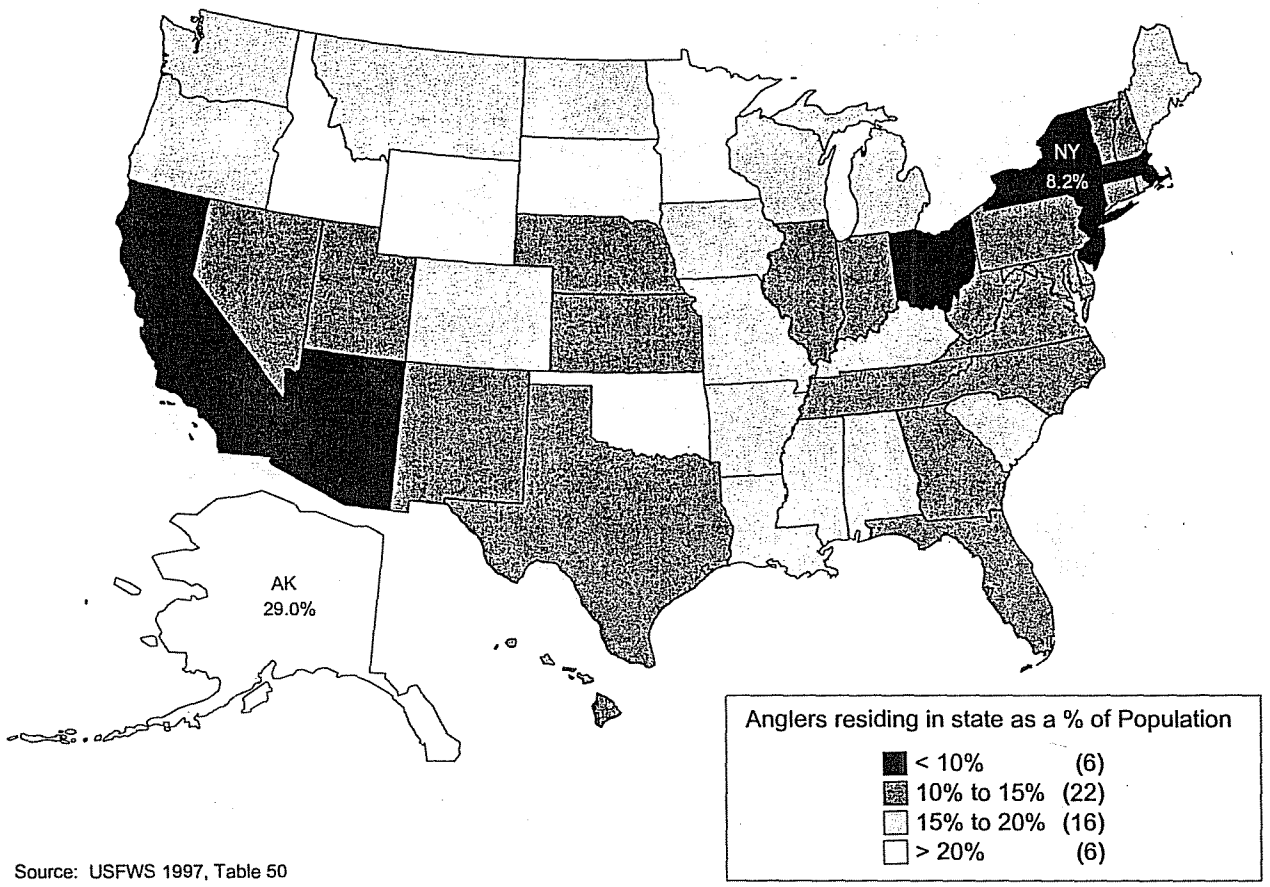
In chapter 2, several maps illustrate the size of hunting, fishing, and wildlife-watching constituencies across states. The size of each constituency, as represented by figures 2.1, 2.2, and 2.5, is influenced heavily by the population of the state. Figures B.1, B.2, and B.3 below illustrate the number of hunters, fisherman, and wildlife-watchers per-capita. These maps help to illustrate the relative strength of constituencies across states.

Figure B.1: Hunters as a Percent of Population



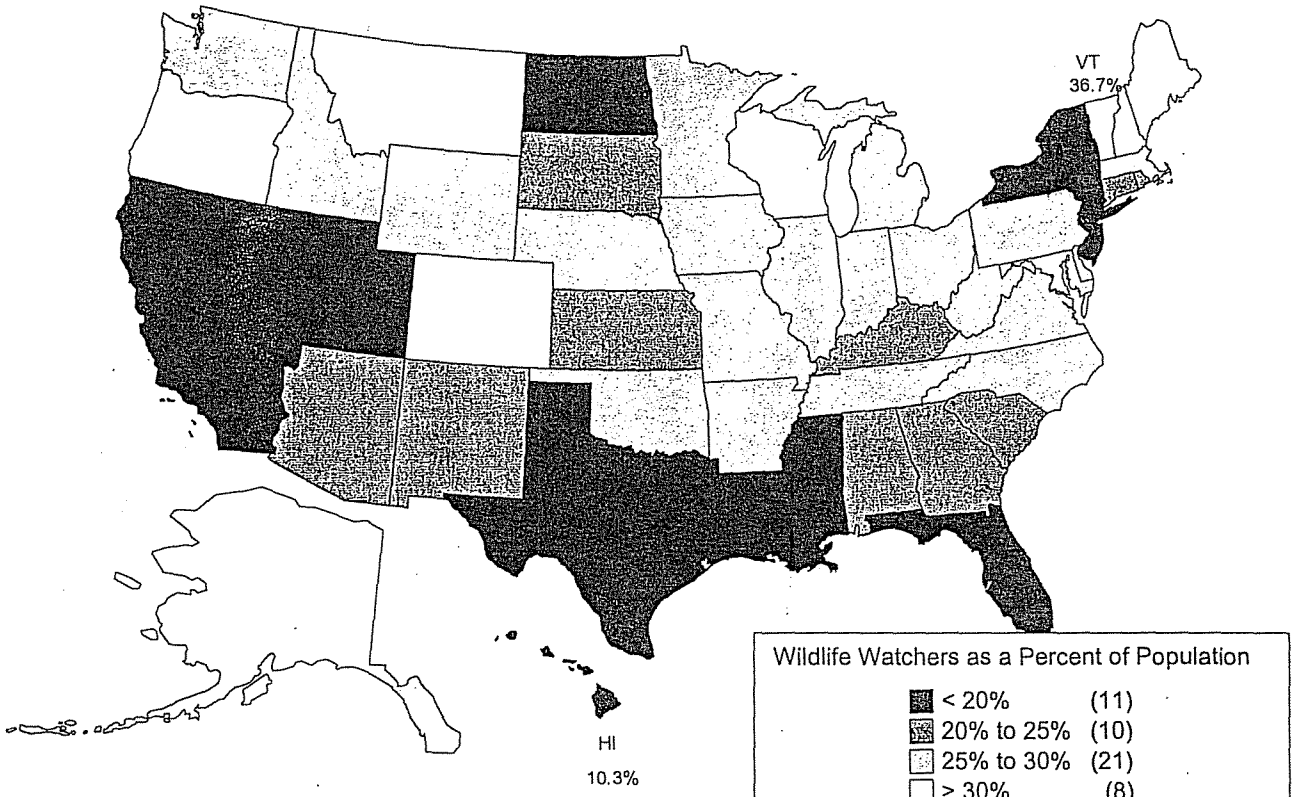
Source: USFWS 1997, Table 50

Figure B.2: Anglers as a Percent of Population



Source: USFWS 1997, Table 50

Figure B.3: Wildlife Watchers as a Percent of Population



Source: USFWS 1997, Table 47

Data Sources and Correlations

This section provides a detailed listing of the sources of variables used for the empirical analyses and their correlations. Table B:1 lists the chapter 4 variables and their sources. Table B:2 shows the sources for the empirical variables used only in chapter 5. Table B.3 shows a correlation matrix for all empirical variables.

Table B:1: Chapter 4 Data Sources

Variable Name	Source
BUDGET	WCFA, *1996 Survey of State Wildlife Agency Revenue.*
HUNTERS	USFWS, *1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreations* (Survey), Table 50.
ANGLERS	USFWS Survey, Table 50.
NONRESIDENT HUNTERS	USFWS Survey, Table 51.
NONRESIDENT ANGLERS	USFWS Survey, Table 51.
WILDLIFE WATCHING DAYS	USFWS Survey, Table 63.
INCOME	U.S. Census Bureau, *USA Statistics in Brief*, http://www.census.gov/statab/
PERCENT PUBLIC LAND	General Services Administration, Governmentwide Real Property Policy, *Comparison of Federally Owned Land with Total Acreage of State* and USPS, *Land Resources Division, Listing of Acreage by State*
FARM SIZE	USDA, National Agricultural Statistics Service, *1997 Census of Agriculture*
FARM VARIANCE	USDA, National Agricultural Statistics Service, *1997 Census of Agriculture*
GENERAL FUNDS SHARE	WCFA, *1996 Survey of State Wildlife Agency Revenue.*
INDEPENDENT AGENCY	WMI, *Organization, Authority and Programs of State Wildlife Agencies*, 1997 and individual websites of state wildlife agencies.
NARROW JURISDICTION	WMI, *Organization, Authority and Programs of State Wildlife Agencies*, 1997 and individual websites of state wildlife agencies.
POPULATION	U.S. Census Bureau, *USA Statistics in Brief*, http://www.census.gov/statab/
AREA	General Services Administration, Governmentwide Real Property Policy, *Comparison of Federally Owned Land with Total Acreage of State*

Table B:2: Chapter 5 Data Sources

Variable Name	Source
NONGAME ALLOCATION	IAFWA, *State Wildlife Diversity Program Funding: A 1998 Survey* and WCFA, *1996 Survey of State Wildlife Agency Revenue,* Appendix 2. Data from Nevada, Maine, and Illinois was modified after phone conversations with nongame biologists at each department.
HUNTING DAYS	USFWS, *1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreations* (Survey), Table 54.
FISHING DAYS	USFWS Survey, Table 59.
URBAN LAND	USDA, Economic Research Service, *Major Land Uses*, http://usda.mannlib.cornell.edu/data-sets/land/
ENDANGERED SPECIES	USFWS, *Threatened and Endangered Species System*, http://ecos.fws.gov/webpage/webpage_usa_lists.html
ESA SECTION 6 FUNDS	IAFWA, *State Wildlife Diversity Program Funding: A 1998 Survey*, Appendix 2.
TAX CHECKOFF	IAFWA, *State Wildlife Diversity Program Funding: A 1998 Survey*, Appendix 1.

Table B.1: Correlation Grid of Empirical Variables

	BUDGET	HUNTERS	ANGLERS	NONRESIDENT HUNTERS	NONRESIDENT ANGLERS	WILDLIFE WATCHING DAYS	INCOME	PERCENT PUBLIC LAND
BUDGET	1.00	0.58	0.59	0.20	0.32	0.59	0.03	0.20
HUNTERS	0.58	1.00	0.79	0.33	0.34	0.68	-0.02	-0.28
ANGLERS	0.59	0.79	1.00	0.07	0.47	0.89	0.21	-0.22
NONRESIDENT HUNTERS	0.20	0.33	0.07	1.00	0.10	0.06	-0.25	-0.11
NONRESIDENT ANGLERS	0.32	0.34	0.47	0.10	1.00	0.31	0.04	-0.14
WILDLIFE WATCHING DAYS	0.59	0.68	0.89	0.06	0.31	1.00	0.33	-0.09
INCOME	0.03	-0.02	0.21	-0.25	0.04	-0.14	1.00	-0.04
PERCENT PUBLIC LAND	0.20	-0.28	-0.22	-0.11	-0.14	-0.09	-0.04	1.00
FARM SIZE	-0.01	-0.31	-0.29	-0.06	-0.19	-0.21	-0.22	0.55
FARM VARIANCE	0.22	-0.21	-0.15	-0.14	-0.11	-0.09	-0.11	0.51
GENERAL FUNDS SHARE	0.34	-0.02	0.06	-0.14	0.21	-0.04	0.07	-0.07
GENERAL FUNDS DUMMY	0.17	0.09	0.11	-0.20	0.08	0.03	0.11	0.05
1991 GENERAL FUNDS SHARE	0.31	-0.13	-0.01	-0.13	0.18	-0.07	0.05	-0.02
INDEPENDENT AGENCY	0.13	-0.07	-0.11	-0.04	-0.03	-0.15	-0.35	0.03
NARROW JURISDICTION	0.07	0.07	0.08	-0.16	0.20	0.08	0.04	0.22
POPULATION	0.52	0.66	0.93	-0.02	0.33	0.91	0.28	-0.14
AREA	0.49	0.06	0.10	-0.02	0.03	0.09	-0.08	0.43
NONGAME ALLOCATION*	0.04	-0.11	0.09	-0.06	0.15	0.12	0.09	0.07
HUNTING DAYS	0.49	0.95	0.75	0.33	0.40	0.60	-0.08	-0.35
FISHING DAYS	0.49	0.74	0.93	0.09	0.49	0.76	0.15	-0.32
ENDANGERED SPECIES	0.22	0.24	0.52	-0.04	0.33	0.43	-0.08	0.03
ESA SECTION 6 FUNDS*	0.19	0.15	0.18	0.08	0.05	0.11	-0.18	0.18
TAX CHECKOFF*	-0.26	0.02	-0.07	0.03	-0.10	0.08	0.13	0.00

Note: * indicates that California is excluded from correlation.

Table B.1 Continued: Correlation Grid of Empirical Variables

	FARM SIZE	FARM VARIANCE	GENERAL FUNDS SHARE	GENERAL FUNDS DUMMY	1991 GENERAL FUNDS SHARE	INDEPENDENT AGENCY	NARROW JURISDICTION	POPULATION
BUDGET	-0.01	0.22	0.34	0.17	0.31	0.13	0.07	0.52
HUNTERS	-0.31	-0.21	-0.02	0.09	-0.13	-0.07	0.07	0.66
ANGLERS	-0.29	-0.15	0.06	0.11	-0.01	-0.11	0.08	0.93
NONRESIDENT HUNTERS	-0.06	-0.14	-0.14	-0.20	-0.13	-0.04	-0.16	-0.02
NONRESIDENT ANGLERS	-0.19	-0.11	0.21	0.08	0.18	-0.03	0.2	0.33
WILDLIFE WATCHING DAYS	-0.21	-0.09	-0.04	0.03	-0.07	-0.15	0.08	0.91
INCOME	-0.22	-0.11	0.07	0.11	0.05	-0.35	0.04	0.28
PERCENT PUBLIC LAND	0.55	0.51	-0.07	0.05	-0.02	0.03	0.22	-0.14
FARM SIZE	1.00	0.77	-0.16	-0.19	-0.13	0.29	-0.01	-0.23
FARM VARIANCE	0.77	1.00	0.02	-0.09	0.10	0.30	-0.01	-0.11
GENERAL FUNDS SHARE	-0.16	0.02	1.00	0.54	0.89	-0.07	-0.16	0.00
GENERAL FUNDS DUMMY	-0.19	-0.09	0.54	1.00	0.38	-0.26	0.10	0.09
1991 GENERAL FUNDS SHARE	-0.13	0.10	0.89	0.38	1.00	-0.07	-0.22	-0.06
INDEPENDENT AGENCY	0.29	0.30	-0.07	-0.26	-0.07	1.00	-0.26	-0.16
NARROW JURISDICTION	-0.01	-0.01	-0.16	0.10	-0.22	-0.26	1.00	0.06
POPULATION	-0.23	-0.11	0.00	0.09	-0.06	-0.16	0.06	1.00
AREA	0.39	0.75	0.12	0.02	0.20	0.26	0.10	0.10
NONGAME ALLOCATION*	0.21	0.13	0.39	0.09	0.37	-0.12	-0.19	0.13
HUNTING DAYS	-0.38	-0.25	0.00	0.11	-0.10	-0.03	0.08	0.61
FISHING DAYS	-0.29	-0.14	0.04	0.05	-0.01	-0.03	-0.04	0.84
ENDANGERED SPECIES	-0.10	-0.03	0.03	0.11	0.04	-0.02	0.03	0.57
ESA SECTION 6 FUNDS*	0.04	0.10	0.29	0.06	0.33	-0.05	-0.20	0.10
TAX CHECKOFF*	-0.06	-0.17	-0.28	-0.04	-0.36	-0.36	0.14	-0.02

Note: * indicates that California is excluded from correlation.

Table B.1 Continued: Correlation Grid of Empirical Variables

	AREA	NONGAME ALLOCATION	HUNTING DAYS	FISHING DAYS	ENDANGERED SPECIES	ESA SECTION 6 FUNDING	TAX CHECKOFF
BUDGET	0.49	0.04	0.49	0.49	0.22	0.19	-0.26
HUNTERS	0.06	-0.11	0.95	0.74	0.24	0.15	0.02
ANGLERS	0.10	0.09	0.75	0.93	0.52	0.18	-0.07
NONRESIDENT HUNTERS	-0.02	-0.06	0.33	0.09	-0.04	0.08	0.03
NONRESIDENT ANGLERS	0.03	0.15	0.4	0.49	0.33	0.05	-0.10
WILDLIFE WATCHING DAYS	0.09	0.12	0.6	0.76	0.43	0.11	0.08
INCOME	-0.08	0.09	-0.08	0.15	-0.08	-0.18	0.13
PERCENT PUBLIC LAND	0.43	0.07	-0.35	-0.32	0.03	0.18	0.00
FARM SIZE	0.39	0.21	-0.38	-0.29	-0.10	0.04	-0.06
FARM VARIANCE	0.75	0.13	-0.25	-0.14	-0.03	0.10	-0.17
GENERAL FUNDS SHARE	0.12	0.39	0.00	0.04	0.03	0.29	-0.28
GENERAL FUNDS DUMMY	0.02	0.09	0.11	0.05	0.11	0.06	-0.04
1991 GENERAL FUNDS SHARE	0.20	0.37	-0.1	-0.01	0.04	0.33	-0.36
INDEPENDENT AGENCY	0.26	-0.12	-0.03	-0.03	-0.02	-0.05	-0.36
NARROW JURISDICTION	0.10	-0.19	0.08	-0.04	0.03	-0.20	0.14
POPULATION	0.10	0.13	0.61	0.84	0.57	0.10	-0.02
AREA	1.00	-0.13	0.02	0.11	0.06	0.07	-0.26
NONGAME ALLOCATION*	-0.13	1.00	-0.12	0.02	0.28	0.48	-0.15
HUNTING DAYS	0.02	-0.12	1.00	0.74	0.29	0.18	-0.06
FISHING DAYS	0.11	0.02	0.74	1.00	0.44	0.14	-0.20
ENDANGERED SPECIES	0.06	0.28	0.29	0.44	1.00	0.45	-0.14
ESA SECTION 6 FUNDS*	0.07	0.48	0.18	0.14	0.45	1.00	-0.17
TAX CHECKOFF*	-0.26	-0.15	-0.06	-0.20	-0.14	-0.17	1.00

Note: * indicates that California is excluded from correlation.

Other Empirical Specifications

The empirical tests of the Chapter 4 and Chapter 5 models assume a linear relationship between the independent and dependent variables. Neither model, however, explicitly suggests that this need be the case. This section presents and interprets log-log, log-level, and level-log specifications of the empirical models used in each chapter.

Chapter 4 Specifications

Specifications 1 and 2 of table B.2 present OLS results from a log-level empirical specification. Specifications 3 and 4 present the OLS results from a log-log empirical specification. In each specification, every independent variable except PERCENT PUBLIC LAND, GENERAL FUND SHARE, INDEPENDENT AGENCY, and NARROW JURISDICTION is logged. Specifications 2 and 4 exclude Alaska.

Table B.4: Log-Log and Log-Level OLS Estimates of Fish and Wildlife Agency Budgets

Dependent variable = log of total budget

INDEPENDENT VARIABLES	Predicted Sign	(1)	(2) w/o Alaska	(3) w RHS logs	(4) w RHS logs w/o Alaska
CONSTANT		15.90 (28.02)***	15.76 (24.97)***	4.33 (0.89)	4.68 (0.97)
Wildlife Demand Variables					
HUNTERS	+	1.45E-06 (2.65)**	1.47E-06 (2.65)**	0.42 (2.43)**	0.50 (2.66)**
ANGLERS	+	2.80E-07 (0.62)	6.91E-07 (0.11)	0.04 (0.14)	0.05 (0.18)
NON-RESIDENT HUNTERS	+	4.41E-06 (2.64)**	4.22E-06 (2.46)**	0.07 (1.38)*	0.07 (1.39)*
NON-RESIDENT ANGLERS	+	3.17E-07 (0.75)	4.85E-07 (0.90)	0.08 (1.17)	0.08 (1.07)
WILDLIFE WATCHING DAYS	+	3.66E-08 (1.32)*	4.41E-08 (1.41)*	0.30 (2.53)**	0.25 (2.04)**
Contracting Cost Variables					
PERCENT PUBLIC LAND	+	9.06E-03 (2.35)**	7.61E-03 (1.60)*	0.007 (2.37)**	0.008 (2.57)***
FARM SIZE	-	3.12E-05 (0.39)	-3.06E-06 (0.02)	0.03 (0.37)	0.10 (0.92)
Agency Funding Variables					
GENERAL FUNDS SHARE	+	0.014 (3.31)***	0.015 (3.21)***	0.0158 (5.05)***	0.0149 (4.59)***
Bureaucratic Cost Variables					
INDEPENDENTAGENCY (=1 if independent)	+	0.34 (2.54)**	0.34 (2.51)**	0.13 (1.37)*	0.14 (1.48)*
NARROW JURISDICTION (=1 if narrow)	+	0.29 (1.77)**	0.34 (1.76)**	0.15 (1.31)*	0.12 (1.03)
Control Variables					
POPULATION	+	-2.19E-08 (0.59)	-1.80E-08 (0.47)	-0.21 (0.95)	-0.16 (0.72)
AREA	+	1.85E-06 (2.29)**	3.50E-06 (1.10)	0.20 (1.95)**	0.09 (0.62)
INCOME	?	-1.87E-05 (1.02)	-1.52E-05 (0.78)	0.31 (0.71)	0.20 (0.46)
Adjusted R^2		.757	.746	.877	.874
F-Statistic		12.80	11.89	27.91	26.74
Observations		50	49	50	49
White's Test – level of confidence in rejecting homoscedasticity		46%	80%	34%	43%

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test.

The interpretation of the coefficients in columns 1 and 2 is as follows: $\beta = \%\Delta Y/100 \bullet \Delta X$. The coefficient on HUNTERS means that an increase of 1,000 hunters is correlated with a total budget increase of 1.45 percent. The coefficient on WILDLIFE WATCHING DAYS means that an increase of 1,000 wildlife watching days is correlated with a budget increase of about 0.04 percent. The coefficient on PERCENT PUBLIC LAND indicates that an increase of 10 percent public land is correlated with an increase of about 9 percent in the size of the agency budget. The coefficient on NARROW JURISDICTION means that an agency with narrow jurisdiction will have a budget about 29 percent greater than an agency with broad jurisdiction when controlling for the influence of the other variables.

The interpretation of the coefficients in columns 3 and 4 is as follows: $\beta = \%\Delta Y/ \%\Delta X$. The coefficient on HUNTERS means that a 100 percent increase in HUNTERS is correlated with a 42 percent increase in budget size. The coefficient on GENERAL FUNDS SHARE means that a 100 percent increase in GENERAL FUNDS SHARE is correlated with a 1.5 percent increase in budget size. The coefficient on AREA indicates that a 100 percent increase in square miles is correlated with a 20 percent increase in budget size.

In general, the log-level and log-log specifications support the Chapter 4 model. Of the 48 hypothesis tests presented in table B.4, 85.4 percent of the coefficients are the same sign as predicted and 60.4 percent are of the same sign and statistically significant at least at the 90 percent level.

While it is difficult to compare the magnitude of the coefficients in table B.4 with those presented in table 4.5 and 4.6, their signs and t-statistics are readily comparable. There are two noteworthy differences in coefficient estimates across specifications. First, the coefficient estimates on ANGLERS and NONRESIDENT ANGLERS are always positive, as predicted, with the logged specifications. Second, the coefficient estimates on FARM SIZE are positive in 3 of 4 of the logged specifications. In contrast, the estimates on FARM SIZE using natural units, are all negative as predicted.

Because the coefficient results on ANGLERS, NONRESIDENT ANGLERS, and FARM SIZE lack statistical significance, they do not beg an explanation. Nevertheless, the estimation results on the angler variables suggest that the positive relationship between fishing interest and budget size is not linear. It may be the case that at higher levels of budgets and number of anglers, increases in the number of anglers "crowd out" other budget sources. The estimation results on FARM SIZE may suggest that private contracting costs are only influenced changes in farm size when those changes are distinct and large. If this is the case, logging FARM SIZE would decrease the variance and thus the explanatory power of the variable on budget size.

Chapter 5 Specifications

Table B.5 presents OLS results from four level-log empirical specifications. In each specification, HUNTING DAYS, FISHING DAYS, WILDLIFE WATCHING DAYS, FARM SIZE, ESA SECTION 6 FUNDS, and POPULATION are logged. The interpretation of these coefficients is as follows: $\beta = 100 \bullet \Delta Y / \% \Delta X$. The coefficient on HUNTING DAYS (in column 1) means that a 100 percent increase in hunting days is

correlated with a 0.023 decrease in budget allocations towards nongame. The coefficient on FARM SIZE means that a 100 percent increase in the average size of farms is correlated with a 0.016 increase in budget allocations towards nongame.

In general the results presented in table B.5 offer only weak support for the chapter 5 model. While 100 percent (36 of 36) of the coefficient estimates are the same sign as predicted, only 36.1 percent are statistically significant. The variables that were statistically significant in level-level models presented in tables 5.4 and 5.5 but are not in level-log specifications include FISHING DAYS, WILDLIFE WATCHING DAYS, GENERAL FUNDS DUMMY, NARROW JURISDICTION, TAX CHECKOFF, and ESA SECTION 6 FUNDS. The variables that remain statistically significant in the level-log specifications are HUNTING DAYS, GENERAL FUNDS SHARE, INDEPENDENT AGENCY, FARM SIZE, and POPULATION.

The results shown in table B.5 suggest that the level-log model is a poor empirical specification of my model. The results also suggest, however, that a level-log relationship fits best with HUNTING DAYS, FARM SIZE, and POPULATION. In addition, the table B.5 results, when combined with the results from tables 5.5 and 5.6, suggest that GENERAL FUNDS SHARE, INDEPENDENT AGENCY, HUNTING DAYS, and FARM SIZE are the most significant determinants of agency nongame budget allocations.

Table B.5: Level-Log OLS Estimates of Nongame Budget Allocation

Dependent variable = nongame spending as a percentage of total budgets

INDEPENDENT VARIABLES	Predicted Sign	(1)	(2)	(3)	(4)
CONSTANT		0.121	0.247	0.334	0.428
		(0.152)	(0.29)	(0.42)	(0.52)
Game Demand Variables					
LOG OF HUNTING DAYS	-	-0.023	-0.027	-0.028	-0.031
		(1.38)*	(1.58)*	(1.71)**	(1.85)**
LOG OF FISHING DAYS	-	-0.022	-0.02	-0.019	-0.019
		(1.11)	(1.01)	(0.99)	(0.93)
Nongame Demand Variables					
LOG OF WILDLIFE WATCHING DAYS	+	0.018	0.020	0.010	0.012
		(0.90)	(0.92)	(0.53)	(0.59)
Agency Organization Variables					
GENERAL FUNDS SHARE	+	0.092	-------	0.087	-------
		(1.82)**		(1.68)*	
GENERAL FUNDS DUMMY	+	-------	0.009	-------	0.008
			(0.63)		(0.54)
INDEPENDENTAGENCY (=1 if independent)	-	-0.024	-0.026	-0.022	-0.025
		(1.47)*	(1.54)*	(1.32)*	(1.43)*
NARROW JURISDICTION (=1 if narrow)	-	-0.009	-0.014	-0.008	-0.013
		(0.48)	(0.73)	(0.43)	(0.62)
Contracting Cost Variables					
LOG OF FARM SIZE	+	0.016	0.015	0.014	0.013
		(1.60)*	(1.44)*	(1.37)*	(1.25)
PERCENT PUBLIC LAND	-	-0.057	-0.059	-0.048	-0.052
		(1.09)	(1.08)	(0.90)	(0.95)
Control Variables					
LOG OF INCOME	?	-0.035	-0.048	-0.067	-0.077
		(0.45)	(0.58)	(0.88)	(0.97)
ENDANGERED SPECIES	+	6.57E-04	6.20E-04	-------	-------
		(1.19)	(1.08)		
LOG OF ESA SECTION 6 FUNDS	+	-------	-------	2.34E-04	3.89E-4
				(0.25)	(0.41)
TAX CHECKOFF	?	-0.013	-0.022	-0.018	-0.026
		(0.75)	(1.24)	(0.99)	(1.46)*
LOG OF POPULATION	?	0.029	0.032	0.044	0.046
		(1.24)	(1.30)	(2.18)**	(2.18)**
Adjusted R^2		.198	.133	.168	.109
F-Statistic		1.98	1.61	1.81	1.49
Observations		49	49	49	49

Notes: Absolute values of t-statistics in parentheses. *Significant at the 10% level for a one-tailed t-test. **Significant at the 5% level for a one-tailed test. ***Significant at the 1% level for a one-tailed t-test. Results exclude California.

APPENDIX C

GENERAL FUNDS AND NISKANEN'S BUDGET IMPLICATIONS

GENERAL FUNDS AND NISKANEN'S BUDGET IMPLICATIONS

The prevalence of general funds among wildlife agencies may allow for an empirical analysis of Niskanen's model. In a Niskanen setting, generally funded agencies (mixed agencies) are distinguished from self-supporting agencies because they receive funding from a sponsor (the governor and legislature) through the appropriations process. Under some rather rigid assumptions, Niskanen's model implies that the output behavior of the mixed and self-supporting agency will differ in a predictable manner.

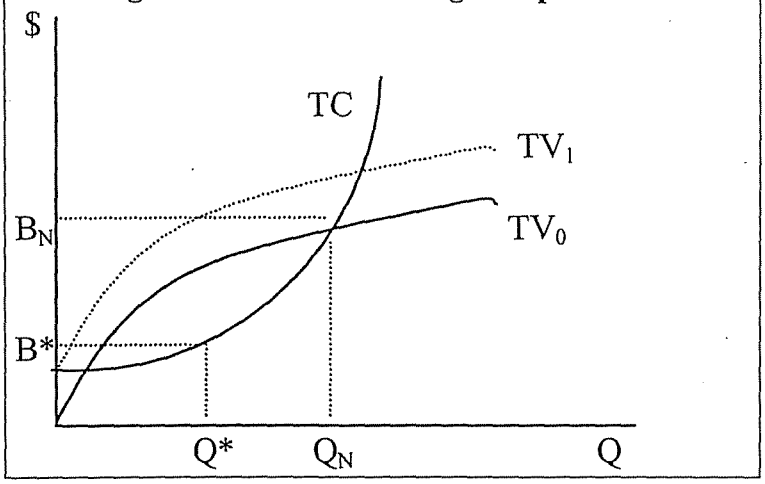
In Niskanen's analysis, a mixed bureau is one that receives money from customers as well as a sponsor organization for the same service. Examples of mixed bureaus include universities, hospitals, and in the past, the U.S. Postal Service.[50] Niskanen's mixed bureau faces a total value curve directly from users and a total value curve from the sponsor. To examine this model in a wildlife agency setting, first assume that the self-supporting agency faces only a total value curve from game users. Game users demand output such as law enforcement, restocking and population monitoring, hunter education, and access to land. Next, assume that the mixed agency faces an additional total value curve, from legislature, for the exact same kinds of output. Recall, from chapter 3, that Niskanen assumes that the agency has an information advantage (concerning its production costs) that it exploits in order to receive the largest possible grant. The agency, however, is perfectly monitored by its customers. Under this strict

[50] Niskanen does not explain why these agencies are not fully financed by user fees.

set of assumptions, what are the differences in the budget implications of a mixed and self-supporting agency?

Figure C.1 provides a graphical analysis. The curve labeled TV_0 represents a generic, aggregate total value curve faced by self-supporting and mixed wildlife agencies. Under the given set of assumptions, a self-supporting agency will produce Q* while an agency that is 100 percent funded by general funds will produce at Q_N. The budget size of the 100 percent generally funded agency is shown by B_N and the budget size of the self-supporting agency is shown by B*. Given the assumed shape of the cost curve (TC), as the percentage of funding from general funds grows, the budget size goes further away from B* and closer to B_N. The testable proposition that emerges from this discussion is that the budget size of wildlife agencies will increase positively with the proportional reliance on general funds.

Figure C.1: Niskanen Budget Implications



This proposition is not unique to Niskanen's model. There are other explanations for why budgets will grow with a greater reliance on general funds. Consider dropping the assumption that fee-paying wildlife users and the legislature demand the same output from the agency. Instead assume that the legislature demands some non-game output (e.g., bird-watching observatories and the research and population monitoring of bats, songbirds, and turtles) from the wildlife agency through its general fund appropriations. If this is the case, then an increase in general funds will increase the optimal output and the optimal size of the mixed agency. This is shown graphically in figure 3.2. Suppose that TV_0 represents customer demand for a self-supporting agency's output and that TV_1 indicates the aggregate (customer and legislature) demand for a mixed agency's output. The mixed agency will produce more total output than the self-supporting agency ($Q > Q^*$) and as a result, its budget will be also be greater ($B > B^*$). There need not be "fat" or "fluff" in the mixed agency for it to have a larger budget than the self-supporting agency. The increase in the budget of the mixed agency is simply a response to an increased demand for different output.

In summary, a testable proposition can be derived from Niskanen's model: An increase in an agency's reliance on general funds (the percentage of the total budget that comes from general funds) will increase the total size of the agency's budget. In order for this proposition to be unique to Niskanen's model, however, some rigid assumptions must hold. Most notably, mixed and self-supporting agencies must face identical aggregate demand and cost curves for identical output.