

THESIS

HUMAN DIMENSIONS OF LEAD IN THE ENVIRONMENT FROM
AMMUNITION AND FISHING TACKLE

Submitted by

Danielle Ross-Winslow

Department of Human Dimensions of Natural Resources

In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Spring 2013

Master's Committee:

Advisor: Tara Teel

Kirsten Leong

Timothy Davies

Copyright by Danielle Ross-Winslow 2013

All Rights Reserved

ABSTRACT

HUMAN DIMENSIONS OF LEAD IN THE ENVIRONMENT FROM AMMUNITION AND FISHING TACKLE

Significant attention has been directed in recent years toward examining and addressing the impacts of lead in the environment from ammunition and fishing tackle. Lead issues are relevant to those interested in protecting the health of humans, wildlife, and ecosystems, such as national and regional land management agencies, national and state agencies that manage fish and wildlife resources, national and state health and human services agencies, and non-profit conservation and environmental research organizations. The topic of lead in the environment from ammunition and fishing tackle is also highly controversial among stakeholders. Strong and conflicting public opinions about the use of lead ammunition and fishing tackle make decision-making and communication surrounding these issues particularly challenging for agencies.

This thesis presents two manuscripts that explore how human dimensions research can inform agency efforts to minimize lead impacts by providing a more adequate representation of diverse viewpoints and enhancing the ability of various entities interested in this topic to identify likely sources of controversy related to potential management activities, communicate more effectively with the public, and develop more successful management solutions.

The first paper synthesizes the relevant literature regarding the use of lead in recreational hunting and fishing with specific objectives to overview: 1) trends in lead use in the U.S. and emerging awareness of the hazards to human health and the natural environment; 2)

impacts of lead from hunting and fishing and specific measures, including regulatory and non-regulatory action, that have been introduced by agencies and organizations in the U.S. to reduce these impacts; and 3) results of recent human dimensions investigations aimed at addressing this topic.

The second paper documents a basic interpretive qualitative research study that was undertaken in the summer of 2012. The purpose of this study was to better understand the meaning people assign to issues involving the use of lead ammunition and fishing tackle. More specific objectives related to (a) how stakeholders make sense of actions that are being pursued, or could be taken, to manage human activities with a view to prevent, reduce, or mitigate negative impacts of lead use on the environment, wildlife, and/or humans; and (b) what are crucial aspects of human thought about lead issues and management actions that can contribute to an understanding of the controversy surrounding this topic. The findings were able to identify different attitudinal positions with regard to lead use; different preferences for management strategies; and that differences were associated with conflict. More importantly, the research explored elements that were key to how meaning was constructed by individuals that correlated to these different elements.

ACKNOWLEDGEMENTS

This thesis would not have been possible without the advice, suggestions, and support of many. First, I would like to thank my committee whose expertise and commitment was invaluable to this work and to my own growth as a researcher. Dr. Timothy Davies, your instruction and guidance in qualitative research methods provided me with the skills and confidence I needed to produce the bulk of this work. Dr. Kirsten Leong, thank you for your patience and guidance throughout; your contributions elevated the quality of my thesis and its applicability to natural resource management. Dr. Tara Teel, I consider it an honor to have worked with you and to have had access to your immense knowledge and experience in this field. You've been a great mentor and friend – thank you for investing in me and trusting me to undertake this project. I'd also like to thank my undergraduate advisor, Dr. Brian Eisenhauer, who introduced me to the field of Environmental Sociology and encouraged me to pursue graduate studies. It was his enthusiasm for teaching and getting students involved in research that set me on this path.

Many of my fellow graduate students and friends also provided great advice and emotional support. I'd especially like to acknowledge Andrew Don Carlos, Xrisanthi Naselaris, Monty Naselaris, Alia Dietsch, Emily Eddins, Becky Thomas, and Ashley Gramza.

Finally, I'd like to thank my family. I wouldn't be here without my parents who have always supported and encouraged me. Most of all, I want to thank my husband Chris. He was willing to leave friends and family in New England and relocate to Colorado for me to pursue this dream. Thank you so much for taking this journey with me and for your unwavering support, love, and friendship. I love you guys!

TABLE OF CONTENTS

ABSTRACT.....ii

ACKNOWLEDGEMENTS.....iv

INTRODUCTION..... 1

REFERENCES..... 3

CHAPTER ONE 5

The Quest to Eliminate Lead from Units of the National Park System: Understanding and Reaching Out to Audiences..... 5

 Introduction..... 5

 A Brief History of Lead Use and Effects on Human Health and the Environment..... 6

 NPS Efforts to Reduce the Impacts of Lead on Its Lands..... 8

 The Role of Human Dimensions in Addressing Lead in the Environment 13

 Efforts to Reduce the Impacts of Lead from Recreational Fishing 25

 Efforts to Reduce the Impacts of Lead from Recreational Hunting and Shooting Sports 38

 Overall Findings for Outreach to Reduce the Impacts of Lead from Hunting and Fishing 59

 Conclusion 65

 REFERENCES..... 67

CHAPTER TWO 85

Exploring the Meaning of Lead Use through a Basic Interpretive Qualitative Research Study ... 85

 Introduction..... 85

 Study Purpose..... 87

 Methodology 88

 Findings..... 95

 I. Broad Patterns from the Data 96

 II. Major Themes from the Data 105

 Discussion 138

 REFERENCES..... 144

CONCLUSION..... 154

APPENDIX..... 157

INTRODUCTION

Across the United States, the topic of lead released into the environment from hunting and fishing activities has increasingly attracted the attention of a wide array of audiences. By some estimates, millions of pounds of lead used in hunting, fishing, and shooting sports end up in the environment each year (Pokras & Kneeland, 2009; Rattner et al., 2008). Potential impacts to wildlife, humans, and ecosystems have prompted many entities to examine this topic in greater detail, particularly land, wildlife, and natural resource management agencies.

Management decisions regarding lead use have frequently been contested; in fact, this topic has been hotly debated and controversial among stakeholders for decades (e.g., Thomas, 2011; Wright & Tolbert, 1987). More broadly, contemporary interests in natural resource/wildlife-related issues are increasingly characterized by conflict, and by the public's expectation of being both informed about, and involved in, the process surrounding management decisions. Evidence of this situation can be found in diverging positions about appropriate management goals and strategies that have resulted in appeals and challenges through court cases, legislative proposals, and ballot initiatives (e.g., Craynon, Sarver, & Robertson, 2013; Molina, Marcot, & Leshner, 2006). Because issues are often highly complex and deeply contested, it can be particularly challenging for agencies to attend to the multitude of public interests and values at the root of the conflict that can affect the formulation and implementation of successful management solutions. These challenges have led to a realization of the need for information that can improve agency understanding of diverse stakeholder perspectives, and in response there has been growing involvement of social scientists and social

science inquiry in natural resource decision-making (e.g., Decker, Brown, & Siemer, 2001; Manfredo, Vaske, & Decker, 1995; Mascia et al., 2003; Stankey & McCool, 2004).

This thesis presents two manuscripts that explore how human dimensions research can inform the decision-making process by providing a more adequate representation of diverse viewpoints and enhancing the ability of various entities interested in this issue to identify likely sources of controversy related to potential management activities, communicate more effectively with the public, and develop more successful management solutions.

The first paper synthesizes the relevant literature regarding the use of lead in recreational hunting and fishing with specific objectives to overview: 1) trends in lead use in the U.S. and emerging awareness of the hazards to human health and the natural environment; 2) impacts of lead from hunting and fishing and specific measures, including regulatory and non-regulatory action, that have been introduced by agencies and organizations in the U.S. to reduce these impacts; and 3) results of recent human dimensions investigations aimed at addressing this topic.

The second paper documents a basic interpretive qualitative research study that was undertaken in the summer of 2012. The purpose of this study was to better understand the meaning people assign to issues involving the use of lead ammunition and fishing tackle. More specific objectives related to (a) how stakeholders make sense of actions that are being pursued, or could be taken, to manage human activities with a view to prevent, reduce, or mitigate negative impacts of lead use on the environment, wildlife, and/or humans; and (b) what are crucial aspects of human thought about lead issues and management actions that can contribute to an understanding of the controversy surrounding this topic.

REFERENCES

- Craynon, J. R., Sarver, E. A., & Robertson, D. P. (2013). Could a public ecology approach help resolve the mountaintop mining controversy? *Resources Policy*, 38(1), 44-49.
doi:10.1016/j.resourpol.2012.08.001
- Decker, D. J., Brown, T. L., & Siemer, W. F. (2001). *Human dimensions of wildlife management in North America*. Bethesda, MD: The Wildlife Society.
- Manfredo, M. J., Vaske, J. J., & Decker, D. J. (1995). Human dimensions of wildlife management: Basic concepts. In R. L. Knight & K. J. Gutzwiller (Eds.), *Wildlife and recreationists: Coexistence through management and research* (pp. 17–31). Washington, DC: Island Press.
- Mascia, M. B., Brosius, J. P., Dobson, T. A., Forbes, B. C., Horowitz, L., McKean, M. A., & Turner, N. J. (2003). Conservation and the social sciences [Editorial]. *Conservation Biology*, 17(3), 649–650.
- Molina, R., Marcot, B. G., & Leshner, R. (2006). Protecting rare, old-growth, forest-associated species under the Survey and Manage Program guidelines of the Northwest Forest Plan. *Conservation Biology*, 20(2), 306-318.
- Pokras, M. A., & Kneeland, M. R. (2009). Understanding lead uptake and effects across species lines: A conservation medicine approach. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 7–22). Boise, ID: The Peregrine Fund.
- Rattner, B. A., Franson, J. C., Sheffield, S. R., Goddard, C. I., Leonard, N. J., Stang, D., & Wingate,

P. J. (2008). *Sources and implications of lead ammunition and fishing tackle on natural resources* (Technical Review no. 08-01). Retrieved from The Wildlife Society website: <http://wildlife.org/documents/technical-reviews/docs/Lead08-1.pdf>

Stankey, G. H., & McCool, S. F. (2004). Social sciences and natural resources management: An assessment of advances. In M. J. Manfredi, J. J. Vaske, B. L. Bruyere, D. R. Field, & P. Brown, Jr. (Eds.), *Society and natural resources: A summary of knowledge* (pp. 21–34). Jefferson City, MO: Modern Litho.

Thomas, V. G. (2011). Conflicts in lead ammunition and sinker regulation: Considerations for US national parks. *The George Wright Forum*, 28(1), 24–33.

Wright, M. L., & Tolbert, G. (1987). Reform at last for the lead shot controversy. *William & Mary Environmental Law and Policy Review*, 12(3), 8–11.

CHAPTER ONE

The Quest to Eliminate Lead from Units of the National Park System: Understanding and Reaching Out to Audiences¹

Introduction

This report is intended to synthesize the relevant literature regarding issues involving the use of lead in recreational hunting and fishing activities. We begin the report with a brief overview of lead use in the US and the emerging awareness of the hazards of lead to human health and the natural environment. This overview is followed by a discussion of the National Park Service's (NPS's) efforts to reduce the impacts of lead from hunting and fishing in NPS units. We then turn to an important emphasis of this report, which is on the role of the social sciences and human dimensions information in addressing the issue of lead in the environment. Included in this section is a discussion of the need for public outreach to help raise stakeholder awareness and support for future management actions. Also included is an overview of relevant theories and frameworks from social psychology and risk communication that can be used to inform outreach activities. Later sections of the report provide additional background on the use of lead in hunting and fishing as well as specific measures, including regulatory action and voluntary mechanisms, that have been introduced by agencies and organizations in the US to reduce the lead-related impacts of these activities. We conclude with overall recommendations for future outreach initiatives and research to reduce the impacts of lead from hunting and fishing.

¹ Originally published as Ross-Winslow, D. J., & Teel, T. L. (2011). The quest to eliminate lead from units of the National Park System: Understanding and reaching out to audiences. *George Wright Forum*, 28(1), 34–77.

A Brief History of Lead Use and Effects on Human Health and the Environment

For over 2000 years the toxic effects of lead in humans and animals have been well documented (Nriagu, 1983). As far back as 1848, the famous medical observations of Tanquerel Des Plances described human lead poisoning (Pokras & Kneeland, 2009). Despite the long history of lead's adverse health effects, approximately 3,600,000 metric tons of lead are refined annually for commercial uses (Eisler, 2000). The use of lead for fishing net sinkers dates back to 3300–1200 BCE (Galili, Rosen, & Sharvit, 2002; Pulak, 1988), and lead use for ammunition emerged in the 14th century (Tunis, 1954). The production of lead ammunition and fishing tackle continues today; the US Geological Survey (USGS) estimates that roughly 10% of lead produced in, or imported to, the US is used for sporting purposes (Guberman, 2007).

Lead ammunition and fishing tackle, when used as intended, release lead into the environment. The USGS estimates that 6,000–10,000 tons of lead are released by hunters and anglers annually in the US (Guberman, 2007), but the use of lead ammunition and tackle is minimally regulated by state and federal agencies. This seems to contradict the efforts of state and federal regulatory agencies in the US that try to minimize the amount of lead released into the environment from mining, manufacturing, and the recycling of lead products by requiring permits for any sort of industrial lead release (Pokras & Kneeland, 2009).

The effects of spent lead shot and bullets on wildlife have been recognized in the US since the 1870s (Sanderson & Bellrose, 1986), and the hazards of lead fishing sinkers to waterbirds were recognized in the 1970s when swans were poisoned in the UK (Sears, 1988). The documentation of lead's toxic effects on wildlife has accumulated; over 500 peer-reviewed articles have examined the impacts of lead ammunition on wildlife (Petterson, 2009). Recent

studies have illustrated that lead ammunition fragments on impact much more than previously believed, dispersing small lead particles throughout the tissues of game animals (Grund, Cornicelli, Carlson, & Butler, 2010; Pain et al., 2010). Fragmentation varies widely by ammunition type; Grund et al. (2010) found that rapid-expansion bullets fragment to a higher degree than controlled-expansion bullets, for example. Fragments in the tissues of animals harvested with lead bullets or lead shotgun pellets are a serious source of lead exposure to scavenging animals that consume the meat with lead fragments; an estimated 134 species, including reptiles, birds, and mammals, have been poisoned by ingesting lead from spent ammunition and fishing tackle in the environment (Pettersen, 2009), and similar pathways exist for humans.

The ingestion of lead can lead to a range of molecular and behavioral effects as well as mortality and population-level consequences in some species (Rattner et al., 2008). Some of the noted adverse effects on human health are headaches, fatigue, myalgia, arthralgia, abdominal discomfort, renal system dysfunction, anemia, impaired fetal development, and brain dysfunction (Kosnett, 2009; Nordic Council of Ministers, 2003). Recent studies have also tied elevated bone or blood lead levels (BLLs) to increased aggression, delinquent behavior, and attention-deficit hyperactivity disorder (Braun, Kahn, Froehlich, Auinger, & Lanphear, 2006; Needleman, 2004). Many of the effects occur at moderate-to-low levels of exposure, and a statement from the Centers for Disease Control and Prevention (CDC) in 2005 stated that there is no threshold BLL value for which there is no effect. Due to the nonspecific nature of many of the symptoms, especially low-level exposure effects, the causes are often attributed to other relatively common acute and chronic diseases (Kosnett, 2009). This may be one of the reasons

that lead is still being used; even though empirical evidence suggests that lead ingestion does occur, the health risks are not overt enough to prove causation.

A lack of overt causation is one of many factors that have contributed to the protracted use of lead for ammunition and fishing tackle. The potential hazardous effects of lead on humans, ecosystems, and fauna have led to greater societal pressure and concerted efforts to reduce the amount of lead introduced into the environment by human activities (Goddard et al., 2008), but strong opposition from sportsmen and industries has limited the success of such actions. To further mitigate the impacts of lead from spent ammunition and fishing tackle in the environment, the arguments, attitudes, and beliefs of all stakeholders need to be understood.

NPS Efforts to Reduce the Impacts of Lead on Its Lands

The NPS has stepped up efforts to reduce lead in national park environments, starting with the recent policies to eliminate lead from internal NPS activities for the protection of human health, wildlife health, and ecosystem health. Lead reduction efforts began in 2001 when the Environmental Protection Agency (EPA), per Executive Order No. 13,148 (2000), lowered the threshold for lead releases into the environment from 1,000 to 100 pounds per calendar year. Parks with outdoor firing ranges were required to meet the new requirements for lead, and parks releasing at or over the 100-pound threshold were required to submit a toxic release inventory (TRI) to the EPA. In 2003, to lessen the NPS's reporting burden, comply with the Executive Order, and mitigate further lead contamination of the environment, NPS began phasing out the use of leaded ammunition for firearms qualifications and shooting practice. In 2007, Executive Order No. 13,423 (2007) required federal agencies to reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed. NPS then

mandated that a complete transition to non-lead ammunition for law enforcement qualification and training be achieved by October 1, 2008. The NPS transitioned to non-lead ammunition in culling operations and the dispatching of wounded and sick animals in 2009. These actions have advanced the NPS goal of being a leader in the use of least toxic products and services, for the protection of park employees, visitors, and the lands under NPS management.

Future efforts to further reduce lead contamination of the environment include exploring the prospect of reducing the effects from lead in public hunting and fishing activities in NPS units. Recreational hunting is generally prohibited in NPS units except in park areas where it is specifically mandated by federal law, and it may be allowed in park areas where it is specifically authorized as a discretionary activity under federal law; units with discretionary authorization must determine that hunting is consistent with public safety and enjoyment and sound resource management principles and must adopt special regulations to implement that authority (Code of Federal Regulations, Title 36, Pt. 2.2b, 2010). NPS currently manages 62 units that meet these criteria. Hunting is mandated or authorized and implemented on a discretionary basis under federal law in 61 of these units (Figure 1.1). Except in designated areas, or as outlined in the Code of Federal Regulations (Title 36, Pt. 2.3, 2010), fishing is allowed in park areas in accordance with the laws and regulations of the state in which the park is located. While the NPS is interested in all landscapes, it is first looking at its own footprint from lead use in parks and exploring ways to lessen that footprint as well as the impacts of park visitors who pursue hunting and fishing in units where these activities are allowed.

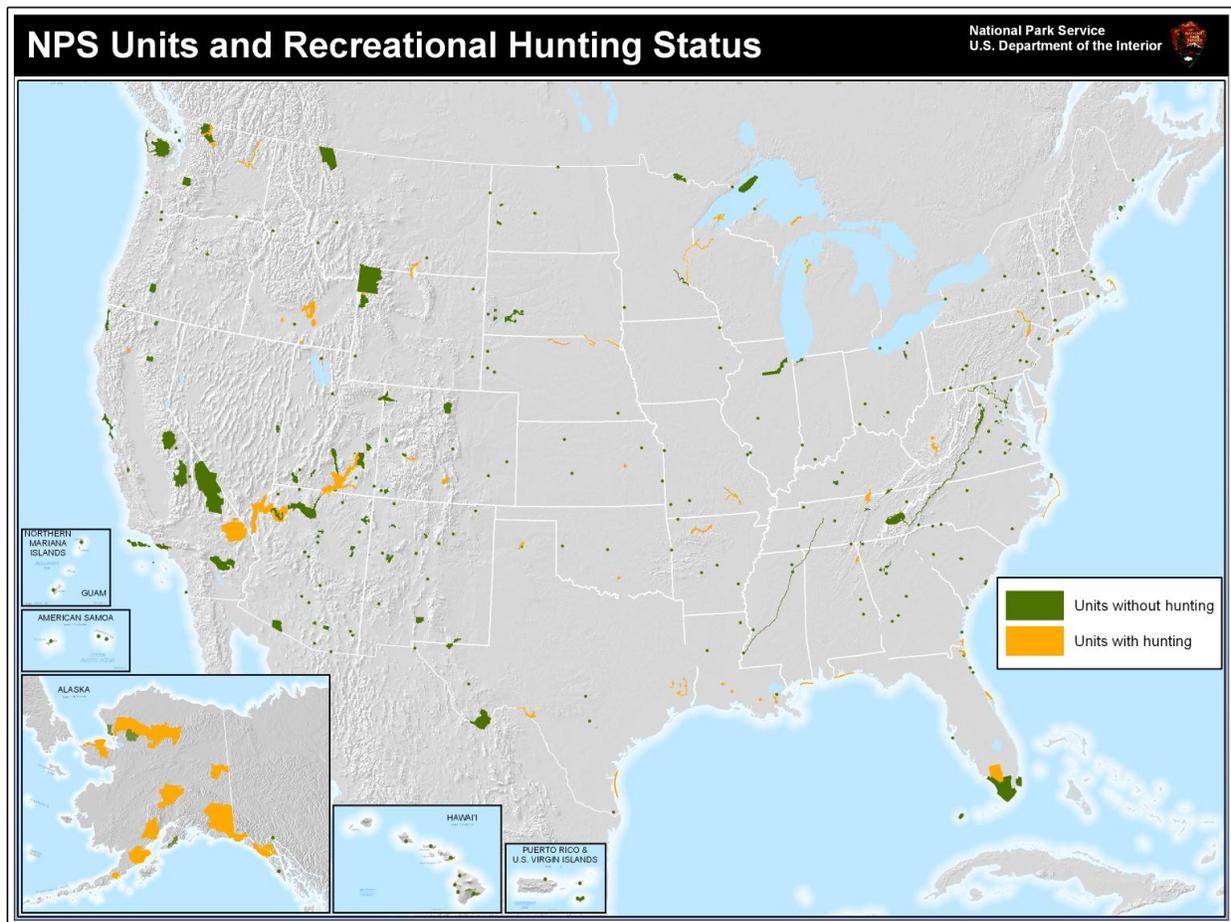


Figure 1.1. NPS units and recreational hunting status. “Units with hunting” include units where hunting is (1) mandated or (2) authorized and implemented on a discretionary basis, under federal law.

In March 2009, a NPS news release announced the goals of eliminating lead from NPS activities. It stated the intentions of the NPS to eventually remove all lead from NPS lands. Acting Director Dan Wenk was quoted as saying, “Our goal is to eliminate the use of lead ammunition and lead fishing tackle in parks by the end of 2010” (National Park Service, 2009a). To some, this was an indication that the use of lead ammunition and fishing tackle by visitors in park units was in jeopardy. Reactions from stakeholders that followed indicated that this issue was highly visible and controversial. Several organizations were quick to offer comments and criticism. For example, the American Sportfishing Association (ASA), which

opposes bans on lead fishing tackle, stated that if the NPS pursued such a ban, they would seek an appropriate rule-making process (American Sportfishing Association, 2009). The National Rifle Association (NRA) also announced its intent to oppose NPS actions to eliminate lead ammunition, calling these actions unnecessary (National Rifle Association–Institute for Legislative Action, 2009). The response from the National Shooting Sports Foundation (NSSF) was similar (Personal Liberty Digest, 2009). Thirteen Republican US senators also spoke out against a possible NPS ban on lead ammunition, claiming that the ban would have negative impacts on hunters, the economy, and wildlife populations (PLD, 2009).

While there was a strong response by opponents to the potential for future NPS action on this issue, there were also many proponents who demonstrated their support for requiring non-lead-based ammunition and fishing tackle. Public Employees for Environmental Responsibility (PEER) organized a group letter to Interior Secretary Ken Salazar urging him to support an NPS lead ban. In the letter, the groups stated, “We applaud the leadership demonstrated by this effort,” and “We strongly support this effort to achieve a lead-free national park system by the end of 2010” (Public Employees for Environmental Responsibility, 2009). Signatories included the Coalition of NPS Retirees, the Humane Society of the United States, Wildlife Stewards, the Arizona Zoological Society, Desert Protective Council, Wilderness Watch, and Delaware Audubon. The groups cite the poisoning of wildlife and the potential for dissolved lead to contaminate groundwater as key reasons for their support.

Responses from all perspectives prompted the NPS to release a clarification statement days after the original news release; it stated that nothing had changed for the public and that the future potential for transitioning to non-lead for recreational use would enlist public

involvement, comment, and review (NPS, 2009b). The agency stated that its decision-making on this high-profile issue would be guided by a combination of the best available science, accurate fidelity to the law, and commitment to diverse public interests, along with significant public involvement, comment, and review. Further, the agency stated that it would address immediate controversies and long-term challenges, and ultimately improve its ability to preserve the integrity of park ecosystems. The NPS would review and consider all possible mechanisms for reducing the impacts of lead from hunting and fishing in park units. For example, conversion to the use of non-lead ammunition and fishing tackle would eliminate lead pathways to humans, wildlife, and the environment from hunting and fishing. Regulatory action is one way of attempting to achieve such a conversion, but issues of compliance and enforcement may affect the success of this type of action. Non-regulatory mechanisms, including provision of incentives and public outreach to raise awareness and motivate voluntary change, are also options to explore. It is important to note that these action categories (i.e., regulatory vs. non-regulatory) are not necessarily mutually exclusive; the most effective and realistic approach may involve a combination of techniques.

Most prior efforts to mitigate lead contamination from hunting and fishing focused on the switch to non-lead alternatives, but for hunting at least, there may be other strategies to consider. For example, in some areas, removal of visceral remains (or offal piles) of animals harvested with lead has been suggested. To illustrate, a proposed regulation by the US Fish and Wildlife Service (USFWS) for Turnbull National Wildlife Refuge reads, “Hunters must use nontoxic ammunition or remove or bury the visceral remains of harvested animals” (National Wildlife Refuge System, 2010). While offal piles can provide wildlife with an excellent source of

nourishment, they can also have adverse impacts when lead ammunition is used. High concentrations of lead can be found in these remains given that hunters typically aim for vital organs to ensure a humane and rapid takedown. Removal of the remains would eliminate this source of lead for wildlife, but there is some question as to whether simply burying the remains is effective (Sullivan, 2009). Suggesting that remains be buried also may not be an option in some NPS units where digging is prohibited due to the presence of sensitive resources, such as soils and historical or archeological resources. This strategy also does not address game that is wounded but not recovered by hunters, which would still be a likely source of lead ingestion for wildlife.

In selecting among these and other alternatives for reducing lead in NPS units, an important consideration is the extent to which measures will be supported by different stakeholder groups and the effectiveness of these measures in producing desired changes. In recognition of this, we now turn to a discussion of the role of human dimensions in informing future NPS decisions and public outreach on the lead contamination issue.

The Role of Human Dimensions in Addressing Lead in the Environment

Management decisions regarding lead ammunition and fishing tackle have the potential to be highly controversial, with stakeholders with different perspectives becoming highly involved. As discussed in greater detail later on in this report, a nationwide ban on the use of lead shot for waterfowl hunting in 1991 was implemented without much regard for hunters' attitudes toward the regulation (Association of Fish and Wildlife Agencies, 2007); it was subsequently met with much resistance and animosity, thereby diminishing its effectiveness (Pokras & Kneeland, 2008). From past experiences like this, natural resource agencies have

come to understand that stakeholders want to be included in the decision-making process; that they need to understand human behavior and its impacts upon natural resources; and that successful solutions to conservation and management problems will depend upon effective communication with and acceptance from the public. None of the NPS's current efforts to reduce impacts from lead ammunition and fishing tackle include human dimensions research, but the need for such research to inform NPS response to this issue has been recognized. Future decisions regarding these issues should begin with an understanding of factors at the root of human behavior and stakeholders' preferences for management. These social considerations are crucial to successfully address impacts of lead in NPS environments.

The need for public outreach. Human behavior is the root cause of lead in the environment from spent ammunition and fishing tackle; it is only by affecting human behavior that these pathways can be modified or eliminated. Public outreach includes a broad spectrum of activities, ranging from education and information provision to persuasive communication strategies, and can play an important role by serving as a mechanism to promote behavior change and build support for management actions. Outreach efforts often are among the preferred mitigation strategies to address undesirable behaviors and promote alternative forms of human action (Jacobson, 2009). At times, outreach may be preferred over regulatory measures for altering behavior because it can provide an enduring solution that transcends many contexts; it retains one's freedom of choice and is typically less intrusive; and it is thought to be less expensive than other alternatives. For example, we may hypothesize that some hunters and anglers use non-lead products only in areas where there are regulations, but through effective communication these individuals might resolve to use non-lead products

outside of regulated areas as well. Public outreach can also be viewed as a necessary complement to regulatory solutions. In situations where regulations may be the preferred management option, they contribute to mitigation only when individuals comply with them or when they can be stringently enforced. In these situations, outreach may be used to help raise awareness of the need for regulatory action and thereby contribute to greater levels of support and compliance.

In addition to the reasons stated above, public outreach can often attenuate contentious debates over scientific evidence that are commonplace with issues involving environmental impacts and their mitigation. Health and environmental policies are always based on scientific evidence, up to a point (Wilson & Anderson, 1997). While this is necessary and valuable for many reasons, Wilson and Anderson (1997) argue that defining that point can become particularly problematic and controversial for certain issues. They go on to articulate specific concerns in this matter. Scientific uncertainty and disagreement among scientists create the greatest challenges for applying science to policy. Policymakers, who often hear from different scientists who have drawn disparate conclusions, most often agree with evidence that is in line with their previously held views. Also, scientific uncertainty is frequently cited as a reason to hold off on decision-making, but waiting for science to be definitive, if that is achievable, may not be possible for matters of public health. Uncertainty can be introduced easily and there is no guiding principle for the amount of scientific evidence necessary to inform a particular course of action. The precautionary principle has emerged as a counter-argument to the belief that a lack of proof should suspend action. Sometimes described as “better safe than sorry,” the precautionary principle has been defined as “a general rule of public policy

action to be used in situations of potentially serious or irreversible threats to health or the environment, where there is a need to act to reduce potential hazards *before* there is strong proof of harm” (Harremoës et al., 2002, p. 4). Despite being frequently cited and discussed, there is no set criterion with which to apply the precautionary principle to decision-making and policy. With regard to the use of lead products in hunting and fishing, the perceived lack of scientific certainty has called into question the justification for policy decisions (e.g., regulatory bans) in many cases. Justification has become very subjective, as it often does when threats and causation are not visible, direct, immediately detectable, ignored, or the issue is political. Due to such concerns and the overall nature of environmental policy decisions in the US, public outreach (and more specifically, communication aimed at promoting voluntary behavior change) may prove to be the most promising alternative for effectively reducing the impacts of lead from hunting and fishing activities on a large scale.

Practitioners often embark upon communication initiatives rather naively, assuming that simply by making information available, desired behavior changes will follow. In reality, effective communication is notoriously difficult to develop. Various factors confound our ability to persuade someone with informational messages (Wood, 2000). The extent of attitude and behavior change may depend upon source factors, recipient factors, and message factors (Eagly & Chaiken, 1993; Petty & Cacioppo, 1996; Wood, 2000). Some important source factors to consider are how credible a source is to recipients and the perceived intent of the source. Pertinent characteristics of recipients include their prior knowledge and the strength and function of existing attitudes. Message factors that are important to consider may seem apparent, but many entities embark upon persuasive communication campaigns without asking

these key questions: (1) Are messages relevant to the issue and to the audience? (2) How strong are the arguments being presented? (3) Are messages comprehensible to recipients? (4) What is an appropriate number of arguments to be persuasive, but not overwhelm and dilute key points? (5) Should messages be personal or non-personal in nature? (6) Are messages one-sided or do they provide both sides to an argument? (7) What is the channel of communication (e.g. radio, television, brochures, events) that will be most effective for conveying the message to the target audience? These factors are likely to be highly salient for communicating about lead issues; lessons learned by practitioners, discussed later in this report, give credence to their importance to the development of effective communication with hunters, anglers, and other stakeholders.

While research has been unable to identify simple and broadly generalizable conclusions about persuasion, important conceptual advancements in relation to these and other factors have been made recently that can help guide communication programs (Crano & Prislin, 2006). Adding to this body of literature, Schweizer, Thompson, Teel, and Bruyere (2009) recently identified “10 key principles” for effective communication that provides practical guidance to natural resource agencies (Table 1.1). Although the focus was on informing strategies for communicating about climate change, the authors acknowledged that many of these principles apply to communication in any situation. This would be particularly important for this issue because, like climate change, communication about lead issues often spark highly adversarial and divisive debates.

Table 1.1. Ten key principles for effective communication (adapted from Schweizer et al., 2009).

-
1. Know your audience and select a credible messenger for that audience.
 2. Know what type of claim or argument you are asserting and why it is appropriate for your audience. Lead with your strongest argument or your most confident point.
 3. Connect your message to cultural values and beliefs; people react to traditions, experiences, and shared values – not abstract concepts and scientific data.
 4. Make the message meaningful; appeal to values that are meaningful for your audience.
 5. Make the message empowering; tell your audience what specific actions they can take to make a difference.
 6. Encourage your audience to engage in systems thinking and help them to understand dynamic interrelationships and interconnections.
 7. Partner with other organizations, key players, leaders, employees, entertainers, and neighbors.
 8. Start from the inside – get your organization’s top leaders involved, inspire action internally first, then communicate about it.
 9. Communicate about actions and remember that actions and events are an effective mode of communication.
 10. Situate the issue in a specific location or place.
-

Additional lessons learned from social psychology. Theories from social psychology can be useful in understanding the factors that form the basis for human behavior and in facilitating more targeted communication initiatives that are able to account for those factors (Teel, 2008). Two theories which have been widely-applied in a natural resources context are the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB; Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; for example applications, see Bright, Manfreda, Fishbein, & Bath, 1993; Manfreda, Fishbein, Haas, & Watson, 1990). According to TRA, individual behavior stems from one’s behavioral intentions, which are in turn a function of specific attitudes and norms. In many cases, hunters and anglers may have well-established social and personal norms for the use of lead-based ammunition and tackle; they may have grown up using lead products and close others (i.e., friends and family) may also use lead-based products. TPB, introduced later, also accounts for the role of perceived behavioral control, recognizing that some behaviors require certain resources and skills to enable individual action. Two possibly applicable

considerations for communication with hunters are that: (1) they may not know if or where they can acquire non-lead ammunition, and (2) they may believe that the performance of non-lead bullets is inferior. Strategies that focus on minimizing perceived barriers to individual action might yield better results than the mere provision of scientific information.

Another important theoretical framework that builds upon these attitude-behavior models is the cognitive hierarchy, which specifies relationships among attitudes and more general and more enduring cognitions such as values and value orientations (Manfredo, Teel, & Henry, 2009). Attitudes are a key concept in each of these models and have been a major focus of human dimensions investigations because they are useful in predicting behaviors and can offer a parsimonious way of describing a group's thoughts on an issue (Manfredo, 2008; Manfredo, Teel, Bright, 2004). Attitudes are defined as the evaluation of an object (e.g., an issue, entity, or behavior) with some degree of favor or disfavor (Eagly & Chaiken, 1993). Individuals have thousands of attitudes in memory that are held with varying levels of strength and certainty. The extent to which attitudes guide behavior and are resistant to change is based in part on how strongly they are held by an individual (Petty & Krosnick, 1995). A number of strength-related attributes of attitudes have been identified in the literature. These include, for example, degree of involvement with the issue or attitude object, level of emotion experienced in relation to the issue/object, and prior knowledge about the issue/object (Table 1.2).

The functions and characteristics of attitudes, especially their strength, make mere provision of information about a natural resource issue an oftentimes ineffective strategy if the goal is attitude (and ultimately, behavior) change. One approach to improving communication

Table 1.2. A sample of attitude strength-related attributes.

Attribute	Definition	Example
Involvement	- Outcome-relevant involvement (the decision affects me personally)	- A ban on lead ammunition will affect my success as a hunter.
	- Value-relevant involvement (the issue is important to me because of my basic values)	- A ban on lead fishing tackle will protect wildlife from lead poisoning.
Emotion	- Affective response (the issue make me angry, sad, happy, etc.)	- The thought of a lead ban makes me very angry.
		- The thought of lead poisoning in condors makes me very sad.
Knowledge	- Objective knowledge (factual information)	- I know a lot about the issue.
	- Subjective knowledge (what I believe to be true about the issue)	- My beliefs may not all be factual, but they are many.

effectiveness is the belief-targeted approach, which builds upon attitude-behavior models such as TRA (Fishbein & Manfredo, 1992; Bright et al., 1993). According to this approach, the content of messages should be designed to target beliefs that form the basis for attitudes. Here it is important to know which beliefs are accessible and salient to the audience; that is, which beliefs come to mind readily when thinking about the issue (Stutman & Newell, 1984). For example, an angler may have a negative attitude toward using non-lead sinkers. His/her attitude may be based on the belief that the monetary costs of using non-lead alternatives is too high, and/or that non-lead sinkers do not perform as well as lead ones. In this example, simply providing information about the scientific justification for transitioning to non-lead products is likely not enough to affect change. Instead (or in addition), it would be important to consider the angler's pre-existing beliefs in terms of what gets emphasized in the persuasive messaging. In the belief-targeted approach, the structure of the persuasive message consists of an argument followed by evidence. Ideally, the message recipient accepts the supportive evidence, which in turn leads to acceptance of the arguments, and ultimately a change in

beliefs and corresponding attitudes. This approach often yields better results than providing information alone; however it is not a guaranteed success, as many other factors can intervene and influence communication effectiveness.

Another lesson learned from social psychology is that the level of attitude change can depend on the extent to which individuals elaborate on, or think about, the information in a message (Petty & Cacioppo, 1986). Dual-process models, including the Elaboration Likelihood Model (ELM) and Heuristic-Systematic Model (HSM), detail the factors that make recipients more or less prone to do this (Giner-Sorolla & Chaiken, 1997; Na, 1999; Petty & Cacioppo, 1986). According to these models, effortful processing can result in more lasting attitude change, but it demands understanding and elaboration of message content by the recipient. This type of processing can be facilitated by ensuring that recipients have both the motivation and ability to engage in thoughtful evaluation of information contained in the message. Tactics along these lines might include limiting distractions and making messages more personally relevant and understandable to members of the target audience. Alternatively, a less-demanding route to persuasion that does not depend on careful scrutiny of message content relies instead on heuristics, or simple decision rules. In this case, recipients may evaluate messages rapidly based on prior experience or intuitive judgments; source credibility can also serve as a heuristic. The use of celebrities in advertising and the use of simple slogans or visual images that appeal to recipients' basic values are examples of approaches that rely on heuristic cues for persuasion. Eagly and Kulesa (1997) discussed the relevance of these approaches for communicating about environmental issues, which indicate they would also be relevant to communicating about lead. Specifically, they used the northern spotted owl controversy in the

western US as an illustration and described how stakeholders on both sides of this issue were effective in garnering support for their positions through persuasive techniques. The timber industry promoted an “owls versus people” slogan that portrayed the controversy as “a simple case of jobs for people versus habitat for one seemingly less important species” (Eagly & Kulesa, 1997, p. 133). Environmentalist groups responded by releasing photographs to the media of devastation in the form of large expanses of clear-cut forests to convey the importance of environmental protection. Both groups were successful in framing the issue around human values and appealing to those values through simple heuristic-based approaches.

As Eagly and Kulesa (1997) argued, persuasive communication methods often involve cognitive-based appeals that, in order to be effective, presume recipients process information with care. However, the reality is that recipients may lack the motivation and/or ability to do so. As stated previously, various factors related to the source, message, recipient, and context can influence communication effectiveness and, more specifically, the extent to which people elaborate on message content. A phenomenon known as “biased processing” sheds additional light on this topic of factors contributing to the complexity of attitude change. Biased processing occurs when an individual critically evaluates incoming information subjectively and in such a way as to confirm and protect existing attitudes and beliefs (Wood, Rhodes, & Biek, 1995). In other words, information that is consistent with an individual’s prior attitudes and beliefs is accepted, while information that is contradictory is discounted as erroneous. The end result is minimal, if any, attitude change following exposure to the new information. In a study of biased processing of information related to drilling for oil in the Arctic National Wildlife

Refuge, Teel, Bright, Manfreda, and Brooks (2006) found that recipients were not persuaded by arguments that contradicted their initial attitudes toward the issue, even though they were told the arguments were from credible sources. Further, they rated arguments in line with their pre-existing attitudes more favorably. Evidence of biased processing serves as another example of why communicators can't assume that provision of factual information about an issue, especially a controversial one, is enough to produce desired attitude or behavior change. This is not to say that informational messages should be abandoned, but rather they should account for the characteristics of the target audience, including audience members' attitudes, beliefs, and values as well as their ability/motivation to process information.

Another consideration worth mentioning in the context of attitude/behavior change is the influence of norms on attitudes and behaviors. Norms have been conceptualized in the literature in a variety of ways, but here we refer to them as a person's beliefs about what is proper or improper behavior for individuals in a given context (Donnelly, Vaske, Whittaker, & Shelby, 2000; Manfreda, 2008). Norms are associated with social groups and social roles and can be a powerful influence on behavior. Therefore, an understanding of norms can enhance our ability to predict certain behaviors, particularly those more likely to be socially influenced. In thinking about issues related to lead ammunition and fishing tackle, two of the primary stakeholders are hunters and anglers. Generally, hunters and anglers identify strongly with other hunters and anglers. This may be informally with friends and family members who also participate in the activities, or more formally through affiliation with hunting and fishing organizations. In either case, hunters and anglers who identify themselves as part of a social group defined by these activities may consider whether others in the group would approve or

disapprove of their behavior. They may also be guided by descriptive norms, i.e. what other people do will influence their actions.

Risk communication. Risk perception and risk communication are other areas of study that have particular relevance to lead issues. The use of lead products in hunting and fishing can pose health risks to humans, wildlife, and the environment. Risk has been defined as the possibility that actions or events will cause harm to humans or to things human beings value (Hohenemser, Kates, & Slovic, 1983; Kates & Kasperson, 1983; Klinke & Renn, 2002). Risk assessments are used to quantify risks by way of technological analyses that evaluate the possibility and/or severity of hazards, but risk perceptions often do not coincide with actual risk potential (Wilson & Arvai, 2006a, 2006b). Risk perceptions, defined as intuitive judgments of risk (Slovic, 1987), can be a function of personality traits (e.g., Flynn, Slovic, & Mertz, 1994), group membership (e.g., Burt, 1987; Lee, 1998; Scherer & Cho, 2003), and cultural influences (e.g., Slovic & Peters, 1998).

Risk communication involves a purposeful exchange of information about risk between interested parties, often with the goal of providing the public with the necessary information to make informed judgments about risk (Morgan, Fischhoff, & Bostrom, 1992). In designing effective risk communication messages it is important to understand the nature of individuals' beliefs, including their current perceptions of risk, that relate to the behaviors of interest; these perceptions influence attitudes and behavior (Knuth, Stout, Siemer, Decker, & Stedman, 1992). Risk perceptions can also bear upon levels of support for management actions and receptivity to educational messages.

Efforts to Reduce the Impacts of Lead from Recreational Fishing

Lead fishing lures, sinkers, lead core fishing line, downrigger cannonballs, and weights used on fishing traps and nets are introduced into aquatic ecosystems by commercial and recreational anglers through accidental or intentional breakage (Goddard et al., 2008). There is a range of potential consequences from lead introduced through fishing activities, but the extent of hazards is not fully known. Lost lead fishing tackle is thought to be relatively stable, with the potential to remain intact for decades to centuries (Sporting Arms and Ammunition Manufacturers' Institute, 1996). Very few studies have examined the dissolution of lead from fishing tackle, and these have been inconclusive. More research is needed to determine the dissolution of all types of lead fishing tackle at varying densities and water chemistry conditions (Goddard et al., 2008).

A larger body of research has examined the impacts of lost lead on fauna with somewhat more conclusive evidence. No studies have been able to link lead exposure from ingested fishing tackle to fish mortality, and there is no evidence to suggest that ingestion of lead tackle by amphibians or reptiles is a widespread problem (Goddard et al., 2008). Turtles are one exception; published and unpublished literature has documented snapping turtles (*Chelydra serpentina*) suffering from lead poisoning caused by ingesting lead fishing weights (Borkowski, 1997).

Lead fishing tackle has had the greatest impact on bird species that ingest fishing tackle lost or abandoned along banks or in water bodies (Goddard et al., 2008). Birds that normally ingest small pebbles to break down food in their gizzards may mistakenly ingest fishing tackle. They typically ingest lead fishing weights that are less than 57 grams (2 ounces); for this reason,

most harm to waterbirds involves smaller lead weights used by recreational anglers (Scheuhammer & Norris, 1995). Once ingested, lead can poison the birds and eventually kill them.

In the 1970s, lead poisoning of birds from ingesting fishing weights emerged as a significant issue in the UK due to the decline of mute swan (*Cygnus olor*) populations (Sears, 1988). This resulted in the banning of lead fishing sinkers weighing less than 1 ounce in the UK in 1986 (Pattee & Pain, 2003). In 1991, studies confirmed that fewer mute swans were poisoned by lead following the ban (Sears & Hunt, 1991). Swans in the Thames River Valley also showed significant declines in BLLs after the ban, but 60% of swans sampled still had elevated BLLs (Perrins, Cousquer, & Waine, 2003).

The hazards of lead fishing tackle to common loons (*Gavia immer*) were reported in North America in the early 1990s (Franson & Ciplef, 1992; Pokras & Chafel, 1992; Stone & Okoniewski, 2001). Since that time, many studies have attempted to quantify the impacts of lead fishing tackle on common loons. In areas where there are both loon populations, and recreational fishing, lead poisoning from swallowing lead sinkers has accounted for 10–50% of recorded loon mortality (US Fish and Wildlife Service, 1999). In New England, over 50% of adult breeding loon mortalities were caused by ingesting lead sinkers and jigs. Similar evidence reported in Michigan, Minnesota, Ontario, and on Lake Erie in New York has shown that 40%, 17%, 27%, and 30%, respectively, of dead adult loons were likely poisoned by lead (USFWS, 1999). Loons are not the only bird species in the US to be affected by lost lead fishing tackle; more than 30 species in at least ten states have reportedly suffered mortality as a result of lead fishing tackle ingestion (Nadis, 2001). These species include swans, pelicans, geese, ducks,

cranes, herons, and eagles. However, while the problem affects many bird species, loons are the most heavily impacted, followed by brown pelicans (*Pelecanus occidentalis*; Franson & Smith, 1999).

Notable regulatory and voluntary actions in the US. For reasons cited above, loons have been at the center of regulations and outreach efforts regarding the use of lead fishing tackle in the US. Some US federal agencies have banned the use of lead tackle on lands with loon and swan populations, such as NPS units and national wildlife refuges (Table 1.3).

Table 1.3. NPS Units and national wildlife refuges (NWRs) with regulations on the use of lead fishing tackle.

Unit	State(s)	Regulation
Yellowstone NP	ID, MT, WY	Leaded fishing tackle such as leaded split-shot sinkers, weighted jigs, and shot lead-weighted ribbon for nymph fishing are not allowed.
Glacier NP	MT	The use of all lead associated with fishing is prohibited within the park. This includes weights, lures, jigs, line, etc. The only exception is a fisherman who is using a downrigger; cannon ball weights of 2 to 10 pounds may be used on the down-rigger cable.
Bear Lake NWR	ID	Use and possession of lead weights or sinkers is prohibited.
Union Slough NWR	IA	Use and possession of lead terminal tackle is prohibited.
Rachel Carson NWR	ME	Lead jigs and sinkers are prohibited.
Assabet River NWR	MA	Lead sinkers are prohibited.
Seney NWR	MI	Use or possession of fishing weights or lures containing lead is prohibited.
Red Rock Lakes NWR	MT	Use and possession of lead sinkers or any lead fishing product while fishing are prohibited.
Rappahannock River Valley NWR	VA	Use of lead sinkers is prohibited.

In addition, the five states with regulations in place all cite the common loon as their primary purpose for a ban, while also recognizing benefits for other waterbirds (Table 1.4). The prohibition on the use of lead sinkers in Massachusetts, for example, applies to the Quabbin and Wachusett Reservoirs, the two bodies of water that support the bulk of the state’s loon populations. In the four other states, the regulations are statewide. The ban in Massachusetts

Table 1.4. US states with restrictions on the use of lead fishing tackle.

State	Year	Sportfishing Regulation
Maine	2002	A person may not sell or offer for sale a lead sinker for fishing that contains any lead and weights 0.5 ounce or less.
Massachusetts	2001	The use of lead sinkers is banned at two reservoirs (Quabbin and Wachusett).
	2012	Lead fishing sinkers and jigs less than 1 ounce will be prohibited in all inland waters of the Commonwealth effective January 1, 2012.
New Hampshire	2000	The use of lead sinkers and jigs in all fresh water in New Hampshire, including lakes, ponds, rivers and streams is prohibited. The ban prohibits the sale and use of lead sinkers weighing 1 ounce or less and lead jigs less than 1 inch long along their longest axis.
New York	2004	The sale of lead fishing sinkers weighing 0.5 ounce or less is prohibited.
Vermont	2003	A person shall not use a lead sinker in the state of Vermont which weighs 0.5 ounce or less. It is unlawful to sell or offer for sale a lead sinker in the state of Vermont.

of one ounce or less, and according to New Hampshire Fish and Game personnel, enforcement has been done by performing random checks on anglers (Michael, 2006). Violators are subject to a maximum fine of \$250, but unless violators blatantly disregard the rules, they are educated about the ban and the reasons behind it rather than being fined (Michael, 2006). Little information about angler compliance with the use of non-lead fishing weights is available in New Hampshire or the other areas where regulations exist. Officials in Maine, New Hampshire, Vermont, and New York have stated that regulations are too recent for compliance data to be obtained (Rattner et al., 2008). However, one study in New Hampshire has suggested that common loon mortalities due to lead toxicosis saw a 39% reduction after the ban (Vogel, 2005).

In all five states where regulations have been enacted, targeted outreach has occurred prior to and following implementation. Four states (an online search turned up nothing from Maine) produced an informational brochure; displayed in all of the brochures is a picture of a loon along with the slogan “Get the Lead Out.” This slogan has been used in many lead awareness campaigns, most notably to bring attention to the dangers of lead paint in residential buildings. Other common features of the brochures include information about the

state's regulations; other states that have regulations; how lead fishing tackle impacts wildlife, with a focus on loons; what alternatives to lead are available; how to dispose of old lead sinkers; and ways that anglers can help prevent lead poisoning of bird species. Brochures, and a variety of other educational materials such as posters, have been distributed and exhibited through various means. For example, the Boy Scouts of America (BSA) from Massachusetts handed out materials, brochures, and sample fishing weights at local, national, and international sportsmen's events (Browne, 2009). In 2001, a program sponsored by the National Wildlife Federation (NWF) in New England placed educational displays at dozens of state parks, tackle shops, and fishing events throughout the region (Nadis, 2001). The Vermont Fish and Wildlife Department (VTFWD) included a full-page description of the lead issue and specifics of the state law in the *Vermont Digest of Hunting, Fishing, and Trapping Laws* and in its *2005 Angler's Pocket Guide* (Michael, 2006).

Lead tackle exchange programs have also been implemented in these states. These programs encourage anglers to turn in lead fishing tackle to the sponsoring agency or organization to be safely disposed of, and in return anglers receive non-lead tackle. Lead exchanges often take place in conjunction with fishing events, such as fishing derbies. In Massachusetts, the lead tackle exchange program began as an Eagle Scout project with the BSA, which has collected over 65 pounds of lead through the effort (Browne, 2009). Between 1999 and 2000, a campaign in Vermont and New Hampshire gathered more than 40,000 lead sinkers at fishing stores and state parks (Nadis, 2001). The VTFWD has also distributed free samples of non-lead sinkers at its district offices, select state parks, fishing clinics and educational events, and at all of the state fish hatcheries (Vermont Fish and Wildlife Department, n.d.). Exchange

programs and free samples offer a way to introduce anglers to non-lead alternatives, and draw attention to educational campaigns designed to alert anglers to the toxicity of lead in the aquatic environments they use for recreation (Goddard et al., 2008).

In general, when these five states implemented their bans, they were not confronted with strong opposition or controversy. A notable exception to this was in Maine, where the Bass Anglers Sportsman Society (BASS) and people associated with youth fishing programs provided testimony against the proposed regulations during the legislative process (Michael, 2006). Having donated thousands of dollars in fishing gear to kids, BASS was concerned that some of the gear would become illegal. In New Hampshire, most local sportfishing groups did not show much concern, and they did not get involved in the legislative process (Michael, 2006). In New York, there was little resistance to regulations, although the ban that was passed was less restrictive than the one originally proposed; rather than banning the use of lead sinkers under one-half ounce, the ban applied only to the sale of the sinkers to allow anglers time to transition to alternative products (Michael, 2006). In Vermont, where a very thorough program was directed by the legislature, the VTFWD had the support of the Vermont Federation of Sportsmen's Clubs and the NWF, and little opposition was encountered from either anglers or retailers (Michael, 2006). Some small fishing-gear retailers in the different states were unhappy with the ban on sales of small lead tackle because they were left with unsellable inventory; for chain stores this was less of a concern because they could transfer stock to states where lead is legal. Contacting small retailers for purposes of implementing the bans also proved to be a bit of a challenge, whereas chain stores were easier to reach and communicate with (Michael, 2006). It is unclear as to whether the level of opposition and the

corresponding level of response by decision-making agencies has had an impact on the success of the such bans in terms of compliance and/or reducing negative impacts from spent lead.

Although widespread opposition was not encountered in these particular states, nationwide bans and bans on lead fishing tackle proposed in other states have not been successfully implemented. For example, the EPA proposed a ban on the manufacture, processing, and distribution of lead and zinc sinkers in response to a citizen's proposal to require labels or warnings on lead fishing sinkers (Michael, 2006). A bill containing this ban was introduced in Congress in 1994, but it was not passed. Had it become law, the economic impact of the ban was estimated to be less than \$4 per year for the average angler, and an estimated 4,700,000 birds could have potentially been saved from lead poisoning. The EPA's proposed restrictions were unique in that they would have targeted all sizes and types of lead sinkers, whereas the state-level bans currently in place have only applied to sinkers of certain sizes that pose the greatest danger to waterbird species, such as loons. Another example of a failed effort at the national level was the 1999 announcement by the USFWS of its intent to establish additional lead-free fishing areas on units of the NWR system. The areas consisted of places where mortality of common loons from lead sinker ingestion had occurred, or where habitats used by loons co-existed with significant recreational fishing activities (USFWS, 1999). The USFWS has yet to implement these proposed restrictions.

States outside of the Northeast region of the US have also encountered difficulties in implementing regulations. A bill before Minnesota's state legislature during the 2002–2003 session proposed a ban on the use and sale of some lead fishing sinkers and jigs; the bill was dropped due to opposition from angler groups and tackle manufacturers. Minnesota opted to

change the bill from a ban to “a call on the state to encourage the use of non-lead tackle and educate the public about the potential perils of lead tackle” (Smith, 2003). For nearly ten years, the Minnesota Pollution Control Agency (MPCA) has worked to raise public awareness of the need for non-lead alternatives and increase availability of these alternatives at retail stores (Minnesota Pollution Control Agency, 2010). A variety of tools have been used by the MPCA, including lead exchange programs which collected 7,000 pounds of lead tackle from 2001 to 2008 and provision of free educational kits to members of lake associations to help them promote non-lead products. The MPCA also partnered with Minnesota’s Department of Natural Resources and five Minnesota-based manufacturers to offer “Get the Lead Out” retail displays for stores; this came in response to feedback that anglers were frustrated by the difficulty of finding non-lead tackle in stores (MPCA, 2010). While the regulatory actions pursued in Minnesota were opposed by many stakeholders, subsequent voluntary measures have achieved high levels of support as a result of cooperation among tackle manufacturers, retailers, lake associations, conservation organizations, anglers, and the government (MPCA, 2010). Data are largely unavailable to indicate whether these efforts have been successful in reducing lead toxicosis in wildlife and if anglers are switching to non-lead alternatives. However, dead loons collected in Minnesota and Wisconsin are currently being examined in a lab in Wisconsin to determine the cause of mortality, and surveys from a recent Minnesota sportsmen’s event suggest a behavioral change among some anglers (Amanda Baribeau, MPCA Electronic Waste Coordinator, personal communication, April 12, 2010).

The Washington Fish and Wildlife Commission (WFWC) recently approved restrictions on the use of lead fishing tackle at 13 lakes with nesting common loons in early December

2010. The restrictions prohibit the use of lead weights and jigs that measure 1.5 inches or less along the longest axis at 12 lakes in Washington and the use of flies containing lead at Long Lake in Ferry County, Washington. The restrictions, which took effect on May 1, 2011, are designed to protect loons from being poisoned by ingesting small lead fishing gear lost by anglers. The proposal was announced in early November 2009, and opponents, including the NRA, ASA, and BASS, criticized the motives behind the ban. These opponents claimed that the effects on loons are not substantial enough to support a ban. Chris Horton, BASS Conservation Director, stated that “the supporting data is ridiculously insignificant and in no way justifies, scientifically, the proposed ban on lead fishing tackle” (Robbins, 2009). However, after a public hearing on the issue in October where the WFWC reviewed the findings of a Washington Department of Fish and Wildlife (WDFW) advisory group, the regulations to ban certain types of lead fishing tackle were determined to be the best way to minimize risks to loons.

Wisconsin has also been actively involved in educating anglers about dangers posed to wildlife from the accidental loss of lead fishing tackle. Many organizations have partnered in these outreach efforts; they include the Wisconsin Bird Conservation Initiative, Wisconsin Society for Ornithology, Raptor Education Group, Wisconsin Wildlife Federation, Wisconsin Association of Lakes, Loon Watch, Trout Unlimited, and Gordon/St. Croix Flowage Association (Wisconsin Bird Conservation Initiative, n.d.). While management actions in Wisconsin have focused primarily on the promotion of voluntary use of non-lead tackle, the Wisconsin Department of Natural Resources (WDNR) has considered a ban that would phase out the use of lead fishing tackle of the sizes and weights that pose the highest risk to wildlife. Citizens voted on the proposal on April 12, 2010. Although the majority of the citizens voted “yes,” 33

counties approved while 37 counties rejected. In addition, citizens in Bayfield County did not believe the result adequately reflected the wishes of Wisconsin sportsmen and proposed a citizen resolution, which revisited the topic with more specifics in the next sportsman vote. The resolution to proceed with some type of phase-out of lead tackle passed, but no one has figured out on how to proceed on this. The Natural Resources Board is currently in the process of reviewing recommendations from WDNR.

In addition to the above examples of where regulatory and voluntary measures are being pursued, many other states have engaged in outreach campaigns to reduce the impacts of lead from recreational fishing. Almost all states have at least some information publicly available regarding the hazards of lead tackle, often promulgated by the state fish and wildlife agencies. Many other organizations also disseminate information. For example, the Oregon Department of Human Services (ODHS) released a brochure, the cover of which reads, "Attention Fishermen, Fishing Weights Contain Dangerous Levels of Lead" (Oregon Department of Human Services, 2004). The contents of the brochure focus mainly on the threats to human health and how to avoid lead exposure; only one item suggests using non-lead fishing sinkers. While many of the messages espoused in outreach campaigns consistently focus on threats to birds, and in particular loons, there are various messages being used by different entities, and various forms of distribution. A final notable example is California's 2001 requirement that manufacturers of lures that contain lead print a warning on the packaging (Michael, 2006). The warning states that lead can cause cancer, birth defects, and other reproductive harm in humans.

These outreach initiatives, which have occurred mostly at the state level, have been less controversial than regulatory bans. In fact, the ASA, one of the strongest opponents to lead bans, supports efforts aimed at encouraging voluntary use of non-lead tackle (ASA, 2009). The ASA also acknowledges that lead toxicosis of waterbirds such as loons can occur, and that areas that are “hot spots” for ingestion of sinkers should promote restrictions based on sound science (ASA, 2009). Despite the increasing levels of support for voluntary action, the ASA and other groups have spoken out against bans on lead tackle based on the conclusion that there is insufficient scientific data; loon populations are stable and increasing; there are more serious threats to loons, such as loss of habitat due to shore development; alternatives cost six to twenty times more than lead; alternatives do not perform as well as lead; and bans would require significant changes from industries and anglers that aren’t justified (ASA, 2009; Goddard et al., 2008). A similar argument is that lead sinkers have not been shown to cause widespread population-level effects or to cause substantial changes in species distributions (Goddard et al., 2008). Many argue that population-level impacts should not be a prerequisite for corrective action (Goddard et al., 2008). The arguments over the scientific basis for bans also extend to the inconclusiveness of reports on dissolution of lead from fishing tackle in aquatic ecosystems as well as impacts on human health; these debates tend to be the most controversial and difficult to resolve.

The extent to which price factors are problematic depends on the fluctuating cost of alternative materials and general economic conditions. However, alternatives to lead fishing tackle have been available in Canada, the US, and European countries for several years, and many manufacturers already produce non-lead tackle (Scheuhammer & Norris, 1995; NCM,

2003). In addition, the actual cost differences may be minimal. Doug Crumrine, owner of the company Bullet Weights, says that a pack of steel sinkers costs only 10 to 20 cents more than a lead pack of comparable size (Nadis, 2001). Nevertheless, some argue that the increased cost will discourage or restrict the ability of recreational anglers to use non-lead products, especially during difficult economic times. Tied to this is the argument that a decline in angler numbers could result from further restrictions, which would lead to a decrease in conservation funding partially derived from the sale of fishing licenses. No evidence exists, however, to suggest that this trend has occurred in areas where regulations have been imposed.

Another leading argument against bans on lead tackle relates to the performance of non-lead alternatives. Alternatives are not as dense as lead and therefore need to be larger to be of the equivalent weight. Many anglers believe that the increased size is detrimental because it can discourage fish from biting (Goddard et al., 2008). Although it is difficult to debate an angler's performance preferences, some claim there are benefits to using non-lead fishing tackle. For example, brass and steel alternatives are advertised as making more noise than lead as they bump over the bottom of water bodies, which is claimed to attract fish (Goddard et al., 2008). Steel sinkers are also said to be more sensitive, thus providing anglers with a better feel for what is happening at the end of their line. Steel is less malleable than lead too, so it retains its shape and holds paint longer. Both sides of the debate have developed talking points to support their positions, but those in support of non-lead alternatives recognize that the burden is on them to prove these products can provide desired performance at a reasonable cost.

A challenge of a different nature that can interfere with efforts to reduce the use of lead fishing tackle entails the manufacture of lead fishing weights by people in their homes. In 1994, the EPA estimated that approximately 800,000–1,600,000 people make lead fishing weights in their homes, either for personal use or to sell (Goddard et al., 2008). According to the EPA, this “cottage industry” represents 30–35% of lead sinker production in the US. In areas where the sale of lead weights is prohibited, it is likely that lead product use still occurs due to availability of homemade options. This is additionally concerning due to the potential for lead poisoning in humans through lead inhalations that may coincide with the manufacture of these products in the home (Environmental Protection Agency, 2004). Moreover, it makes clear the need for well-informed communication strategies aimed at enhancing compliance with the use of non-lead fishing tackle.

As suggested by the above experiences and arguments that reveal the complexities associated with a transition to non-lead tackle, regulations alone are not likely to produce desired behavior change. In addition, regulations are likely to result in greater public controversy as compared with other alternatives such as promotion of voluntary action. Clearly, public outreach efforts will play a critical role in efforts to reduce the impacts of lead from recreational fishing and building support for management strategies aimed at addressing this issue in the future. To ensure the success of these efforts, additional research is needed to determine the effectiveness of existing outreach mechanisms, as well as to assess the diversity of stakeholder beliefs and attitudes regarding the use of non-lead products. Similar conclusions can be drawn from a review of the literature on the use of lead in recreational hunting, which we address in the next section.

Efforts to Reduce the Impacts of Lead from Recreational Hunting and Shooting Sports

Incidents of lead poisoning of waterfowl at hunting sites appeared in the press and scientific literature in the late 1800s (Friend, Franson, & Anderson, 2009; Sanderson & Bellrose, 1986). Continued investigations by leading scientists led to reports of widespread lead poisoning in the 1930s (Friend et al., 2009). Then, in the mid-1950s, attention to the issue of lead poisoning declined; it wasn't until the publication of *Lead Poisoning as a Mortality Factor in Waterfowl Populations* (Bellrose, 1959) that interest in the hazards of spent lead shot was renewed. The continued decline of major waterfowl populations resulted in a sustained and heightened concern about lead poisoning (Friend et al., 2009), yet it took decades more research and contentious debate to reach scientific consensus that ingesting lead from ammunition was a significant mortality factor affecting waterfowl populations (Dolton, 2008). Data during this time span estimated that the annual mortality of waterfowl in North America due to lead poisoning was between 1,600,000 and 3,900,000 birds (Bellrose, 1959; Feierabend, 1983).

Most of the scientific research related to lead poisoning from ammunition has focused on avian species, due to the fact that the most pronounced exposures and effects have been seen in waterfowl (Sanderson & Bellrose, 1986), certain upland game birds (Kendall et al., 1996), and predatory and scavenging birds (Pattee & Hennes, 1983). Exposure depends on species-feeding and grit-ingestion habits, and birds that forage in areas where lead objects accumulate are more at risk (NCM, 2003). Early evidence of upland bird mortality from lead ingestion was gathered in labs, and while it showed that ingesting lead ammunition was fatal to upland birds, more research is needed to determine the extent of exposure for upland species

in the wild (Buerger, Mirarchi, & Lisano, 1986; Hunter & Rosen, 1965; Stowe, Goyer, & Cates, 1972; Westemeier, 1966). In predatory and scavenging species, secondary poisoning from consumption of wounded or dead prey is the most significant source of toxicosis; this has had significant effects on bald eagles (*Haliaeetus leucocephalus*; Griffin, Baskett, & Sparrowe, 1980; Pattee & Hennes, 1983) and the California condor (*Gymnogyps californianus*; Church et al., 2006; Kramer & Redig, 1997; Meretsky, Snyder, Beissinger, Clendenen, & Wiley, 2000). Shot, bullets, and bullet fragments have been observed in wounded prey and gut piles that hunters discard (Hunt et al., 2006; Janssen et al., 1986; Knopper, Mineau, Scheuhammer, Bond, & McKinnon, 2006). For California condors, poisoning from lead bullet fragments in scavenged carcasses and offal piles has been identified as the greatest mortality factor for this species (Meretsky et al., 2000; Sieg, Sullivan, & Parish, 2009).

The effects of lead from spent ammunition are well documented for avian species, and, more recently, the literature has focused on impacts to other wildlife. Reports have shown elevated lead concentrations in invertebrates, amphibians, reptiles, and small and large mammals in areas that are heavily hunted and/or in close proximity to shooting ranges (Rattner et al., 2008). At a small firing range at West Point in New York, for instance, lead concentrations in earthworms (*Oligochaeta* spp.) were reported to be 90 times greater than levels in earthworms at a distant reference site (Labare, Butkus, Riegner, Schommer, & Atkinson, 2004). Some evidence also suggests that lead from spent ammunition could be a challenge for the conservation of large carnivores and other scavenging mammals (Rogers, Bedrosian, Craighead, Quigley, & Foresman, 2009). These include black bears (*Ursus arctos*), grizzly bears (*U. americanus*), grey wolves (*Canis lupus*), and coyotes (*C. latrans*) that scavenge on ungulate and

offal piles left by hunters (Wilmers, Stahler, Crabtree, Smith, & Getz, 2003). Studies are ongoing in Yellowstone National Park, and the area surrounding the park, to determine the effects of the fall hunting season on carnivores in the region (Rogers et al., 2009). Grizzly bears have been shown to alter their movement patterns around the park during hunting season to feed on wounded elk (*Cervus elaphus*) and gut piles (Haroldson, Schwartz, Cherry, & Moody, 2004; Ruth et al., 2003), and more research is needed to determine the immediate and long-term effects.

Notable regulatory and voluntary actions in the US. By 1986, the scientific research and numerous lawsuits surrounding the use of lead in hunting and shooting sports resulted in the passing of federal regulations that phased out the use of lead shot in hunting waterfowl and American coots (*Fulica americana*) over a five-year span in the US (Rattner et al., 2008). The ban, which applies specifically to hunting activities on federally regulated lands, has been in effect since 1991.

The ban on lead shot for waterfowl and coot hunting was met with resistance from the ammunition industry and sportsmen (Pokras & Kneeland, 2008). Resistance took the form of lawsuits that were filed against state and federal wildlife agencies for instituting the bans, as well as noncompliance with the regulations. A lack of communication between scientists and other stakeholders was largely to blame for the contentiousness of the debate (Pokras & Kneeland, 2008). One of the most poignant lessons to be learned from the events leading up to and following the 1991 ban is that strict legislation banning the use of lead for hunting that does not account for the interests of sportsmen and the ammunition industry will likely result in ardent protest, low compliance, and ultimately failure to resolve lead poisoning issues. Others cite the ban from the opposite perspective, arguing that the ban was contentious, but now

people comply with the regulation without objection. While the controversy has waned over time, by learning from past situations, and acting proactively, agencies may reduce the initial level of controversy and increase the rate of acceptance.

Given that large amounts of spent lead ammunition are still deposited in the environment through a variety of other hunting, depredation control, and shooting sport activities (Scheuhammer & Norris, 1995; Schulz et al., 2002), with a range of associated implications for wildlife and the environment, it is prudent for those advocating for further reductions of lead use to understand the factors that inhibited and facilitated the 1991 ban and other regulatory measures in the US. The Association of Fish and Wildlife Agencies (AFWA) conducted a survey of people who were involved in the ban in the 1990s that provides useful insight in this context (AFWA, 2007). A few of the key findings are summarized in Table 1.5.

Table 1.5. Suggestions about what should have been done differently for the 1990s federal ban on lead shot use for waterfowl hunting, from a survey of people involved in the ban (adapted from AFWA 2007).

-
1. More effort should have been made to obtain input from hunters prior to making policy decisions.
 2. Greater attention and analysis of supply issues should have occurred.
 3. Actions moved too fast; there should have been more time afforded to inform, educate, and convince agencies, nongovernmental organizations, manufacturers, retailers, media, and sportsmen of the need for the policy.
 4. Sales people, especially in large stores, should have been trained to provide accurate information because they may be the main source of information for buyers.
 5. Sources should have been established for reliable and accurate information.
-

Many US states have taken additional regulatory actions to restrict the use of lead in hunting; these actions are specifically directed at lead shot, not all lead ammunition. Nearly half of US states have regulations requiring the use of non-lead shot that extend beyond the federal law for waterfowl hunting (Figure 1.2). However, these restrictions are not statewide; they have been applied in ranges where there are species of concern. Use of lead ammunition to hunt

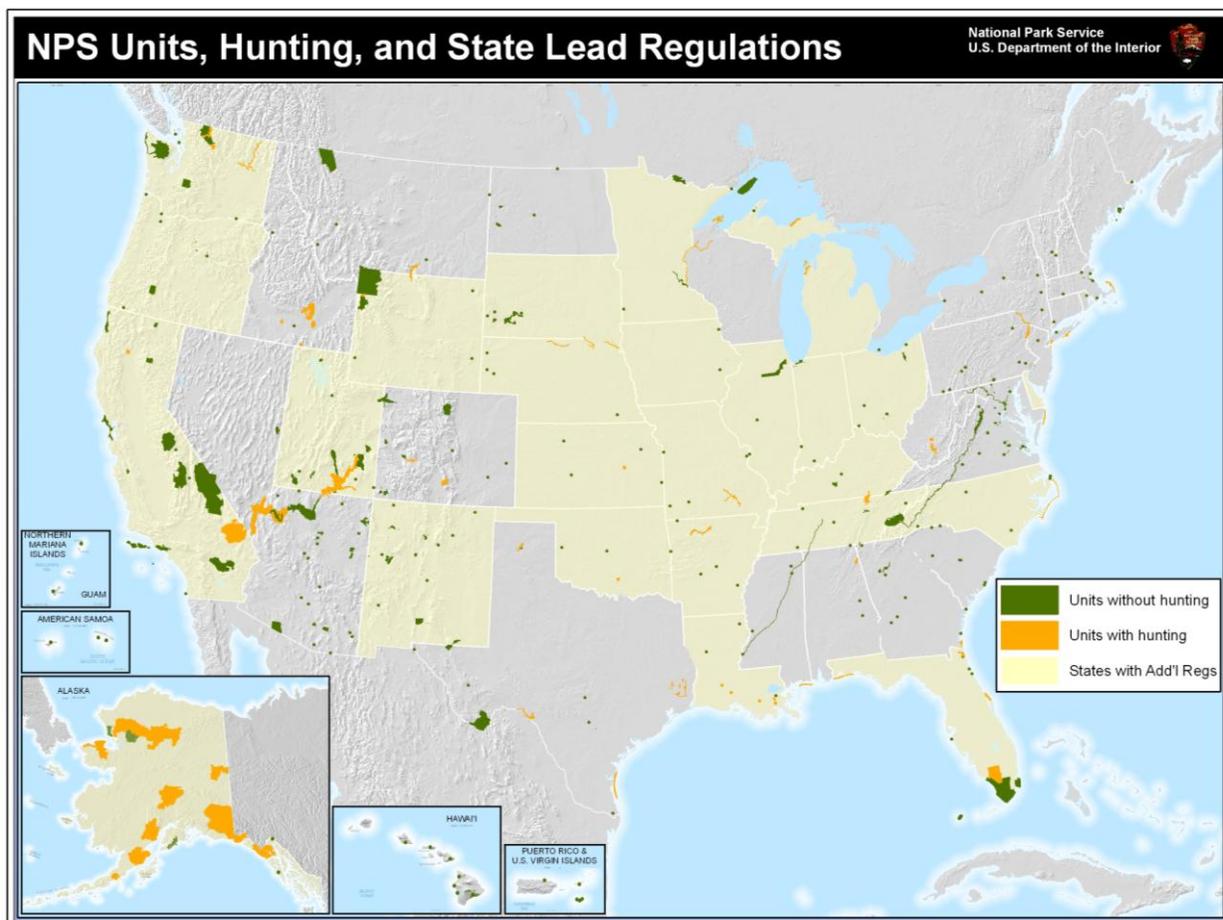


Figure 1.2. NPS units, recreational hunting status, and states with lead regulations. States shown in yellow have implemented lead ammunition restrictions beyond federal bans on the use of lead shot in hunting waterfowl.

certain species was banned in some cases because their habitats coincide with waterfowl (e.g., crane, snipe rail). In Alaska, for example, the risk of lead exposure to waterbirds, including the threatened spectacled eider (*Somateria fischeri*), was an important factor leading up to additional regulatory measures (D. J. Case and Associates, 2006).

In addition to these regulatory actions, several states have employed public outreach campaigns, again, aimed primarily at species of concern, to reduce the impacts of lead from hunting. In Arizona, California, and Utah, outreach efforts were initiated based on concerns about lead in the California condor's range. A report on condor-lead issues produced in 2003 by

the lead mitigation subcommittee of the California Condor Recovery Team (CCRT), which found that lead poisoning from spent ammunition was the leading cause of condor fatalities (Redig et al., 2003), was influential in inciting action in this area. In the late fall of 2003, the USFWS and the Wildlife Management Institute (WMI), following the recommendation of the CCRT, conducted hunter surveys in the three states to understand hunters' knowledge and attitudes of condor-lead issues (Sieg et al., 2009). Information obtained from these surveys was intended to inform communication with hunters and ranchers, and it revealed that hunter awareness of lead poisoning of California condors was relatively low (D. J. Case and Associates, 2005). Awareness was highest in California; 45% of hunters there responded "yes" to the question, "Are you aware that lead poisoning is a problem currently faced by condors?" compared with 23% of Arizona hunters and 12% of Utah hunters. Despite the low levels of awareness, the majority of respondents indicated that they would be willing to take some action to help prevent lead poisoning. Arizona and California have since implemented extensive outreach programs that have many similarities, but also unique differences. In December 2007, the California Fish and Game Commission modified the methods authorized for taking big game species, nongame birds, and nongame mammals in areas designated as California condor range by prohibiting the use of lead ammunition for these purposes. The regulations became effective in July of 2008. Arizona is currently limited to voluntary participation tactics due to the status of the California condor there (i.e., its being designated as a "non-essential and experimental" population), so regulatory actions are not being considered. Utah has not implemented a formal outreach campaign, but recently began working on plans to do so (Sieg et al., 2009).

Below are more detailed descriptions of existing outreach initiatives in Arizona, California, and other states where active programs have been pursued.

Arizona. The Arizona Game and Fish Department (AZGFD) began efforts to educate the public and engage hunters in voluntary lead reduction efforts in 2003 (Sieg et al., 2009). As mentioned above, results of a phone survey conducted in the fall of 2003 with 205 hunters who held tags in Arizona's condor range that year revealed that only 23% were aware of the problems posed to condors from lead use (Responsive Management, 2003). Additionally, only 9% of respondents were aware of educational efforts pursued in this context, despite the fact that they would have received a letter in the mail from the agency containing details about the issue prior to the survey, and information had been published in the 2003 Arizona hunting regulations (Sieg et al., 2009).

In December 2003, focus groups were conducted in Arizona to test messages for communicating with hunters and to further investigate the barriers to reducing lead use in the condor's range. Results suggested that the best message for communication was, "Hunters and ranchers have a long history of caring for the land and conserving all kinds of wildlife. They can continue this tradition and help prevent lead poisoning in California condors by taking one or more of the following actions in the condor's range: remove all carcasses from the field; hide or bury carcasses and gut piles; remove bullets and surrounding affected flesh; or use non-lead ammunition" (D. J. Case and Associates, 2005). The focus groups also revealed that hunters and ranchers wanted to be shown credible data that linked lead from spent ammunition to condor poisoning and then, if they were asked by a credible source to help condors by adopting specific actions, they would be willing to do so (D. J. Case and Associates, 2005). The AZGFD and

sportsmen's groups were identified as credible sources. Federal agencies and non-profit entities received much lower ratings in the Arizona surveys. This highlights the need to build partnerships. In Arizona, for example, most of the research on the impacts of lead ammunition has been conducted by the Peregrine Fund, a source with lower credibility among hunters. However, the Peregrine Fund has partnered with AZGFD, a partnership that benefits both organizations and provides a credible source for message delivery. It is especially important to partner with trusted sportsmen's groups. The NRA, one of the most outspoken and active opponents of non-lead initiatives, is less credible than some sportsmen's groups but more credible than federal agencies. Messages coming from non-credible sources can set back progress rather than further it.

Results of the phone surveys and focus groups were used by the AZGFD to develop a strategy for communicating with hunters (Sieg et al., 2009). In 2003–2004, information was included in the hunting regulations booklet, and between 2,000 and 7,000 hunters with big game tags for the condor range were mailed information. During that time, the AZGFD also began to deliver educational presentations and lead reduction messages to the general public through such channels as wildlife fair displays, legislative contacts, the AZGFD website, the AZGFD *Wildlife Views* magazine and television programs, as well as through other general media outlets (Sieg et al., 2009). The AZGFD also sought the partnership of sportsmen's organizations in Arizona, asking them to support the agency's efforts (Sieg et al., 2009). The AZGFD has been successful in forming a coalition that includes the Arizona Antelope Foundation, the Arizona Desert Bighorn Sheep Society, the Arizona Deer Association, the Arizona Elk Society, and the Arizona Chapter of the National Wild Turkey Foundation.

In 2005, the AZGFD partnered with Sportsman's Warehouse and Cabela's to begin a voluntary free non-lead ammo program which distributed coupons good for two free boxes of non-lead ammunition to 2,390 hunters in the core condor range (Seng, 2006). Hunters could redeem their coupons either at a Sportsman's Warehouse store or by mail from Cabela's. Included with the coupons was a letter outlining the issues related to lead ammunition that asked for voluntary help with the program; 65% of hunters redeemed their coupons that year (Sieg et al., 2009). Surveys of hunters who did not redeem their coupons identified the primary reasons as non-lead ammunition not being available in their caliber or preferred bullet weight; that it would take too long to sight in new ammunition; that the redemption coupon was too complicated; that they were not convinced that lead from spent ammunition was a problem for condors; and that they believed that the nature of the program was "anti-hunting" (Seng, 2006). In response to some of these barriers to participation, the AZGFD provided significantly more information to hunters in 2006, but subsequently received a negative response for providing too much information that most hunters did not read (Sieg et al., 2009).

A number of additional efforts were made in 2007 to increase hunters' participation in voluntary non-lead programs. Among these efforts were lead articles about condors in sportsmen's publications, increased media coverage of how hunters were helping to recover condors, simplified outreach messages that only emphasized using non-lead alternatives, mailing of follow-up information to hunters who did not redeem their non-lead ammo coupons, and an increased number of field staff to directly contact hunters about this issue. In addition, a DVD hosted by Nolan Ryan and entitled "How to be successful in your upcoming deer hunt" was

produced; it contained five minutes of information on lead exposure and asked for hunters' help. Outreach materials and the DVD were mailed to hunters along with their tags.

Since 2007, the AZGFD has continued to focus on improving its outreach and increasing voluntary non-lead program participation. Specific emphasis has been on working with ammunition distributors to increase availability of non-lead alternatives and placing non-lead displays with educational materials in retail locations. Human dimensions surveys conducted since 2004 suggest that the agency's efforts have been successful in encouraging behaviors that reduce lead in the condor range (Table 1.6; Sieg et al., 2009). The AZGFD appears to be the only organization administering outreach that has comprehensively evaluated the impacts of its initiatives.

Table 1.6. Human dimensions survey results showing hunter participation in voluntary non-lead programs in Arizona's condor range, 2004-2008 (Sieg et al., 2009).

Year	Successful Hunters ¹	Took Lead Reduction Actions	Used Non-Lead Ammunition	Used Lead Ammunition & Packed Out Gut Pile	Took No Lead Reduction Action
2008	910	90%	72%	61%	10%
2007	767	83%	61%	54%	17%
2006	548	60%	58%	3%	40%
2005	909	50%	50%	N/A	50%
2004		<5%			

¹Number of hunters who harvested a deer.

California. The hazards of spent lead ammunition to condors have long been recognized in California, and over the past few years major efforts have been taken to address this issue. As mentioned previously, only 45% of California hunters surveyed by phone in 2003 (n = 200) were aware of lead poisoning problems faced by condors (D. J. Case and Associates, 2005). Around that time, some communication initiatives had been launched, but they had not been

well researched or well implemented (D. J. Case and Associates, 2005). Only 24% of respondents were aware of these initiatives. In 2007, the Institute for Wildlife Studies (IWS) received a grant from the National Fish and Wildlife Foundation (NFWF) to launch an outreach program to raise awareness about alternatives to lead bullets among hunter and ranchers (Theyerl, Petterson, & Garcelon, 2010). The program was launched in collaboration with Pinnacles National Monument (PNM), whose own effort to reduce lead available to condors began in 2006. PNM is one of five sites where California condors have been released, and with a flock of 28 condors, it hosts one of the main populations of free-ranging condors in California. Partnerships were also forged with the USFWS, Ventana Wildlife Society, Pinnacles Partnership, the Peregrine Fund, and AZGFD.

While initially looking to encourage hunters to voluntarily switch to non-lead ammunition, the program's objective were slightly modified with the passing of the Ridley-Tree Condor Preservation Act, which was signed into law by the governor in January 2008 (Theyerl et al., 2010). The act, effective as of July 1, 2008, mandated the California Fish and Game Commission enact regulations requiring the use of non-lead bullets when taking big game and coyote within the historic California condor range. Recognizing that new legal requirements are often defied by a portion of the public, and/or are resisted due to encountering misinformation or a lack of information, the efforts still focused on encouraging hunters to use non-lead ammunition and offering venues for trying non-lead calibers for free, with the goal of gaining full compliance with the ban.

The California Lead Ammunition Awareness Campaign, spearheaded by the IWS in conjunction with PNM, initially set out to offer hunters and landowners opportunities to

evaluate non-lead ammunition and learn about the hazards of ammunition containing lead. Outreach efforts to meet these objectives included: (1) shooting demonstration events, (2) booths at sporting equipment trade shows and county fairs, (3) meeting with local NRA chapters, (4) opportunities for hunting guides, hunting clubs, and local ranchers to field-test ammunition through visits to local ranches, and (5) presenting information about the threats of non-lead ammunition and the results of outreach efforts at professional conferences (Theyerl et al., 2010).

All of the objectives initially set forth were met or exceeded during the awareness campaign from 2007 through 2009 (Theyerl et al., 2010). A total of 14 shooting events were held, providing 319 sportsmen the opportunity to try non-lead ammunition. Over 15,000 rounds of non-lead ammunition were given out as free samples to sportsmen at the shooting events. Through participation in community forums to educate community members about lead and condors, 1,900 individuals were reached. Booths were also placed at 15 county fairs and community event, resulting in contacts with 2,663 individuals. The IWS outreach coordinator also volunteered on the Hollister Friends of the NRA committee. According to the outreach coordinator, participation with the NRA helped to create better relationships with local sportspersons and countered the common misconception that the lead campaign is anti-hunting or anti-firearms (Theyerl et al., 2010).

Another important focus of the program is on educating willing ranchers surrounding PNM, encouraging them to use non-lead ammunition when hunting or eradicating animals they consider “pests” (e.g., feral pigs, coyotes, squirrels) and to educate hunters who may also use their ranchlands (Pinnacles National Monument, 2010). The IWS outreach coordinator met with

215 ranchers, vineyard operators, and other large property managers on an individual basis. Tejon Ranch Company, the largest state-licensed private hunting operation in California, became the first to voluntarily discontinue and ban the use of lead ammunition in its hunting and ranching operations (Hill, 2009). Other operations have considered and/or implemented similar policies since Tejon's was implemented in 2008. In addition, US Army Garrison Fort Hunter Liggett began phasing out lead ammunition for hunting on their lands in 2007.

IWS and PNM personnel involved in the outreach efforts believe that hunters do come to understand the threats lead ammunition can pose, and are typically convinced of the high performance of non-lead ammunition when they are provided with well-prepared information and demonstrations (Theyerl et al., 2010). Surveys distributed following shooting demonstrations have shown that hunters attending these events are accepting of non-lead ammunition and that most are surprised by the amount of lead fragments that result from lead ammunition. The outreach efforts are continuing in California and will extend to areas beyond those in close proximity to PNM.

Minnesota. Minnesota is among the states that have been active in public outreach to address the use of lead shot in hunting. In May 2006, the Minnesota Department of Natural Resources (MDNR) and Division of Fish and Wildlife (FAW) formed the Nontoxic Shot Advisory Committee (NSAC). The NSAC comprised representatives from the manufacturing and retail industry, hunting constituencies, environmental groups, and technical experts from other state and federal agencies (Nontoxic Shot Advisory Committee, 2006). The goals of the committee were to develop recommendations for future restrictions on lead shot in Minnesota, a time frame for implementation, and a public communication/education plan, and to identify gaps in

understanding and potential research needs. Based on several meetings held throughout 2006, accompanied by a thorough investigation of lead issues, the NSAC reached a consensus that the MDNR should (1) regulate lead shot on managed dove fields (which was implemented in 2006) and for shotgun hunting in general, and (2) implement regulations that are more restrictive than current state and federal legislation (NSAC, 2006). The committee did not, however, reach consensus as to what the extent of these regulations should be.

A cooperative human dimensions investigation was conducted in 2007–2008 by the Minnesota Cooperative Fish and Wildlife Research Unit and MDNR to provide information about small-game hunter perceptions and knowledge of non-toxic shot and to help identify appropriate messages for communication programs (n = 927; Schroeder, Fulton, Penning, & Don Carlos, 2008). The study was very context-specific and focused on attitudes and norms about a potential ban on lead shot in the Minnesota farmland zone. Results indicated that over half of the respondents believed that a ban on lead shot would help protect wildlife from lead poisoning, benefit the quality of the environment, prevent the spread of lead in the natural environment, and improve awareness about lead contamination issues. Half of the respondents also believed that such a ban was likely to increase crippling and wounding losses for small game hunting and would require the use of less effective shot. Over 75% believed the ban would require hunters to use more expensive ammunition, and over 40% thought the ban was unnecessary government regulation that would make it more difficult for some people to hunt. Much of the data suggests that many hunters perceived both positive and negative impacts. Over 70% of respondents felt that it was good to protect wildlife from lead poisoning, and most thought that hunters would adjust to the ban after a few seasons. Respondents' intent to

support or oppose the ban was fairly evenly split, indicating the potential for high controversy; 44% said it was unlikely that they would support the ban, and 42% said it was likely (Schroeder et al., 2008). The likelihood of supporting the potential ban was positively correlated with respondents' trust of the MDNR.

Building on the results of this investigation, the MDNR's website currently contains many examples of outreach aimed at educating hunters about the hazards of lead to wildlife and human health. Along with the Minnesota Department of Health, the MDNR also has been very active in raising awareness among hunters about the specific risks associated with lead in venison. Informing these efforts are recent studies conducted by the agency to determine levels of lead bullet fragmentation and deposition in white-tailed deer (*Odocoileus virginianus*) and domestic sheep (*Ovis aries*; Grund et al., 2010). Results indicate that using copper bullets or bullets with no exposed lead can significantly reduce or eliminate lead exposure that would otherwise occur with lead bullets. This research was conducted in response to findings from investigations conducted in North Dakota which we discuss in more detail below.

North Dakota. In 2008, a study of lead in venison showed that, much like wildlife species, humans can be exposed to lead by consuming deer harvested with lead ammunition. Concerns arose after a study by a Bismarck physician found that, out of 95 packages of ground venison donated to food pantries, 53 contained lead fragments (North Dakota Department of Health, 2008a). Following this discovery, the North Dakota departments of Health, Agriculture, and Game and Fish advised food pantries to stop the distribution of ground venison (NDDoH, 2008b). A few weeks later, tests in Minnesota also discovered lead in venison donated to food pantries. As in North Dakota, Minnesota's departments of Health, Agriculture, and Natural

Resources issued similar advisories to halt the distribution of venison. In addition to removing venison from food banks, public advisories were issued to the hunting community about the dangers of lead exposure, especially for children and pregnant women. Other Midwestern states, such as Wisconsin, also began to study venison and to issue letters of caution to food pantry managers (Warzecha & Thiboldeauz, 2008).

The measures taken in North Dakota and Minnesota were highly controversial, and the NSSF emerged as the most outspoken opponent to the agencies' actions. The initial scientific evidence to support pulling venison was minimal and, in North Dakota, gathered very informally. Subsequent studies have been conducted to determine whether people who eat wild game harvested with lead bullets have higher BLLs than those who don't. A study of 738 North Dakotans showed a link between eating wild game shot with lead bullets and higher BLLs (NDDoH, 2008b). However, while the correlation was statistically significant, other sources of lead exposure were not controlled for, and results were considered inconclusive. In fact, the results revealed that individuals who consumed game harvested with lead ammunition had lower BLLs than average Americans exposed to other sources of lead. Additionally, only a 0.3 microgram per deciliter difference was shown between participants who consumed game harvested with lead and those who did not.

These results added fuel to the controversy. The NSSF issued statements claiming that the study proved traditional ammunition poses no threat to humans (National Shooting Sports Foundation, 2008). Those on the other side of the issue used the findings to claim that lead ammunition should be banned because humans are exposed to some amount of lead, and no amount is safe. Due to the study, and similar ones that followed, the agencies in North Dakota

and Minnesota revised their initial advisories. New advisories stated that lead is a harmful substance, firearm ammunition used for taking deer contains lead, and venison processed by hunters and commercial processors has been shown to contain lead particles (Bihrlle, 2008). But, they also note that no incidence of human lead poisoning has been documented in the US and make recommendations for limiting the possibility of exposure. One of the recommendations is to use non-lead ammunition, but the rest focus on precautions to take when using lead bullets. As this situation suggests, more research is needed to determine if the exposure to lead from consuming game harvested with lead ammunition is detrimental enough to the health of humans to warrant regulatory action, or to be perceived as a high enough risk among hunters to prompt voluntary use of non-lead alternatives. (Following NPS internal policies, Theodore Roosevelt National Park in North Dakota now requires volunteers who are chosen to participate in elk reduction efforts to use non-lead ammunition.)

Wyoming. In 2009, officials in Grand Teton National Park (GTNP) and the National Elk Refuge (NER) began encouraging hunters to use non-lead ammunition during the elk and bison seasons (Skaggs & Iverson, 2009). This came in response to a series of studies, beginning in 2004, that were conducted by Craighead Beringia South (CBS), a non-profit science and education organization (Craighead Beringia South, 2009). The studies found that BLLs of ravens (*Corvus corax*), bald eagles, and golden eagles (*Aquila chrysaetos*) in the Jackson Hole valley were highest during the fall hunting season. GTNP and the NER also cite the recent findings of research on potential lead contamination in humans, stating that one of the goals of the non-lead program is to raise awareness about the risks to hunters so that hunters can make informed decisions when choosing ammunition (Skaggs & Iverson, 2009). To begin to monitor

program participation, GTNP and the NER asked hunters to report their use of non-lead ammunition for the 2009 season; hunters were able to record their responses on their hunting permits. This baseline information will not only be used to track hunter behavior in the context of lead use but also to inform possible incentive strategies that can be used in the future to increase use of non-lead products. GTNP and the NER have stressed the voluntary nature of their program and are not pursuing regulatory bans in those areas.

CBS also recently began its own outreach program targeting hunters in the Jackson Hole area (CBS, 2009). The focus of the program is on educating hunters about the hazards of lead and distributing non-lead rifle ammunition. In 2009, 194 boxes of ammunition were distributed. However, follow-up research to help determine the effectiveness of the program did not detect lower BLLs in eagles, and the drops in raven BLLs were minimal. The CBS has acknowledged that its program needs to be expanded, and future plans are to provide non-lead ammunition to more hunters while educating them about the positive impacts of voluntarily switching to non-lead alternatives. Future research on the impacts of these initiatives in the Jackson Hole valley may prove valuable in facilitating comparisons with other programs, such as those in Arizona's California condor range.

Emerging efforts in other states: The case of dove hunting. The use of lead for hunting mourning doves (*Zenaida macroura*) has attracted attention in states across the nation in recent years. Efforts aimed at reversing declines in hunter numbers in the US have prompted many states to provide more dove hunting opportunities (National Mourning Dove Survey, 2010). However, this has raised concerns about the potential for mourning doves and other wildlife to be exposed to significant quantities of lead shot in the future, particularly given that

large amounts of lead have been shown through prior research to accumulate in relatively small areas from dove hunting (Best, Garrison, & Schmitt, 1992; Lewis & Legler, 1968; Schulz et al., 2002). To inform future management decisions on this issue, several states have conducted human dimensions investigations. In Missouri, small-game hunters were surveyed to determine their attitudes toward regulations requiring the use of non-lead shot for hunting small game, specifically mourning doves (Schulz, Reitz, Sheriff, & Millspaugh, 2007). The survey found that most hunters (72–85%) opposed additional regulations. Surveys were also recently administered in Illinois and Texas, but due to differences in study design, the results of these investigations are not comparable (National Mourning Dove Survey, 2010). The need for a national survey to assess dove hunters' current awareness of lead issues and levels of support for the use of non-lead ammunition, which would be comparable across regions and states, has been identified. Results could also help in determining what information is needed to better inform and communicate with hunters about lead issues. Plans, including survey development, are currently underway to implement such an investigation in 2011 (National Mourning Dove Survey, 2010).

WAFWA and AFWA activities. In June 2009, the Western Association of Fish and Wildlife Agencies (WAFWA) established an ad hoc work group charged with making recommendations to WAFWA with regard to lead use in hunting and fishing (Elicker, 2010). Recognizing the sensitivities surrounding this issue, and its complexity, the work group members were drawn from multiple disciplines, including chairs of the Wildlife Health, Human Dimensions, and Resource Information and Education, Wildlife, and Fish Chiefs committees, and is chaired by the director of the Washington Department of Fish and Wildlife. The work

group believes that fish and wildlife agencies should help lead efforts to address this issue due to the potential impacts on hunters, anglers, industry, retailers, and fish and wildlife management (Western Association of Fish and Wildlife Agencies, 2010). The work group focused on developing practical, realistic, and science-based recommendations and ultimately developed ten recommendations for WAFWA (Elicker, 2010): (1) coordinate with other WAFWA committees; (2) develop consistent messaging; (3) utilize human dimensions research to develop messages; (4) monitor research on lead and wildlife; (5) collaborate with industry, partners, and public agencies; (6) seek consistent federal policy; (7) monitor state efforts; (8) encourage manufacturers to make non-lead products available and affordable; (9) address funding issues; and (10) identify further research needs regarding impacts on wildlife. The ad hoc work group will continue for an additional year and work towards reaching some of the objectives set forth in their recommendation (WAFWA, 2010).

In September 2010, AFWA passed a resolution to adopt a number of principles regarding future regulation of lead ammunition and fishing tackle. These principles stated a belief that future regulation was best addressed by individual states and should focus on population- level impacts to wildlife that are substantiated by the best available science (AFWA, 2010). However, they also noted that state fish and wildlife agencies should proactively coordinate with state health agencies, industry, conservation organizations, and hunting, angling, and shooting sports interests. In addition, they called for the development of effective human dimensions strategies, as well as the use of public education and voluntary programs where appropriate in lieu of regulation.

Lead ban petition to the EPA. On August 3, 2010, conservation groups petitioned the EPA for a nationwide ban on the production and sale of lead bullets, shotgun pellets, and fishing sinkers (EPA, 2010). The petition was filed by the Center for Biological Diversity, American Bird Conservancy, PEER, Association of Avian Veterinarians, and the hunters' group Project Gutpile. The petitioners want the EPA to act under the auspices of the Toxic Substances Control Act (TSCA) which gives the EPA the broad authority to regulate chemical substances that pose a risk to the health of humans or the environment. The EPA is prohibited from regulating ammunition or firearms under the TSCA, but if non-toxic alternatives are commercially available, toxic elements of ammunition can be regulated (EPA, 2010). There are no such restrictions for fishing sinkers. As with previous moves to impose regulations, the petition generated much debate and roused both those who support a ban and those who do not. On November 4, 2010, the EPA denied the petition, stating that the petitioners had failed to demonstrate that such a ban was necessary to protect against an unreasonable risk of injury to health or the environment as required by TSCA. Following the denial of the petition, the groups sued the EPA in late November 2010 and further action is pending.

Partially in response to the petition, the chairs of the Congressional Sportsmen's Caucus— Senators Jon Tester (D-MT) and John Thune (R-SD) and Representatives Jeff Miller (R-FL) and Mike Ross (D-AR)—introduced the Hunting, Fishing and Recreational Shooting Sports Protection Act (S. 838 and H.R. 1558) on April 14, 2011. The bill would amend TSCA to deny the EPA authority to outlaw lead bullets, shot, and fishing tackle. In addition, Representative Paul Braun (R-GA) introduced two bills that would prohibit the EPA from regulating any type of firearm ammunition or fishing tackle based on material composition (H.R. 1443 and H.R. 1445).

H.R. 1445 would also prohibit the Department of the Interior and the Department of Agriculture from newly prohibiting or limiting, based on material content, the use of traditional hunting implements on federal lands.

Overall Findings for Outreach to Reduce the Impacts of Lead from Hunting and Fishing

Many important lessons have come out of the work being done by various states, agencies, and organizations that can inform development of effective outreach strategies and messages for addressing issues related to the use of lead in recreational hunting and fishing. While there are more examples to draw upon for hunting, many of these lessons would also be applicable to communicating about lead use in recreational fishing. Additionally, while recommendations stem largely from context-specific outreach efforts—e.g., efforts applied to condor conservation (Sullivan, 2009) and lead shot use in Minnesota’s farmland zone (Schroeder et al., 2008)—many are relevant for considering how the NPS might address lead issues on its lands in the future. The following lists are an attempt to synthesize key lessons learned from our review of the relevant literature.

Some general findings

- Surveys of hunters in Arizona and California showed that, depending on the nature of the request and the source, most hunters are willing to take some action to help prevent lead poisoning of wildlife (D. J. Case and Associates, 2005).
- Many hunters may be unaware of the impacts of lead ammunition on wildlife, suggesting the need for strategies that can help raise basic awareness among sportsmen about lead issues (D. J. Case and Associates, 2005).

- Voluntary measures typically require less concrete evidence; i.e., they allow for more uncertainty than regulatory bans would. However, this should not be seen as an invitation to offer scientific evidence that is not rigorous or to avoid providing scientific evidence altogether (Sullivan, 2009).
- Negative media has been a challenge in many cases, and researchers have found that a single negative media article can nullify the impacts of providing factual information (AFWA, 2007). This indicates the need to develop good ties to the media and accurately disseminate information through media outlets.
- In states such as Washington, where proposed bans on lead fishing tackle have been controversial, it is recommended that agencies work to promote the use of non-lead alternatives and the proper disposal of lead products until regulatory legislation can be enacted (Gumm & Poleschook, n.d.).
- Tools used by many states to eliminate lead in the environment from fishing are: lead sinker exchanges (promoting proper disposal), brochures educating anglers about the hazards of lead, warnings for children and pregnant women about their susceptibility to detrimental effects of lead exposure, and promotion of responsible fishing practices such as retrieval and disposal of fishing line and tackle.

Outreach-specific findings, including tactics for message creation and delivery

- Many states have emphasized the importance of knowing one's audience, and educating oneself about hunters, hunting, and ballistics expertise to be well received and seen as credible by hunters (Sullivan, 2009).

- Hunters in Arizona and California stated that they would be more supportive of non-lead alternatives if they were given credible scientific evidence of the detrimental impacts of lead on California condors (D. J. Case and Associates, 2005). However, when the AZGFD responded by providing hunters with detailed information on the topic, they found that fewer hunters read the information and that it was therefore less effective than if the communication delivery had been less in-depth (Sieg et al., 2009). It is important to find the right balance of adequate information and home in on the key points in an appropriate communication style, given that the public may not have the time or level of interest to process large amounts of information.
- Providing hunters with incentives, such as free non-lead ammunition, has proven to be a powerful tool to enhance the success of outreach initiatives (Sieg et al., 2009). The AZGFD also points out the necessity of partnerships to implement this type of program, as some government and non-governmental organizations cannot distribute ammunition directly.
- Photos of x-rayed ballistics gel and wildlife carcasses have made a huge impression on hunters in Arizona and California (Petterson, 2009). Many hunters are unaware of the amount of lead lost through fragmentation; a visual display is one of the most effective ways to portray this information.
- Participatory outreach mechanisms—e.g., demonstrations with ballistics gel and water jug testing—have been effective ways to engage the public on issues of lead use in California (Petterson, 2009). They provide an opportunity for hunters to experience firsthand the degree to which lead bullets fragment compared with non-lead bullets.

They also provide hunters a chance to test non-lead ammunition, which can help dispel negative misconceptions regarding non-lead products. For example, many hunters may believe that non-lead ammunition is less effective, but when non-lead bullets are shot into ballistics gel, participants can witness the hydraulic shock and compare it with that of lead bullets.

- The Ad Hoc Mourning Dove and Lead Toxicosis Working Group has emphasized the importance of training salespeople—i.e., the people from which hunters buy their ammunition—as they are often the main source of information for hunters (AFWA, 2007).
- Messages that highlight the importance of conservation heritage to hunters were rated highly by focus groups in Arizona (D. J. Case and Associates, 2005). These messages focus on deeply held core values for many hunters. Hunters are rightfully proud of the hunting tradition and its contributions to wildlife conservation in this country; using non-lead products can be seen as an extension of this tradition (Sullivan, 2009). It is worth noting, however, that some research (Schroeder et al., 2008) has suggested that other message points may be more effective.
- The AZGFD has stressed in some of its communications that using non-lead ammunition makes hunting more beneficial to wildlife (e.g., the endangered California condor), which, again, invokes the conservation ethic of hunters (Sullivan, 2009). Certain species depend on hunting for survival, and wildlife carcasses and offal piles (without lead fragments) can enhance survival of these species. This approach demonstrates that agencies are not blaming hunters, but rather asking for their help.

- Persuasive messages from credible sources may help generate support for bans on lead shot. More specifically, Schroeder et al. (2008) found that basic, factual, first-person narratives that mention a social group hunters identify with (e.g., Ducks Unlimited) may be more persuasive than other alternatives, including declarative statements from the state agency, counterarguments, value-expressive messages about hunting heritage, and third-person narratives.
- Tied to the above point, credible sources are needed to deliver messages aimed at promoting voluntary lead reduction measures. Surveys in Arizona identified sportsmen's groups as the most credible source (D. J. Case and Associates, 2005).
- Hunter education instructors have been suggested by some researchers as important sources for getting messages out to new hunters (AFWA, 2007).
- In Arizona, research found that references to endangered or rare species should not be used at the outset of communication messages (Sullivan, 2009). This is important supportive information, but it is not the first topic that should be presented or emphasized.
- Focusing on one-to-one communication whenever possible has been an important strategy in outreach efforts in California and Arizona (Pettersen, 2009). The opportunity to do so occurs oftentimes in the field where agency staff can interact with hunters on a less formal basis. An important consideration in this context is the need to ensure field staff, concessionaires, interpreters, law enforcement, etc., are aware of, and on board with, the agency's agenda with regard to lead issues.

- Adding to the previous point, it is important for recipients to receive one unified message from all sources (AFWA, 2007). Mixed messages from various organizations can decrease the credibility of all involved and confuse hunters as to what is fact or opinion.

Conclusion

Management decisions about the use of lead ammunition and fishing tackle are needed to mitigate further impacts of lead on wildlife, wildlands, and humans. Unfortunately, these decisions will have to be made in an environment of uncertainty and controversy. Despite the significant body of literature on lead poisoning caused by spent lead ammunition and fishing tackle, there are still gaps in scientific understanding that create an environment of scientific uncertainty, making lead product bans difficult and expensive to implement.

Previous efforts to reduce the amount of lead introduced by hunters and anglers in the environment are valuable for understanding the current issues surrounding lead bans and efforts to increase voluntary use of non-lead alternatives. However, most of the research aimed at informing these efforts thus far has been very context-specific, and the attitudes and beliefs of hunters and anglers regarding lead issues are still largely unknown. We do know that in areas with key species of concern, hunters and anglers are often unaware of the lead-related impacts of their activities, even though they may be more aware than in areas where there has been less attention paid to such impacts. There is a definite need for more thorough evaluation of existing communication strategies, as well as a need to understand the beliefs and attitudes of the diverse array of stakeholders, in order to inform more targeted outreach initiatives. While the political will at individual state levels, and at the national level, appears to be lacking to support a broad-scale ban on lead products in hunting and fishing, this has not been fully explored, and those who oppose such a ban have been more unified and vocal in their objections. Exploring the full range of beliefs and attitudes is an important next step to take if

policy and outreach to reduce impacts from lead are to be considered viable options in the future.

REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50, 179–211.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.
- American Sportfishing Association. (2009). Government affairs: Lead in fishing tackle [Press Release]. Retrieved from www.asafishing.org/government/lead_in_tackle.html
- Association of Fish and Wildlife Agencies. (2007). *Final report and recommendations to Association of Fish and Wildlife Agencies from Ad Hoc Mourning Dove and Lead Toxicosis Working Group*. Rhinelander, WI: AFWA.
- Association of Fish and Wildlife Agencies. (2010). *Lead ammunition and fishing tackle (Resolution #1-2010)*. Washington, DC: AFWA.
- Bellrose, F. C. (1959). Lead poisoning as a mortality factor in waterfowl populations. *Illinois Natural History Survey and Bulletin* 27, 235–288.
- Best, T. L., Garrison, T.E., & Schmitt, C. G. (1992). Availability and ingestion of lead shot by mourning doves (*Zenaida macroura*) in southeastern New Mexico. *Southwestern Naturalist* 37, 287–292.
- Bihrlé, C. (2008, August/September). Fall followup: An evolving perspective on lead in venison. *North Dakota Outdoors*, pp. 30–35.
- Borkowski, R. (1997). Lead poisoning and intestinal perforations in a snapping turtle (*Chelydra serpentina*) due to fishing gear ingestion. *Journal of Zoo and Wildlife Medicine* 28, 109–113.

- Braun, J. M., Kahn, R. S., Froehlich, T., Auinger, P., & Lanphear, B. P. (2006). Exposures to environmental toxicants and attention deficit hyperactivity disorder in US children. *Environmental Health Perspectives* 114, 1904–1909.
- Bright, A. D., Manfredi, M. J., Fishbein, M., & Bath, A. (1993). Application of the theory of reasoned action to the National Park Service's controlled burn policy. *Journal of Leisure Research* 25, 263–280.
- Browne, M. (2009). Get the lead out of fishing. Retrieved from <http://www.replacelead.com/leadfacts.shtml>
- Burger, T. T., Mirarchi, R. E., & Lisano, M. E. (1986). Effects of lead shot ingestion on captive mourning dove survivability and reproduction. *Journal of Wildlife Management* 50, 1–8.
- Burt, R. S. (1987). Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology* 92, 1287–1335.
- Craighead Beringia South. (2009). *Removing Lead from Our Wildlife and Wildlands: 2009 Interim Report*. Retrieved from http://www.fws.gov/nationalelkrefuge/Documents/2011_Hunting/CBS_09_Lead_Results.pdf
- Church, M. E., Gwiazda, R., Risebrough, R. W., Sorenson, K., Chamberlain, C. P., Farry, S., Heinrich, W., Rideout, B. A., & Smith, D. R. (2006). Ammunition is the principal source of lead accumulated by California condors re-introduced to the wild. *Environmental Science and Technology* 40, 6143–6150.
- Crano, W. D., & Prislin, R. (2006). Attitudes and persuasion. *Annual Review of Psychology* 57, 345–374.
- D. J. Case and Associates. (2005). *Communicating with hunters and ranchers to reduce lead*

available to California condors [Unpublished report to the Wildlife Management Institute (WMI) and US Fish and Wildlife Service (USFWS)]. Mishawaka, IN: D. J. Case and D. J. Case and Associates. (2006). *Non-toxic shot regulation inventory of the United States and Canada*. Mishawaka, IN: D. J. Case and Associates.

Dolton, D. (2008). *Report on conference: Ingestion of spent lead from ammunition: Implications for wildlife and humans*. May. Boise, ID: The Peregrine Fund.

Donnelly, M. P., Vaske, J. J., Whittaker, D., & Shelby, B. (2000). Toward an understanding of norm prevalence: A comparative analysis of 20 years of research. *Environmental Management* 25, 403–414.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Orlando, FL: Harcourt Brace Jovanovich College Publishers.

Eagly, A. H., & Kulesa, P. (1997). Attitudes, attitude structure, and resistance to change: Implications for persuasion on environmental issues. In M. H. Bazerman, D. M. Messick, A. E. Tenbrunsel, & K. A. Wade-Benzoni (Eds.), *Environment, ethics, and behavior: The psychology of environmental valuation and degradation* (pp. 122–153). San Francisco: The New Lexington Press/Jossey-Bass Publishers.

Eisler, R. (2000). Lead. In R. Eisler (Ed.), *Handbook of chemical risk assessment: Health hazards to humans, plants and animals* (pp. 201–290). Boca Raton, FL: Lewis.

Elicker, R. (2010). *Lead and Wildlife Ad Hoc Working Group presentation, findings, and recommendations*. Presented at the meeting of the Western Association of Fish and Wildlife Agencies, Anchorage, AK.

Environmental Protection Agency. (2004). Humans and lead fishing sinkers. Retrieved from

<http://water.epa.gov/scitech/swguidance/fishshellfish/humans.cfm>

Environmental Protection Agency. (2010). *Petition to the EPA to ban lead shot, bullets, and fishing sinkers under the Toxic Substances Control Act (TSCA)*. Document: EPAHQ- OPPT-2010-0681-0002.

Exec. Order No. 13,148, *Greening the government through leadership in environmental management*. Federal Register 65 (81), 24595–24605 (2000).

Exec. Order No. 13,423, *Strengthening federal environmental, energy, and transportation management*. Federal Register 72 (17), 3917–3923 (2007).

Feierabend, J. S. (1983). *Steel shot and lead poisoning in waterfowl: An annotated bibliography of research, 1976–1983* (Science and Technical Series no. 8). Washington, DC: National Wildlife Federation.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, PA: Addison-Wesley.

Fishbein, M., & Manfredo, M. J. (1992). A theory of behavior change. In M. J. Manfredo (Ed.), *Influencing human behavior: Theory and applications in recreation, tourism, and natural resources management* (pp. 29–55). Champaign-Urbana, IL: Sagamore.

Flynn, J., Slovic, P., & Mertz, C. K. (1994). Gender, race, and perception of environmental health risks. *Risk Analysis* 14, 1101–1108.

Franson, J. C., & Cliplef, D. J. (1992). Causes of mortality in common loons. In L. Morse, S. Stockwell, & M. Pokras (Eds.), *Proceedings from the 1992 conference on the loon and its ecosystem: Status, management, and environmental concerns* (pp. 2–59). Bar Harbor, ME: College of the Atlantic.

- Franson, J. C., & Smith, M. R. (1999). Poisoning of wild birds from exposure to anticholinesterase compounds and lead: Diagnostic methods and selected cases. *Seminars in Avian and Exotic Pet Medicine* 8, 3–11.
- Friend, M., Franson, J. C., & Anderson, W. L. (2009). Biological and societal dimensions of lead poisoning in birds in the USA. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 34–60). Boise, ID: The Peregrine Fund.
- Galili, E., Rosen, B., & Sharvit, J. (2002). Fishing-gear sinkers recovered from an underwater wreck site, off the Carmel coast, Israel. *The International Journal of Nautical Archaeology* 31, 182–201.
- Giner-Sorolla, R., & Chaiken, S. (1997). Selective use of heuristic and systematic processing under defense motivation. *Personality and Social Psychology Bulletin* 23, 84–97.
- Goddard, C. I., Leonard, N. J., Stang, D. L., Wingate, P. J., Rattner, B. A., Franson, J. C., & Sheffield, S. R. (2008). Management concerns about known and potential impacts of lead use in shooting and in fishing activities. *Fisheries* 33, 228–236.
- Griffin, C. R., Baskett, T. S., & Sparrowe, R. D. (1980). Bald eagles and the management program at Swan Lake National Wildlife Refuge. *Transactions of the 45th North American Wildlife and Natural Resources Conference* 45, 252–262.
- Grund, M. D., Cornicelli, L., Carlson, L. T., & Butler, E. A. (2010). Bullet fragmentation and lead deposition in white-tailed deer and domestic sheep. *Human-Wildlife Interactions* 4(2), 257–265.
- Guberman, D. E. (2007). Lead. In *US Geological Survey: 2007 minerals yearbook* (pp. 42.0–

- 42.18). Retrieved from <http://minerals.usgs.gov/minerals/pubs/commodity/lead/myb1-2007-lead.pdf>.
- Gumm, V. R., & Poleschook, D. P., Jr. (n.d.). Getting the lead out of fishing: Loon Lake, Washington. Retrieved from www.palouseaudubon.org/Misc/GetLeadOut.pdf
- Haroldson, M. A., Schwartz, C. C., Cherry, S., & Moody, D. S. (2004). Possible effects of elk harvest on fall distribution of grizzly bears in the Greater Yellowstone Ecosystem. *Journal of Wildlife Management* 68, 129–137.
- Harremoës, P., Gee, D., MacGarvin, M., Stirling, A., Keys, J., Wynne, B., & Guedes Vaz, S. (2002). *The precautionary principle in the 20th century: Late lessons from early warnings*. Sterling, VA: Earthscan.
- Hill, H. J. (2009). Taking the lead on lead: Tejon Ranch's experience switching to non-lead ammunition [Abstract]. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (p. 350). Boise, ID: The Peregrine Fund.
- Hohenemser, C., Kates, R. W., & Slovic, P. (1983). The nature of technological hazard. *Science* 220, 378–384.
- Hunt, W. G., Burnham, W., Parish, C. N., Burnham, K. K., Mutch, B., & Oaks, J. L. (2006). Bullet fragments in deer remains: Implications for lead exposure in avian scavengers. *Wildlife Society Bulletin* 34, 167–170.
- Hunter, B. F., & Rosen, M. N. (1965). Occurrence of lead poisoning in wild pheasant (*Phasianus colchicus*). *California Fish and Game* 51, 207.
- Jacobson, S. K. (2009). *Communication skills for conservation professionals* (2nd ed.).

Washington, DC: Island Press.

- Janssen, D. L., Kelts, D. G., Wiemeyer, S. N., Anderson, M. P., Oosterhuis, J. E., & Allen, J. L. (1986). Lead poisoning in free-ranging California condors. *Journal of the American Veterinary Medical Association* *189*, 1115–1117.
- Kates, R. W., & Kasperson, J. X. (1983). Comparative risk analysis of technological hazards (A review). *Proceedings of the National Academy of Sciences of the United States of America* *80*, 7027–7038.
- Kendall, R. J., Lacker, T. E., Jr., Bunck, C., Daniel, B., Driver, C., Grue, C. E., . . . Whitworth, M. (1996). An ecological risk assessment of lead shot exposure in non-waterfowl avian species: Upland game birds and raptors. *Environmental Toxicology and Chemistry* *15*, 4–20.
- Klinke, A., & Renn, O. (2002). A new approach to risk evaluation and management: Risk-based, precaution-based, and discourse-based strategies. *Risk Analysis* *22*, 1071–1094.
- Knopper, L. D., Mineau, P., Scheuhammer, A. M., Bond, D. E., & McKinnon, D. T. (2006). Carcasses of shot Richardson's ground squirrels may pose lead hazards to scavenging hawks. *Journal of Wildlife Management* *70*, 295–299.
- Knuth, B. A., Stout, R. J., Siemer, W. F., Decker, D. J., & Stedman, R. C. (1992). Risk management concepts for improving wildlife population decisions and public communication strategies. *Proceedings of the 57th North American Wildlife and Natural Resources Conference* *57*, 63–74.
- Kosnett, M. J. (2009). Health effects of low dose lead exposure in adults and children, and

- preventable risk posed by the consumption of game meat harvested with lead ammunition. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 24–33). Boise, ID: The Peregrine Fund.
- Kramer, J. L., & Redig, P. T. (1997). Sixteen years of lead poisoning in eagles, 1980–95: An epizootiologic view. *Journal of Raptor Research* 31, 327–332.
- Labare, M. P., Butkus, M. A., Riegner, D., Schommer, N., & Atkinson, J. (2004). Evaluation of lead movement from the abiotic to biotic at a small-arms firing range. *Environmental Geology* 46, 750–754.
- Lee, C. (1998). *Alternatives to cognition: A new look at explaining human social behavior*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Lewis, J. C., & Legler, E. (1968). Lead shot ingestion by mourning doves and incidence in soil. *Journal of Wildlife Management* 32, 476–482.
- Locke, L. N., & Bagley, G. E. (1967). Lead poisoning in a sample of Maryland mourning doves. *Journal of Wildlife Management* 31, 515–518.
- Manfredo, M. J. (2008). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. New York: Springer.
- Manfredo, M. J., Fishbein, M., Haas, G. E., & Watson, A.E. (1990). Attitudes toward prescribed fire policies. *Journal of Forestry* 88, 19–23.
- Manfredo, M. J., Teel, T. L., & Bright, A. D. (2004). Application of the concepts of values and

- attitudes in human dimensions of natural resources research. In M. J. Manfredo, J. J. Vaske, B. L. Bruyere, D. R. Field, & P. J. Brown (Eds.), *Society and natural resources: A summary of knowledge* (pp. 271–282). Jefferson City, MO: Modern Litho.
- Manfredo, M. J., Teel, T. L., & Henry, K. L. (2009). Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly* 90, 407–427.
- Meretsky, V. J., Snyder, N. F. R., Beissinger, S. R., Clendenen, D. A., & Wiley, J. W. (2000). Demography of the California condor: Implications for reestablishment. *Conservation Biology* 14, 957–967.
- Michael, P. (2006). *Fish and wildlife issues related to the use of lead fishing gear* (General Technical Report no. FPT 06-13). Olympia, WA: Washington Department of Fish and Wildlife, Fish Program.
- Minnesota Pollution Control Agency. (2010). Let's get the lead out! Retrieved from <http://proteus.pca.state.mn.us/oea/reduce/sinkers.cfm>
- Morgan, M. G., Fischhoff, B., & Bostrom, A. (1992). Communicating risk to the public. *Environmental Science & Technology* 26, 2048–2056.
- Na, E.-Y. (1999). Is biased processing of strong attitudes peripheral? An extension of the dual process models of attitude change. *Psychological Reports* 85, 589–605.
- Nadis, S. (2001). Getting the LEAD out. *National Wildlife* 39, 46.
- National Mourning Dove Survey. (2010). *National mourning dove hunter survey on*

awareness of the issue of lead poisoning, and attitudes about potential actions

[Unpublished report]. Update for North American Wildlife and Natural Resources Conference.

National Park Service. (2009a). National Park Service gets the lead out! [Press release].

Retrieved from <http://home.nps.gov/applications/release/Detail.cfm?ID=855>

National Park Service. (2009b). Clarification statement [Press release]. Retrieved from

<http://home.nps.gov/news/release.htm?id=857>

National Wildlife Refuge System. (2010). 2009-2010 Refuge-specific hunting and sport fishing regulations—additions, final rule. 75 Federal Register 18413–18427.

Nordic Council of Ministers. (2003). *Lead review* (Report no. 2003:1308). Retrieved from Nordic

co-operation webstie: http://www.norden.org/en/publications/publikationer/2003-1308/at_download/publicationfile

North Dakota Department of Health. (2008a). *Blood lead level study results* [Fact sheet].

Retrieved from www.ndhan.gov/data/mrFacts/BloodLeadLevelStudyResultsFactSheet.pdf

North Dakota Department of Health. (2008b). Food pantries notified about lead fragments

discovered in donated ground venison [Press release]. Retrieved from www.ndhan.gov/data/mrNews/Leadinvenison.pdf

Needleman, H. (2004). Lead poisoning. *Annual Review of Medicine* 55, 209–222.

National Rifle Association–Institute for Legislative Action. (2009). Lead ammo ban by National

Park Service an anti-hunting move [Press Release]. Retrieved from

<http://www.nraila.org/News/Read/NewsReleases.aspx?ID=12216>

Nontoxic Shot Advisory Committee. (2006). *Report of the Nontoxic Shot Advisory Committee submitted to Minnesota Department of Natural Resources Fish and Wildlife Division.*

Retrieved from http://files.dnr.state.mn.us/recreation/hunting/fawweb/nts/nontoxic_shot_report.pdf

National Shooting Sports Foundation. (2008). Firearms industry statement on results of CDC blood lead levels in hunters study [Press Release]. Retrieved from

www.nssf.org/news/PR_idx.cfm?PRloc=share/PR/andPR=110608.cfmandCFID=2

Nriagu, J. (1983). *Lead and lead poisoning in antiquity*. New York: John Wiley & Sons.

Oregon Department of Human Services. (2004). *Fishing weights contain dangerous levels of lead* [Brochure]. Retrieved from www.oregon.gov/DHS/ph/lead/docs/fishingb.pdf

Pain, D. J., Cromie, R. L., Newth, J. J., Brown, M. J., Crutcher, E. E., Hardman, P. P., . . . Green, R. E. (2010). Potential hazard to human health from exposure to fragments of lead bullets and shot in the tissues of game animals. *PLoS ONE* 5(4), e10315.
doi:10.1371/journal.pone.00- 10315

Pattee, O. H., & Hennes, S. K. (1983). Bald eagles and waterfowl: The lead shot connection.

Transactions of the 48th North American Wildlife and Natural Resources Conference 48, 230–237.

Pattee, O. H., & Pain, D. J. (2003). Lead in the environment (2nd ed.). In D. J. Hoffman, B. A.

Rattner, G. A. Burton Jr., & J. Cairns Jr. (Eds.), *Handbook of ecotoxicology* (pp. 373–408).

Boca Raton, FL: CRC Press.

Public Employees for Environmental Responsibility. (2009). Letter to Ken Salazar, Secretary of

- the Interior. Retrieved from www.peer.org/docs/nps/09_01_05_lead_ammoban_letter_to_salazar.pdf
- Perrins, C. M., Cousquer, G., & Waine, J. (2003). A survey of blood lead levels in mute swans *Cygnus olor*. *Avian Pathology* 32, 205–212.
- Petterson, J. (2009, November). *Non-lead ammunition, it's better for wildlife, it's better for people: Educational outreach approaches with hunters and ranchers in California*. Presented at the California Condor Outreach Workshop, Grand Canyon National Park, AZ.
- Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology* 19, 123–205.
- Petty, R. E., & Cacioppo, J. T. (1996). *Attitudes and Persuasion: Classic and contemporary approaches*. Boulder, CO: Westview Press.
- Petty, R. E., & Krosnick, J. A. (1995). *Attitude strength: Antecedents and consequences*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Personal Liberty Digest. (2009). Republican lawmakers criticize NPS ammunition ban proposal [Press Release]. Retrieved from www.personalliberty.com/news/republican-lawmakers-criticizenps-ammunition-ban-proposal-19394021/
- Pinnacles National Monument. (2010). *Lead bullet risks—Wildlife and humans*. Retrieved from www.nps.gov/pinn/naturescience/leadinfo.htm.
- Pokras, M. A., & Chafel, R. (1992). Lead toxicosis from ingested fishing sinkers in adult common loons (*Gavia immer*) in New England. *Journal of Zoo and Wildlife Medicine* 23, 92–97.
- Pokras, M. A., & Kneeland, M. R. (2008). Lead poisoning: Using transdisciplinary approaches to

- solve an ancient problem. *EcoHealth* 5, 379–385.
- Pokras, M. A., & Kneeland, M. R. (2009). Understanding lead uptake and effects across species lines: A conservation medicine approach. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 7–22). Boise, ID: The Peregrine Fund.
- Pulak, C. (1988). The Bronze Age shipwreck at Ulu Burun, Turkey: 1985 campaign. *American Journal of Archaeology* 92, 1–37.
- Rattner, B. A., Franson, J. C., Sheffield, S. R., Goddard, C. I., Leonard, N. J., Stang, D., & Wingate, P. J. (2008). *Sources and implications of lead ammunition and fishing tackle on natural resources* (Technical Review no. 08-01). Retrieved from The Wildlife Society website: <http://wildlife.org/documents/technical-reviews/docs/Lead08-1.pdf>
- Redig, P., Artz, N., Byrne, R., Heinrich, B., Gill, F., Grantham, J., . . . Wallace, M. (2003). *A report from the California condor lead exposure reduction steering committee, a subcommittee of the California condor recovery team* [Unpublished report to the US Fish and Wildlife Service]. Retrieved from www.biologicaldiversity.org/species/birds/California_condor/pdfs/LERSC-Report.pdf
- Responsive Management. (2003). *Hunters' knowledge of and attitudes towards threats to California condors* [Report to the US Fish and Wildlife Service California Condor Recovery Team and California Condor Lead Exposure Reduction Committee]. Retrieved from www.responsivemanagement.com/download/reports/AZ_Condor_Report.pdf
- Robbins, J. R. (2009). Washington weighs lead restrictions for anglers. Retrieved from www.nrahuntersrights.org/Article.aspx?id=2767

- Rogers, T., Bedrosian, B., Craighead, D., Quigley, H., & Foresman, K. (2009). Lead ingestion by scavenging mammalian carnivores in the Yellowstone ecosystem [Extended abstract]. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 206–207). Boise, ID: The Peregrine Fund.
- Ruth, T. K., Smith, D. W., Haroldson, M. A., Buotte, P. C., Schwartz, C. C., Quigley, H.B., . . . Frey, K. (2003). Large-carnivore response to recreational big-game hunting along the Yellowstone National Park and Absaroka-Beartooth Wilderness boundary. *Wildlife Society Bulletin 31*, 1150–1161.
- Sporting Arms and Ammunition Manufacturers' Institute. (1996). Lead mobility at shooting ranges (Catalog no. FD-1/708). Newtown, CT: National Shooting Sports Foundation.
- Sanderson, G. C., & Bellrose, F. C. (1986). A review of the problem of lead poisoning in waterfowl (Special Publication no. 4). Urbana-Champaign: Illinois Natural History Survey.
- Scherer, C. W., & Cho, H. C. (2003). A social network contagion theory of risk perception. *Risk Analysis 23*, 261–267.
- Scheuhammer, A. M., & Norris, S. L. (1995). A review of the environmental impacts of lead shotshell ammunition and lead fishing weights in Canada (Occasional Paper no. 88). Ottawa, ON: Canadian Wildlife Service, Environment Canada.
- Schroeder, S. A., Fulton, D. C., Penning, W., & Don Carlos, K. (2008). *Small game hunter lead shot communication study* [Executive summary]. St. Paul, MN: University of Minnesota, Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology.

- Schulz, J. H., Millspaugh, J. J., Washburn, B. E., Wester, G. R., Lanigan, J. T., & Franson, J. C. (2002). Spent-shot availability and ingestion on areas managed for mourning doves. *Wildlife Society Bulletin* 30, 112–120.
- Schulz, J. H., Reitz, R. A., Sheriff, S. L., & Millspaugh, J. J. (2007). Attitudes of Missouri small game hunters toward nontoxic-shot regulations. *Journal of Wildlife Management* 71, 628–633.
- Schweizer, S., Thompson, J. L., Teel, T. L., & Bruyere, B. (2009). Strategies for communicating about climate change impacts on public lands. *Science Communication* 31, 266– 274.
- Sears, J. (1988). Regional and seasonal variations in lead poisoning in the mute swan *Cygnus olor* in relation to the distribution of lead and lead weights in the Thames area, England. *Biological Conservation* 46, 115–134.
- Sears, J., & Hunt, A. (1991). Lead poisoning in mute swans, *Cygnus olor*, in England. In I. J. Sears & P. J. Bacon (Eds.), *Proceedings of the 3rd IWRB International Swan Symposium, Wildfowl Supplement* (pp. 383–388). Oxford: The Wildfowl and Wetlands Trust.
- Seng, P. T. (2006). *Non-lead ammunition program hunter survey* [Final report to the Arizona Game and Fish Department]. Retrieved from www.azgfd.gov/w_c/documents/AmmoSurveyFINALReport2-23-06_000.pdf
- Sieg, R., Sullivan, K. A., & Parish, C. N. (2009). Voluntary lead reduction efforts within the northern Arizona range of the California condor. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 341–349). Boise, ID: The Peregrine Fund.
- Skaggs, J., & Iverson, L. (2009). Grand Teton National Park and National Elk Refuge encourage

- voluntary use of non-lead ammunition during the 2009 elk and bison seasons [Press Release]. Washington, DC: NPS and US Fish and Wildlife Service.
- Slovic, P. (1987). Perception of risk. *Science* 236, 280–285.
- Slovic, P., & Peters, E. (1998). The importance of worldviews in risk perception. *Risk Decision and Policy* 3, 165–170.
- Smith, D. (2003). Lead tackle ban dropped; non-lead alternatives promoted [Press Release]. Retrieved from www.pca.state.mn.us/oea/reduce/sinkers-startribune030402.cfm
- Stone, W. B., & Okoniewski, J. C. (2001). Necropsy findings and environmental contaminants in common loons from New York. *Journal of Wildlife Diseases* 37, 178–184.
- Stowe, H. D., Goyer, R. A., & Cates, M. (1972). Lead poisoning in a wild turkey. *New York Fish and Game Journal* 25, 169.
- Stutman, R. K., & Newell, S. E. (1984). Beliefs versus values: Salient beliefs in designing a persuasive message. *Western Journal of Speech Communication* 48, 362–372.
- Sullivan, K. (2009). *Lead reduction program in Arizona*. Presented at the California Condor Outreach Workshop, Grand Canyon National Park, AZ.
- Teel, T. L. (2008). The science of communication: A few lessons learned from social psychology [PowerPoint slides]. Retrieved from http://welcome.warnercnr.colostate.edu/images/docs/climate_change_conf/teel_CSU.pdf
- Teel, T. L., Bright, A. D., Manfredi, M. J., & Brooks, J. J. (2006). Evidence of biased processing of natural resource-related information: A study of attitudes toward drilling for oil in the Arctic National Wildlife Refuge. *Society & Natural Resources* 19, 447–463.
- Theyerl, J. J., Petterson, J., & Garcelon, D. K. (2010). *California lead ammunition awareness*

- campaign, 2006–2009* [Report]. Arcata, CA: Institute for Wildlife Studies.
- Tunis, E. (1954). *Weapons: A pictorial history*. Cleveland, OH: World.
- US Fish and Wildlife Service. (1999). Establishing “lead free fishing areas” and the prohibition of the use of certain fishing sinkers and jigs made with lead on specific units of the National Wildlife Refuge system, 64 Federal Register 17992 (to be codified at 50 CFR 32).
- Vermont Fish and Wildlife Department. (n.d.) *Let’s get the lead out* [Brochure]. Retrieved from www.vtfishandwildlife.com/library/Factsheets/Fishing/Get_the_lead_out/Get_the_Lead_Out_Brochure.pdf
- Vogel, H. (2005). *The effectiveness of current legislation in mitigating loon mortality from the ingestion of lead fishing sinkers and jigs in New Hampshire*. Moultonborough, NH: Loon Preservation Committee of the Audubon Society of New Hampshire.
- Western Association of Fish and Wildlife Agencies. (2010). *Report from WAFWA Lead and Wildlife Ad Hoc Work Group* [Unpublished report]. Olympia: Washington Department of Fish and Wildlife.
- Warzecha, C., & Thiboldeauz, R. (2008, October 16). *Information for food pantries regarding the distribution of deer killed with lead ammunition* [Letter to food pantry managers]. Retrieved from <http://www.dhs.wisconsin.gov/eh/hlthhaz/pdf/foodpantryltr2008.pdf>
- Wisconsin Bird Conservation Initiative. (n.d.). What’s in your tackle box? Retrieved from www.wisconsinbirds.org/RackCard.pdf
- Westemeier, R. L. (1966). Apparent lead poisoning in a wild bobwhite. *Wilson Bulletin* 78, 471–472.
- Wilmers, C. C., Stahler, D. R., Crabtree, R. L., Smith, D. W., & Getz, W. M. (2003). Resource

- dispersion and consumer dominance: Scavenging at wolf- and hunter-killed carcasses in Greater Yellowstone, USA. *Ecology Letters* 6, 996–1003.
- Wilson, J., & Anderson, J. W. (1997). What the science says: How we use it and abuse it to make health and environmental policy. *Resources* 128, 5–8.
- Wilson, R. S. & Arvai, J. L. (2006a). Evaluating the quality of structured environmental management decisions. *Environmental Science & Technology* 40, 4831–4837.
- Wilson, R. S. & Arvai, J. L. (2006b). When less is more: How affect influences preferences when comparing low and high-risk options. *Journal of Risk Research* 9, 165–178.
- Wood, W. (2000). Attitude change: Persuasion and social influence. *Annual Review of Psychology* 51, 539–570.
- Wood, W., Rhodes, N., & Biek, M. (1995). Working knowledge and attitude strength: An information-processing analysis. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 283–314). Mahwah, NJ: Lawrence Erlbaum Associates.

CHAPTER TWO

Exploring the Meaning of Lead Use through a Basic Interpretive Qualitative Research Study

Introduction

Across the United States, the topic of lead released into the environment from hunting and fishing activities has increasingly attracted the attention of a wide array of audiences. By some estimates, millions of pounds of lead used in hunting, fishing, and shooting sports end up in the environment each year (Pokras & Kneeland, 2009; Rattner et al., 2008). Potential impacts to wildlife, humans, and ecosystems have prompted many entities to examine this topic of lead used for ammunition and fishing tackle in greater detail, particularly land, wildlife, and natural resource management agencies. In some cases this has led to actions being taken to manage human activities to prevent, reduce, or mitigate harmful effects. For example, the U.S. Fish and Wildlife Service (USFWS) instated a nationwide ban on the use of lead shot for waterfowl hunting in 1991 to prevent waterfowl mortality from lead poisoning (Nontoxic Shot Zones, 1991). Federal agencies have also banned the use of lead fishing tackle on lands with swan and loon populations; Yellowstone (Fishing Regulations, 2011) and Glacier National Parks (Fishing Regulations, 2012), and several National Wildlife Refuges (NWRs) have such regulations in place¹ (Refuge-Specific Hunting and Sport Fishing Regulations, 2012).

Management decisions regarding lead use have frequently been contested; in fact, this topic has been hotly debated and controversial among stakeholders for decades (e.g., Thomas, 2011; Wright & Tolbert, 1987). More broadly, contemporary interests in natural resource/wildlife-related issues are increasingly characterized by conflict, and by the public's

¹ See chapter 2 of this thesis for a broader overview of the actions that have been taken in the U.S. to address the impacts of lead in the environment from hunting and fishing activities.

expectation of being both informed about, and involved in, the process surrounding management decisions. Evidence of this situation can be found in diverging positions about appropriate management goals and strategies that have resulted in appeals and challenges through court cases, legislative proposals, and ballot initiatives (e.g., Craynon, Sarver, & Robertson, 2013; Molina, Marcot, & Leshner, 2006). Because issues are often highly complex and deeply contested, it can be particularly challenging for agencies to attend to the multitude of public interests and values at the root of the conflict that can affect the formulation and implementation of successful management solutions. These challenges have led to a realization of the need for information that can improve agency understanding of diverse stakeholder perspectives, and in response there has been growing involvement of social scientists and social science inquiry in natural resource decision-making (e.g., Decker, Brown, & Siemer, 2001; Manfredo, Vaske, & Decker, 1995; Mascia et al., 2003; Stankey & McCool, 2004). Past examples show that decisions made without this type of understanding of the social context can be met with much resistance and animosity, thereby diminishing the effectiveness of conservation efforts. This is especially true of controversial issues, for example species reintroduction in the U.S. (e.g., Alvarez, 1994; Fritts, Bangs, Fontaine, Brewster, & Gore, 1995).

Of particular interest here is the extent to which future decisions about the controversial topic of lead use could benefit from a better understanding of how people perceive this issue as well as actions under consideration to address it. Although some investigations have begun to explore public opinion regarding the use of lead ammunition, and

to a lesser extent fishing tackle², these studies have been narrowly focused on specific populations or groups, geographic locations, issues, and cognitive constructs. For example, research conducted in Arizona focused on hunters' knowledge and attitudes about the impacts of lead ammunition on California condors (Sieg, Sullivan, & Parish, 2009). While this emerging body of research contributes to an understanding of some of the attitudes about specific uses of lead and provides some recommendations for communication strategies, a broader understanding of the full array of viewpoints on this topic is needed to get a clearer depiction of the surrounding controversy that will continue to affect and challenge management responses.

Study Purpose

This study is part of a larger research project sponsored by the National Park Service (NPS) to provide information that could inform the agency's management and communication efforts aimed at minimizing the impacts of lead in the environment from hunting and fishing activities. The purpose of this study was to better understand the meaning stakeholders³ assign to issues involving the use of lead ammunition and fishing tackle. More specific objectives related to (a) how stakeholders make sense of actions that are being pursued, or could be taken, to manage human activities with a view to prevent, reduce, or mitigate negative impacts of lead use on the environment, wildlife, and/or humans; and (b) what are crucial aspects of human thought about lead issues and management actions that can contribute to an understanding of the controversy surrounding this topic. The assumption that controversy

² See chapter 2 of this thesis for a more in-depth review of human dimensions research on the topic of lead in the environment from hunting and fishing activities.

³ Grimble and Chan (1995, p. 114) define stakeholders as "all those who affect, and/or are affected by, the policies, decisions and actions of the system; they can be individuals, communities, social groups, or institutions of any size, aggregation or level in society."

existed was based on a review of literature (see Chapter 2 of this thesis) in which controversy surrounding the topic was well documented.

Methodology

A qualitative research design was chosen to understand the complexities of thought regarding lead use at a detailed level. A purposeful sampling technique was used in which information-rich cases were sought (Patton, 2002). Specifically, data collection focused on gathering information from: (1) documents in which individuals expressed what lead use and related issues and management strategies meant to them; and (2) participants who could provide rich descriptions of experiences related to professional involvement in efforts to minimize the use, or impacts, of lead ammunition and fishing tackle.

A basic interpretive qualitative study, with the author as the primary researcher, was undertaken in the summer of 2012. In general, qualitative research is interested in how meaning is constructed from the perspective of participants, and how people make sense of their lives and worlds (Bogdan & Biklen, 2007; Merriam, 2002; Patton, 2002). The primary goal of a basic interpretive qualitative study is to uncover and interpret the meaning of a particular phenomenon to individuals (Merriam, 2002). This is done through an exploration of how people interpret their experiences, how they construct their world, and what meaning they attribute to their experiences.

Data collection. Documents analyzed for purposes of this investigation included posts and associated comments from blogs related to hunting, fishing, and firearms that discussed the topic of lead ammunition and/or fishing tackle (the audiences for these blogs were most commonly participants in hunting or fishing, or were gun owners, and comments typically

explored a variety of topics related to those activities); comments to the Environmental Protection Agency (EPA) about a proposed lead-related regulation; and a deliberation hosted online (referred to as “e-deliberation”) specifically about the topic of lead in the environment. In these documents, which could be described as ‘unsolicited documents of life’ or ‘personal documents’, individuals described in their own words how they viewed lead use and related management actions. Personal documents have been used by social scientists for several decades and are defined as self-revealing records that yield information regarding the structure, dynamics, and functioning of the author’s mental life (Allport, 1943; Plummer, 2001). The second means of data collection involved semi-structured interviews with representatives from different agencies and organizations who had prior experience with the lead use topic. Below is a more detailed description of document sources and interview methodology.

Blogs. A blog (more formally called a weblog) is a website containing posts, usually written by a single author, that are reverse chronologically ordered and archived (Bar-Ilan, 2005; Herring, Scheidt, Bonus, & Wright, 2005; Serfaty, 2004). Posts can be updated as frequently as an author desires and immediately published to the web. A feedback feature allows readers to comment on specific posts, and to respond to others’ comments on a post. Blogs offer many benefits for data collection; they allow for unobtrusive observations of contributors’ private thoughts in a natural context (i.e., they occur in a real-world setting, in this case a web-based setting, and the researcher does not attempt to manipulate the phenomenon of interest; Patton, 2002). Additionally, because of the anonymity of online interactions, blog authors and readers who comment may be less self-conscious about what they write (Hookway, 2008; Gurak & Antonijevic, 2008), thereby reducing social desirability bias inherent

in other forms of data collection such as interviews and focus groups. In fact, Hookway (2008) and Williams and Merten (2008) found that the online context encouraged contributors to reveal more information than traditional methods.

Data for this study were collected in the summer of 2012 from five blogs, which contained posts that addressed the use of lead ammunition and/or fishing tackle. Initially, blogs were identified through discussions with agency staff, as part of the larger NPS project, and then additional blogs were located by exploring links in these blogs. Two of the blogs selected focused on hunting topics, two on fishing, and one on sport shooting, the firearms industry, and hunting with a particular focus on gun rights and government actions. As previously stated, the blogs were originally identified because they contained content related to lead ammunition and/or fishing tackle, and once these were identified, the blogs were searched for all posts related to this topic. To be included in the dataset a post had to receive comments; while the perspective of the post's author was of interest, examining how individuals responded to the topic and to each other was also of interest. Few blogs had more than one post that met this criterion, but for those that did, posts were selected based on the richness of content from the perspective of the researcher. Selected posts received between 19 and 151 comments. Table 2.1 provides additional information about the blogs to aid with interpretation of the study findings.

Comments to the EPA. On August 3, 2010, the Center for Biological Diversity, American Bird Conservancy, Public Employees for Environmental Responsibility, Association of Avian Veterinarians, and the hunters' group Project Gutpile petitioned the EPA to enact a nationwide regulation that would ban the production and sale of lead bullets, lead shotgun pellets, and

Table 2.1. Additional information about the blogs to aid with interpretation of the study findings.

Blog Title (Abbreviation)	Post Title	Post Date	Comments
The Gun Nut (GN)	Thoughts on Lead Bans	3/25/2009	94
The Honest Angler (HA)	What's The Big Deal About Lead Sinker Bans?	2/15/2010	23
NSSF Blog (NSSF)	EPA Considering Ban on Traditional Ammunition – Take Action Now	8/25/2010	151
The Hog Blog (HB)	Lead Ban Chronicles - Hog Blog in the news	3/4/2009	31
	Lead Ban Chronicles - What's New(s)?	2/3/2011	30
	Lead Ban Chronicles - Breaking News - Ventana Wildlife Society Providing Lead-Free Ammo to Central Coast Hunters	3/27/2012	33
Mark Byrne's Blog- WAFishing.com (WA)	Washington Lead Tackle Ban 2012	1/14/2012	19

lead fishing sinkers. A federally-mandated public comment period was then open from August 25 through September 15, 2010, allowing members of the public to submit comments on the petition to the EPA through Regulations.gov. This site is a source of information on the development of federal regulations and other related documents issued by the U.S. government. Through this site, one can find, read, and comment on personally-relevant regulatory issues. Comments submitted by other means (e.g., email, handwritten letters) are also accepted and uploaded to Regulations.gov. According to the website, 17,685 comments were received directly online or through other means (as of November 28, 2012), but only 6,657 comments were posted in the summer of 2012 when data were collected. One reason for the discrepancy was that bulk submissions that were part of mass campaigns were not uploaded to the site; however, submissions that were part of mass campaigns that were individually submitted were uploaded to the site, and as a result there were many comments that were identical. A subset of the comments from this site was reviewed based on the following criteria:

1. Instead of merely expressing support for or opposition to the ban proposed by the petition, selected comments included additional information allowing deductions of the respondents' reasons or basis for their opinions.
2. Selected comments were unique (i.e., not part of duplicate postings associated with mass campaigns) and written in the contributor's own words.

The identification numbers for all the comments available on Regulations.gov were entered into an Excel spreadsheet and randomly sorted. Comments were analyzed in the randomized order until successive examination of the source yielded redundancy, indicating that the data seemed complete and integrated (Creswell, 2007). One hundred and eighty-two comments were ultimately included in the final analysis.

E-deliberation. An online deliberation, or "e-deliberation", about the topic of lead ammunition and fishing tackle took place as part of the Deliberative E-Rulemaking (DeER) Project. The DeER Project is a National Science Foundation-funded project led by researchers at University of Albany, State University of New York (SUNY) and Texas Tech University (Muhlberger, Webb, & Stromer-Galley, 2008). The goal of DeER was to implement and test technological solutions and deliberative methods to improve the quality of public comments made to state and federal government agencies. Researchers from the participating universities worked with government agencies to determine e-deliberation topics for particular issues that were of interest, and where input could inform possible management and/or communication strategies. During the e-deliberation, participants could discuss and debate common concerns, access information about the topic, and reflect upon and revise their understanding of the topic.

The “Lead in the Environment” e-deliberation was one that came about when NPS staff brought the topic to the attention of DeER researchers. This topic met with the researchers’ needs on several levels, and they worked with NPS staff and researchers at Colorado State University to obtain background materials and develop questions to explore as part of the e-deliberation process. The e-deliberation lasted for one month, beginning at the start of August and ending on September 3, 2010. While 162 people initially signed up to participate in the e-deliberation, 14 people ultimately participated, producing 33 posts. In a post-discussion follow-up survey, the most common reason individuals identified for not participating was a lack of time. To begin the e-deliberation, participants were asked to discuss the assumption that there is a problem with lead ammunition and fishing tackle in terms of its impacts on the environment, and then move on to discuss ways that federal and state agencies could respond to concerns about lead introduced onto public lands by hunting and fishing activities.

Some descriptive data about the 14 e-deliberation participants were available from a pre-discussion questionnaire. All but two individuals indicated they either hunt (n=11) and/or fish (n=10); nine indicated they belonged to a sportsman’s organization; seven belonged to an environmental organization; two were affiliated with state fish and wildlife agencies; and one was affiliated with a federal agency.

Interviews. The primary researcher conducted five semi-structured telephone interviews in the summer of 2012. Interviews ranged in length from 35 to 55 minutes each and were digitally recorded and then transcribed. Individuals were purposefully selected based on their professional involvement in efforts to minimize the use or the impacts of lead-based ammunition and fishing tackle. Two individuals were associated with non-profit organizations,

two with federal agencies, and one with a state agency. All participants were asked to describe how their professional careers dealt with the use of lead ammunition and/or fishing tackle, their perceptions of lead use and its impacts on the environment, and common public/stakeholder perceptions about lead use they may encounter through their work (see Appendix). Additional questions of interest evolved organically during the individual interviews.

Data analysis. Coding of the interviews and documents from blog, EPA petition, and e-deliberation comments was conducted using a constant comparative analysis approach; the primary researcher examined the data set for repeated patterns and meaning and then related the findings to the literature (Strauss & Corbin, 1998). Review of the data and preliminary analysis were done sequentially, as this allowed for emerging themes to influence subsequent analysis. All of the interviews and documents were read repeatedly and then read line-by-line; then, they were coded using Dedoose (2012). With this software, key words or phrases that described the content were applied to segments of text. Consistent with a constant comparative analysis approach, initial codes were applied to later data; new codes developed as new themes emerged; and some initial codes were revised. After repeated readings of the coded documents, related codes were then grouped together into major themes. To enhance confidence in the findings, triangulation of the data was accomplished by drawing from multiple sources so that different times, levels of interaction between individuals, and a variety of people were represented. External reflection and input from peer reviewers also helped in an effort to enhance the credibility and trustworthiness of the findings (Creswell, 2007).

Findings

The following section contains information about the patterns and themes that emerged in the data. Quotes drawn from interview transcripts have been edited; verbal pauses, false starts, and stutters have been removed. Quotes drawn from documents have also been edited; the researcher's judgment was used to remove grammatical errors and typos that interrupted flow and readability, but grammatical nuances that added emphasis or are common vernacular were not altered. Although there is some concern that editing words can inadvertently alter meaning (Neufeld, Marchessault, & Dean, 2006), only minor edits were made and, for the purposes of this study, the primary researcher believes that the quotes remain faithful to the individual's intent while greatly improving the flow and readability. Some quotes contain derogatory language or profanity which was not edited in the text; in some cases it may appear as though language was censored by the researcher, but unless words appear in brackets they are unedited. The names of interview participants have been changed to ensure confidentiality. In other data sources, alphanumeric codes replace any identifying information, including online pseudonyms. These codes consist of initials that represent the data source, followed by an arbitrary numeric code unique to the contributor (see Table 2.1 for blog initials; EPA is used for comments to the EPA; DeER is used for comments from the e-deliberation). For example, if the comment was from The Gun Nut it would be labeled GN-123, where 123 is the code for the contributor.

Findings are presented in two major sections. First, broad *patterns* that emerged in the data related to how individuals evaluate the use of lead ammunition and fishing tackle and management actions that could be taken (or not taken) in that context are presented. These

patterns provide an overarching frame of reference for the subsequent findings reported in Section 2, which consist of the more specific *themes* that were identified in the data. The major themes are represented by subsection headings, which are essentially codes that were applied during the data analysis phase. Section 2 begins with an overview of theoretical frameworks from the social sciences that provide a foundation for interpreting the meaning of the themes. Consistent with common approaches employed in truly qualitative research, no frameworks or expectations guided the research at the outset (Creswell, 2007; Mitchell & Cody, 1993); these frameworks were identified inductively as a way of explaining the observations and interconnected ideas that emerged during data analysis. A wide variety of theoretical frameworks from social science disciplines were explored, including social identity theory (e.g., Ellemers, Spears, & Doosje, 2002; Hogg & Abrams, 1988; Tajfel, 1972, 1974, 1978; Tajfel & Turner, 1979; Turner, 1982, 1999; Turner & Giles, 1981), self-categorization theory (e.g., Turner, 1985, 1999; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987), and theories of intergroup bias (e.g., Brewer, 2001; Brewer & Brown, 1998; Brown & Gaertner, 2001; Hewstone, Rubin, & Willis, 2002), which were used to interpret the thematic structure of the responses.

I. Broad Patterns from the Data

Overall attitudes toward lead use. The attitudes⁴ toward lead use that emerged from the data can be viewed as existing along a continuum. At one end of the continuum are individuals who have strong positive attitudes toward the use of lead ammunition and fishing tackle; on the other end are individuals who have strong negative attitudes toward the use of

⁴ Attitudes are defined as an evaluation (e.g., good/bad, favorable/unfavorable) of a particular entity or issue (Ajzen & Fishbein, 1980; Eagly & Chaiken, 1993), in this case representing how individuals felt about the issue of lead in the environment from hunting and fishing activities and management actions to address this situation.

these sources of lead. In the middle of the continuum are individuals whose attitudes may depend upon the situation, or who were undecided in their evaluation of lead use⁵ (Figure 2.1).

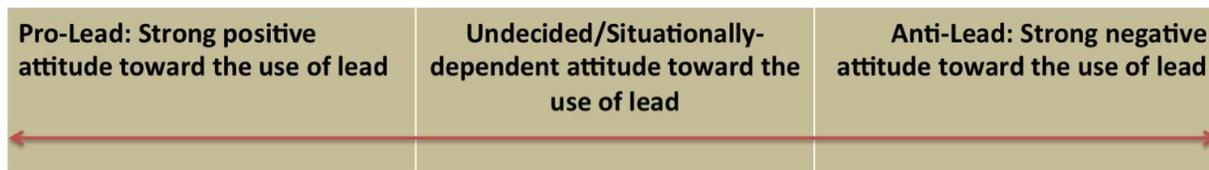


Figure 2.1. Continuum of attitudes toward the use of lead ammunition and/or fishing tackle.

While it is important to acknowledge that individuals fall all along this continuum, the majority of attitudes represented in the data were clustered at opposite ends of the continuum. In each data source there tended to be a predominance of a particular attitude represented, although there were some dissenting attitudes in all sources. Strong positive attitudes toward lead use were more common in the blogs and EPA petition comments, while the interview and e-deliberation responses were more heavily dominated by individuals with negative attitudes. The quotes below demonstrate how various attitudes were expressed in the data.

Pro-Lead Attitude:

Lead cored ammunition is the way it is because it is the only commonly available material with the density and malleability to function as a practical small arms projectile. Other materials might eventually be cheaper, yet shooters still prefer lead cored ammunition because of its far superior exterior ballistic performance. (EPA-187)

I would like to point out that for hundreds of years lead sinkers have been used along with other lead products, without the effects causing drastic harm. [...] lead is the most practical thing for sinkers. (HA-167)

⁵ Typically, on attitudinal variables, the middle ground also represents individuals who may be more neutral with respect to a topic because of less knowledge or less interest. However, this was not detected, as the topic of lead use appeared highly salient to individuals represented in the data.

Undecided or Situationally-Dependent Attitude:

I'm split on the issue. On one hand, most of my tackle (and some of my favorite lures) contain lead. On the other, I am not aiming to harm the environment and lead alternatives work just as well if not better. It's a tough call to make. (HA-29)

While I remain skeptical about the effects of lead ammo used in [hunting] grouse, deer, elk, etc., if it is ever proved that the lead from my guns is hurting any species, swans, raptors, buzzards, etc., I will switch to lead free ammo. (GN-201)

Anti-Lead Attitude:

Lead is clearly a dreadful biologic poison, harmful to all life when ingested or otherwise penetrating the body, even in small doses. We've gotten the lead out of gasoline and paint; we now need to get it out of all hunting ammunition and all fishing tackle. (DeER-117)

I'm doing just fine using steel shot waterfowling; maybe it's about time we start taking the lead out of fishing too. It's some pretty nasty stuff and you don't want it in your water. (HA-182)

Lead is bad stuff, even in tiny amounts that don't make you feel sick but can eventually kill you prematurely. Sort of like cholesterol, you don't feel the tiny amount in your bloodstream until you have a heart attack and die! (DeER-180)

Overall preferences for management actions. Different perspectives about actions to be taken, or not taken, to manage human activities with a view to mitigate potential negative impacts of lead in the environment were also represented in the data. Overall, the primary focus was on regulatory actions that would ban the use or production of lead ammunition and

fishing tackle. This was particularly the case for EPA comments (as would be expected given that the focus of the petition under review was on proposing a ban) and many of the blog posts and associated comments. Voluntary approaches were also frequently discussed as a management option, particularly in the interviews and e-deliberation. These approaches refer to encouraging self-regulation of activities linked to lead-related impacts and encompass a range of different actions; in general, they involve raising awareness through outreach and education initiatives with the goal of influencing stakeholders' choices and behaviors, and/or offering incentives to encourage desired behavior change (e.g., using non-lead alternatives rather than lead ammunition or fishing tackle). It is important to note that the actions described were not always viewed as mutually exclusive; aspects of both could occur simultaneously. The actions encompassed by voluntary approaches, in particular, were often viewed as important elements that ought to accompany any action taken to manage lead use.

Pro-lead preferences for management actions. Referring back to the attitude continuum, those with pro-lead attitudes tended to prefer that no action be taken to manage lead use. Generally, their reactions consisted of strong opposition to regulatory actions, as indicated by the sample quotes below.

NEVER!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! (NSSF-280)

Holy frickin' crap. This would not be good. (WA-192)

The pro-lead group did not reflect upon voluntary approaches as frequently, but there were instances where individuals expressed resistance to voluntary compliance or skepticism about voluntary efforts. For example:

I am [...] concerned that by voluntarily switching to green ammo we will inadvertently throw all of us lead shooters under the bus. (HB-51)

When the 'voluntary ban' is a set up for a progressive, incremental and total ammunition ban, that is when counter-activism is warranted.[...] Another way that I am sure you are familiar with is to hire polling and public image firms and 'tweak' a message with enough one-tailed 'conclusions' and factoids to obtain an agenda goal. When one sees records of a polling company involved with the various program efforts whose billing nearly matches the annual expenditure for one year's worth of subsidized ammunition in Arizona, one wonders as to what is really going on behind the scenes. To me personally, these approaches are potentially two sides of the same coin. (HB-24)

Anti-lead preferences for management actions. In general, those with negative attitudes toward lead use desired some action to be taken to manage human behavior. Outreach and education were overwhelming viewed as essential to any action, as the examples below demonstrate.

Outreach and education has to be the key. I don't care what the mitigating effort is, whether it is a voluntary or mandatory ban, it doesn't matter. The bottom line is education and outreach. (Roger)

You know, ban or voluntary, the key is education and buy-in. It's not whether it's mandatory or voluntary, it's whether the people involved actually want to change their behavior. (Joan)

Desires for management actions to be used in *conjunction* with outreach and education diverged based on views about the essential requirements for delivering the best outcomes.

Most commonly, there were different views about the use of regulations or voluntary approaches.

There were many in the negative attitude group who expressed negative sentiments about regulations. This is evidenced by the dysphemistic phrases below that were used to describe this type of action:

Hitting them over the head with a law. (Don)

Regulations [are] wielded as a stick. (Don)

[Have] it forced down their throat. (Pete)

Instead of using the stick...why doesn't the government use a carrot or two. (DeER-145)

In contrast, voluntary approaches were described as being more appreciated and associated with such notions as empowerment and being treated with respect:

Getting people to feel empowered. (Don)

If folks had not heard about the issue before, just being presented the information on it, they were very appreciative whether they agreed with it or not, they were very appreciative that we were providing that information and letting hunters make their own choice. And not so much with the legislation, obviously no one likes to be told what they're doing is wrong and then told what to do to fix it, they would much rather come to that conclusion on their own and make the decision on their own. (Paul)

As you can imagine, people don't like to be forced to do things, they'd rather be treated with respect and asked to do things. (Joan)

Some viewed voluntary approaches as the most effective, lasting means of preventing, reducing, or mitigating harmful effects of lead on wildlife or humans.

Changing the law doesn't change people's behavior necessarily. Long-standing behavioral changes come from information and where people are willing to participate.
(Roger)

By the same token, others felt that voluntary approaches are inadequate, and regulations are the only way to reduce lead use and the resulting impacts.

178 stated emphatically that reliance on voluntary actions never work, and he seems to speak from considerable experience. My own experiences lead me to agree with him completely.[...] Likewise, I have serious doubts that local, regional, or even state-wide restrictions on the use of lead projectiles can be very effective in significantly reducing the exposure of human beings and wildlife to lead from spent bullets and shot, contrary to what seems to be the underlying assumption in the minds of the organizers of this deliberation. Again, as 178 noted, most state wildlife agencies and commissions will be reluctant to stick their necks out and take action, especially in regard to bullets, and would prefer for somebody else to take care of the problem for them.[...] For the past five years I have been convinced that the only effective, permanent solution to the problems [...] has to be some form of national (federal government) requirement.

(DeER-188)

In the previous example, the e-deliberation participant not only believes that voluntary action will not work, but only a nationwide, federally imposed regulation would be effective.

While not a direct management action, market dynamics were often treated as a third driver of human behavior that influenced whether lead use was maintained or changed. Factors

such as the cost of lead and non-lead ammunition and fishing tackle, and the forces of supply and demand were regarded as most instrumental.

Perspectives on the impacts of market forces. Market forces were viewed by those with pro-lead attitudes as a barrier to modifying the use of lead; non-lead ammunition and fishing tackle were generally viewed as cost prohibitive and this was regarded as a stable quality of the market that would not be influenced by supply and demand. To illustrate:

The cost impact on individual hunters and fishermen like myself would be detrimental. (EPA-184)

Lead costs \$2.00/pound retail, Bismuth \$14.00/pound. Bismuth's price will not come down, it will actually go up because there is not much supply nor will there be. (HA-152)

I couldn't imagine paying for tungsten football heads or drop shot sinkers. I couldn't afford to fish anymore. (WA-101)

Similar to those with pro-lead attitudes, the increased cost of non-lead ammunition and fishing tackle was sometimes viewed by those with anti-lead attitudes as a barrier to reducing lead use:

[The] issue that often comes up is still cost. People really don't like to pay more if they have something that already works. (Pete)

[The] problem is an uninformed populace, who use the cost of a product as the sole factor in making purchasing decisions. If we can spend less and get more, we are happy. (DeER-140)

I would fish lead substitutes, if the states made a rebate program or somehow cheapened the price. I LOVE tungsten weights, but at 8 bucks for one 1oz flippin' weight, that's a little hard. (HA-40)

The following quotes express a different perspective held by those with anti-lead attitudes about the increased cost, suggesting that it is not a major issue or constraint.

I spend a lot of money each year to hunt and fish (I am not rich), but spending a few more dollars to protect the environment is no big deal. It is worth it in the long run. If more manufacturers make non-lead ammunition then the cost will go down. It has happened with steel shot and will happen with bullets as well. The cost argument is bogus! (DeER-171)

I don't think price is a legitimate issue, hunters tend to buy the best products on the market, but even if so, price will eventually drop as demand increases and competition between products and choices expand. (DeER-178)

These examples also suggest that changes in supply or demand may eventually decrease the cost of alternatives. Supply and demand dynamics were additionally viewed by some as affecting, or being affected by, regulations. The following quotes illustrate these relationships:

I fully understand that there are many companies employing vast numbers of people who make their living manufacturing lead-containing products. It is unfortunate that banning and phasing out all lead ammunition may eliminate jobs and cause economic hardship. Nevertheless, technology will evolve, businesses will adapt, economies will supply if the public demands. (DeER-172)

If a demand for non-lead products based upon their superior effectiveness is developed, the market will follow, and resistance to legislation or regulation may be reduced to the point where it actually becomes possible instead of a pipe dream to be debated by academics. (DeER-178)

In summary, the patterns described above reveal the presence of different and oppositional attitudes about lead use and related management strategies. As additional, more detailed findings from the data presented below will reveal, the topic of lead use for ammunition and fishing tackle is heavily characterized by conflict that can be better understood through an examination of the underlying meanings that people assign to this topic.

II. Major Themes from the Data

Guiding theoretical frameworks. Research suggests that individuals' perceptions of conflicts related to conservation issues may be shaped by the particular value systems of the groups they belong to (e.g., Stoll-Kleemann, 2001, 2004). Group membership itself can be a key explanation for conflicts, and important contributions to understanding this process are provided by the social identity approach, subsuming social identity theory (e.g., Ellemers et al., 2002; Hogg & Abrams, 1988; Tajfel, 1972, 1974, 1978; Tajfel & Turner, 1979; Turner, 1982, 1999; Turner & Giles, 1981) and self-categorization theory (e.g., Turner, 1985, 1999; Turner et al., 1987), and also by theories of intergroup bias (e.g., Brewer, 2001; Brewer & Brown, 1998; Brown & Gaertner, 2001; Hewston et al., 2002). An overview of these theoretical frameworks is provided here to offer the relevant background necessary to understanding the discussion and interpretation of the major themes from the data that follow.

Social identity theory (SIT) was originally developed as a theory of intergroup relations to explain aspects of racism, prejudice, and discrimination (e.g., Tajfel, 1969,1970; Tajfel & Wilkes, 1963). Tajfel (1981) defines social identity as “that part of an individual’s self-concept which derives from his knowledge of his membership in a social group (or groups) together with the value and emotional significance attached to that membership” (p. 255). There are two components to this definition: (a) the belief that one belongs to a group; and (b) the importance and felt attachment one attributes to that group membership. Social groups exist when a collection of individuals perceive themselves to be members of the same social category and share a common definition of themselves (Tajfel & Turner, 1979). An individual’s self-concept can consist of many distinct group identities that vary in their overall importance and how accessible they are in certain situations (Hogg, 1996). In sociology and social psychology, a social group to which a person psychologically identifies as being a member is referred to as an in-group. Categorization and self-enhancement are the underlying cognitive processes that account for social identity phenomena.

Categorization is a cognitive process by which individuals assign people, including themselves, to contextually-relevant categories (Hogg, 1996; Turner & Reynolds, 2001). This process is driven by the basic need to impose meaning on the world, and because the world is complex and ever changing, to do so in a simplified manner (Tajfel, 1969; Oakes, Haslam, & Turner, 1994). To categorize someone, or even something, is to assume they possess characteristics that subjectively represent that category, and whether accurate or not, this allows for impressions to be made quickly and efficiently. In relation to social identity,

categorization defines intergroup boundaries, producing group stereotypes and normative⁶ perceptions and actions.

Self-enhancement is a process that refers to the basic need people have to view themselves in a positive light in relation to others (Hogg, 1996). In group contexts, this is achieved through evaluation of the in-group in a positive light in relation to out-groups (i.e., groups an individual does not identify with) that are relevant for comparison. This guides the categorization process in such a way that in-group norms and stereotypes are largely in-group favoring.

Self-categorization theory (SCT) elaborates on how the process of categorization affects self-definitions, and in turn regulates social interactions (Hogg, 1996; Turner, 1985; Turner et al., 1987). Basically, this entails assimilation of the self to the in-group category prototype whereby a person acts in accordance with group norms and perceives oneself as representing the group, not as an individual. In the same way, out-group members are not viewed as individuals, but as prototypical members of the relevant group, which may perpetuate, or give rise to, stereotypical beliefs about members of out-groups (Ellemers, 2012; Ellemers et al., 2002; Tajfel & Turner, 1979). Like social identity, categorization is regarded as a dynamic process that is context-dependent and determined by which comparative group or comparative domain provides the frame for one's judgments (Hogg, 1996). For example, at a baseball game, categorizations of oneself and others may be made on the basis of which team a person supports, whereas, in a university setting, categorizations may be made on the basis of which

⁶ In social psychology the concept of norms has more than one meaning (Shaffer, 1983). For these purposes, normative perceptions and actions refer to descriptive norms. Descriptive norms describe what is typical or normal and specify what is typically done (Cialdini, 2001).

department a person belongs to. At the baseball game, the categorizations that are relevant in the university setting may be irrelevant, and vice versa.

The social identity approach suggests that when a particular social identity is accessed in a given situation, it may shape one's self-perception and conduct in important ways (Hogg, 1996) and help explain why individuals in intergroup situations do not interact as individuals, but as members of the relevant in-group. The idea of an interpersonal-intergroup continuum was part of the evolution of SIT (Tajfel, 1974; Tajfel & Turner, 1979). The interpersonal extreme of the continuum describes interactions between individuals that are based solely on their individual characteristics and personal relationships, and that are not at all affected by various social groups or categories. The intergroup extreme refers to interactions that are based solely on the respective social category memberships of those involved, and that are not affected by their individual characteristics. While it is unlikely that either extreme exists in a "pure" form, certain conditions are thought to determine which extreme individuals' social behavior will tend towards. According to Tajfel and Turner (1979), "the more intense is an intergroup conflict, the more likely the individuals who are members of the opposing groups will behave toward each other as a function of their respective group membership, rather than in term of their individual characteristics or interindividual relationships" (p. 34).

Theories of *intergroup bias* elaborate on the factors that contribute to in-group favoritism and out-group derogation. In-group favoritism may include the extension of trust, positive regard, cooperation, and empathy to members of the group but not the out-group (Brewer & Brown, 1998). This is distinguished from out-group derogation, which is intergroup bias that includes elements of aggression, antagonism, hostility, and/or belittling of an out-

group (Hewstone et al., 2002). One of the factors of intergroup interactions that may lead to out-group derogation is perceived threat to the in-group's social identity, its goals and values, and even its existence.

The frameworks discussed above were used to facilitate interpretation of the underlying themes detected in the data for meanings people assigned to lead use issues, which seemed to center largely around intergroup conflict. Because these themes differed to some extent by the type of attitude (i.e., positive v. negative) toward lead use that was being exhibited, themes are divided into two sub-sections below. However, this is not intended to suggest a directional relationship in which attitudes determined how meanings were constructed.

Major themes from the data associated with pro-lead attitudes. One's identity as a member of a particular group or groups (e.g., hunters, anglers, sport shooters, gun owners⁷) provides the framework for how individuals with pro-lead attitudes understand the use of lead ammunition and fishing tackle and related management strategies. Coupled with the importance of their in-group membership are subjective perceptions about out-groups, in particular the belief that these out-groups pose a threat to their values, customs, and traditions. Throughout the data, out-groups were identified as "anti-hunters", "anti-guns", "animal rights activists", and "environmentalists", and with political labels like "liberals", "socialists", "the left", and "communists" among others.

Nationality identity. Nationality identity is one group identity or social category that was detected in the data in relation to individuals' reactions to lead use issues. In this case, national identify refers to identifying oneself as an American. The following quotes

⁷ It is important to note that identification with a particular stakeholder group, like hunters, exists all along the continuum, but those in the pro-lead group contextualize lead use in a different way than those in other groups.

demonstrate this connection and are in reference to proposed regulations prohibiting the use of lead:

Personally I think all of our current administration and politicians, along with all these anti-gun idiots, should be rounded up and fed some lead. Another example of our out of control government wanting total domination and control of the American people. It is past time to stop the stupidity going on in Washington! (NSSF-808)

Quit trying to pass YOUR WILL on the American Population [...]. You, like Obama, are ruining the America that I LOVE. If you want my Bullets, Come and get them, I dare you to try. People like YOU and the People who THOUGHT THIS UP, are taking my LIBERTY. (EPA-87)

If you pass this law, you commit another travesty and farce that only aids in stripping another American right. This seems to be a common occurrence as of late. Please protect our rights, or you are not American!!! (EPA-36)

I do not want the government to control any more of our lives; putting a ban on lead sinkers and ammo is just another way of trying to control our gun rights by increasing the cost of ammo. Leave us alone and let us be Americans!!!!!!!!!! (EPA-107)

While one's status as an American is generally viewed as a matter of citizenship, in this context it symbolically refers to the qualities regarded as definitive of America or Americans. Individuals are viewed as un-American because they do not exhibit these qualities. Being un-American can be viewed as an out-group in and of itself, but it also may be a characteristic attributed to other out-groups like "anti-gun idiots", Obama, the "current administration and politicians", and the EPA (the "you" referent). Phrases like "another example" and "a common occurrence as of late"

reveal the in-group perception that intergroup conflict exists in general, and not only in regards to lead use.

Liberty and freedom. In an introduction to a special issue of *Applied Developmental Science* on American Identity, Damon (2011) states:

A belief that the United States stands for certain elevated ideals has long been part of the American identity, both at home and abroad.[...] High on the list of the defining ideals that have shaped American identity are freedom and democracy. (p. 51)

Tied to the above-mentioned theme of nationality, freedom and democracy are the particular qualities regarded as definitive of America or Americans, and they are also highly relevant to other in-group identities. There exists among in-groups the subjective perception that out-groups pose a threat to these values. In one sense, freedom may be viewed in the broader context of liberty, i.e., the state of being free within society from oppressive restrictions imposed by authority on one's way of life, behavior, or political views (Cranston, 1967). For instance, one of the quotes appearing above states: "People like YOU...are taking my LIBERTY"; the quotes below elaborate on this idea and are in reaction to what are viewed as oppressive restrictions by authority:

To quote Barry Goldwater: 'Extremism in the defense of liberty is no vice.' It beats being disarmed gradually, in any case. (HB-11)

Don't even think about banning lead bullets. That is just a backdoor attack on the Second Amendment. 'When the people fear the government, there is tyranny. When the government fears the people, there is liberty' – Thomas Jefferson. I vote for liberty! (EPA-196)

In the field of psychology, freedom is recognized as a basic value that is motivated by the desire for independent thought and action, or in other words, the desire to make one's own choices (Schwartz, 1992, 1994). Freedom is similar to liberty but distinct. Liberty refers to rights possessed in common by people of a community, state, or nation as they apply to its government, while freedom is the exemption from control by another person, or arbitrary restriction of specific rights (Cranston, 1967)⁸. The following quotes show to what extent freedom to make one's own choices is an important goal:

This is a great country because we can all choose to be different and to do different activities. It's called 'freedom' and it is why all other countries envy us. (EPA-74)

Remember, you have no right to choose the ammunition that I buy and hunt and shoot with. (EPA-181)

I don't want to hurt loons (birds), but I don't want loons (people) telling me what I can and can't do. (HA-63)

If you want to help the environment, then make your own decisions and live by them without pushing it on other people. (DeER-123)

As these comments suggest, regulatory measures for lead ammunition and fishing tackle were perceived as highly undesirable because they evoke the feeling that liberty and freedom are not being preserved.

Rights. The concept of rights is strongly tied to liberty and freedom, which are ideals, but are also viewed as rights of every American. As revealed by the data, some individuals who

⁸ The definitions of, and distinctions between, freedom and liberty are debated among scholars (see Fischer, 2004; Pitkin, 1988)

identified with groups like hunters, shooters, and gun owners, also focused on specific rights to hunt and own guns, and equated the use of lead ammunition to the 2nd Amendment of the U.S. Constitution. The Bill of Rights guarantees a number of personal freedoms; the 2nd Amendment guarantees the personal right to firearms for individual use, and lead ammunition is viewed as falling under this protection. The following quotes show to what extent proposed regulations on lead use were perceived as restricting rights:

Please do not take away another freedom, and that is the right to have the type of ammunition and fire arms we desire. (EPA-53)

We take the constitution seriously. (EPA-78)

Anti-gun, anti-hunting, and anti-constitutionalists will do whatever it takes to undermine 2nd amendment and hunter's rights. Preventing me from owning and shooting traditional ammunition is a clear infringement on my 2nd amendment right to bear arms. (EPA-44)

Every citizen has the right to keep and bear arms for security and defense, for lawful hunting and recreational use, and for other lawful purposes. (NSSF-482)

The disregard of freedom and rights brought up in relation to the issue of lead use was believed, by some, to have implications for further freedoms of choice. The following "slippery slope" arguments demonstrate the belief that any step to restrict lead use could initiate a chain of related restrictions:

First they ban lead, then they will go after all forms of fishing, because fish are more important than humans. (WA-167)

This just seems like a slippery slope of new regulation. First bullets and now this?

(HA-35)

It's the 'first step' if you ask me. If they pass this, then all tackle containing lead will be next. (HA-86)

Lead bans for hunting scare me because it leads to an all out lead ban which would effectively kill the shooting sports. (GN-324)

Stop impacting the fisherman. Why curb use of poles, do you want to increase use of guns for game? No, we'll just ban all the guns too, right? What will they take away next? (EPA-113)

While the quotes related to lead ammunition were focused on 2nd Amendment rights, the quotes provided here from blogs related to fishing (WA-167, HA-35, & HA-86) demonstrate that anglers seem concerned that one regulatory measure would potentially lead to further restrictions.

Democracy. While the term democracy is used in different ways, at its core it refers to majority rule and the opportunity of each individual to contribute to the development of public policy. Study findings indicated that democracy was particularly relevant to groups when decisions about lead use were being made by an agency like the EPA. In many realms, but especially in the area of natural resource management, there has been a growing expectation on the part of the public of being both informed about, and involved in, the decision-making process surrounding regulatory actions (Parkins & Mitchell, 2005). Today, most theorists and practitioners recognize public participation as an important factor in effective democratic processes and improved decision-making. Decisions made without the involvement of affected

stakeholders can violate expectations of democracy and be perceived as unfair. The statement appearing in one of the previously-mentioned quotes, “quit trying to pass YOUR WILL on the American Population,” expresses the sentiment that democratic ideals, such as a say in decisions that affect one’s life, are not being upheld. Other examples also embody this sentiment:

I don’t need anybody with good intentions making laws without asking my opinion. (GN-226)

The true American hunters and sportsmen and sportswomen will not stand for this. This is just another underhanded way of pushing legislation without even taking a vote. (EPA-179)

Individuals expressed that their democratic ideals are not being upheld, and perhaps more significantly indicated that they desire representation, participation, and involvement in the decision-making process.

Equality. In addition to freedom and democracy, equality can also be viewed as a defining ideal of American identity. It was common for hunters and anglers to ascribe a high level of importance to the value of equality. In fact, “democracy of hunting” is one of seven components that form the foundation of the North American Model of Wildlife Conservation (Geist, 2006). Democracy of hunting, which stipulates that all citizens have the opportunity to participate in hunting, and everyone is a stakeholder, stands in contrast to the European model that allocated wildlife by land ownership and privilege. Theodore Roosevelt was the foremost spokesperson for egalitarian allocation of wildlife and the participation of the “common man” in hunting (Roosevelt, Van Dyke, Eliot, & Stone, 1902). These ideas, while originally applied to

hunting, have been extended to include fishing. So, while only wealthy individuals can afford to participate in certain recreational activities in the U.S. (e.g., downhill skiing, equestrian sports, sailing), the idea that hunting and fishing could be among them is unacceptable. In this sense, the belief that alternatives to lead ammunition and fishing tackle cost a lot more than their lead counterparts may be tied to notions of equality. The following quotes, consisting of an exchange among three different commenters on one of the blog sites, demonstrate the belief that the high cost of non-lead alternatives will result in unequal access to hunting and fishing:

Right now 'Little Johnny' can pick up some jig heads and Mr. Twisters for a few bucks and he is catching fish. Go green and he is in for 10 bucks or so. (HA-98)

I don't think it's a big deal at all. However the non-lead weights tend to be more pricey, at least in my experiences, but it is for a good cause. In reality what is 50 more cents? (HA-116)

50 cents more is the difference between Jonny, age 10, fishing and not fishing, like as not. (HA-63)

Others that demonstrate this belief:

This proposed ban on lead ammo would increase the price of ammunition beyond the means of the average hunter. (EPA-119)

While there may be alternatives to lead bullets and fishing tackle, the price of such will outpace the ability of any but the wealthy to participate in recreational activities that are a significant heritage of this country. (EPA-72)

Cost was previously discussed in Section 1 of the findings, in terms of it being a barrier to moving away from lead use, but as the quotes above suggest, some also tied the more significant consequence of equal access to cost-related barriers.

Tradition. The quote above describes fishing and hunting as “activities that are a significant heritage of this country,” which captures the significance that was placed on hunting, fishing, and shooting as important American and family traditions. Like freedom, in the field of psychology, tradition is also recognized as a basic value. Tradition is defined as respect, commitment, and acceptance of the customs and ideas that one’s culture imposes on the individual (Schwartz, 1992, 1994). This value is important to in-group members who believe it should guide decisions to prevent any actions that would impact the traditional activities themselves, and any actions that would modify how individuals participate in them. As the findings reported here reveal, this would include modifying ammunition and fishing tackle to eliminate lead. Lead ammunition itself is commonly referred to as “traditional ammunition”, a label that may carry with it more symbolic meanings. The following quotes demonstrate how lead use is tied to the importance of tradition:

We should be able to continue to use lead as a weight in fishing equipment. This is a sport that the entire family can enjoy and we do not need to add an extra expense. (EPA-175)

There is no scientific data to support this claim and it will only jeopardize one of America's oldest and most honored traditions, hunting. (EPA-191)

A lead ban would be worse than useless. It is indeed a backdoor way to whittle away at our hunting heritage and firearms freedoms. (GN-326)

I say if you don't like shooting and hunting, then just don't participate. Both activities are traditional heritages of this country and for those who enjoy these traditions, let them be. They pose no threat to you, others, or the environment. (EPA-74)

In the last quote above the commenter does not refer to lead ammunition, but rather the activities of hunting and shooting themselves, suggesting that criticisms of lead ammunition are understood as criticisms of the broader activities and social groups. This is an important idea that was common throughout the data as it related to positive attitudes about lead use.

Threat to existence. What the findings have demonstrated thus far is a perception that relevant out-groups pose a threat to the values and traditions of in-groups. Some of the quotes above also touch upon the belief that out-groups pose a threat to the very existence of in-groups. For example, out-groups were viewed in some, more extreme cases as using effort to minimize the impacts of lead use as a ploy to end hunting, fishing, shooting sports, and/or gun ownership. The term “backdoor” was used often to refer to this, as demonstrated in the first quote below:

Let us be candid with each other. This proposal to ban ‘traditional ammunition’ is a back-door legislative effort on the part of radical ideologues to ban all guns under the pretext of environmental concern. You are not fooling anyone!!! (EPA-56)

I'm down on bad science, and most of it comes from the environmental left. Raising prices, anything to discourage hunting and fishing (i.e., folks out killing, and even harassing game), and they want to eliminate them. They have an agenda for applying bad science. (HA-151)

PETA, HSUS, etc. ad nauseam, do not want animals hunted. Period. They are hand-in-hand with the Brady Bunch, the AMA, and all the other anti-gun groups. If they cannot legislate guns and hunting out of existence, they will use junk science, lead bans, any scare tactic to accomplish their aims.[...] Whatever the anti-hunting, anti-gun groupies come up with, their ultimate aim is the abolishment of our sport. (GN-141)

In this way, out-groups may be demonized and viewed as not to be trusted. In-groups may believe that their traditional outlooks and practices are not being respected, and they therefore cannot, in good faith, trust out-groups to be honest and sincere in their intentions to minimize lead use.

Self-enhancement. The perceived threats to one's social identity and the very existence of important referent groups may heighten the need for self/group-enhancement. One example of this that could be found in individuals' comments, was an attempt to defend the use of lead for hunting and fishing in the face of criticisms about these practices and abdicate the supposition that lead ammunition and fishing tackle are harmful to wildlife:

The banning of traditional ammunition will negate the only protection that the natural wildlife resources of the United States have, the sportsman/hunters and their organizations. (EPA-32)

Many hunters will not practice as much as they have in the past which will lead to fewer wildlife cleanly harvested, having a negative impact on wildlife populations.

(EPA-169)

It will do a lot of harm to the wildlife of all 50 states. (EPA-115)

IF lead free ammo is passed, what will happen to the herds of animals that are controlled by hunting? They'll be in our yards, gardens, parkways, and on our car hoods. (EPA-69)

Sport fishing in our state brings in considerable revenue and is an activity that many families enjoy. Passing this bill as written is an attack on sport fishing, and will result in less people fishing, thus less revenue to our state at a time when we need revenue. (WA-167)

The position on lead use taken by out-groups was characterized in this context as categorically wrong and illegitimate, while in-group goals (i.e., to continue using lead) were characterized as categorically right, legitimate, and benevolent because of the benefits that hunting and fishing activities provide for wildlife populations and society.

Glass houses. Other examples also demonstrated how in-groups may perceive their own identity in a positive light, in such a way as to believe their group is “better” than the out-groups. “Glass house” arguments, such as those touched upon in the quotes below, are indicative of this phenomenon which surfaced in discussions about the relative impacts of lead use on the environment:

The hormone supplements and anti-depressants the birders take everyday and urinate into their septic systems cause more environmental damage than my lead fishing sinkers! Give me a break! (WA-131)

Lakefront homeowners association...you mean the ones who live on the lakes who have REALLY nice, weed free lawns.... Maybe they should do more research on the effects of the chemicals to keeps those lawns so nice. Oh, I forgot, those chemicals are

ok because the chemical companies have the lobby money that says so. It seems they are playing pin the tail on the least powerful group. How about we propose a bill to ban lakefront homes...see how they like that. (WA-147)

[In response to another commenter who expressed an anti-lead use attitude]: I can't believe that you are saying that millions of people should not use lead [...] because you think you saw an eagle dying of lead. I am a biologist and you need help. How many poor little God's creatures die from cars every year? Do you still drive? What about plastic bags? What about cows that you eat? I know, let's just get rid of all children because they tend to litter more than adults...or wait I know, let's get rid of your computer because there are lots of toxic part in it that are not 'earth friendly.' It would stop you from spreading your hate. (NSSF-124)

In the first two quotes above the blog commenters are speaking about, but not directly to, two of the groups that are identified in the blog's post and comments as responsible for trying to get a statewide ban of all lead fishing tackle enacted in Washington. The authors' indignation is evident as they express feeling as though the groups who are criticizing *them* have the same faults they accuse them of: as the saying goes, "people who live in glass houses shouldn't throw stones." Similar sentiments are expressed in the comment from the NSSF blog, which was in direct response to another commenter who expressed beliefs about the negative impacts of spent lead ammunition. Here and in similar quotes, the authors do not view their faults and those of out-groups as being equal; the impacts of out-groups are viewed as more malevolent than the suggested impacts of lead use.

Conservation ethic. Tied to the above-mentioned theme of self-enhancement, hunters and anglers may demonstrate their benevolence by highlighting their connection to wildlife conservation in the U.S. In this way, they retain a strong sense of themselves as conservationists, individually as well as collectively. This was exhibited in the data when individuals referred to themselves, and to in-groups, as conservationists, or they referred to specific contributions to conservation including their provision of funding:

I am an environmental enthusiast and a conservationist, but this a step towards deleting one of our Constitutional Rights. (EPA-168)

This country was founded by sportsmen and no one contributes more to the preservation of wildlife than the sportsman. (EPA-172)

Hunters fund most conservation programs in this country through license fees and excise taxes, and success stories such as that of the Bald Eagle can be attributed to closely monitored and well funded breeding and harvesting programs by a number of legitimate wildlife agencies and sportsman's organizations. (EPA-137)

The American sportsman also supports numerous conservation efforts as well.

Lose the sportsmen in this country and we're screwed! (NSSF-146)

As evidenced in several of the quotes above, the in-groups may view their relationship to conservation as exclusive, that is, the identity rests on the view that contributions to conservation, and a conservation ethic, belong to it alone. Further, they may feel that others' claims with regard to conservation support are not legitimate or not authentic. So, while they talk about their own support for and contributions to conservation, they also criticize out-groups' contributions (or lack thereof):

How ironic that birdwatchers don't pay squat to fund biologists or environmental conservation efforts through licenses or Sport Fishing Restoration Act taxes; yet they want to ban the very activity that provides the funding stream for biologists and habitat for the birds. (WA-131)

It almost seems that enviro-freaks are making money hand over fist in this.[...] Maybe the folks so 'worried' about the environment should stop using it to make money: unrealistic, extortionist amounts. (HA-98)

The last quote above contains another example of the legitimacy of the out-group being called into question; the term "enviro-freaks" was used as a label in this case. The commenter suggested that their environmental concern in general is not legitimate as it is motivated by greed. The juxtaposition of in-group benevolence and out-group malevolence indicated that intergroup bias in the form of in-group favoritism was occurring. As the following theme suggests, derogation, hostility, and antagonism against out-groups was also evident.

Out-group derogation. Already in some of the quotes used above, out-groups have been referred to as "idiots", "loons", "radical ideologues", and "freaks". The following quotes demonstrate other examples of derogation, hostility, and antagonism against out-groups:

Truly I would like to know how you people get your heads stuck soooo far up your asses. Our forefathers would hang you all from the highest tree!!!! (EPA-195)

Any writer supporting non-lead bullets can take a frickin' hike. Lead shot in marshes, maybe, lead out in the woods ain't hurting nothing. Your arm chair experts, a lot of sports writers fall in this category, are always supplying PETA and those idiots their data. (GN-237)

I'm tired of all this talk. ITS TIME FOR ACTION! Overthrow these low down, no good dirty b*@%#*\$s [sic]. I've had more than enough of their shit. There are more of us than there are of them and they are scared. That's why they want the guns so that we can't stand up against them. TIME TO ACT NOW! (NSSF-709)

The most pejorative and hostile comments directed towards, or about, out-groups were often political in nature and highly critical of the current administration/political leaders; President Obama was often the direct target of derogatory comments. This suggests that in-group and out-group categorizations based on political party affiliation were also viewed as relevant in this context.

Reestablish freedom. Other reactions towards out-groups along political lines were also evident in which individuals resisted allowing their behavior to be controlled by others. The theory of psychological reactance (Brehm, 1966, 2000; Brehm & Brehm, 1981; Burgoon, Alvaro, Grandpre, & Voulodakis, 2002) provides a useful explanation for this phenomenon. It states that when personal rights to decide and act are perceived as threatened, reduced, or eliminated (this perception was demonstrated and discussed previously in the findings), individuals are motivationally aroused to re-establish the threatened freedom. The reaction of many individuals is to argue that if they lose their rights they will retaliate. As some of the quotes below demonstrate, one of the ways in which people could propose they will retaliate is by using their influence to remove those who infringe on their rights from positions of power.

This is the straw that has persuaded me to change my vote this November, and many more Novembers to come. (EPA-168)

I will be watching how the vote of each committee member goes down, and will make damn sure that everyone who votes for this [lead fishing tackle ban], their opposition sees a check from me in the next election. (WA-167)

This is another example of bureaucrats using EPA authority to push another agenda. In this case it will only result in a drastic change in the executive and legislative bodies in the next election so that people like you can be removed from your office and sent back to a job you are qualified to do. (EPA-60)

In this way, the political system is being suggested as the mechanism for reestablishing freedom by placing those they believe will support their position on lead, or more generally align with their political desires, in power through means of their vote of financial contributions.

Non-compliance. Another way that individuals can assert their freedom, particularly in the face of possible regulatory actions on lead use, is to suggest that even if such regulations were passed they would not comply with them:

I have easily 10,000 jigs and lead 'jigging' spoons in my storage room waiting for either paint, or the right conditions to fish. I'm not just throwing away all of those if the state bans lead. To hell with them, I'll fish lead all I wish, the state doesn't realize there are bigger problems that lead sinkers. (HA-40)

Better go bury your ammo now! (WA-170)

I know that I personally have a lot of money tied up in lead ammo and have no intention of not using it as I please with the exception of waterfowl hunting. (NSSF-146)

Another law we must ignore. I don't recognize their authority to propose this law. Besides, just say your ammo is for protection, not hunting. LOL. (NSSF-743)

Freedom, therefore, may not be viewed as a matter of the law, but as a matter of continuing to decide and act as one wishes regardless of regulations.

Group boundaries. To conclude this sub-section on themes associated with a positive attitude toward lead use, below is an example from the data that demonstrates the importance of in-group norms. In this example, an individual identifies himself or herself as a hunter, but expresses opinions or beliefs that do not necessarily adhere to in-group expectations. Group boundaries are then constructed; the individual is defined as separate from the in-group and the corresponding differences are magnified. In this example, NSSF-370 is critical of the arguments and tone of other contributors and has a different attitude about lead use:

All this hype does is inflame the idiots who keep 4,000 rounds of ammo under their bed. (NSSF-370)

I guess that makes me an idiot. 4,000 rounds is trivial. I go through about 8,000 a year. Competitive national level IPSC shooters go through about 40,000/year. They must be extra stupid right? (NSSF-606)

I certainly hope you don't store it under your bed...! Hey, I hunt, I shoot...and I know the constitution and how the government works. With the exception of the rights given away when we passed the Patriot Act, we are no closer to losing anything than we were before this petition was sent. And yes, there are acceptable alternatives. Look it up on Google...I still say, if you store 4,000 rounds under your bed...you stand a pretty good chance of being an idiot. (NSSF-370)

You seem to be part of the problem. Who are you to determine what or how much personal property (ammo included) an individual can own? So long as they are not

infringing on your rights what business is it of yours? Please go 'F' yourself! I am willing to place a wager you voted for the 'Hope and Change' candidate. (NSSF-942)

Exactly what I suspected...anyone who disagrees with YOU can expletive deleted [sic]...and is part of the problem. I do not care how much of what kind of ammo you own...makes not a damn bit of difference to me. I primarily shoot arrows, so it isn't going to drive my prices up beyond what is reasonable. For all I care, you can store live hand grenades up your ass. (NSSF-370)

Fudds, gotta love 'em. (NSSF-408)

If you think that you are safe from the government infringing on rights and you will not stand up, then you are a misguided idiot...just sayin'. (NSSF-238)

In this case, NSSF-370 is viewed as not valuing individual rights and as having different political views; he or she is called an idiot and a fudd, which, according to the Urban Dictionary, is defined as:

Slang term for a 'casual' gun owner; e.g., a person who typically only owns guns for hunting or shotgun sports and does not truly believe in the true premise of the second amendment. These people also generally treat owners/users of so-called 'non sporting' firearms like handguns or semiautomatic rifles with unwarranted scorn or contempt. (Fudd, 2007)

This example was chosen for illustration purposes because it demonstrates many of the findings from the data that reinforce a connection to the theoretical frameworks introduced at the outset. The normative perception of lead use that seemed to be prevalent among many in-group members is that there's a threat to their rights that is perpetuated by out-groups.

Major themes from the data associated with anti-lead attitudes. There was a general tendency among those with an anti-lead attitude to make sense of the lead use debate by characterizing it as being socially, politically, and economically driven by groups with a vested interest in preventing changes to lead ammunition and fishing tackle use or production. The following quotes identify some of the more formal group organizations and relate how they may influence stakeholders' perceptions about lead use:

Shooters and hunters [...] don't buy into or believe [conservation concerns based on research] and probably won't on a wide scale regardless of any educational campaign as long as 'their' organizations (NRA [National Rifle Association], NSSF [National Shooting Sports Foundation], USSA, etc. [United Special Sportsman Alliance]) continue to campaign against any prohibitions under the hysteria of 'they're trying to end hunting and shooting'. (DeER-180)

What I've run into a lot is people saying, 'well that's not a trustworthy source,' and at some point there is going to be no trustworthy source. So, it doesn't really matter what you do, they're just well, 'I don't believe you, it wasn't the NRA that told me that, so it didn't happen.' I mean that's one of the problems that we have, is that we have the special interest groups saying, 'well the science is no good.' (Pete)

There's the obstacles of having to deal with other organizations such as the NRA who have a vested interest in preventing change from happening with respect to lead ammo and they are a very powerful lobby and put out a lot of pushback on anything. And they aren't the only group, but they're the most highly visible and well known. (Don)

It is difficult because [special interest groups], they use this issue almost as a fundraising tool in a lot of instances because it's an easy scare tactic to get people to start giving them money and donating so that 'those damn environmentalist' don't take their guns away. (Pete)

I am not a member or affiliate of the NRA, NSSF, USSA or others that I have referenced, but I have worked on policy and legislative issues where they were supportive or opposed to various initiatives and see the incredible political clout they can have. (DeER-178)

It is important to point out that some individuals also believed that groups and organizations representing the other extreme (i.e., those who want all lead use banned) were also at fault for exacerbating conflict and polarizing people on the issue. While fewer individuals expressed this sentiment, it is an important perception of what factors contribute to conflict. The first quote below provides a good example of views like those captured above, but it is quickly followed by a qualifying statement that also implicates those on the other extreme.

Hunters say [...] 'I heard that this was just another attempt at further restricting my rights to keep and bear arms.' I mean this all comes of course from the NRA, the likes of the NRA, but as soon as I badmouth them I have to badmouth the other side too, the litigious conservationist movement in overstating or misrepresenting the problem. (Roger)

There's basically two radical positions on this, you know, one that this is an anti-gun issue, and one that banning it is the only way to solve this problem.[... The] two sides are just fighting over this issue in the public's eye and in the court system. (Joan)

Joan expressed other sentiments about the desire to “not polarize people” and described efforts that were taken by various entities working together on a national non-lead campaign to distance themselves from groups that were involved in activities that were viewed as exacerbating conflict and polarizing people, like pursuing regulations through lawsuits:

We actually said that folks that were actively engaged in lawsuits and things like that were not going to be welcome in the group. That hasn't been officially declared but that was certainly unofficially talked about and kind of agreed on; that would go against the progress of this movement for sure. (Joan)

There was also a specific reference to the Center for Biological Diversity (CBD) which spearheaded the petition to the EPA:

The current approach by the CBD is dead on arrival [...] It also risks creating severely entrenched positions which will eliminate any possibility of an unbiased evaluation of the issue. (DeER-178)

As the following quote demonstrates, the extreme positions on this issue were viewed as an impediment to successful solutions:

It kind of burns me that in this day and age we can't get more together on a conservation topic or issue because of our previous battles and scars, and therefore everybody has to be at one extreme or the other, and they battle from those extremes and that's what's represented to the public. (Roger)

Opposing advocacy groups with extreme positions were viewed as the major driver in the conflict surrounding lead use, and as impeding the progress of efforts to move toward resolutions. Certain groups on the pro-lead extreme were viewed as having a foothold on how

lead use and related management actions are framed and subsequently viewed by key stakeholders⁹. Certain groups on the anti-lead extreme were viewed as alienating key stakeholders and exacerbating the conflict by pursuing highly undesirable management actions (e.g., bans on all lead ammunition and fishing tackle) in highly undesirable ways (e.g., petitions, litigation).

Group stereotypes. Interviewees who were involved in outreach with stakeholders about the topic of lead use indicated that they are perceived and treated by key stakeholders in terms of how they are categorized. How they are categorized, in turn, is often based on their professional affiliation, and categorizations may be associated with negative perceptions and stereotypes. To illustrate:

Conservationists and environmentalists are becoming dirty words and that's too bad. (Roger)

Being in that private non-profit, we've been labeled as animal rights activists and anti-hunting, and it's crazy. (Roger)

I think there's a distrust with anything coming from the environmental community and a disbelief that it could have any kind of common ground with the hunting community. The environmental community's been portrayed as a bunch of extremist tree huggers that want to stop you from using wilderness, stop you from hunting, stop you from fishing, and portrayed as obstructionists. So I think there's a

⁹ From the perspective of those with anti-lead attitudes, the key stakeholders include both hunters and anglers. However, the data more heavily represented individuals who focused on hunters and lead ammunition use. As one individual stated: "Hunters are the ones we're, they're our target audience, they're the ones that we're asking for their behavior to be changed by using non-lead, so I think that has to be number one" (Roger).

tendency that if you're coming from a conservation organization you are aligned with environmentalists and therefore there's a distrust in what you're saying and why you're talking to them about it. Secondly, I think there's a higher amount of distrust towards the government in general, so being a federal employee you are battling that stigma.

(Don)

The quote above starts to articulate the view that, how people respond about lead use may be a result of the stigma associated with being categorized as an environmentalist, conservationist, federal employee, etc.; distrust is one response mentioned by Don. Other accounts describe how people may respond with skepticism, anger, and frustration and negative reactions to information and the efforts to minimize lead use in general:

If I had to summarize a typical interaction it would be cynicism and skepticism mixed with a little anger and then, sometimes that's how it's left they say, 'don't bother talking to me, nothing you're gonna say is gonna convince me there's an issue here.' [...] Generally the interactions have been somewhat antagonistic, or at least we're the visible lightning rod to vent frustration out on because they don't really have a means to actually express their frustration to someone face to face. (Don)

I heard through the grapevine, that there were those who said, we fabricated all of that, we made all of that up. (Roger, referring to research findings from lead fragmentation studies)

When it comes down to the nitty-gritty of it [...] they're concerned it's an anti-hunting movement and they are concerned that the cost is going to make it so they can't hunt anymore. (Pete)

Interviewees expressed that there was a disconnect between how they were perceived and categorized by others, and their own self-perceptions and identities. In the same way, they also perceived a disconnect between how they thought lead use issues were perceived by others, and how they themselves perceived those issues. The focus of outreach and education strategies, as described by interviewees, was often on changing what they viewed as misperceptions about themselves or the issue. As the subsequent themes are discussed below, some of the ways in which these individuals redefine their identities and redefine the topic of lead use emerge.

Common ground. As demonstrated in the above findings, individuals with anti-lead attitudes felt that lead use and related management strategies are plagued by conflict; however, in their estimation, there are not conflicting interests and values associated with lead use. Instead, they view their concerns as shared, overlapping, or at least compatible with the concerns of hunters and anglers. In fact, they often identified themselves as hunters or anglers, and believed their group affiliation and their attitudes about lead are not mutually exclusive, but rather, complimentary.

I do not see what the problem in switching to non-lead alternatives is. I'm an avid hunter and angler, but most importantly I am a CONSERVATIONIST. I have made a decision not to buy any more lead ammunition. (DeER-104)

I generally think doing something about the lead issue as hunters is pro-hunting, as it shows we are concerned with all wildlife and human health, that we are a truly conservationist constituency. (DeER-171)

If we love the outdoors and we love to fish and hunt, we need to work together to make sure all are protected. (HA-159)

Not only did respondents seem to feel that their concerns were shared, they seemed to indicate that everyone is on the same team under the umbrella of conservation. Individuals who were involved in education and outreach efforts described how, often, they try to point out the compatibility or shared nature of interests and values to hunters.

The thing we try to point out is that hunters are the original conservationist, and no ethical hunter wants to feel that they're effecting non-target wildlife by the way in which they hunt, so you're appealing to their conservation ethic. (Don)

I am a hunter as well, and what I'm looking to do is not take away hunting rights, but to promote further conservation efforts by hunters which, for me, is really where this non-lead ammunition falls. It's just a continuation of the tradition we've have for a long time. (Pete)

We are pro-hunting and pro-gun rights and all of those things that we are said to be in opposition of. And I've read that we are a claimed animal rights group and we're out to ban hunting, and that is absolutely false. We're very supportive of hunting, we would just like the hunting done in condor range to be done with non-lead ammunition to reduce lead exposure, and also, would like hunters to consider the fact that use of lead in any hunting situation may prove it available to other scavengers. And whether it's proven to affect them at a population limiting effect or not, I think most hunters when presented with this would say, 'Hey, we're not willing to poison other species as well.' (Roger)

Supporting management strategies that aim to address the potential negative impacts of lead use was understood by many of those with an anti-lead attitude as a way to uphold the values, customs, and traditions important to hunters and anglers. As is evidenced in the above quotes, there were efforts made in some cases by interviewees to subvert the stereotypes about themselves or the organizations/agencies they work for (and, in one case, an individual self-categorized himself as a hunter).

Interpersonal interactions. These common ground beliefs were supported by positive interactions with key stakeholders where shared concerns and values, while not always resulting in support for the mitigating strategies, were helpful in terms of reducing conflict or addressing some of the more negative perceptions associated with lead use reduction efforts. The following quotes describe the importance that was attributed to interpersonal interactions, especially with key stakeholders, and how those interactions resulted in positive outcomes.

People are more likely to listen about an issue if it's based on one-on-one contact [...] expos and things are important also, but that's contacting hunters in general, whereas this is specifically contacting the hunters that we need to take action to reduce the lead exposure in the condors. (Joan)

I think hearing the message a few times and hearing it from multiple sources has also helped people realize, hey, this isn't just one of the overnight environmental movements, this is actually real, this is happening, and if the state agency, if the hunting agency is involved, and they're the ones sharing this data with us, then [...] this isn't made up by some granola crunch group that just wants to take their guns away. (Joan)

There's a lot of skepticism about whether any of the issues are actual or if they're fabricated. And even with people that are very skeptical, you'll sit down and talk to them for a little while and you'll ask them about their experience with different ammunition and hunting, and you can relate some of your own experiences and talk about some of the things that are being studied with wildlife, and some of the misconceptions that are going on with non-lead ammunition. And even if they come up to you and they're agitated, they don't like this, after talking with them they realize that you're not an extremist where you're trying to end hunting or take away their gun rights, they understand the issue. And whether they're going to switch to using non-lead ammunition or not is another story, but they've heard what you had to say and now they know that, it's not just an environmental ploy to end something that they've enjoyed for their entire life, sometimes, generations. (Paul)

The benefits of interpersonal interactions were also viewed as a key component to successful outreach with individuals who have other perspectives about lead use, and who may believe lead ammunition and fishing tackle should simply be banned:

I really like them to hear the information from the source and make their own judgment at that point because I think a lot of people on the surface may be inclined to believe, 'oh well just ban it, it doesn't affect me, so just ban it. I don't see what the big deal is.' But when I explain how complicated the issue is to them and what we've actually accomplished through our voluntary program, I certainly win over pretty much everybody with that logic, and you know, they realize how much thought we've put into this program. (Joan)

As the following quote demonstrates, however, sometimes even the benefits associated with interpersonal interactions, while generally positive, fall short of combatting the negative perceptions about efforts to minimize lead use. This quote was in reference to interactions with individuals who were members of organizations, like the NRA, that were referred to earlier on in this section.

If you talk to individuals on the individual level, the folks who are part of those different organizations, a lot of them are interested in the idea and they just think that it makes sense. But the problem is you run into the national level and they don't want to give the ground on the off chance that it gives the ammunition to groups that are anti-hunting, which are out there, and are using the information that we have gathered to attack hunting and say that hunting is a bad thing. (Pete)

These interactions are representative of the more interpersonal extreme of the continuum described by Tajfel and Turner (1979). Individual characteristics and personal relationships, in this case, tended to appear more important than the social groups or categories one was associated with, although they were not entirely independent. In the above quote, the distinction between interpersonal and intergroup interaction is well demonstrated. Interactions on the individual level are viewed positively, but are still influenced by intergroup dynamics that generate conflict. The interactions described under the “group stereotypes” theme represented the intergroup extreme of the continuum, and even when those interactions were face-to-face, they were characterized by conflict.

Discussion

The purpose of this study was to better understand the meaning people assign to issues involving the use of lead ammunition and fishing tackle. More specific objectives related to (a) how stakeholders make sense of actions that are being pursued, or could be taken, to manage human activities with a view to prevent, reduce, or mitigate negative impacts of lead use on the environment, wildlife, and/or humans; and (b) what are crucial aspects of human thought about lead issues and management actions that can contribute to an understanding of the controversy surrounding this topic. The findings were able to identify different attitudinal positions with regard to lead use; different preferences for management strategies; and that differences were associated with conflict. More importantly, the research explored elements that were key to how meaning was constructed by individuals that correlated to these different elements.

Individuals who held more positive attitudes toward lead use tended to base the meaning of issues associated with this topic on perceptions of in-group and out-group relationships, specifically, on the notion that out-groups posed a threat to the values of social groups they identified with, and that out-groups were motivated by a desire to eliminate the activities that were the basis of their existence (e.g., hunting, fishing, shooting sports). Themes that emerged from the data (nationality, liberty, freedom, rights, democracy, equality, tradition, and threat to existence) explored specific elements related to these perceptions. Subsequent themes (self-enhancement, glass houses, conservation ethic, out-group derogation) focused on the nature of positive perceptions about in-groups and negative perceptions about out-groups. In relation to lead use, the positions associated with out-groups

were characterized as categorically wrong and illegitimate, while in-group goals (i.e., to continue using lead) were characterized as categorically right, legitimate, and benevolent. Finally, themes (reestablish freedom and non-compliance) related to ways in which individuals responded to perceived threats from out-groups were explored.

Individuals who held more negative attitudes toward lead use tended to believe that the conflict surrounding this topic and related management strategies stemmed from opposing groups with special interests that represented extreme positions on lead use, and whose tactics and actions polarized people on the issue. Negative stereotypes associated with those categorized as environmentalists, conservationists, federal employees, etc. were perceived to impact how people responded to the lead use issue; examples of responses included distrust and skepticism. Despite the surrounding conflict, the goal of reducing lead impacts was seen by these individuals as compatible with the values and concerns of many different groups, suggesting that the core divisions on the issue may be exaggerated at times and could be addressed through tactics that capitalize on areas of common ground. Conservation was the overarching common concern believed to unite all groups.

Using qualitative research methods to explore these overall positions and underlying reactions to the topic of lead use allowed the primary researcher to discover the richness of meaning associated with observations. Through this process, connections were made to theoretical frameworks that were useful for explaining the observations and interconnected ideas that emerged during data analysis. In doing so, this study addresses an important conceptual area that is largely underrepresented within the context of natural resource issues. In the human dimensions of natural resources field, explanations of human thought and

behavior typically focus on individual level or macro (e.g., societal) level influences (Manfredo, 2008), and this study demonstrates how theories about social groups might also be relevant to understanding how people respond to conservation issues, especially those that are more controversial in nature.

The findings of this investigation were consistent with what social identity theory (e.g., Ellemers et al., 2002; Hogg & Abrams, 1988; Tajfel, 1972, 1974, 1978; Tajfel & Turner, 1979; Turner, 1982, 1999; Turner & Giles, 1981), self-categorization theory (e.g., Turner, 1985, 1999; Turner et al., 1987), and theories of intergroup bias (e.g., Brewer, 2001; Brewer & Brown, 1998; Brown & Gaertner, 2001; Hewston et al., 2002) suggest happens in situations involving intergroup conflict. To illustrate, social identity theory suggests that in group contexts, self-enhancement is achieved through evaluation of the in-group in a positive light in relation to out-groups. Examples from the data demonstrated how individuals attributed positive stereotypes to the groups they identified with; for example, some described sportsmen including hunters as “the only protection that the natural wildlife resources of the United States have,” or stated, “this country was founded by sportsmen and no one contributes more to the preservation of wildlife than the sportsman.” In contrast, negative stereotypes were held about out-groups, as evidenced by statements like “[most] bad science...comes from the environmental left” and “birdwatchers don't pay squat to fund biologists or environmental conservation.”

The findings from this study could inform the decisions and communication strategies of land, wildlife, and natural resource management agencies that are interested in this issue. For one, they provide additional insight into what management actions may be acceptable, and

why some of these strategies are more or less preferred over others. For example, reactions to regulations were the most extreme and complex. These actions were deemed highly unacceptable, or undesirable, to most groups and generated concerns that one's freedom and rights were being violated. Voluntary approaches, like outreach and education, were more preferable, but in some cases they were viewed with as much skepticism as regulations, in part due to concerns about their effectiveness. However, professionals involved in efforts to mitigate lead impacts related stories about successful outcomes of outreach and education that occurred through one-on-one contact. A successful outcome could be defined on the one hand as changing the behavior of members of a target audience, but also in some cases it could entail simply getting individuals to see the controversial issue in a new light. This interpersonal communication, as indicated by the data, was less characterized by group stereotypes.

In addition to enhancing understanding of stakeholder reactions to management actions, including regulations as well as outreach mechanisms for addressing lead use, the specific themes identified through this investigation may provide a basis for thinking about actual communication strategies and messaging. The findings point to certain concerns that may be fueling the conflict and opposition to management strategies; for example, some viewed attempts to address lead use as a "backdoor" means of ultimately ending hunting, fishing, and/or shooting sports. This seems to highlight, from a communication standpoint, the need to be explicit about the goals of the agency in a way that would address any misperceptions revealed in the data, while also focusing on the interconnecting sets of values and practices that make cooperation possible. In particular, for the above example, this would include acknowledgement of shared interests that center around conservation and recognition

of the important contributions made by hunting and fishing activities in this context. It might also include an explicit commitment to ensuring access to opportunities to pursue these activities in the future. Again, the findings also suggest that interpersonal interactions should be considered, where possible, as a key component of communication strategies.

Other theories on conflict reduction suggests that reconciliation may be necessary for intergroup conflict resolution, especially when conflicts have lasted for a long time (at least two decades) and there is considerable accumulation of animosity, hatred, and prejudice (Bar-Tal, 2000). John Burton (1969, 1979, 1987, 1990) pioneered a framework for thinking about relationships of conflict and cooperation that involved “problem-solving workshops”. These workshops consist of small groups comprised of members of conflicting communities. Interactions are designed to be nonbinding and confidential; the goal is for each side to gain an understanding of the other’s needs, fears, and concerns from the perspective of the other, and engage in joint thinking about solutions to the conflict that would be responsive to the fundamental concerns of both sides. The conflict itself is viewed as a shared problem that requires joint effort to find a mutually satisfactory solution. Given what this study revealed about the nature of the deep-rooted conflict between groups over lead use issues, alternatives to traditional communication strategies may be needed, and the problem-solving approach would be an option to consider given that it strives to build relationships between groups that are based on mutual respect for group identities.

In conclusion, it is important to acknowledge certain study limitations that may point to the need for future human dimensions research on the topic of lead use. This study did not capture all potential audiences, and other perspectives about lead use for certain stakeholder

groups may be absent from the findings. For example, the data were collected from sources that represented individuals who were likely to find lead use to be a highly salient issue (given that they contributed their time and energy to producing comments or posts about the topic), and the analysis revealed that these individuals tended, for the most part, to have well-formed attitudes about the issue. Therefore, future research could benefit from casting a wider net to include different populations (including those less familiar with the topic and whose opinions about it may be less well-formed), other data sources, and additional methodologies (e.g., surveys). Many different entities are interested in the topic of lead in the environment from hunting and fishing activities; it is a critical conservation issue that has implications for wildlife and humans. Human dimensions research can inform strategies for addressing this issue that are dependent on public support for their success.

REFERENCES

- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.
- Allport, G. (1943). *The use of personal documents in psychological society*. New York: Social Science Research Council.
- Alvarez, K. (1994). The Florida panther recovery program: An organizational failure of the Endangered Species Act. In T. W. Clark, R. P. Reading, & A. L. Clarke (Eds.), *Endangered species recovery: Finding the lessons, improving the process* (pp. 205–226). Washington, D.C.: Island Press.
- Bar-Ilan, J. (2005). Information hub blogs. *Journal of Information Science*, 31(4), 297–307.
doi:10.1177/0165551505054175
- Bar-Tal, D. (2000). From intractable conflict through conflict resolution to reconciliation: Psychological analysis. *Political Psychology*, 21(2), 351–365.
- Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods* (5th ed.). Boston, MA: Allyn and Bacon.
- Brehm, J. W. (1966). *A theory of psychological reactance*. New York: Academic Press.
- Brehm, J. W. (2000). Reactance. In A. E. Kazdin (Ed.), *Encyclopedia of psychology* (Vol. 7, pp. 10–12). New York: Oxford University Press.
- Brehm, S. S., & Brehm, J. W. (1981). *Psychological reactance*. New York: Academic Press.
- Brewer, M. B., (2001). Ingroup identification and intergroup conflict: When does ingroup love become outgroup hate? In R. D. Ashmore, L. Jussim, & D. Wilder (Eds.), *Social identity, intergroup conflict, and conflict reduction*. New York: Oxford University Press.

- Brewer, M. B., & Brown, R. J. (1998). Intergroup relations. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 2, pp. 554–594). Boston, MA: McGraw-Hill.
- Brown, R. J., & Gaertner, S. (2001). *Blackwell handbook of social psychology: Intergroup processes*. Malden, MA: Blackwell.
- Burgoon, M., Alvaro, E., Grandpre, J., & Voulodakis, M. (2002). Revisiting the theory of psychological reactance. In J. P. Dillard & M. Pfau (Eds.), *The persuasion handbook* (pp. 195–211). Thousand Oaks, CA: Sage.
- Burton, J. W. (1969). *Conflict and communication: The use of controlled communication in international relations*. London: Macmillan.
- Burton, J. W. (1979). *Deviance, terrorism and war: The process of solving unsolved social and political problems*. New York: St. Martin's Press.
- Burton, J. W. (1987). *Resolving deep-rooted conflict: A handbook*. Lanham, MD: University Press of America.
- Burton, J. W. (1990). *Conflict: Resolution and prevention*. New York: St. Martin's Press.
- Cialdini, R. B. (2001). *Influence: Science and practice* (4th ed.). Boston, MA: Allyn and Bacon.
- Cranston, M. W. (1967). *Freedom*. New York: Basic Books.
- Craynon, J. R., Sarver, E. A., & Robertson, D. P. (2013). Could a public ecology approach help resolve the mountaintop mining controversy? *Resources Policy*, 38(1), 44-49.
doi:10.1016/j.resourpol.2012.08.001
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five*

- approaches* (2nd ed.). Thousand Oaks, CA: Sage.
- Damon, W. (2011). Introduction to the special issue on American identity. *Applied Developmental Science, 15*(2), 51–53.
- Decker, D. J., Brown, T. L., & Siemer, W. F. (2001). *Human dimensions of wildlife management in North America*. Bethesda, MD: The Wildlife Society.
- Dedoose. (2012). [Online application software]. Retrieved from <http://www.dedoose.com/>
- Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Orlando, FL: Harcourt Brace Jovanovich College Publishers.
- Ellemers, N. (2012). The group self. *Science 336*, 848–852.
- Ellemers, N., Spears, R., & Doosje, B. (2002). Self and social identity. *Annual Review of Psychology 53*, 161–186. doi:10.1146/annurev.psych.53.100901.135228
- Fischer, D. H. (2004). *Liberty and freedom: A visual history of America's founding ideas*. New York: Oxford University Press.
- Fishing Regulations: Glacier National Park. (2012). Retrieved from <http://www.nps.gov/glac/planyourvisit/upload/Fishing-regs-2012-web.pdf>.
- Fishing Regulations: Yellowstone National Park. (2011). Retrieved from <http://www.nps.gov/yell/planyourvisit/upload/11fishreg.pdf>.
- Fritts, S. H., Bangs, E. E., Fontaine, J. A., Brewster, W. G., & Gore, J. F. (1995). Restoring wolves to the Northern Rocky Mountains of the United States. In L. D. Carbyn, S. H. Fritts, & D. R. Seip (Eds.), *Ecology and conservation of wolves in a changing world* (pp. 107–125). Edmonton, Alberta: Canadian Circumpolar Institute.
- Fudd. (2007). Urban Dictionary. Retrieved from

<http://www.urbandictionary.com/define.php?term=fudd>

- Geist, V. (2006). The North American Model of Wildlife Conservation: A means of creating wealth and protecting public health while generating biodiversity. In D. M. Lavigne (Ed.), *Gaining ground: In pursuit of ecological sustainability* (pp. 285–93). Guelph, Ontario, Canada: International Fund for Animal Welfare and University of Limerick, Ireland.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine.
- Grimble, R. J., & M-K. Chan. (1995). Stakeholder analysis for natural resource management in developing countries: Some practical guidelines for making management more participatory and effective. *Natural Resources Forum*, 19(2), 113–124.
- Gurak, L. J., & Antonijevic, S. (2008). The psychology of blogging: You, me, and everyone in between. *American Behavioral Scientist*, 52(1), 60-68.
- Herring, S. C., Scheidt, L. A., Wright, E., & Bonus, S. (2005). Weblogs as a bridging genre. *Information Technology & People*, 18(2), 142–171. doi:10.1108/09593840510601513
- Hewstone, M., Rubin, M., & Willis, H. (2002). Intergroup bias. *Annual Review Of Psychology*, 53(1), 575–604.
- Hogg, M. A. (1996). Intragroup processes, group structure and social identity. In W. P. Robinson (Ed.), *Social groups & identities: Developing the legacy of Henri Tajfel* (pp. 65–93). Oxford: Butterworth-Heinemann.
- Hogg, M. A., & Abrams, D. (1988). *Social identifications: A social psychology of intergroup relations and group processes*. New York: Routledge.
- Hookway, N. (2008). 'Entering the blogosphere': Some strategies for using blogs in social

- research. *Qualitative Research*, 8(1), 91-113. doi:10.1177/1468794107085298
- Manfredo, M. J. (2008). *Who cares about wildlife? Social science concepts for exploring human-wildlife relationships and conservation issues*. New York: Springer.
- Manfredo, M. J., Vaske, J. J., & Decker, D. J. (1995). Human dimensions of wildlife management: Basic concepts. In R. L. Knight & K. J. Gutzwiller (Eds.), *Wildlife and recreationists: Coexistence through management and research* (pp. 17–31). Washington, DC: Island Press.
- Mascia, M. B., Brosius, J. P., Dobson, T. A., Forbes, B. C., Horowitz, L., McKean, M. A., & Turner, N. J. (2003). Conservation and the social sciences [Editorial]. *Conservation Biology*, 17(3), 649–650.
- Merriam, S. B. (2002). *Qualitative research in practice: Examples for discussion and analysis*. San Francisco, CA: Jossey-Bass.
- Mitchell G. J., & Cody, W. K. (1993). The role of theory in qualitative research. *Nursing Science Quarterly*, 6(4), 170–178.
- Molina, R., Marcot, B. G., & Leshner, R. (2006). Protecting rare, old-growth, forest-associated species under the Survey and Manage Program guidelines of the Northwest Forest Plan. *Conservation Biology*, 20(2), 306-318.
- Muhlberger, P., Webb, N., & Stromer-Galley, J. (2008). The Deliberative E-Rulemaking project (DeER): Improving federal agency rulemaking via natural language processing and citizen dialogue. *Proceedings of the 2008 international conference on Digital government research*, 298, 403404.
- Neufeld, H., Marchessault, G., & Dean, H. (2006). From talk to text: balancing

- ethical and aesthetic considerations in editing [Editor's note]. *Canadian Journal Of Diabetes*, 30(4), 379-380.
- Nontoxic Shot Zones, 50 C.F.R. pt. 20.108 (1991).
- Oakes, P. J., Haslam, S. A., & Turner, J. C. (1994). *Stereotyping and social reality*. Oxford: Blackwell.
- Parkins, J. R., & Mitchell R. E. (2005). Public participation as public debate: A deliberative turn in natural resource management. *Society and Natural Resources*, 18, 529–540.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.
- Pitkin, H. (1988). Are freedom and liberty twins? *Political Theory: An International Journal of Political Philosophy*, 16, 523–552.
- Plummer, K. (2001). *Documents of life 2: An invitation a critical humanism* (2nd ed.). Thousand Oaks, CA: Sage.
- Pokras, M. A., & Kneeland, M. R. (2009). Understanding lead uptake and effects across species lines: A conservation medicine approach. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 7–22). Boise, ID: The Peregrine Fund.
- Rattner, B. A., Franson, J. C., Sheffield, S. R., Goddard, C. I., Leonard, N. J., Stang, D., & Wingate, P. J. (2008). *Sources and implications of lead ammunition and fishing tackle on natural resources* (Technical Review no. 08-01). Retrieved from The Wildlife Society website: <http://wildlife.org/documents/technical-reviews/docs/Lead08-1.pdf>
- Refuge-Specific Hunting and Sport Fishing Regulations; Final Rule, 77 Fed. Reg. 176 (2012)

(to be codified at 50 C.F.R. pt. 32).

Roosevelt, T., Van Dyke, T. S., Eliot, D. G., & Stone, A. J. (1902). *The deer family*. MacMillan Company, New York.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 25, pp. 1–65). New York: Academic Press.

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues*, 50, 19-45.

Serfaty, V. (2004). Online diaries: Towards a structural approach. *Journal of American Studies*, 38(3), 457–471. doi:10.1017/S0021875804008746

Shaffer, L. S. (1983). Toward Pepitone's vision of a normative social psychology: What is a social norm? *Journal of Mind and Behavior*, 4, 275– 294.

Sieg, R., Sullivan, K. A., & Parish, C. N. (2009). Voluntary lead reduction efforts within the northern Arizona range of the California condor. In R. T. Watson, M. Fuller, M. Pokras, & W. G. Hunt (Eds.), *Ingestion of lead from spent ammunition: Implications for wildlife and humans* (pp. 341–349). Boise, ID: The Peregrine Fund.

Spencer, M. B. (2011). American identity: Impact of youths' differential experiences in society on their attachment to American ideals. *Applied Developmental Science*, 15(2), 61–69.

Stankey, G. H., & McCool, S. F. (2004). Social sciences and natural resources management: An

- assessment of advances. In M. J. Manfredi, J. J. Vaske, B. L. Bruyere, D. R. Field, & P. Brown, Jr. (Eds.), *Society and natural resources: A summary of knowledge* (pp. 21–34). Jefferson City, MO: Modern Litho.
- Stoll-Kleemann, S. (2001). Barriers to nature conservation in Germany: A model explaining opposition to protected areas. *Journal of Environmental Psychology, 21*(4), 369–385.
doi:10.1006/jevp.2001.0228
- Stoll-Kleemann, S. (2004). The social-psychological dimension of biodiversity conservation. In S. Light (Ed.), *The role of biodiversity conservation in the transition to rural sustainability* (pp. 147–159). Burke, VA: IOS Press.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.
- Tajfel, H. (1969). The cognitive aspect of prejudice. *Journal of Social Issues, 25*, 79–97.
- Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American, 223*, 96-102.
- Tajfel, H. (1972). Social categorization. English manuscript of La catégorisation sociale. In S. Moscovici (Ed.), *Introduction à la psychologie sociale* (Vol. 1, pp. 272–302). Paris: Larousse.
- Tajfel, H. (1974). Social identity and intergroup behaviour. *Social Science Information, 13*, 65-93.
- Tajfel, H. (1978). *Differentiation between social groups: Studies in the social psychology of intergroup relations*. London: Academic Press.
- Tajfel, H. (1981). *Human groups and social categories: Studies in social psychology*. Cambridge: Cambridge University Press.
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin

- & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33–47). Monterey, CA: Brooks-Cole.
- Tajfel, H., & Wilkes, A.L. (1963). Classification and quantitative judgment. *British Journal of Psychology*, *54*, 101–114.
- Thomas, V. G. (2011). Conflicts in lead ammunition and sinker regulation: Considerations for US national parks. *The George Wright Forum*, *28*(1), 24–33.
- Turner, J. C. (1982). Towards a cognitive redefinition of the social group. In H. Tajfel (Ed.), *Social identity and intergroup relations* (pp. 15–40). Cambridge: Cambridge University Press.
- Turner, J. C. (1985). Social categorization and the self-concept: A social cognitive theory of group behaviour. In E. J. Lawler (Ed.), *Advances in group processes: Theory and research* (Vol. 2, pp. 77–122). Greenwich, CT: JAI Press.
- Turner, J. C. (1999). Some current issues in research on social identity and self-categorization theories. In N. Ellemers, R. Spears, & B. Doosje (Eds.), *Social identity* (pp. 6–34). Oxford: Blackwell.
- Turner, J. C., & Giles, H. (1981). *Intergroup behaviour*. Oxford: Blackwell.
- Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory*. Oxford: Blackwell.
- Turner, J. C., & Reynolds, K. J. (2001). The social identity perspective in intergroup relations: The theories, themes, and controversies. In R. J. Brown & S. Gaertner (Eds.), *Blackwell handbook of social psychology: Intergroup processes* (pp. 133–152). Malden, MA: Blackwell.

Williams A. L., & Merten, M. J. (2008). A review of online social networking profiles by adolescents: Implications for future research and intervention. *Adolescence*, 43(170), 253–274.

Wright, M. L., & Tolbert, G. (1987). Reform at last for the lead shot controversy. *William & Mary Environmental Law and Policy Review*, 12(3), 8–11.

CONCLUSION

The purpose of this thesis was to explore the topic of lead ammunition and fishing tackle use to improve agencies' understanding of audiences, provide a more adequate representation of diverse viewpoints, and enhance the ability of various entities interested in this topic to identify likely sources of controversy related to potential management activities, communicate more effectively with the public, and develop more successful management solutions. This was accomplished by a review and synthesis of the relevant literature that particularly focused on the role of the social sciences and human dimensions information in addressing the issue of lead in the environment, as well as the regulatory and voluntary mechanisms that have been introduced by agencies and organizations in the U.S. to reduce the negative impacts of lead use activities. Recommendations for future outreach initiatives and research to minimize the impacts of lead from hunting and fishing were derived from this literature review. Additionally, a basic interpretive qualitative research study was undertaken to better understand the meaning people assign to issues involving the use of lead ammunition and fishing tackle. The findings of this investigation were able to identify different attitudinal positions with regard to lead use; different preferences for management strategies; and that differences were associated with conflict. More importantly, the research explored elements that were key to how meaning was constructed by individuals that correlated to these different elements.

Information collected through both the literature review and qualitative study contributed to an understanding of how different stakeholders perceive this complex issue of lead use and to the identification of important considerations for communication strategies that could be undertaken by land, wildlife, and natural resource management agencies that are

interested in the topic. In the first of two papers presented as part of this thesis, many important lessons came out of a review of the relevant literature and the work being done by various states, agencies, and organizations that can inform development of effective outreach strategies and messages for addressing issues related to the use of lead in recreational hunting and fishing.

The second paper summarizing results of the qualitative investigation provided additional insight into what management actions for minimizing lead use impacts may be acceptable among different stakeholder groups, and why some of these strategies are more or less preferred over others. For example, reactions to regulations were the most extreme and complex. These actions were deemed highly unacceptable, or undesirable, to most groups and generated concerns that one's freedom and rights were being violated. Voluntary approaches, like outreach and education, were more preferable, but in some cases they were viewed with as much skepticism as regulations, in part due to concerns about their effectiveness. In addition to enhancing understanding of stakeholder reactions to management actions, including regulations as well as outreach mechanisms for addressing lead use, the specific themes identified through this investigation may provide a basis for thinking about actual communication strategies and messaging. The findings point to certain concerns that may be fueling the conflict and opposition to management strategies that could be addressed through communication; for example, some viewed attempts to address lead use as a "backdoor" means of ultimately ending hunting, fishing, and/or shooting sports. This seems to highlight, from a communication standpoint, the need to be explicit about the goals of the agency in a way that would address any misperceptions revealed in the data, while also focusing on the

interconnecting sets of values and practices that make cooperation possible. In particular, for the above example, this would include acknowledgement of shared interests that center around conservation and recognition of the important contributions made by hunting and fishing activities in this context. It might also include an explicit commitment to ensuring access to opportunities to pursue these activities in the future.

Through the qualitative research analysis process, connections were made to theoretical frameworks that were useful for explaining the observations and interconnected ideas that emerged during data analysis. In doing so, this study addresses an important conceptual area that is largely underrepresented within the context of research on the human dimensions of natural resource issues. Specifically, it demonstrates how theories about social groups might be particularly relevant to understanding how people respond to conservation issues, especially those that are more controversial in nature. In the human dimensions of natural resources field, explanations of human thought and behavior have typically focused on individual level or macro (e.g., societal) level influences, and less on the role of social groups.

Management decisions regarding lead ammunition and fishing tackle have the potential to be highly controversial, with divergent stakeholder perspectives and reactions. Thus, it will be critical in the future that these decisions begin with an understanding of factors at the root of human behavior and stakeholders' preferences for management.

APPENDIX

Interview Questions

1. Can you describe your job to me, taking me through your general responsibilities and roles?
2. How is it that you became involved in the work that you do involving lead?
3. What is the goal or desired outcome of your organization with regards to lead? What is your personal goal?
4. Through your work with lead I imagine that you interact with or engage the public about this issue. Can you describe a common setting in which this takes place?
5. What are the dynamics of these interactions? What types of exchanges occur?
6. Can you describe for me a typical case that comes to mind when you think about a confrontational or argumentative interaction? Can you describe a unique case?
7. Can you describe for me a typical case in which productive dialogue occurred? Can you describe a unique case?
8. Can you describe a situation in which you feel your outreach had the desired outcome? What about one that did not?
9. Can you identify any needs that you believe would improve your communication strategies? For example, are there informational needs or a lack of specific resources?
10. I imagine you also interact with others within the workplace or work sphere. Please describe the nature of these interactions?
11. Please describe interactions you have within the work place that are formal (part of your job)?

12. Please describe a typical informal (or unique) interaction with other people you work with or other professionals?
13. What is your sense of their general attitude about this issue in relationship to internal operations? What is your sense of internal support for the agency's/organization's goals?
14. What types of people are you not interacting with, or that you want to reach, but are not internally?
15. Can you identify any needs that you believe would improve communication with internal audiences? For example, are there informational needs or a lack of specific resources?
16. Given the experiences you have had with lead issues, what are the biggest obstacles to moving forward? What about the most successful approach?
17. Is there anything else you would like to share that was not covered?