Subjectivity in Expert Decision Making: Risk Assessment, Acceptability, and Cognitive Heuristics Affecting Endangered Species Act Listing Judgments for the Greater Yellowstone Ecosystem Grizzly Bear

THESIS

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By

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Abstract

The Endangered Species Act (ESA) was signed into U.S. law in 1973, with the purpose of conserving species at risk of extinction. The law mandates that "the best scientific and commercial data available" be used to determine the protection status of potentially imperiled organisms and provides a process in which decision makers answer two questions: What is the risk to the species? And, is that risk acceptable? The first question can be answered by science, but the second cannot; ultimately, acceptability of a certain level of risk is an ethical or policy decision rather than a scientific decision. Scientific factors and objectivity are scrutinized in this type of expert decision making process, however the other factors such as individual level heuristics that may influence the decision making process have received limited attention to date. This research investigates the process of expert decision making involved in listing determinations for the grizzly bear (*Ursus arctos horribilis*) in the Greater Yellowstone Ecosystem (GYE) during the timeframe where proposals to delist this population segment of grizzlies from the ESA are being considered. A web-based survey of researchers who have published peer-reviewed findings on *Ursus arctos* within the past 10 years, and Interagency Grizzly Bear Committee members was conducted to investigate the degree of consensus regarding the threats facing the GYE grizzly and also to understand what factors influence expert listing recommendations. Level of expertise, threat assessment, and six individual heuristics were analyzed in a bivariate logistic regression to determine which factors have an impact on the choice between keeping the GYE grizzly listed or delisted. Findings showed little agreement regarding the threats facing the long-term survival of the GYE grizzly bear population but a clear majority believe grizzlies should remain listed as either endangered or threatened. Of the six heuristics, degree of expertise, and threat assessment factors that were considered in the model, only values (a mutualism wildlife value orientation) and normative beliefs about what other professionals believe were found to be significant influences on expert listing determination.

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Table of Contents

List of Tables

List of Figures

CHAPTER 1
INTRODUCTION

Numerous species are disappearing worldwide to the point that some scientists believe we are poised to enter a sixth mass extinction (Leakey & Lewin, 1996; Wake & Vredenburg, 2008). Large carnivores, in general, are among the most imperiled taxa worldwide (Ripple et al., 2014). Governments around the world have mobilized to protect imperiled species, and have seen some success in their restoration efforts (Chapron et al., 2014; Smith & Bangs, 2009). In the United States, large carnivores such as grizzly bears, wolves, and the Florida panther were protected under the federal Endangered Species Act of 1973 (ESA); however, ESA protections are controversial, and the federal agencies charged with recovering threatened and endangered species are under considerable pressure to accelerate species recovery and curtail species listings (Sidle, 1998; Bruskotter & Enzler, 2009).

The purpose of the Endangered Species Act (ESA) is to protect species in danger of extinction (16 U.S.C. §1532(6)(2000)), protect their ecosystems (Id. §1531(b)), and promote their recovery (Id. §1532; (Wymyslo, 2009). Consideration of species for protection under the ESA is triggered either by a third-party petition or via internal review by one of the two federal agencies charged with making listing determinations (the U.S. Fish and Wildlife Service [USFWS], or the National Marine Fisheries Service [NMFS or NOAA Fisheries] in the case of some marine species).

If a petition to list a species is filed, the responsible agency then has 90 days to determine if the petition contains sufficient evidence to warrant further consideration. If they decide a listing may be warranted, the agency has 12 months (from the initial date of receiving the petition) to conduct a status review of the species by collecting and interpreting the information required to make a determination of appropriate listing status (Wymyslo, 2009; Freyfogle & Goble, 2009). This listing decision must include a detailed summary of the threats faced by the species (often referred to as the "threat analysis"), and a listing status determination - that is, a decision as to whether the species should be listed as threatened, endangered, warranted but precluded, or not listed) (Freyfogle & Goble, 2009). If a species is listed, it is afforded legal protections as designated by the ESA; the three main legal protections of the act include prohibition on "take" or "harm" (16 U.S.C. §§ 1538(a)(1)(B)-(C), 1532 (19)), the ban on jeopardizing a species or adversely modifying its critical habitat (16 U.S.C. §1536(a)(2)), and a designation of a recovery plan (Freyfogle & Goble, 2009). Additional rules also limit imports, trades, and sales of any kind of animal or animal part (alive or dead) to listed species.

Part of the difficulty of penning legislation is ensuring that its provisions are accepted by a majority of Congress. In practice, this may require language that is sufficiently ambiguous to allow those charged with carrying out the provisions some flexibility, yet also narrow enough so that the provisions can be implemented consistently and in a manner that accomplishes the legislative intent. The ESA is no exception. Some of the most controversial provisions include the questions of what is the unit of life that the Act will protect (i.e., what is a "species" under the Act), what qualifies a species to be listed (i.e., deemed "threatened" or "endangered"), and also how experts should make these decisions, specifically, what criteria do they use to judge whether a species merits protection (see, for example: Vucetich et al., 2006, Waples et al., 2007, Greenwald 2009, Enzler & Brusktotter, 2009).

To answer the first question (i.e., *What qualifies as a "species?"*) the ESA provides a broad definition that includes any "subspecies of fish, or wildlife, or plant" and also any "distinct population segment" (DPS) of an animal (16 U.S.C. §1532(16)). One problem that arises here is that the distinctions between subspecies, DPS, or even species are often not unanimously agreed upon. Considerations of morphological and genetic differences are hotly debated for many animals including the recent, well-known debates regarding distinctions between the gray wolf populations segments and subspecies (Syntheses, 2014 Jan; Bruskotter et al., 2014), as well as the merits of separate subspecies classifications of brown bear occupying different northern population segments between the lower 48, Alaska, and Canada. In addition, the ESA contains no definition of a DPS. It is only under an additional policy adopted in 1996 that a DPS is defined as a population that is "physically discrete" (based on factors of physical, physiological, ecological, or behavioral differences of the animal) and "significant to a species as a whole" (61 Fed, Reg.4722 (Feb. 7, 1996)). Yet, what constitutes "discrete" enough, or "significant" to qualify as a DPS has still not been clarified.

To answer the second question (i.e., *What qualifies a species to be listed?*), the ESA requires the agency in charge to assess the risks that potentially threaten a species or its habitat within five categories: "(A) the present or threatened destruction, modification, or curtailment of [the species'] habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting [the species'] continued existence." (Id. § 1533(a)(1)(A)-(E)). Using these factors the agency must "determine if and when the threat is substantial enough that it may critically reduce a species' viability and lead to extinction" (Wymyslo, 2009). If the agency determines that the threat warrants protection, then an additional decision is made as to whether the species should be considered "threatened" or "endangered." The ESA defines "endangered" as a species that is "in danger of extinction through all or a significant portion of its range" (16 U.S.C. §1532(6)), and "threatened" as "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. §1532(20)). This language raises additional questions about what may constitute the "foreseeable future," "likely," and "significant portion of its range."

In cases where the text of a law is ambiguous, agencies charged with its implementation are typically granted wide discretion in how they choose to interpret the language (Chevron U.S.A., Inc v. Natural Resources Defense Council, Inc., 467 U.S. 837 (1984)). However, the ESA includes a strict science mandate that dictates that all decisions must be made solely on the "best available scientific and commercial data" (16

U.S.C. §1533(b)(1)(A)) and that economic, social, or political consequences that might result from the classification or declassification of a species are not to be taken into account. This language appears designed to minimize bias, ensure listing status determinations are supported by empirical evidence, and promote consistency in the criteria used to determine threats. The language also seemingly constrains administrative discretion such that agencies could not interpret ambiguous language in a way that conflicts with science.

Determining the Listing Status of a Species

Determining whether or not a species should be listed involves a two-part consideration (Figure 1) that begins with science, but inevitably moves beyond what science has the capacity to determine (Freyfogle & Goble, 2009; Wilhere, 2008). First, the agency must determine *the risk of extinction* for the species in question. While this judgment contains considerable uncertainty (as there are always limits to our abilities to quantify such risks), it is ultimately a scientific endeavor. The second consideration is largely implicit and often unrecognized in listing status decisions and considers whether the assessed risk is considered *acceptable* (Freyfogle, 2009). This second question cannot be answered solely through collection of scientific data; rather it requires a separate judgment based on the interpretation of available data. Thus, the "strict science" mandate of the ESA obscures the fact that listing determinations ultimately rely both on science (assessed risk) as well as implicit judgments (perceived acceptability of risk) (Freyfogle & Goble, 2009).

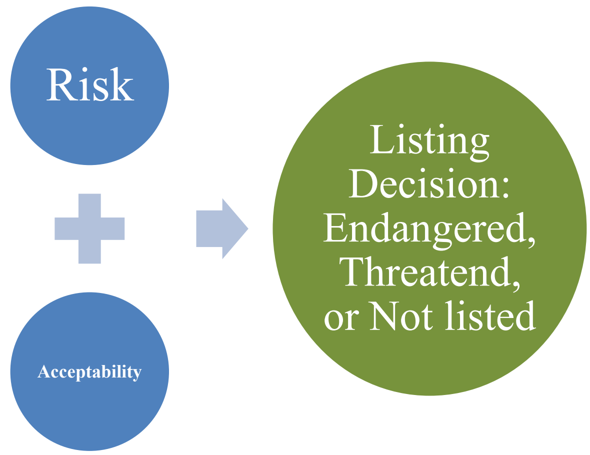


Figure 1 - The Two Main Parts of an ESA Listing Decision

Science can describe what the risk for a species *is* or *is likely to be*, but science cannot tell us what the risk *ought to* be (Bruskotter, 2013). For example, if empirical evidence makes the claim that a species faces a 1% chance of extinction over the next 10 years, that claim must still be further assessed by an ethical decision regarding whether that level of risk is acceptable to us, or *should* we intervene with money and resources if we deem it is not. How about a 20%, 50%, or 70% chance of extinction over 100 years or 1,000 years? At what point does the risk shift from a determination of acceptable to unacceptable? This is an ethical question that the ESA does not clearly answer, but is one that the ESA, by virtue of the mandate to base listing decisions solely on science, asks decision makers to answer (Freyfogle, 2009; Goble, 2009; Vucetich, 2006).

The mandate that listing determinations be made solely on the best available science perpetuates the myth that science - and science alone - can, and should, determine whether a species is endangered (Bruskotter, 2013). For that reason, limited prior research has examined the role of factors other than science in the listing recommendations of experts. Because judgments regarding the listing status of a species *require* subjective evaluations of the acceptability of risk, the inconsistency between what decision makers are told to base their decision on and what assessments are needed in order to make the decision may mask heuristics (decision making short cuts) used by individual decision-makers during that process. Heuristics, if relied on too regularly and systematically, may become a bias in their decision making.

This study seeks to understand how and to what extent such heuristics may impact the judgments of scientists regarding a species' appropriate listing status. Individual-level heuristics may influence decisions about whether a species should be listed as threatened or endangered. We tend to look to scientific experts to make these important decisions due to their depth of technical knowledge, and a perceived ability to be objective. However, human decision making, even among experts, is subject to a variety of heuristics (Maguire & Albright, 2005; Shanteau, 1988; Wilson, Winter, Maguire, & Ascher, 2011). Therefore, it is important to explore whether such heuristics are present among experts who may inform pending listing determinations. By becoming aware of the full range of factors that influence listing determinations, decision makers may be able to more effectively delineate judgments based upon science from the ethical judgments about the acceptability of risks. Moreover, mere awareness of one's own use of heuristics can be useful for minimizing possible resulting biases on future decisions (Kleindorfer, 1999; Schwenk, 1988).

This is an important consideration for species facing such listing decisions today, such as the Grizzly Bear (*Ursus arctos horribilis),* which has been listed in the ESA as "threatened" in the lower 48 states since 1975 (Knight & Eberhardt, 1985; USFWS, 1993; 16 U.S.C. § 1531 et seq.). However, the Greater Yellowstone Ecosystem (GYE) population of grizzly bears recently surpassed the total population target specified in the Grizzly Bear Recovery Plan (Servheen, 1998; USFWS, 1993). Recovery plans describe steps that will be taken to recover listed species and provide criteria that can be used to determine when whether a species is recovered. Because the criteria for the GYE grizzly have been met, the U.S. Fish and Wildlife Service is currently considering removing the GYE grizzly population from ESA protections. Absent federal protections provided by the ESA, grizzly bear management in the GYE would revert back to the individual states and it would open up the possibility of state regulated hunting of grizzly bears - something not seen since the times of the bear's lowest population count in the early 1970's. Therefore, this decision, like the delisting of any endangered or threatened species, is an important judgment with large potential ramifications for the future of the species.

This research examines judgments of experts regarding ESA listing status of the GYE Grizzly Bear. I completed an internet-based survey of grizzly bear experts (those who have published peer-reviewed research on grizzly bears in the last ten years and members of the Interagency Grizzly Bear Committee) to examine their beliefs about the appropriate listing status and current risks for this population of bears and also assess the influence of values, attitudes, and norms as sources of heuristics in their judgment of appropriate listing status. The following chapters provide a review of the history of the population status of the GYE grizzly bear focusing on successes and failures of coexisting with a growing human population (Chapter 2) and the social and psychological heuristics to be investigated along with how they affect human relationships with wildlife which in turn affect grizzly conservation (Chapter 3). These chapters are followed by detailed descriptions of methods (Chapter 4), results (Chapter 5), discussion (Chapter 6), and conclusion (Chapter 7) for the expert survey conducted for this research.

CHAPTER 2
GRIZZLY BEAR-HUMAN INTERACTION IN THE GYE

Prior to 1800, North American brown bears were present in at least 16 of the lower 48 states, with an estimated population of around 50,000 (USFWS, 1993). Early European settlers viewed these animals as competitors and threats to their livelihoods resulting in organized efforts to remove the bears wherever possible. These actions resulted in a 75% reduction to the brown bear population, due almost exclusively to human-caused mortality over the next century (Servheen et al., 1999). By the early 1920's all remaining populations of North American brown bears in the contiguous U.S. were isolated (Servheen et al., 1999), and their range south of Canada had been reduced to 1% of it historic size (Miller & Waits, 2003; Paetkau et al., 1998) (Figure 2).

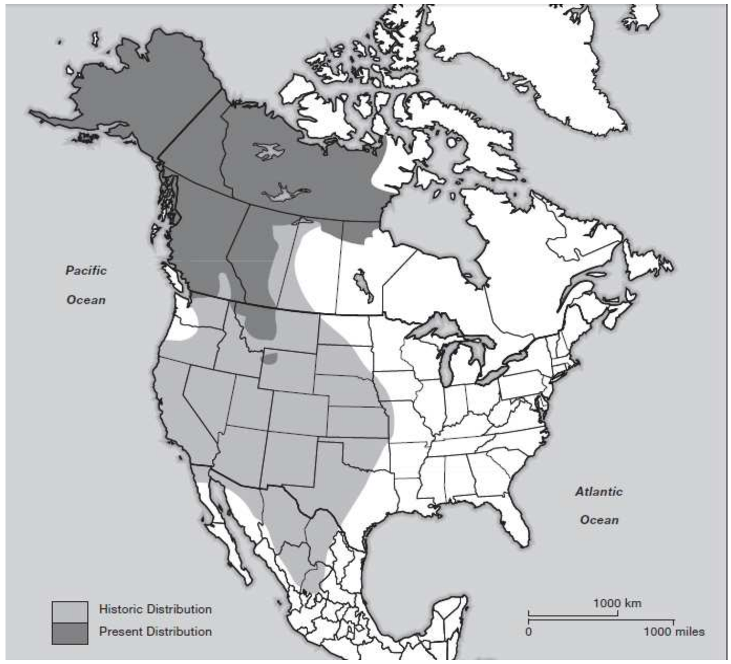


Figure 2: Brown Bear (Ursus arctos) Distribution in North America
(Kavanaugh & Benson, 2013; Servheen et al., 1999)

Human-caused mortality (legal and illegal hunting, kills in defense of human life or property, or removal of "problem bears") is the leading cause of grizzly bear mortality in the contiguous U.S. (Mattson et. al. 1996; Merril, et al., 1999). This suggests that human tolerance for grizzlies, similar to other large carnivores (i.e. all wildlife perceived as potentially dangerous to humans), is likely the main limiting factor to population sizes, distributions, and densities (Bruskotter & Wilson, 2013). While wildlife populations may be limited by a biological carrying capacity (the upper limit of population that an environment can sustain based on biological factors such as physical space available, food supply, water available, birth rate, and natural death rate), in practice, population levels may be thought of as being dictated by a social carrying capacity - the size of a wildlife population stakeholders are willing to tolerate. Stakeholder acceptance of grizzly bears is influenced by beliefs about grizzly bears, perceived risks and benefits of having grizzly bears in the region, attitudes toward the animal, and also individual values (Carpenter, et al., 2000; Riley & Decker, 2000; Zinn, et al., 1998). Over time, these human variables have a dynamic influence on wildlife management policies and serve to increase or decrease the size of specific species populations.

Human-bear conflict and interactions are a primary driving influence to change policies that ultimately decide the fate of the species in the region. Of all of the reasons humans and grizzly bears might come into contact with one another, such incidents primarily result from bears seeking or being attracted to a human food source (Gunther, 1994; Smith, Herrero, & DeBryun, 2005; Clarke & Slocombe, 2009; Peine, 2004; Baptiste, Whelan, & Frary, 1979; Servheen, 1998). Research indicates that grizzly bears prefer to avoid areas of human concentration and development (Mattson, Knight, & Blanchard, 1987; McLellan, 1990; USFWS, 1993; Mattson, 1990; Peine, 2001). However, grizzly bear physiology is such that their survival requires them to seek food nearly unremittingly. Because obtaining food is such a crucial part of bear survival behavior, food availability largely dictates their movement patterns (Blanchard & Knight, 1991) and behavior (Beckmann & Verger, 2003; McLellan, 1990; Zajac, 2010; Gunther, 1994; McCullough, 1982; Smith, Herrero, & DeBruyn, 2005). When anthropogenic sources such as improperly stored food or trash are available, they may override the normal tendency of grizzlies to avoid human inhabited areas and result in return visitors to sites where food was once found. Moreover, over time, repeated exposure to people without consequence habituates bears to people and reduces fear and avoidance.

The history of Grizzly Bear management in Yellowstone National Park provides an example of how coupled human and bear behavior can influence both wildlife behavior and management strategies. As early as 1889, Grizzly bears were recorded feeding from garbage dumps in the Greater Yellowstone Ecosystem and the first recorded reports of bears begging for food along road-sides were made in 1910 (Gunther, 1994). Bear viewing at trash cities and bear feeding were popular activities for park visitors. Not surprisingly, these activities resulted in human-bear conflicts; the first human death caused by a grizzly bear within Yellowstone occurred in 1916 and between 1931 and 1959, 48 people were injured by bears and 98 cases of property damage occurred each year (Gunther, 1994). The second human death caused by a bear in Yellowstone took place in 1942, resulting in the first substantial criticisms for how the park was handling its "bear problem" (Gunther, 1994). Throughout the 1950's the bear management was somewhat informal and mainly consisted of removing problem bears whenever it *seemed* necessary, but over the following two decades, management programs were formalized; the main goals were to reduce human-bear conflict by restoring bears to their natural state (NPS, 1960), via proper food storage, quicker trash removal, bear proof trashcans, and an increased enforcement of the "don't feed the bears" rule. The largest change made to reduce human-bear conflict was the closure of the garbage dumps in the late 1960's; this drastically reduced the available attractants for bears in areas that were frequented by park visitors (Gunther, 1994). All dumps were closed in Yellowstone by 1971. As these dumps had provided a steady food source since at least the 1920's, the initial response of the grizzly bears to the removal of this food source was a population crash, and a spike in human-bear conflict incidents.

It took a period of about 15 years for the bears to recover their original feeding habits as human encroachment and habitat loss had removed many other equivalent natural food sources (Craighead, 1998). A new management plan that lasted throughout the 1970's included public education efforts about safety around bears and the tragic consequences of feeding bears in congruence with the dump closure motives. Grizzly bears were also listed as threatened on the ESA during this period and human injuries decreased significantly (Gunther, 1994).

By the 1980's, grizzly bear populations had declined substantially and subsequent management programs began to focus on recovering bear populations and emphasizing habitat protection. The dramatic decline in bear removal (Figure 3) is both a testament to the change in management and an increased public concern of losing all grizzly bears from the area and a decreased perceived risk of grizzly bear attack (Gunther, 1994). Whether the shift in public attitude is reflective of a change in public value supporting grizzly bears or merely a reflection of the listing of grizzly bears on the ESA is not established. Conservation status itself can shift attitudes because support for the conservation of the animal is related to knowledge of their given status (Kellert, 1994). It has been argued that identification of a species as "vulnerable," "threatened," or "endangered" may lead to greater tolerance of the species and willingness to support actions to support the conservation of that species with the identified status implying that that species is rare (Kellert, 1994).

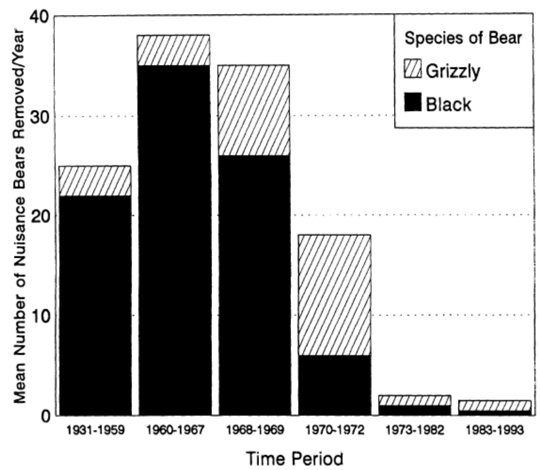


Figure 3- Average Number of Nuisance Bears Removed per Year During Different Time Periods in Yellowstone National Park, 1931-93. - (Gunther, 1994)

As this example illustrates, grizzly bear history and survival has been deeply entwined with human populations by way of human's very physical presence and their management strategies for handling human-bear coexistence (or lack thereof). It is for this reason, that integration of the biological and social sciences as well as ethical considerations should be used to address issues of human-grizzly bear coexistence. Here we examine how heuristics may influence expert judgment about the appropriate listing status for the grizzly bears.

Current Status of North American Grizzly/Brown Bear Populations

Brown bears have the widest distribution of any bear species (Columbus Zoo, 2014). Their current distribution includes North America, Europe, and Asia (Figure 4). North American populations include brown bears in Alaska and Canada, and grizzly bears in five separate population segments located in the pacific northwest of the contiguous U.S. Brown bear populations in Alaska and Canada are currently considered stable, but they face many of the same threats grizzly bears of the lower 48 of the U.S., such as industrial development, human encroachment, poaching, and habitat destruction and fragmentation. Because of these threats, these populations of bears are still considered at risk or vulnerable, but hunting the species is legal (but tightly regulated) in these areas (Davradou & Namkoong, 2001; McFarlane et al., 2007; Vaske, Bright, & Absher, 2008). As of 2002 Canada had a brown bear population of approximately 25,000 with a 24% reduction from their historical range (Miller, Miller, & McCollum, 1998) while Alaska, has a population of approximately 30,000 brown bears (the largest brown bear population outside Russia) with little to no reduction from historical range (just reduced density) (Minette Johnson, 2006).

Figure 4- World Population Distribution of Ursus arctos - (IUCN, 2008)
(IUCN and Wildlife Conservation Society 2008. Ursus arctos.
The IUCN Red List of Threatened Species. Version 2014.3)

There are five fragmented and isolated populations of grizzly bears in the contiguous U.S. with a combined total of between 1,000 and 1,200 individuals (Minette Johnson, 2006) (Figure 5). The five populations are located in the Northern Continental Divide Ecosystem, the Cabinet/Yaak Ecosystem, the Selkirk Ecosystem, the Northern Cascades Ecosystem, and the Greater Yellowstone Ecosystem (GYE). A sixth grizzly bear recovery zone was also specified in the Grizzly Bear Recovery Plan, but currently no grizzlies reside there. Of these population segments, the population in the Yellowstone Ecosystem has been able to make the biggest steps towards stability, and as such is currently in consideration for delisting.

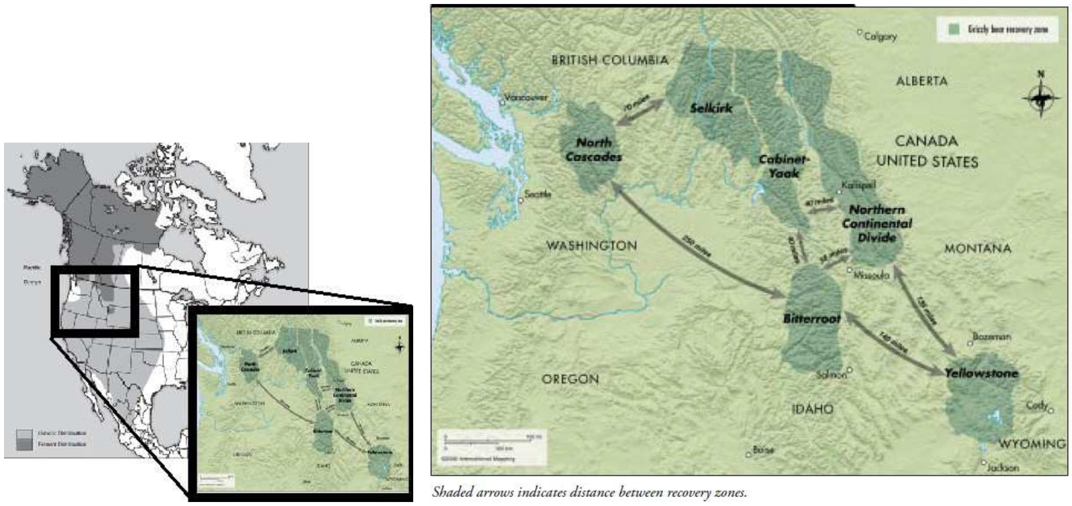


Figure 5 - Present and Proposed Grizzly Bear Recovery Area - (Minette Johnson, 2006)

The Greater Yellowstone Ecosystem

The GYE is a 9,200sq mile habitat that includes parts of Wyoming, Idaho, and Montana and, contains the most studied grizzly bear population on earth (Minette Johnson, 2006). Because of Yellowstone National Park's history with grizzly bears, these bears have become a cultural symbol for many people inside and outside of the GYE; Yellowstone visitors rank the grizzly bear as the number one wildlife species they hope to see in coming to visit Yellowstone (Minette Johnson, 2006). The GYE is the largest intact, or nearly intact ecosystem in the lower 48, and it includes seven National Forests and three wildlife refuges (Reading et al., 1994). Despite the many threats these bears face from various forms of human-caused mortality, habitat destruction, and fragmentation, this population has been increasing at an estimated rate of 4%/year (Servheen, et al., 1999; France et al., 2007). Current population estimates indicate there are 500-600 bears in the GYE, surpassing the recovery plan's target goal for delisting. This population has also met the recovery plan's target goals for habitat occupancy, number of females with cubs-of-the-year, and mortality rates (USFWS, 1993; Kavanaugh & Benson, 2013; France et. al. 2007).

Proposals for removing these Grizzly bears from the Endangered Species Act (ESA) are currently being considered. Bears protected under ESA's federal law are not allowed to be harassed or killed except in defense of life or property, and resource extraction and related management activities such as timber harvesting, mining, and road building are subject to additional scrutiny (Servheen, 1999). If delisted, Yellowstone grizzly bears would lose this federal protection and bear management would be turned over to the states possibly leading to adoption of hunting seasons for the first time since the 1970's.

GYE Grizzlies have been previously considered for delisting. In 2006, the Department of the Interior proposed their removal from ESA protections, but the decision was overturned in resulting litigation due to insufficient data about the decline of white bark pine trees - a chief food source for GYE grizzly bears (Minette Johnson, 2006; Ertz, 2011).

Another point of concern, are uncertainties as to the accuracy of population counting methods currently employed to deem whether or not recovery goals have truly been met (Camenzind, 2013; Higgs, et al., 2013). Estimating grizzly bear numbers in forested areas is notoriously difficult, and current methods provide counts that are likely overestimates rather than underestimates (Miller & Waits, 2003; Craighead, 1998). Many argue that until this level of uncertainty can be reduced, it is unwise to move forward with their delisting (Craighead, 1998; Camenzind, 2013; Higgs, et al., 2013). There has been a substantial increase in numbers of grizzlies sighted, but researchers indicate that could also be due to the fact that they have spent increased time and effort looking for them (Cole, 1974; Camenzind, 2013; Higgs, et al., 2013).

Potential Threats to Grizzly Bears in the GYE

Potential threats to the long-term survival of grizzly bears in the GYE as noted in the scientific literature include genetic isolation, decrease in important food sources, low reproductive rates, roads, and human-bear conflict. Each of these threats is briefly described below.

i. Genetic isolation. Genetic isolation is a condition that can arise in small and fragmented populations, or populations geographically segregated from incoming genetic variations, that can cause a decrease in long term evolutionary potential for the population segment and inbreeding resulting in individuals with reduced fitness (Townsend, Begon, & Harper, 2003). A population can become genetically isolated when they are small or are geographically cut off from other populations - Yellowstone is both. For the GYE population, over next several generations, losses in genetic diversity are not viewed as an imminent threat to these grizzlies' survival (Paetkau et al., 1998; Miller & Waits, 2003; Franklin 1980), but multiple researchers believe that gene flow from outside sources, whether from development of corridors between populations or by successful translocation of a few individuals annually, is necessary to ensure their *long term* survival (Miller & Waits, 2003; Paetkau et al., 1998).

ii. Decline of grizzly bear food resources. The main reason the 2006 proposed delisting determination was reversed was the decline in two of the Yellowstone grizzly's important food sources - whitebark Pine (*Pinus albicaulis*), and cutthroat trout (*Oncorhynchus clarkii*). Whitebark pine is a preferred food source these bears nutritionally rely on (Mattson & Merrill, 2002) and it is also one that grows only in high elevations, typically distant from human settlements (Mattson, et al., 2001; Mattson & Merrill, 2002). Whitebark pine has declined in recent years due to the white pine blister rust (*Cronatum ribicola)* (Mattson, 1990; Miller & Waits, 2003). This has not only resulted in less food for this growing bear population, but also has led to bear movement into more densely human populated areas in search of alternative food sources. Decline of the cutthroat trout due to the presence of exotic lake trout pose a similar concern (Gunther, et al., 2004).

iii. Low reproduction rate. The grizzly bear's reproduction rate is the slowest of any land mammal in North America with the exception of the musk ox (Minette Johnson, 2006; Knight & Eberhardt, 1985). Due to their later ages of initial reproduction, and the time between pregnancies due to cub rearing, female grizzlies only produce an average of eight cubs in their life time (Davradou & Namkoong, 2001). Sexual maturity is also dependent on the presence of environmental stressors, and the age-of-first-cub has been on the rise in Yellowstone (Pasitschniak-Arts, 1993; Stokes, 1970). Another limitation to grizzly reproduction is that there is only a 50% survivorship to age 5.5 (USFWS, 1993) making replacement rates even lower. Because Yellowstone is isolated from other grizzly bear populations, and translocation has such low success rates, the only source of new numbers is reproduction.

i*v. Roads.* Human development is an issue for numerous wildlife species but the impact of roads on Yellowstone grizzly bears deserve special mention. Over two million people visit Yellowstone National Park each year during the period of high grizzly bear activity (Mattson et al., 1987). Roads increase access for illegal hunting (McFarlane et al., 2007; McLellan & Shackleton, 1988), increase the probability of vehicle-bear collision (Gunther et al., 2004; McLellan & Shackleton, 1988), increase the frequency of energy costly flight responses by bears to amplified human presence, disrupt efficient foraging strategies, and cause indirect population constraints from long term displacement leading to fragmentation (McLellan & Shackleton, 1988; Mattson et al., 1987). One study in British Columbia (McLellan & Shackleton, 1988), found grizzly bear displacement by roads was equivalent to a 58% reduction in habitat in the zone 0-100m from road and 7% reduction in the 101m-250m zone. Other studies show similar displacements and also note that females and sub-adults are disproportionately impacted by displacement (Mattson et al., 1987; Pasitschniak-Arts, 1993; Blanchard & knight, 1995; Maguire & Servheen, 1992; Graber & White, 1983; Clark & Slocombe, 2009; Mattson, 1990; Blanchard and Knight, 1991).

Avoidance of roads was even found to be independent of traffic volume which suggests that even a few cars or a road put in place by a decommissioned industry (such as currently unused logging roads) can displace bears (McLellan & Shackleton, 1988;

Morzillo, 2007). Avoidance of roadways and human development centers also serves as an anthropogenic barrier causing not only habitat loss, but also habitat fragmentation. The grizzly bear recovery plan cites roads as the most imminent of threats to grizzly bear habitat (USFWS, 1993).

v. *Human-bear conflict.* While many of the aforementioned threats to the bear population in the GYE have received some attention by decision makers, social based threats, such as the influence of public attitudes and values towards grizzly bears and grizzly bear management plans have received limited attention in delisting considerations. Changes in human attitude and behavior (less lethality) have been critical to the survival of grizzly bears from 1970-present (Mattson & Merrill, 2002). Due to both the "public trust" doctrine affirmed by the Unites States Supreme Court in 1986 which held that wildlife in the U.S. belong to the public, and the region's history of systematically attempting to eliminate "hazardous" wildlife (i.e. bears and large carnivores) from human-inhabited areas, public acceptance is critical both for the Yellowstone grizzly's survival and for the successful implementation of post-delisting related bear management policies (e.g., Bruskotter, Vaske, & Schmidt, 2009; Slagle, et al., 2012; Zajac, et al., 2011; Servheen, et al., 1995; Stokes, 1970; Gore et al., 2004).

When human behavior creates the threat to the survival of a species, the recovery of that species is dependent on either aiding the species' ability to adapt to the human behavior or altering the human behavior to reduce or eliminate the impact on the species (Kavanaugh & Benson, 2013). Deciding which of those courses should be taken will be based on social values as well as biological constraints; it is a product of an empirical scientific premise and an ethical one (Vucetich & Nelson, 2012).

CHAPTER 3
HEURISTICS IN DECISION MAKING

Substantial research has examined human decision making and the results of this work suggests there are two systems, cognitive and affective, that may be used to process information and form decisions (Gardner, 2008). The cognitive approach includes deliberate consideration of observations in a slow and methodical way, while the affective approach typically occurs quickly without our conscious awareness and is based on feelings or emotions (Gardner, 2008; Slovic et al., 2002). Reliance on affect and emotion is a quicker and easier way to decide a course of action in the face of a complex or uncertain environment (Slovic et al., 2002). Affective thinking precedes analytic thought and is the only requirement for decision making (Gardner, 2008). Thus, decisions requiring careful cognitive analysis require deliberate effort to engage the cognitive system of information processing (Slovic et al., 2004). This dual system of processing information is a useful adaptation that allows us to deliberate and weigh alternatives of a choice, but also choose a course of action quickly if needed in a situation of high risk or high uncertainty where an immediate decision is required. However, in situations where more deliberate calculations are required, the affective approach may cloud an individual's reasoning resulting in a flawed decision. The affect heuristic occurs when decisions are made by relying on feelings associated with a particular topic rather than a systematic evaluation of the issue and decision alternatives (Slovic et al., 2004). The feelings that become salient in a judgment process depend on characteristics of the individual and the situation at hand. Without effortful analytic calculations of the situation, this may lead to decisions based on a series of mental shortcuts, or heuristics, that help interpret the information at hand in an affective processing way rather than a cognitive and deliberate processing way. The use of heuristics in human decision making is not inherently faulty, in fact it can provide an advantage when snap decisions are needed, or when there is limited information on which to base a decision, and is also necessary due to the limited processing capacity of the human brain (Kleindorfer, 1999). However, if the use of heuristics becomes systematic and predictable, decisions become biased (Shanteau, 1988).

Individual judgment and decision making is impacted by a variety of heuristics that can limit the quality of our decisions (Kahneman et al., 1982). Scientists, despite their training, also appear to be subject to these heuristics. Yet it is scientific experts we turn to in order to inform important policy decisions that affect the future of humans and wildlife. Indeed, the idea of "science-based" policy is codified as a principle of sound wildlife management by *The Wildlife Society* - the professional society that certifies wildlife biologists in the U.S. (TWS, 2007-2014). We turn to experts for these decisions with the idea that they can provide an objective judgment in the face of complicated environmental decisions that often involve powerful vocal interest groups with conflicting policy goals. However, while scientific understanding may be most critical to help inform highly complex decisions with high levels of uncertainty (like species listing determinations), these are the types of decisions that are most likely to be influenced by biases and experience-based heuristics (Wilson et al., 2001). In making a listing determination, heuristics in the form of individual values, attitudes, perceptions of risk, trust, social norms, and levels of ambiguity tolerance may interact to influence decision making behavior for grizzly bear listing decisions.

Values / Value Orientations

Values are defined as fundamental cognitions that serve as a foundation for attitudes and beliefs (Bjerke & Kaltenborn, 1999; Cline, Sexton, & Stewart, 2007), or more simply and specifically as "what we hold dear" (Cline et al., 2007). Values are central to our identity, are few in number (Fulton, Manfredo, & Lipscomb, 1996), more resistant to change than attitudes or behavior, and transcend situations and objects (Fulton, et al., 1996; Cline et al., 2007. Because values are formed through socialization, they are theorized to be widely shared by people within a culture and therefore are not likely to explain much variation in people's behaviors. Rather, values impact on behavior is believed generally to come about through its effect on higher-order cognitions, such as beliefs, attitudes, and value orientations.

A value orientation is defined as a "schematic network of beliefs" that gives context-specific meaning to broad values (Manfredo, et al., 2009; Rohan, 2000; Smith, 1998). Within a society, the value about the importance of preserving life may be widely shared; however, two people who have the same value may differ in their value orientation. For example, two people who share the value of preserving life may differ in their value orientations resulting in different attitudes about the lethal control of problem-wildlife. One person may believe that lethal means of dealing with a problem animal is an unacceptable harm to a living thing and is therefore not justified under any circumstance, while the other may come to a different conclusion if he/she believes human concerns are superior to that of the animals' (Manfredo, et al., 2009; Fulton, et al., 1996). Some research suggests that value orientations toward wildlife can be categorized along a spectrum ranging from "mutualism" to "domination" (Manfredo, Teel, & Henry, 2009). The domination orientation is characterized by viewing wildlife as having primarily instrumental value (e.g. that "animals exist to advance the needs of humans" and "animals are subordinated to humans"), while those expressing the mutualism orientation view wildlife as having intrinsic value and emphasize equality of all life including wildlife and humans. Manfredo et al. argue that those with a strong domination orientation will be more likely to prioritize human well-being over the well-being of wildlife and more likely to accept management actions that could result in death or intrusive control of wildlife than those with a more mutualism orientation (2009). Correspondingly, those with a stronger mutualism orientation are expected to hold beliefs that do not prioritize human needs above those of wildlife in situations where those needs conflict (Manfredo, et al., 2009).

Attitudes

Attitudes are defined as an association in memory towards an object and an evaluation of favor or disfavor (Fazio, Chen, McDonel, & Sherman, 1982). Favorable attitudes have been shown to be an important predictor of support for bear policy as well as for tolerant behavior/behavioral intentions (e.g. not killing bears or attempting to block conservation efforts for bears) (Kaczensky, Blazic, & Gossow, 2004). Affective assessments of a species are found to affect beliefs about risks and benefits regarding that species and acceptance for a species (Bruskotter & Wilson, 2013; Sjöberg, 1998). Research indicates that affect is often used as a heuristic in judgment and decision making (Gardner, 2008). The affect heuristic is based on the idea that humans experience affective emotions first and those emotions then shape thoughts, words, and reasoning that follow (Gardner, 2008).

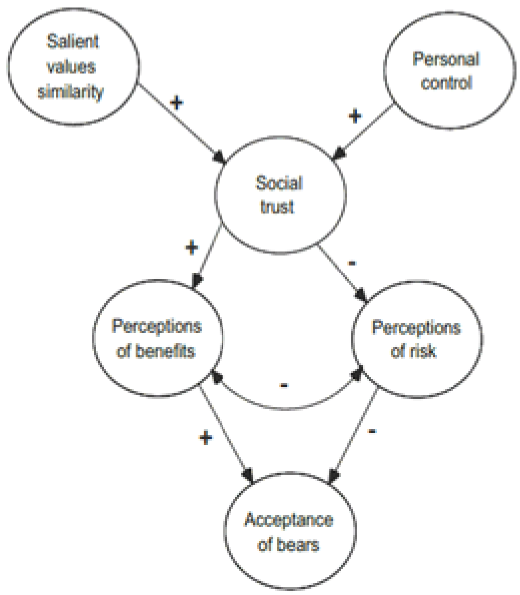
Risk

Traditionally, risk assessments were made by experts based on the probability of the risk multiplied by the consequence (typically measured as harm to human populations particularly through expected fatalities) (Sjöberg, 2000). However, the lay public also evaluates risk and their risk perceptions are likely to incorporate many more aspects of "risk" then typically included in technical assessments. Risk perception is defined as an intuitive evaluation of the threat an object or activity may pose (Gore, Knuth, Curtis, & Shanahan, 2006, 2007; Slovic, 2000; Zajac, 2010). These judgments include a cognitive (the perceived possibility of a threat) and affective component (the perceived feeling associated with that threat) (Gore et al., 2006; Gore et al., 2005; USFWS, 2007; Sjoberg, 1998). Risk perceptions of environmental hazards such as bears are believed to influence and shape future beliefs and attitudes of support (or lack of) for associated management goals and activities (e.g., bear management goals and associated management actions) (Gore, Siemer, Shanahan, Schuefele, & Decker, 2005). It is well established that perceptions of risk and benefits of environmental hazards influence an individual's willingness to accept a hazard such as coexisting with bears, large carnivores, or allowing forest management to carry out prescribed burns for forest maintenance (Bruskotter & Wilson, 2013). Likewise, it is also well established that the public may not have an accurate understanding of the risks associated with wildlife (over or under estimating these risks) (Beebe & Omi, 1993; Vaske et al., 2008). Because of these two well-documented social phenomena, risk perceptions of hazards are imperative to consider when making decisions regarding actions at the interface of humans and wildlife.

However, "risk" perceptions in this study should be looked at from a slightly different perspective, as my subjects are not the general public but instead experts involved in research on a particular species currently under federal protections to maintain its viability. Given my emphasis on listing status determinations, the "risk" in question is whether the species is likely to go extinct without continuing federal protections. Tolerance to such risks (describing how comfortable an individual is at making a gamble) may differ between individuals (Plous, 1993). Some individuals are more prone to avoid risk, whereas others are more prone to be risk takers in decisions. This personality difference among individuals may influence listing determinations with experts who are risk averse being more likely to favor listing protection than someone who has greater risk tolerance.

Trust

Hazard Acceptance theory posits that the risks and benefits associated with a hazard are not necessarily a result of logical cost-benefit analysis, but instead are a function of the social trust perceived in a management authority. Social trust is defined as "one's willingness to rely on those who have the responsibility for making decisions and taking management actions in the realms of public health and safety" (Siegrist & Cvetkovich, 2000; Zajac, et al., 2011). Social trust serves as a heuristic (a decision making short cut) that influences the risk/benefit analysis of a hazard (Bruskotter & Wilson, 2013; Zajac, 2010). A model of hazard acceptance in the context of bears posited by Zajac et al., (2012) includes social trust as a key predictor of acceptance of bears (Figure 7). Social trust is essential to an agency's ability to act (Toman, Shindler, & Brunson, 2006). An increase in trust leads to lower perceptions of risk compared to those who do not trust agencies (Vaske et al., 2008), and therefore an increase in tolerance of that hazard. A 2008 study, found trust to be the factor that explained the most variance in attitude towards environmental hazard acceptance (Kavanaugh & Benson, 2013; Vaske et al., 2008)



The sign on each causal correlative pathway indicates the expected direction of relationship. Straight lines represent causal pathways and double-headed curved lines represent correlations.

Figure 6: Conceptual Model of Public Acceptance of Bears - (Zajac et al., 20013)

An important note about this model is that perceptions of risks and benefits are inversely correlated. When lay people assess risk they tend to incorrectly assume that events or objects judged with high risk also have a low benefit. This is likely due to the subconscious preference to be cognitively consistent (to not hold inconsistent thoughts about an object, entity, or action) (Eagly & Chaiken, 1993).

In the context of grizzly bear conservation, a few studies have shown that attitudes toward bears are mostly positive among the general public; however, support for their reintroduction to areas where bears were extirpated is still low (Clark et al., 2002; Kavanaugh & Benson, 2013). Some suggest the reason for this discrepancy is limited trust in the managing agencies in charge (Kavanaugh & Benson, 2013). If the public trusts that wildlife managers have the interest of both bears and humans in mind, it is found that the public will be more likely to support recovery programs, and population expansion of grizzly bears (Servheen, 1998). For grizzly bear experts in the context of the possible delisting of this population segment the risk perceived in this model would be the risk of the grizzly bear going extinct in the GYE if they are delisted; and in the event that their delisting does occur, management for these grizzly bears would transition back to state agencies. Therefore the element of social trust included in this model that could affect expert perception of the degree of risk these bears face may be linked to the experts trust toward these state wildlife management agencies.

Norms

Norms can be described as what people typically do (a descriptive norm), and what people ought to do or what people typically approve or disapprove of in a given situation (an injunctive norm) (Cialdini, 2003; Cline et al., 2007). The effect of norms on human decision making, sometimes called the "bandwagon effect," is the idea that what others do or believe has a tendency to affect what we do or believe. This can happen, often without awareness, as individuals may be influenced to adopt beliefs and attitudes prevalent within society or their more specific social groups. Similar influences may exist within professional affiliations, possibly with an even greater degree of influence as job security, advancement, or cohesion could be seen to be tied to the upholding of certain normative beliefs and behaviors.

Scientific experts do not all hold the same position, share the exact the same level of expertise or experience, nor are they employed by the same professional entity. The type of professional associations an individual holds, their source of funding, or their employment and their position within that organization could result in a different set of perceived norms that may influence their decision making. For example, it is possible that systematic differences may be found between experts employed by state or federal agencies and those employed by academic institution or by those with different levels of experience.

Ambiguity tolerance

Ambiguity tolerance is a measure of individuals' comfort making a decision in a context where not all of the information is provided or is certain. Interest in tolerance for ambiguity started in the late 1940's (Macdonald, 1970; Rokeach 1948; Adorno et. al., 1950; Frekel-brunskwick, 1949, 1951) and later studies demonstrated that uncertainty or ambiguity in a situation affects decision making choices (Røskaft, 2003; Macdonald, 1970). Specifically, attitudes towards both risk and ambiguity have been shown to interact and substantially affect choice behavior (Macdonald, 1970; Einhom & Hogarth, 1985; Kahn & Sarin, 1988; Ghosh & Ray, 1992). Budner (1962) defined an ambiguous situation to be one that "cannot be adequately structured or categorized by the individual because of lack of sufficient cues," and intolerance to that ambiguity as "a general tendency to perceived ambiguous material or situations as threatening" (Macdonald, 1970; Ghosh & Ray, 1992). Budner further classified ambiguity into three types: "A completely new situation in which there are no familiar cues, a complex situation in which there are a great number of cues to be taken into account, or a contradictory situation in which different elements or cues suggest different structures."

In terms of uncertainty regarding environmental decisions such as choices about the protection of a species like the grizzly bear, elements of all three types of ambiguity could be perceived by those responsible for these important decisions. For example, there are many uncertainties associated with the present atmosphere of resource extraction on public lands, the increased numbers of both humans and bears in natural areas, and also the contradictory cues from public advocacy groups that promote either businesses that create resource utility for human populations or those that promote increased protection for conservation areas and the species within them. The level of ambiguity found in a problematic decision is affected by factors such as the amount of evidence available, the perceived reliability of sources of that evidence, lack of causal knowledge regarding the process generating the outcomes, and the direction and the magnitude of the payoffs associated with the uncertainties (Macdonald, 1970). ESA listing decisions are generally characterized by each of the above factors.

Prospect theory, developed by Daniel Kahneman and Amos Tversky (1979) suggests that ambiguity will accentuate the effects of risk-aversion or risk-proneness of decision-makers (Plous, 1993; Macdonald, 1970). This theory represents the idea behind the heuristic, commonly called "ambiguity effect" which happens when there is a tendency to avoid choosing options that have elements of missing information or increased ambiguity (Baron, 1994).

CHAPTER 4
METHODS

Purpose of Study

The central purpose of this research is twofold (Figure 7). The first part focuses on the initial step in the listing assessment (i.e., *What are the risks to GYE grizzlies?*). The goal is to determine if there is a consensus among the grizzly bear experts as to their assessment of the threats facing GYE grizzly bears. The second part of the research addresses the more subjective second step in the listing status determination (i.e., *Is the perceived level of risk acceptable?*). Here I assess participant judgments of the appropriate listing status for the GYE grizzly population and examine the influence of multiple variables including cognitive and social factors on their preferred listing status.

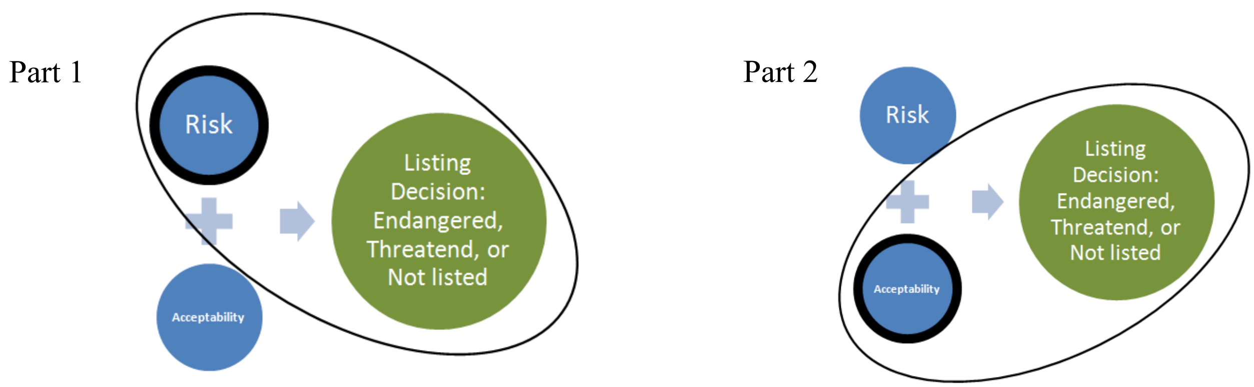


Figure 7: Illustration of the Minimum Information Needed to Determine the Listing Status of a Species

Research Design

Study Population and Selection

To address expert opinion regarding the threats to the GYE grizzly bear and their listing status, a web-survey (Appendix C) was conducted with a sample of grizzly bear experts. There is no universal database of experts or any generally accepted criteria for determining who would qualify as a grizzly bear expert. For the purposes of this study "grizzly bear experts" were defined as individuals who published peer reviewed articles about the species *Ursus arctos* in the last 10 years (2004-2014), as well as those listed as current members of the Interagency Grizzly Bear Committee (IGBC). I compiled a sample frame using search terms "*Ursus arctos*," "Brown bear," and "Grizzly bear" in the database Academic Search Complete. This search resulted in the identification of 1345 authors. This initial list was augmented by the current members of the IGBC (90 listed members) listed on their website (http://www.igbconline.org/). The numbers do not add up to 1430 due to 5 IGBC members who were previously identified through my search for authors. This method of defining "grizzly bear experts" was deemed most inclusive for the type of expert that would have an adequate level of knowledge to be able to scientifically assess threats to the GYE population of grizzlies and have an informed opinion on their listing status. For those who felt they were not informed enough to further participate in the study, an opt out option was also included (see contact letters in appendix A) and an initial screen question asked participants to self-identify their level of expertise. The survey was ended for those who indicated "I have no wildlife research or management experience at all"

Additional searches were then completed on each of the 1430 experts (except in the two cases where the initial search listed them as deceased) in attempt to collect contact information. Of those 1430, e-mail contact information was found for 1216, and all 1216 e-mail addresses were sent an invitation to participate in the survey. In total, 590 (48% of those e-mails sent) were opened confirming an active e-mail address and potential participant.

Data Collection

Three e-mail contacts (Appendix A) were sent over the course of one month at different times and different days of the week to attempt to maximize participation; survey delivery methods were based on Dillman (2000). The initial contact with the participant panel included an e-mailed letter explaining the purpose of the survey, a brief explanation for why they were chosen for inclusion, an invitation to participate, a custom link to the questionnaire, and a link to opt out if they felt they were wrongly selected or if they had no desire to participate. The second and third contact e-mails were spaced several days apart to those panel members who had not yet responded and who had not opted out. Each of the two reminder e-mails again included a cover letter, a custom link to the questionnaire, and an opt-out link. Respondents were allowed to skip any questions that they did not feel they had enough knowledge to answer or were uncomfortable answering.

Operationalization of Variables

The following sections describe how the variables of interest were operationalized in this study along with associated hypotheses.

i. Level of expertise. While all respondents selected for inclusion in this study met the criteria used to designate "grizzly bear experts" (either by serving as an author or co-author of a peer-reviewed article in the previous ten years or as a result of their membership on the IGBC), participants have different levels of experience working with GYE grizzly bears. The questionnaire included a measure to assess participants' level of involvement in grizzly bear research. Knowledge and experience with GYE grizzlies was determined with a self-assessment question that asked respondents to select from a graduated level of involvement ranging from "I was/am involved in GYE grizzly bear related research or management" and "I was/am involved in grizzly bear research or management focused somewhere other than the GYE, but have some knowledge of the population in the GYE," down through "I was/am involved in grizzly bear research or management focused somewhere other than the GYE, and have no knowledge of the population in the GYE," "I have no grizzly/brown bear research or management experience, but have other wildlife research or management experience," and lastly, "I have no wildlife research or management experience at all." If a respondent chose the fifth option, they were thanked for their time but were not allowed to answer any further questions.

ii. Risk/threats assessment - A list of specific threats to brown bear populations was compiled by reviewing threats identified in more than 80 peer reviewed journal articles. The resulting threats were grouped into seven general threats to bears' persistence: 1) Decrease in abundance of grizzly's natural food source (hereafter referred to as "decreased food"), 2) Loss of habitat to human development (hereafter referred to as "habitat loss"), 3) Habitat modification on public lands (e.g. forest harvest, logging roads, oil and gas, recreation) (hereafter referred to as "habitat modification"), 4) Human caused grizzly mortality (i.e. human bear conflict resulting in bear loss or legal or illegal hunting) (hereafter referred to as "human-caused mortality"), 5) Lack of genetic diversity and connectivity to other populations (hereafter referred to as "genetic diversity"), 6) Lack of support for grizzly bear conservation (hereafter referred to as "lack of conservation support"), 7) Shifting ecological conditions due to climate change (hereafter referred to as "climate change"). Respondents were asked to rate each threat on two scales: one asked each respondent to gauge the likelihood that the risk would occur, and the other assessed the severity of that risk to grizzlies continued survival were it to occur. These numbers were multiplied (i.e., likelihood x severity) to create an overall rating for each threat/risk item. A write-in eighth option was also provided if experts wished to include a risk not initially included. Additionally, experts were asked to indicate the level of risk of extinction that, if exceeded, would require ESA protection (risks were rated as probability ranging from 0% to 100% chance of extinction).

iii. Listing status opinion - Immediately following questions asking experts to assess threats, participants were asked to indicate whether they believed the GYE grizzly bear population should be listed as endangered, threatened, not listed, or if they were unsure about the appropriate listing status under the ESA. This item was asked before any of the heuristic related measures in order to attempt to avoid any artificial priming that would elevate the use of these heuristics in their choice of listing status. If anything, this may have primed experts to base their listing status recommendation on the threat analysis questions that came before, and not on the subsequent measures of value orientations, attitudes, or norms.

iv. Value orientation - Survey items also assessed respondents' mutualism and domination value orientation with a nine-item measure adapted from Manfredo, Teel, and Henry (2009). Respondents were asked to select their level of agreement along a five point bi-polar scale ranging from strongly agree to strongly disagree with a neutral midpoint.

> *H_{1a} - Experts who score higher on a mutualism wildlife value orientation will exhibit greater support for keeping the Yellowstone population segment of grizzly bears listed.*
>
> *H_{1b}- Experts who score higher on a domination wildlife value orientation will exhibit greater support for delisting the Yellowstone population segment of grizzly bears.*

v. Ambiguity Tolerance - This measure was adapted from MacDonald's (1970) measure for ambiguity tolerance. Each item is a statement about how a person might feel facing a problem-solving situation with some degree of uncertainty about the solution or conclusion.

> *H_{2a} - Experts who exhibit increased ambiguity tolerance will be more likely to support delisting the Yellowstone population segment of grizzly bears.*
>
> *H_{2b} - Experts who exhibit decreased ambiguity tolerance will be more likely to support keeping the Yellowstone population segment of grizzly bears listed.*

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vi. Risk aversion - Risk aversion measures respondents' general attitude towards acting in situations involving a probability of risks. This measure was developed to be context specific to ESA listing determinations and asks the respondent to rate their level of agreement on a five point scale (from "strongly agree" to "strongly disagree" with a neutral midpoint) for five statements about how an appropriate listing status should be determined given risks to species' chances of survival.

> H_{3a} - *Experts who are more risk averse will show greater support for keeping the Yellowstone population segment of grizzly bears listed than those who are more risk tolerant.*

> H_{3b} - *Experts who are more risk tolerant will show greater support for delisting the Yellowstone population segment of grizzly bears.*

vii. Attitudes toward grizzly bear range expansion - Among the general public, one would expect to find a diverse range of attitudes towards grizzly bears; however, among grizzly bear researchers, I anticipated a relatively homogenous group of people with positive attitudes towards grizzly bears. Among these individuals, I reasoned that attitudinal variance would be more likely when it came to judgments about appropriate listing policy (e.g., encouraging range expansion). Thus, I choose to assess attitudes toward range expansion for the Yellowstone grizzly bear using a semantic differential scale that asks experts to choose an opinion along a scale that ranges from one choice to its antithesis (e.g. "Generally speaking, I think expanding the range of grizzly populations in the GYE is..." five-point scale ranging from harmful to beneficial). Because delisting the grizzly will allow states to classify the species as a game animal instead of a protected animal, hunting would likely be used in a way that would either maintain or reduce grizzly populations and therefore not allow range expansion. Accordingly, I reasoned that positive attitudes toward GYE grizzly range expansion would be associated with keeping grizzlies listed, while negative attitudes towards range expansion would be associated with delisting the species.

> *$H4_a$ - Positive attitudes towards expanding the Yellowstone grizzly bear's range will be associated with greater support for keeping the Yellowstone population segment of grizzly bears listed.*

> *$H4_b$ - Negative attitudes towards expanding the Yellowstone grizzly bear's range will be associated with greater support for delisting the Yellowstone population segment of grizzly bears.*

viii. Norms - This survey includes a measure of how an individual might react to social pressure. The measure is meant to assess to what degree an individual may allow the opinions of those around them to influence their own opinions in a given situation. It asks experts about what they perceive certain groups around them (i.e. scientists, wildlife managers, and lay public) think about protecting or allowing hunting on GYE grizzlies.

> *H_{5a} – Participant normative beliefs about other experts will be directly associated with their decision about the ESA listing status for the GYE grizzly bear.*

> *H_{5b}- Participant normative beliefs about public opinion will be directly associated with their decision about the ESA listing status for the GYE grizzly bear.*

ix. Trust and confidence - Trust in this study is measured as an assessment of respondents' trust and confidence that the state managing agencies would be successful in maintaining a stable population of grizzlies if they were delisted. An individual's assessment regarding the likely outcome of a delisting decision may affect their recommendation. For this measure, both trust and confidence are measured in bi-polar scale form and are adapted to fit the context of trust in wildlife management agencies based on Siegrist, Earle, and Gutscher's (2003) and Zajac's (2010) measure of social trust. Siegrist, Earle, and Gutscher's defined trust as "the willingness to make one-self vulnerable to another based on a judgment of similarity of intentions and values" (based primarily on value similarity) and confidence as "the belief, based on experience or evidence, that certain future events will occur as expected" (based on performance) (2003). Zajac assessed social trust with respect to Ohio black bears using measures of shared value similarity between the general public and the management agency (Zajac, 2010). In this study, a series of six statements assessed trust and confidence. If grizzly bears are delisted, state wildlife agencies will be in charge of grizzly management for the first time since their ESA listing, and therefore, trust in these agencies is important to assess in this context.

> H_{6a} - *Trust in state wildlife agencies will be associated with support for delisting the Yellowstone population segment of grizzly bears.*

> H_{6b} - *Lack of trust in state agencies will be associated with support for keeping the Yellowstone population of grizzly bears listed.*

Missing Data - Regression Analysis

Missing data is a common occurrence in social science research that arises when some participants do not answer every item in a survey. Biases can arise from using results with large amounts or systematic patterns of missing data, but data imputation can help address the problem of missing data by "filling in missing data with plausible values (Schafer, 1999). When data samples are small, such was the case for this project, it is helpful to be able to retain as much information as possible through imputation. For this survey, the maximum number of cases that could potentially be included in the regression analysis was 172 due to number of completed cases for the dependant variable. Without using an imputation method, list-wise deletion would have caused 30% of those cases to be dropped from the analysis (total remaining n=120). There are multiple potential imputation methods. One method commonly used in the social sciences is Multiple Imputation via Chained Equations (MICE) (Schafer, 1999; White, Royston, & Wood, 2009; Schunk, 2007). Multiple imputation approaches are less prone to generating bias estimates than single imputation. The MICE approach was used in this study to impute missing values and allow more cases to be used in the regression analysis. Cases with more than 50% missing data were not included in the imputation to improve the likelihood of accuracy in the imputation of missing values from the existing responses for each case. This removed six cases from the imputation processes making the total number of cases to be used in the regression analysis 166. For more information on the imputation process, please see Andridge & Little, 2011, Van Buuren, 2007, White, Royston, & Wood, 2009, or Schafer, 1999.

For this data, m=5 imputations were pooled to create a simulated score for missing values in each independent variable to be used in the regression analysis. For each imputation, conditional distributions were iteratively sampled 1,000 times, well over SPSS's default of 10 iterations, and Van Buuren's example of 20 times (Van Buuren, 2007). Trace plots for each variable that underwent imputation were then examined to check for any evidence that the chains did not converge; all plots showed no evidence to suggest an issue with the imputation that was completed.

CHAPTER 5
RESULTS

Response Rates

After removing undeliverable addresses and those who refused to participate, 593 e-mail addresses received and opened the survey. In total, 234 members of the sample completed the survey resulting in an adjusted response rate of 39.5% - roughly equivalent to response rates reported in similar wildlife-related mail surveys conducted in the U.S. (e.g., Manfredo, Teel, & Bright, 2003; Zajac et al., 2012). A substantial portion of the panel (n=158) e-mailed the study Principal Investigator to explain why they had chosen to opt out; this data, was aggregated with data from an opt out survey that accompanied the third e-mail (n=22). In both the email contacts and opt-out survey, the overwhelming reason for opting out was that the individual did not believe that they had the expertise necessary to complete the survey. In explaining their reluctance, individuals noted they did research on the GYE grizzly bear long ago and did not feel comfortable providing an opinion on their current status, they worked on another aspect of published research that was not directly related to the grizzly (e.g. statistical analysis), they worked on a different population of brown/grizzly bear, or their current work was more focused on black bears, polar bears, or captive grizzlies instead of the population in question and therefore did not feel they were adequately informed to be considered an expert on the GYE grizzly.

Demographics

The experts in this panel were selected on the basis of having published peer-reviewed articles on grizzly bears, or their membership status in the Interagency Grizzly Bear Committee (IGBC). Participants worked for a variety of organizations. When asked to provide information about their relevant employment history (wildlife, animal, or environment related job types), of the 203 who chose to report this information, individuals reported having held anywhere from one relevant position (n=99), to seven relevant positions (n=1), with the average person having held around 2 relevant professional positions. Length of time participants held these positions range from less than one year up through 42 years. The largest number of participants had experience in academia (211), a large number had also worked in some capacity for government agencies (135), while fewer worked for non-profit organizations (35) or in captive animal programs (10) (Table 1). Participants were also affiliated with a broad range of professional associations (Table 2), with the top reported organizations including The Wildlife Society (TWS) (n=101), Society for Conservation Biology (SCB) (n=68), Ecological Society of America (n= 41), The International Union for Conservation of Nature (IUCN) (n=37), The American Society of Mammalogists (n=36), and International Association for Bear Research and Management (n=36).

*Table 1 - Professional Experience**

Types of organizations	Count	Specific organizations	Count
Academic	211	Academic	211
Governmental Agency	135	Federal Agency	67
		State Agency	50
		Other Governmental Agency	18
Non Profit	35	Non Profit	35
Captive Animal	10	Zoo/Aquarium	5
		Wildlife Park/Sanctuary	4
		Game Ranch	1
Other	37	Other	37

*Respondents allowed to respond with up to 8 relevant positions

Table 2 – Respondents' Affiliations with Professional Associations

Professional Association	Count
The Wildlife Society (TWS)	101
Society for Conservation Biology	68
International Union for Conservation of Nature (IUCN)	37
Ecological Society of America	41
The American Society of Mammologists	36
International Association for Bear Research and Management	36

Note: Several other groups were listed and contained a maximum count of 8 participants.

I. Expertise, Listing Judgments, and Threat Assessment

Participants were asked to indicate their level of experience regarding GYE grizzlies (Table 3). The top two expertise groups (i.e., those with direct research experience with grizzly bears and knowledge of the GYE population) comprised 47.8% of the participants - 12% had direct experience with the GYE population, 35.9% had research experience with grizzly bears and some knowledge of the GYE population. The rest of respondents comprised 47.1% of the participants (34.1% had research experience with bears, but no direct knowledge of the GYE population, and 13% had no direct research or management experience with grizzly bears, but had other wildlife research management experience. The remaining 5.1% indicated no wildlife research or management experience and so were dropped from remaining analyses.

Table 3 - Participant Levels of Expertise

Group	Experience with GYE grizzly bears	Percent
Group 1 - Highest Expertise	I was/am involved GYE grizzly bear related research or management.	12.0
Group 2	I was/am involved in grizzly bear research or management focused somewhere other than the GYE, but have some knowledge of the population in the GYE.	35.9
Group 3	I was/am involved in grizzly bear research or management focused somewhere other than the GYE, and have no knowledge of the population in the GYE.	34.1
Group 4 - Least Expertise	I have no grizzly/brown bear research or management experience, but have other wildlife research or management experience.	13.0
Group 5*	I have no wildlife research or management experience at all.	5.7

*Group 5 did not complete any more of the survey other than this question, and are therefore not included in any subsequent analysis.

Experts' Judgments about the Appropriate Listing Status

Respondents were asked to indicate their preferred listing status for grizzly bears in the GYE. Overall, 60.2% indicated that grizzlies should continue to receive ESA protection (20.4% recommend an increased protective status of endangered, 39.8% recommend continuing its current status as threatened). Approximately, one-fifth (21.3%) of respondents indicated that grizzlies should be delisted from ESA protections while another 18.5% were unsure (Table 4). Among respondents who felt knowledgeable enough to provide a listing status recommendation (i.e. did not select the "unsure" option or skip the question), nearly three-fourths 73.8% indicated that grizzlies should remain listed, while around one quarter (26.2%) indicated grizzlies should be de-listed (Table 5).

Table 4 - Description of Expert's ESA Listing Status Recommendations (All Categories)

Status	Percent
Endangered	20.4
Threatened	39.8
Not Listed	21.3
Unsure	18.5
Total	100.0

Table 5 – Description of Expert's ESA Listing Status Recommendations (Dichotomous Summary of Those Who Provided an Opinion)

Status	Percent
Not Listed	26.2
Listed	73.8
Total	100.0

The majority of those who indicated "unsure" about this item came from those with less self-reported experience with GYE grizzlies (82% of unsure responses came from groups 3 and 4). For each of the other levels of expertise, the largest response category indicated that grizzlies should continue to receive ESA protection with most indicating they should be listed as threatened (Table 6).

Table 6 - Listing Status by Level of Expertise (All)

	Expert Group 1 (n = 29)	Expert Group 2 (n = 92)	Expert Group 3 (n = 66)	Expert Group 4 (n = 24)
Endangered (n = 43)	4 (13.8%)	21 (21.7%)	14 (21.2%)	5 (20.8%)
Threatened (n = 84)	15 (51.7%)	38 (41.3%)	24 (36.4%)	7 (29.2%)
Not Listed (n = 45)	8 (27.6%)	29 (31.5%)	4 (6.1%)	4 (16.7%)
Unsure (n = 39)	2 (5.9%)	5 (5.4%)	24 (35.4%)	8(33.3%)

Note: Percentages are the proportion of each expert group that provided a particular listing status recommendation.

I examined whether there was an association between the level of expertise and listing status recommendation using a Chi-square analysis (excluding those who answered they were unsure). Results indicate that listing status recommendations did not vary significantly between experts ($x^2(6) = 10.366$, p = 0.110) (Table 7).

Table 7 - Listing Status Summary by Expert Group (Only Those Who Gave an Opinion)

	Expert Group 1 (n = 27)	Expert Group 2 (n = 87)	Expert Group3 (n = 42)	Expert Group 4 (n = 16)
Endangered (n = 43)	4 (14.8%)	20 (23.0%)	14 (33.3%)	5 (31.3%)
Threatened (n = 84)	15 (55.5%)	38 (43.7%)	24 (57.1%)	7 (43.8%)
Not Listed (n = 45)	8 (29.6%)	29 (33.3%)	4 (9.5%)	4 (25.0%)

Notes: Pearson Chi-square = 10.37; d.f. = 6; p = 0.11

Threat Assessment

Survey respondents were asked to assess the perceived risk of seven potential threats to the continued viability of the GYE grizzlies based on the threats most commonly cited in current literature (Table 8). An eighth option was also provided for participants to indicate other threats they perceived to grizzly bears; there was no consensus among responses provided to this option and these responses were excluded from further analysis. Each threat was rated on two ten-point scales: one assessing the likelihood that the threat will occur, and the other assessing the severity of the threat if it did indeed occur. Perceived risk of each of these threats can be calculated by multiplying likelihood by severity for each item resulting in a score of 0 to 100 with higher numbers indicating greater perceived risk (Weinstein, 2000). The average score of each of the seven threat assessments were similar, with the top ranked threats including habitat loss ($\overline{X}$=40.61, σ=26.09), habitat modification ($\overline{X}$=38.52, σ=25.94), and human caused grizzly mortality ($\overline{X}$=36.90, σ=26.64). However, there was substantial variation in responses (Figure 8); risk perceptions for each threat covered the entire range of possible ratings from 0 to 100. The large spread of ratings for each threat suggest there is a great level of uncertainty about the current threats facing the grizzly among our participants.

Table 8 - Threat Assessment

Threat	N	Min	Max	Mean	Standard Deviation
Decrease in abundance of grizzly's natural food source	200	0.00	100.00	26.4550	21.64
Loss of habitat to human development	196	0.00	100.00	40.6122	26.09
Habitat modification on public lands (e.g. forest harvest, logging, roads, oil and gas drilling, recreation, etc.)	193	0.00	100.00	38.5181	25.94
Human caused grizzly mortality (i.e. human-bear conflict resulting in bear loss, or legal or illegal hunting)	201	0.00	100.00	36.8955	26.64
Lack of genetic diversity and connectivity to other populations	198	0.00	100.00	29.7778	26.97
Lack of support for grizzly bear conservation	195	0.00	100.00	26.8769	22.23
Shifting ecological conditions due to climate change	198	0.00	100.00	31.2071	25.29

To assess if level of expertise had any effect on how threats were assessed, an ANOVA was run for each threat (Table 9). For each ANOVA that suggested a significant difference between groups, the Games-Howell post-hoc test was used to assess differences between expert groups (Tables 10-12). For the threats of "decreased food abundance," "habitat modification," "human caused mortality," and "climate change," no evidence suggested that degree of expertise impacted threat assessments. However, expert level did have an impact on expert group 3 and expert group 4's assessment of "habitat loss;" group 4 rated habitat loss significantly lower than group 3. Expertise level also had an impact on expert assessment of "genetic diversity." Expert group 3 rated "genetic diversity" significantly higher than did expert group 2. Similarly, there was also an association between level of expertise and the perceived threat of "lack of conservation support" to grizzlies. Expert group 3 rated "lack of conservation support" a significantly higher risk than did expert group 2. In general, expert groups 1 and 2 (those with direct knowledge of the GYE grizzly bear population) provided similar risk assessments across each threat.

Table 9 - Analyses of Variance of Experts' Threat Assessments

		ANOVAs				
Threat		**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**
Decreased food	Between groups	3343.299	3	1114.433	2.430	0.066
	Within groups	89882.296	196	458.583		
	Total	93225.595	199			
Habitat loss	Between groups	5748.33	3	1916.113	2.896	0.036
	Within groups	127034.192	192	661.636		
	Total	132782.531	195			
Habitat modification	Between groups	3281.719	3	1093.906	1.642	0.181
	Within groups	125874.467	189	666.002		
	Total	129156.187	192			
Human-caused mortality	Between groups	1517.194	3	505.731	0.709	0.547
	Within groups	140421.612	197	712.800		
	Total	141938.806	200			
Genetic diversity	Between groups	13087.323	3	4362.441	6.500	<0.001
	Within groups	130194.899	194	671.108		
	Total	143282.222	197			
Lack of conservation support	Between groups	4802.650	3	1600.883	3.359	0.020
	Within groups	91040.396	191	476.651		
	Total	95843.046	194			
Climate change	Between groups	2186.572	3	728.857	1.142	0.333
	Within groups	123823.938	194	638.268		
	Total	126010.510	197			

Table 10 - Post Hoc Comparisons for Significant Differences Between Expertise Groups for Average Assessment of Threat of Habitat Loss to the GYE Grizzly Bear

Expertise Groups	**Expertise Groups (Compared to)**	**Mean Difference**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	Upper Bound
1	2	1.05	5.97	0.998	-14.93	17.03
	3	-5.72	5.97	0.776	-21.69	10.25
	4	12.63	7.70	0.366	-7.85	33.11
2	1	-1.05	6.00	0.998	-17.03	14.93
	3	-6.76	4.11	0.357	-17.46	3.93
	4	11.58	6.35	0.279	-5.54	28.70
3	1	5.72	5.99	0.776	-10.25	21.69
	2	6.76	4.11	0.357	-3.93	17.46
	4	18.34*	6.34	0.032	1.23	35.46
4	1	-12.63	7.70	0.366	-33.11	7.85
	2	-11.58	6.35	0.279	-28.70	5.54
	3	-18.34*	6.34	0.032	-35.49	-1.23

*The mean difference is significant at the 0.05 level.

Table 11 - Post Hoc Comparisons for Significant Differences Between Expertise Groups for Average Assessment of Threat of Loss of Genetic Diversity to the GYE Grizzly Bear

Expertise Groups	**Expertise Groups (Compared to)**	**Mean Difference**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	Upper Bound
1	2	3.01	5.61	0.950	-11.98	18.00
	3	-15.56	6.23	0.070	-32.01	0.89
	4	-1.16	6.63	0.998	-18.78	16.47
2	1	-3.01	5.61	0.950	-18.00	11.98
	3	-18.57*	4.56	0.000	-30.45	-6.69
	4	-4.17	5.09	0.845	-17.86	9.52
3	1	15.56	6.23	0.070	-0.89	32.01
	2	18.57*	4.56	0.000	6.69	30.45
	4	14.40	5.76	0.071	-0.87	29.68
4	1	1.16	6.63	0.998	-16.47	18.78
	2	4.17	5.09	0.845	-9.52	17.86
	3	-14.40	5.76	0.071	-29.68	0.87

*The mean difference is significant at the 0.05 level.

Table 12 - Post Hoc Comparisons for Significant Differences Between Expertise Groups for Average Assessment of Threat of Lack of Conservation Support to the GYE Grizzly Bear

Expertise Groups	Expertise Groups (Compared to)	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2.95	5.03	0.936	-10.52	16.41
	3	-8.47	5.51	0.423	-23.07	6.14
	4	0.55	5.80	1.000	-14.90	16.00
2	1	-2.95	5.03	0.936	-16.41	10.52
	3	-11.41*	3.82	0.018	-21.37	-1.46
	4	-2.40	4.23	0.941	-13.78	8.98
3	1	8.47	5.51	0.423	-6.14	23.07
	2	11.41*	3.82	0.018	1.46	21.37
	4	9.01	4.80	0.249	-3.70	21.73
4	1	-0.55	5.80	1.000	-16.00	14.90
	2	2.40	4.23	0.941	-8.98	13.78
	3	-9.01	4.80	0.249	-21.73	3.70

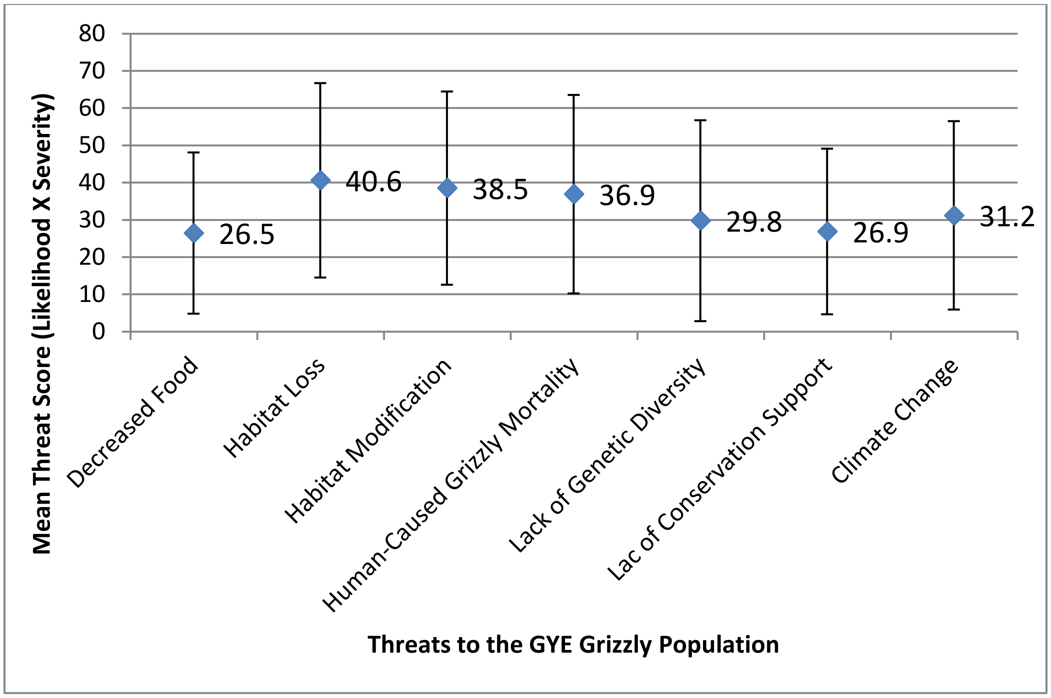
*The mean difference is significant at the 0.05 level.

To assess if variability in experts responses differs by expert level (i.e., is their more or less variability), an ANOVA was run on standard deviations for each threat among expertise groups (Table 13). For each ANOVA that suggested a significant difference between groups, the Games-Howell post-hoc test was used to assess differences between expert groups. All threats, with the exception of "human-caused mortality" and "climate change" showed significant differences of the variability between expert groups. Of the five threats with significant differences, four of them ("decreased food," "habitat modification," "genetic diversity," and "lack of conservation support") show that as expertise increases, standard deviation also increases. Figure 9 illustrates uncertainty in threats based on expertise groups.

Table 13 - Analyses of Variance of The Variation in Experts' Threat Assessments by Expertise

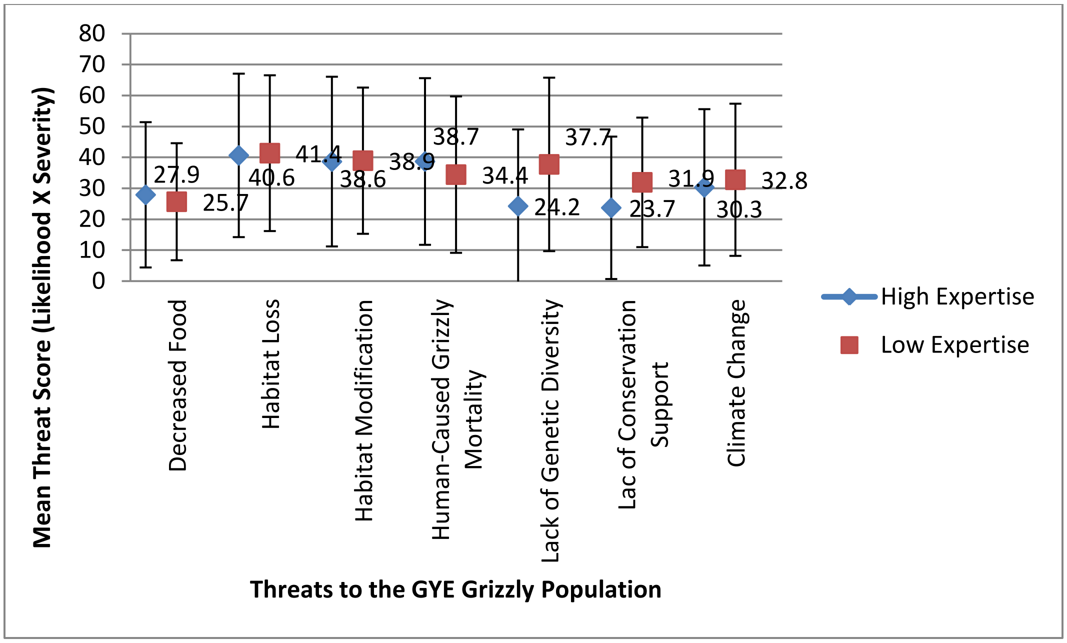
		Expertise Group			
		1	**2**	**3**	**4**
Threat	**Decreased food*[a]**	36.10 (27.02)	24.22 (21.45)	26.18 (19.72)	23.48 (17.25)
	Habitat loss*[b]	43.48 (26.87)	39.69 (26.21)	46.48 (22.51)	27.18 (26.75)
	Habitat modification*[c]	37.82 (30.26)	38.05 (26.73)	42.90 (23.92)	28.57 (20.27)
	Human-caused mortality	39.38 (28.01)	37.80 (27.00)	37.15 (26.34)	29.32 (24.57)
	Genetic diversity*[d]	26.07 (26.80)	23.06 (23.97)	41.63 (29.47)	27.23 (20.53)
	Lack of conservation support*[e]	25.50 (23.96)	22.55 (19.84)	33.97 (24.68)	24.95 (17.03)
	Climate change	34.79 (26.29)	28.02 (24.73)	31.98 (24.73)	37.71 (27.30)

Note: Values reported are "Mean (Standard Deviation)"
*Differences in standard deviation are statistically significant (Games-Howell Post Hoc Test)
a Differences in standard deviation are statistically significant between all groups (Games-Howell Post Hoc Test)
b Differences in standard deviation are statistically significant between group 4 and all other groups, and between group 3 and 4 (Games-Howell Post Hoc Test)
c Differences in standard deviation are statistically significant between groups 1 and 3, 1 and 4, 2 and 3, and 2 and 4 (Games-Howell Post Hoc Test)
d Differences in standard deviation are statistically significant between group 4 and all other groups (Games-Howell Post Hoc Test)
e Differences in standard deviation are statistically significant between groups 1 and 2, 1 and 4, 2 and 4, and 3 and 4 (Games-Howell Post Hoc Test)



Note: Error bars represent 1 standard deviation

Figure 8 - Experts' Mean Threat Scores for GYE Grizzly Population



Note: Error bars represent 1 standard deviation

Figure 9 - Experts' Mean Threat Scores for GYE Grizzly Population by Expertise Level

Acceptable Risk of Extinction

As a measure of risk tolerance in the context of species to be considered for ESA listing, experts were asked to indicate the highest probability of extinction they believe is acceptable (e.g., their judgment of the level of risk of extinction that, if exceeded would require ESA protection). Results showed experts vary in opinion across the entire range with answers including 0 and 1. The average level of maximum risk that experts were willing to tolerate was a .358 chance of extinction for a species over the next 100 years; the median response was a .30 chance. More than three-fourths of experts (77.3%) indicated that a species should be listed if the probability of extinction over the next 100 years exceeds .50 (Table 10). An ANOVA revealed that ESA risk tolerance did not vary based upon respondents' level of expertise ($F(3,194 = 2.270, p=0.082)$).

II. What Factors Affect Experts' Listing Recommendation?

The primary objective of this research was to investigate what factors impact experts' judgments concerning individual listing status recommendations. As previously illustrated, the notion that decisions about ESA listing status can be made solely on the "best available science" (i.e., science that quantifies the objective threats faced by a species) is overly simplistic. Such threat assessments only provide a description of the risks a species faces, they offer no guidance for what to do about the threat. What follows is the idea that other elements do enter in to the expert thought process behind these calculated decisions. Literature also shows that experts, like the general public, are susceptible to biases and heuristics in decision making (Shanteau, 1988; Maguire & Albright, 2005; Wilson et al., 2011). This project examines six potential factors that I reasoned could influence experts' judgments concerning the appropriate listing status of a species based on how they affect public attitudes on wildlife, which seemed most relevant to the listing decision process, and also ability to measure in an internet survey.

The six heuristics tested here include experts' risk tolerance, ambiguity tolerance, attitudes toward range expansion, wildlife value orientations (i.e., mutualism and dominance), trust and confidence in state wildlife management agencies, normative beliefs about what the public believes, and normative beliefs about what other professionals believe (Tables 14-21).

Table 14 - Participant Responses to ESA Risk Tolerance - Highest probability of Risk Acceptable Before Listing

Probability of extinction	**Percent**	**Mean**	**Std. deviation**
0.00-0.20	38.9		
0.21-0.40	37.8		
0.41-0.60	23.7		
0.61-0.80	9.6		
0.81-1.00	4.5		
Total	100.0	0.4	0.2

Note: Participants were asked to give a probability between 0 and 1 that represented the maximum probability of extinction they believe acceptable to not list a species, with 1 being certainty of extinction in the next 100 years and 1 being certainty of survival for the next 100.

More than three-fourths of experts (77.3%) indicated that the maximum acceptable probability of extinction for a species was 0.5 or less over a 100 year time period ($\overline{X}$=0.3, σ=0.23) (Table 14). Most experts (71.6%) had a moderate to high[1] level (0.00-2.99) of ambiguity tolerance ($\overline{X}$=2.5, σ=0.66) (Table 15). In terms of attitude towards range expansion, a large majority (94.1%) had moderate to high (4.00-7.00) positive attitudes ($\overline{X}$=5.50, σ=1.13) (Table 16). A majority of the experts also tended to have high (3.00-5.00) mutualism value orientation ($\overline{X}$=3.71, 0.82) (Table 17), a low (1.00-2.99) dominance wildlife value orientation ($\overline{X}$=2.19, σ=0.57) (Table 18), moderately high (2.00-2.99) level of trust in state wildlife agencies ($\overline{X}$=2.63, σ=0.85) (Table 19), a higher (5.00-7.00) normative belief that the public believes the GYE grizzly should be listed ($\overline{X}$=4.76, σ=1.64) (Table 20) and a moderately high (4.00-5.00) normative belief that other professionals believe the GYE grizzly should be listed ($\overline{X}$=4.39, σ=1.55) (Table 21).

[1] Descriptions of "high," "moderately high," "low," etc., are based on the entire range of each scale that they could have selected for that individual measure.

Table 15 - Respondent Responses to Ambiguity Tolerance

Ambiguity Tolerance	Percent	Mean	Std. deviation
1.00-1.99	13.5		
2.00-2.99	58.1		
3.00-3.99	23.7		
4.00-5.00	4.7		
Total	100.0	2.6	0.7

Note: Scores were averaged from 4 items, each item on a scale of 1-5 with higher scores indicating lower ambiguity tolerance.

Table 16 - Respondent Attitudes Towards the GYE Grizzly Range Expansion

Attitude toward grizzly range expansion	Percent	Mean	Std. deviation
1.00-1.99	1.5		
2.00-2.99	1.0		
3.00-3.99	3.5		
4.00-4.99	19.3		
5.00-5.99	32.2		
6.00-7.00	42.6		
Total	100.0	5.5	1.1

Note: Scores were averaged from 4 items, each item on a scale of 1-7 with higher scores indicating a positive attitude toward range expansion.

Table 17 - Respondent Wildlife Value Orientation - Mutualism Scores

Wildlife value orientation mutualism scores	Percent	Mean	Std. deviation
1.00-1.99	2.3		
2.00-2.99	10.2		
3.00-3.99	42.1		
4.00-5.00	45.4		
Total	100.0	3.7	0.8

Note: Scores were averaged from 3 items, each item on a scale of 1-5 with higher scores indicating a higher mutualism score.

Table 18 - Respondent Wildlife Value Orientation - Domination Scores

Wildlife value orientation domination scores	Percent	Mean	Std. deviation
1.00-1.99	33.5		
2.00-2.99	55.0		
3.00-3.99	11.5		
4.00-5.00	0.0		
Total	100.0	2.2	0.6

Note: Higher score indicates higher dominance orientation

Table 19 - Respondent Responses to Trust in State Agencies

Trust in state wildlife agencies	Percent	Mean	Std. deviation
1.00-1.99	14.8		
2.00-2.99	47.4		
3.00-3.99	29.6		
4.00-5.00	8.2		
Total	100.0	2.6	0.9

Note: Scores were averaged from 6 items, each item on a scale of 1-5 with higher score indicating less trust.

Table 20 - Respondent Public Normative Belief Scores

Belief that the public believes GYE bear should be listed	Percent	Mean	Std. Deviation
1.00-1.99	4.8		
2.00-2.99	6.6		
3.00-3.99	8.4		
4.00-4.99	30.7		
5.00-5.99	13.9		
6.00-7.00	35.5		
Total	100.0	4.8	1.6

Note: Scores were averaged from 2 items, each item on a scale of 1-7 with higher score indicating their belief that the public believes the GYE grizzly should be listed and protected from hunting.

Table 21 - Respondent Professional Normative Belief Scores

Belief that grizzly bear professionals believes GYE bear should be listed	Percent	Mean	Std. deviation
1.00-1.99	3.9		
2.00-2.99	16.7		
3.00-3.99	8.9		
4.00-4.99	30.4		
5.00-5.99	17.2		
6.00-7.00	23.9		
Total	100.0	4.4	1.5

Note: Scores were averaged from 2 items, each item on a scale of 1-7 with higher score indicating their belief that wildlife managers and scientists believe the GYE grizzly should be listed and protected from hunting.

Assessing Reliability and Dimensionality for Measures of Heuristics

Exploratory principal component analyses (PCA) were performed separately for all six heuristics followed by a reliability analysis of resulting sub-scales (Table 22). These sub-scales of heuristics along with the expert's total threat-assessment score, summed across the seven specified risk analysis scores (likelihood multiplied by severity) were then included in bivariate regression analysis. All analyses were completed using SPSS 22 for Windows.

Table 22: Reliability Analysis for Measures of Heuristics

Latent variable	Item	Cronbach's alpha	Alpha if deleted
Ambiguity tolerance		0.624[b]	
	A problem has little attraction for me if I don't think it has a solution.		0.569
	There is a right and a wrong way to do almost everything.		0.486
	Practically every problem has a solution.		0.662[a]
	It bothers me when the implications of my research are unclear.		0.565
	I don't like to work on problems unless there is a possibility of coming out with a clear-cut and unambiguous answer.		0.550
Attitude towards range expansion		0.905[b]	
Generally speaking, I think expanding the range of grizzly populations in the GYE is.... (each on a 7 point scale from one extreme to the other)			
	Harmful/Beneficial		0.883
	Foolish/Wise		0.867
	Worthless/Valuable		0.878
	Bad/Good		0.867
	Dangerous/Safe		0.919[a]
Trust and confidence		0.917	
If grizzly bears are removed from ESA...			
	I believe state fish and wildlife agencies will communicate honestly about the risks to grizzly bears.		0.899

Table 22 continued on next page

Table 22 continued

Should it turn out that there are substantial risks to grizzly populations, I believe state fish and wildlife agencies will openly and honestly inform the public.		0.903
I trust state fish and wildlife agencies to take the long term health of grizzly populations into account when planning grizzly management actions.		0.898
I believe that state fish and wildlife agencies will manage grizzly bears in a way that minimizes risks to grizzly populations.		0.901
I believe state fish and wildlife agencies have the knowledge and capacity to ensure grizzly bears in the GYE are not threatened with extinction again.		0.907
I believe state fish and wildlife agencies posses the competence to mitigate threats to grizzly populations.		0.902
Wildlife value orientations		
Mutualism orientation - Component 1	0.718[b]	
Wildlife have inherent value above and beyond their utility to people.		0.818[a]
I value the sense of companionship I receive from animals.		0.585
I feel a strong emotional bond with animals		0.559
I take comfort in the relationships I have with animals.		0.570
Dominance orientation - Component 2	0.614	
It is acceptable for people to kill wildlife if they think it poses a threat to their property.		0.563
The needs of humans should take priority over wildlife protection.		0.565
Humans should manage wildlife populations so that humans can benefit.		0.524
Wildlife are on earth primarily for people to use.		0.558
Wildlife are only valuable if people utilize them in some way.		0.583

Table 22 continued on next page

Table 22 continued

Norms		
Professionals - Component 1	0.908	
Most scientists with whom I interact believe that the grizzly bear population should be removed from ESA protections/protected by ESA.		0.876
Most scientists with whom I interact believe that grizzly bear populations in the GYE should be hunted/protected from hunting.		0.894
Most wildlife managers with whom I interact believe that the grizzly bear population should be removed from ESA protections/protected by ESA.		0.870
Most wildlife managers with whom I interact believe that grizzly bear populations in the GYE should be hunted/protected from hunting.		0.883
Lay public - Component 2	0.928	
Most of the lay-public with whom I interact believe that the grizzly bear population should be removed from ESA protections/protected by ESA.		–
Most of the lay-public with whom I interact believe that grizzly bear populations in the GYE should be hunted/protected from hunting.		–
Risk tolerance [c]	0.535	
We should only list species as threatened or endangered when they are at risk of worldwide extinction, as opposed to local/regional extinction.		0.377
Species should only be listed under the ESA as a last resort, after all other conservation efforts have failed.		0.443
When there is uncertainty regarding a species status, we should err on the side of caution (i.e. greater protection).		0.481

a. This item was removed and the Cronbach's alpha indicated here is the reliability score for the factor used in regression analysis.

Table 22 continued on next page

Table 22 continued

b. Reliably score was increased by removing noted item.
c. This measure was dropped from regression analysis, and ESA risk tolerance (Table 14 was used as a measure of risk tolerance instead).

After conducting an initial PCA on the five ambiguity tolerance items, two components had eigenvalues over Kaiser's criterion of 1.0, and cumulatively explained 62.29% of the variance. However, reliability analysis indicated that the reliability of the scale could be improved by dropping one item ('Practically every solution has a problem') bringing Cronbach's α up to 0.662. With that item removed, a subsequent PCA conducted on the four remaining items show one component with eigenvalues over 1.0 and 50.20% of the variance explained. These four items scores were then averaged to create an ambiguity tolerance score for each expert.

The PCA for the five items in the attitude measure revealed one component that had an eigenvalue over 1.0 and explained 72.13% of the variance. Reliability analysis showed all five items hung together very well (Cronbach's α = 0.905), but dropping the one item (rating their attitude about GYE grizzly range expansion on a scale from dangerous to safe) raised the Cronbach's α to 0.919 and the cumulative explained variance to 80.31%. The four remaining items' scores were averaged to create an attitude score for each expert.

The PCA for the six items in the trust and confidence measure revealed one component with an eigenvalue over 1.0 and explained 70.41% of the variance. Reliability analysis indicated acceptable scale reliability for all six items (Cronbach's α = 0.917), so no items were dropped. All items' scores were averaged to create trust and confidence score for each expert.

Wildlife value orientations were used to measure a potential value heuristic for each expert, and the scale is built to measure two components - a mutualism value orientation and a dominance value orientation. Creating two subscales created the highest reliability score for this measure. Of the total 9 value items, the sub-scale of dominance includes all five dominance items (Cronbach's $\alpha = 0.614$), and the sub-scale of mutualism used three of the four items (Cronbach's $\alpha = 0.818$). The item 'Wildlife have inherent value above and beyond their utility to people,' was dropped due to the lack of variability in answers to the item - most experts (95.40%) agreed or strongly agreed with this statement. The remaining items in the mutualism sub-scale were averaged to create a mutualism orientation factor score for each expert and the dominance items' scores were averaged to create a dominance orientation factor score for each expert.

The initial PCA for all seven items measuring normative influence showed two components with eigenvalues greater than 1.0 that explained 72.81% of the variance cumulatively. The reliability analysis revealed the same two component loadings with one item scoring low on both components. Intuitively, this item was very different from the other six items that asked for experts' normative belief about ESA protections and hunting are among scientists, wildlife managers, and the general lay-public. The analysis suggested that items pertaining to wildlife managers and scientists constituted one component (professional normative beliefs) and the two items regarding the lay public made up the second (lay-public normative beliefs). The second PCA run on the six normative items (professionals and lay-public items) again revealed two factors with 83.54% of the variance explained cumulatively. Because the lay-public factor could be potentially less stable with only two items, both Cronbach's α ($\alpha = 0.928$) and correlations ($r = .866$, $p < 0.01$) were checked for cohesion between the two items. Items from the professional factor were averaged together to create a professional normative influence score for each expert and items regarding the public were averaged to create a lay-public influence score for each expert as well.

A PCA of the five items in the risk tolerance scale identified two components with eigenvalues above 1.0 that cumulatively explained 55.23%. Cronbach's α was 0.210 - too low to reliably conclude anything about this measure. The three items in the scale with the highest Cronbach's α (0.535) are reported in the reliability summary in table 19. These results did not yield strong enough results to include risk tolerance as a viable variable to include in the regression analysis and it was dropped from further analysis. A measure of participant's ESA related risk tolerance (presented in Table 14 above) was therefore used in the regression analysis in place of this measure of general risk tolerance for wildlife that was dropped due to poor reliability due to the items closer association with the question of acceptability of risk that must be answered in the normative part of the listing determination.

Regression Analysis

Bivariate logistic regression was used to examine the influence of multiple independent variables on expert's judgments regarding appropriate listing status. Listing status, as the dependent variable, was re-coded as "listed" (coded as 1 and included "threatened" and "endangered" responses) and "not listed" (coded as 0) for this analysis. Eleven independent variables in three categories were included in the model: threat assessment, heuristics, and expertise. The threat assessment category, intended to represent the scientific threat assessment that would answer the first part of the listing decision question, included one variable an aggregated score from all seven threats listed in table 9. The heuristics category included the six variables (listed in table 19) hypothesized to have an impact on whether an expert would be more likely to choose "listed" or "not listed" for the decision to be made about the appropriate status for the GYE grizzly bear. Those six heuristics made up eight variables, based on the PCA conducted prior to the regression analysis: ambiguity tolerance, attitude towards range expansion, trust and confidence, wildlife value orientation (mutualism), wildlife value orientation (dominance), influence of professional norms, influence of public norms, and ESA risk tolerance (presented in Table 14). The expertise category made up the remaining independent variable used in the regression analysis as another check on the effect of the variability of expertise included in this sample of experts on listing status judgment. The expertise variable was dichotomized to represent those with direct GYE experience (expert groups 1 and 2) and those without (expert groups 3 and 4), because responses given by those in expertise groups 1 and 2 did not differ significantly for any variables.

In terms of the models' goodness of fit, across the five models (one done for each of the five imputations) these models correctly classified an average of 86.6% of the cases, and the Nagelkereke R squared averaged 0.668. While controlling for all other variables, only two factors significantly contributed to the odds of choosing "listed" at the 0.05 level - mutualism values (odds ratio = 2.014, p = 0.042) and professional norms (odds ratio = 3.176, p = 0.001), and two more factors at the 0.10 level - threat perception (odds ratio = 1.006, p = 0.060) and dominance values (odds ratio = .342, p = 0.065) (Table 23).

Table 23- Regression Analysis

Variable	β	S.E.	Sig.	Odds Ratio	95% C.I. for odds ratio	
					Lower	Upper
Threat Perception†	0.006	0.003	0.060	1.006	1.000	1.013
Values- Mutualism*	0.700	0.345	0.042	2.014	1.024	3.961
Values - Dominance†	-1.072	0.580	0.065	0.342	0.110	1.067
Ambiguity Tolerance	0.627	0.506	0.216	1.872	0.694	5.052
ESA Risk Tolerance	-0.994	1.173	0.397	0.370	0.037	3.690
Attitude toward grizzly range expansion	-0.264	0.312	0.397	0.768	0.417	1.415
Professional Norms*	1.156	0.343	0.001	3.176	1.596	6.321
Public Norms	0.251	0.213	0.245	1.285	0.838	1.970
Trust	0.359	0.457	0.434	1.432	0.578	3.549
Expertise - Direct experience with GYE grizzly	-0.130	0.705	0.854	0.878	0.220	3.510
Constant	-6.192	3.270	0.059	0.002	0.000	1.250

*Significant factor at the 0.05 level
†Significant factor at the 0.10 level

CHAPTER 6
DISCUSSION

This study examined the beliefs and attitudes of grizzly bear experts. Specifically, the study sought to determine: if there is expert consensus regarding (a) the appropriate listing status for the GYE grizzly bears, and (b) the threats faced by grizzly bears in the GYE. The study also sought to determine (c) if level of expertise affects recommendations regarding listing statuses, and (d) what factors contribute to an experts' listing recommendation. I discuss results that speak to each of these questions, in turn.

Expert Consensus

Consensus as a concept is one that can be interpreted in slightly different ways depending on the specific situation. Consensus might be thought of as unanimity of opinion, but in many policy decisions such a standard would be impossible to meet. Consensus can also be defined as a "general agreement" or "group solidarity in sentiment and belief" (Merriam-Webster, 2015). How much "agreement" constitutes "solidarity" is left to interpretation; does a mere majority (51%) qualify as consensus, or does it take two-thirds, three-fourths, or some other proportion of support to qualify as consensus? Of those experts who felt qualified to respond to the item about the appropriate ESA listing status for the GYE grizzly, a clear majority (73.2%) indicated that bears should remain listed under the ESA.

A listing decision is to take into account the best available science including status surveys, biological assessments, and published articles from juried professional journals (Beattie & Schmitten, 1994). The expert panel surveyed here included scientists and wildlife managers who have conducted status surveys and biological assessments and authors of professional juried journal articles providing data and research on the status and threats facing grizzly bear populations. While the interpretation of consensus may be somewhat subjective, in the case of our expert panel, a strong majority of the panel believes that GYE bears should remain listed on the ESA. The ESA is underlined by the "precautionary principle" which recommends erring on the side of caution when making a status assessment (Wymyslo, 2009). Currently, there appears to be political pressure to delist this population segment (IGBST, 2013); however, responses here indicate that a large majority of experts believe delisting would be an incorrect decision, or at the very least a violation of the precautionary principle. Even a more conservative conclusion, drawing from all experts who participated in this survey (including those who selected "unsure") still suggests that a substantial majority (60.2%) of experts believe that the GYE grizzly should remain under ESA protections.

A listing status decision, according to ESA, is mandated to be based upon scientific assessments of the threats facing the species. While there is some degree of consensus to keep the GYE grizzly listed, there appears to be far less consensus regarding the threats faced by this population. The three threats rated highest by these experts (habitat loss, habitat modification, and human-caused grizzly mortality) agree with other literature assessing grizzly bear population trends and concerns (USFW, 1993; Servheen, 1998; Kavahaugh & Benson, 2013; Treves & Karanath, 2003; Proctor et al., 2005;

Minette Johnson, 2006; Gunther et al., 2004; Pasitschniak-Arts, 1993). However, the high variance within each of the seven evaluated threats indicates there is substantial uncertainty among experts regarding threats to the GYE grizzly's continued viability (Figure 8 in results chapter). In fact, uncertainty seems to increase as expertise level rises for at least four of the seven threats, while expertise level has no impact degree of uncertainty for another two of the threats. Status assessments for the GYE grizzly population are complicated by this uncertainty as it could increase the use of heuristics for making such determinations (Meyer, 2012). Expected utility theory says that rational decision making consists of weighing the outcomes between alternatives by adding up the value of each outcome multiplied by the probability of that outcome. However, the more uncertainty a choice possesses, the more likely decisions will be influenced by heuristics and other psychological variables (Meyer, 2012).

Influence of Expertise on Listing Status Recommendations

Despite uncertainty and lack of consensus regarding degree of threat facing the GYE grizzly bear, these data indicate that experts generally agree that the GYE grizzly should be listed under the ESA, and this agreement was relatively consistent across groups with varying levels of expertise. Taking into account only those that felt they had enough information or were willing to offer a distinct opinion on listing status, across all four expert groups there is a clear majority favoring listing the bear: 70.4% from expert group 1, 66.7% from group 2, 90.5% from group 3, and 75% from group 4 all give the opinion that the GYE grizzly should be listed under the Endangered Species Act. However, it is important to note that a substantial minority of experts (18.5%) were unwilling to provide a judgment regarding grizzlies' status (though the majority of those who declined to provide an opinion about the bears' listing status had lower levels of expertise). The majority of those with the greatest familiarity with the GYE population (i.e., experts in groups 1 and 2) indicated that the GYE grizzlies should be listed as threatened under the ESA. The most frequently selected answer by any group that did not choose "unsure" was "threatened;" of those in group 1, 51.7% chose "threatened," and of those in group 2, 41.3% chose "threatened," the former demonstrates majority and the latter plurality. Group 3 chose "unsure" and "threatened" an equal amount (35.4%) and group 4 only had the answer of "unsure" (33.3%) more than the choice of "threatened"(29.2%). All of these numbers suggest not only that the expert plurality opinion on the matter is that GYE grizzlies should be listed under the ESA, but that they should most likely be listed as "threatened" and not de-listed as the current considerations suggest.

The Role of Experts in Peer Review

The USFWS and NOAA Fisheries currently incorporate peer review in the listing proposal process as a check on the validity and significance of asserted conclusions (Wymyslo, 2009; Beattie & Schmitten, 1994), but many have criticized the ambiguity of the review process. Lack of clarity about the way the process is conducted, including selection of expert participants, have drawn criticism (Wymyslo, 2009). Such debate can, in turn, raise questions about the soundness of the policy decisions that follow. The criteria for selection of experts is often opaque and at the discretion of the relevant field office scientist (Wymyslo, 2009). In 2003, the Office of Management and Budget issued a document for guidance for the peer review procedure that recommends that selection for review committees be primarily based on technical expertise (Office of Management and Budget, 2003). However, despite that recommendation, agencies have been accused of "cherry picking" experts that support the agency's preferred listing proposals rather than using a scientific sample of experts on the species or population segment in question to provide a quality check (Wymyslo, 2009). This suggests that an extremely narrow band of people is included in such reviews. For example, the recent review of the proposed rule to delist the gray wolf, initially excluded all experts that had already expressed an opinion about the scientific basis of proposed rule - a choice that ended up excluding a significant number of leading experts in the field (Rosenberg, 2013).

This research employed a very broad definition of an expert (based on authoring a peer-reviewed publication on grizzly bears or membership on the IGBC). It is certainly not necessarily the only or best way to identify grizzly bear experts, but these results show that level of expertise within this broader group of experts did not affect listing recommendations and had minimal impacts on expert threat assessment. This type of approach may provide a more straightforward criteria that can be used to identify potential participants in expert panel review of listing status decisions – something missing from the current approach to panel selection.

Influences on Listing Status Judgments

Mutualism values and professional norms were the only factors significantly associated with experts' listing decisions (i.e. odds ratios did not overlap with 1.0). These results indicate that for each unit increase in mutualistic wildlife value orientation, experts' odds of concluding that bears should be listed doubled (odds ratio = 2.014). This is consistent with hypothesis 1, and supports the notion that wildlife value orientations can be useful predictors of judgments and behavior (Fulton et al., 1996). Values are not typically found to be directly predictive of behavior, but in a decision with increased uncertainty, cognitive elements that are more typically predictive of behavior (behavioral intentions or attitudes) may not be as readily available or completely formed and, thus, be less influential in their decision making process. In these situations of higher uncertainty, it is possible that decisions may be made based on values due to the desire to base the decision on something that feels more stable. Values are the foundational cognitions on which attitudes and beliefs are based (Fulton, et al., 1996; Cline, et al., 2007). Therefore in this context of a very uncertain listing decision, individual values were more predictive then the higher order cognitions of attitudes. The desire to remain cognitively consistent (not hold inconsistent thoughts about an object or entity (Slagle, et al., 2013)) with what our own values are, especially in situations where one may have conflicting attitudes surrounding various aspects of the decision, may cause values to exert a stronger influence on the choice of our own behaviors and decisions as identified here. In addition, the desire to remain cognitively consistent has been suggested as the reason that humans tend to perceive a situation of high risk as also low in benefit (and vice versa) and influence acceptance of that risky situation (Slagle, et al., 2013).

Normative beliefs that most other scientists and wildlife managers believe these bears should retain ESA protections and protected from hunting also had a positive, significant effect on listing status recommendations. These results indicate that for each unit increase in normative beliefs regarding professionals, experts' odds of concluding that bears should be listed more than tripled (odds ratio = 3.176). These findings lend support to hypothesis 5a. Collecting opinions through a survey is one were we might expect to see a heightened use of heuristics due to the nature of the survey leading many participants to answer as quickly as possible as well as the anonymous nature of the responses. However, it would be expected that our participants, grizzly bear experts, would have given substantial thought about these threats in the course of their professional responsibilities and therefore we would expect a reduced influence of heuristics. However, using past professional experience to assess threats may suggest why normative influence was highly predictive as well. The use of norms in situations that include high uncertainty also is unsurprising in a listing decision with many unknowns due to the highly political atmosphere surrounding these types of decisions. If experts are uncertain about the science involved, it may feel safer to base their opinion on what the normative opinion on the situation among their profession happens to be.

Expert's "threat perception" (which quantified the risks facing continued grizzly survival, simulating what ESA mandates the *entirety* of the listing decision be based on) however, was only significant at the 0.10 level. In making a status assessment for the ESA, policy dictates that experts conduct a threat assessment for the species in question based solely on the best available science, and then use this assessment to make their listing determinations. This approach implies that the decision process is a rational, objective, science-based endeavor. The threat assessment included in this survey, while not as extensive as what would be included in a threat analysis for an ESA listing decision, provides an objective measure of how experts view the threats facing the GYE grizzly bear. These findings suggest that individual's assessment of threat for a species such as the grizzly bear may play a weaker role in listing determinations then is currently acknowledged by policy or practice.

The experts included here are not a direct sampling of the USFWS professionals, those ultimately responsible for this decision; rather most of the panel were academic - those that, through their work, have added to the body of literature that assist in the quantification of threats to grizzly bears. Level of expertise was not significant in this model, and had no evidence to suggest any significant impact on deciding whether the grizzlies should be "listed" or "not listed." This agrees with my earlier findings that the level of expertise, in this case measured by direct experience with the GYE grizzly, has negligible to no impact on their listing recommendation for the GYE bear population. No other factors in the model were significantly related to the listing judgments, including threat assessment and risk tolerance.

Experts' assessments of threats to the grizzly bear population were highly variable - there was very little agreement in how experts viewed both the likelihood and severity of threats faced by the GYE population. This demonstrates a high degree of collective uncertainty about this critical component of listing status determinations. Research in behavioral decision theory has shown that individuals faced with difficult decisions under high degrees of uncertainty are more prone to rely on mental shortcuts (Maguire & Albright, 2005). If individual experts viewed the degree of threat facing grizzlies as highly uncertain, then it is not surprising that they would turn to heuristics. That is, if individual decision makers lacked confidence regarding the extent to which bears are threatened, we should expect them to utilize other cues like their normative beliefs about what other experts think, or what decision would be in line with their own values. This would be especially true in situations with high uncertainty, as the threats facing the GYE grizzly seem to be, but in a situation where there is less uncertainty, heuristics would likely have a much smaller influence. If heuristics become something experts systematically rely on in a predictable way, the outcome of the decision making processes would no longer be based on the science and would be considered a biased decision. Therefore, attempting to minimize as much uncertainty would be an ideal that would help to limit the possibility of biased decisions. However, the grizzlies in the GYE are a very highly researched population, and while improvements and additional studies that help minimize uncertainty are ongoing and will always be needed, uncertainty will always be a part of imperiled species research and decision making, especially for those species not as well researched as the GYE grizzly. Therefore, it is important to make clear how decisions should progress in the face of such high uncertainty, and specifically how ESA decision makers should apply that processes to the decisions made to carry out the goals of the ESA.

The direction of the remaining, non-significant variables agreed with all additional hypotheses (H_{3a}, H_{3b}, H_{2a}, H_{2b}, H_{5b}, H_{6a}, H_{6b}), except those regarding attitude (H_{4a}, H_{4b}). However, these results were not strong enough to make claims about these variables impact with any level of certainty.

Limitations

It is important to point out that the inclusion criteria used for this study is incredibly broad, and while that provides an opportunity to see what the opinion is of a more expansive sample of knowledgeable individuals on the topic, it is a much larger a group of experts than USFWS would likely approach for review. This is not to claim that broadening the scope of experts the USFWS included in a listing determinations would be a detrimental amendment to the process; indeed, consulting a more inclusive sample of experts has the potential to provide a more complete picture of the current status of a population segment. However, it would be important to carefully examine inclusion criteria and be cautious of a standard that could be considered *too* inclusive (i.e., including professionals who do not have a certain standard of knowledge about the specific species) while keeping in mind that this study showed that degree of expertise did not actually impact judgments. One reason why expertise may not have influenced judgments in this study is the high degree of variability in experts' judgments concerning threats. Due to the high degree of uncertainty, experts may have been relying more on heuristics then on their scientific training as experts to judge the situation based on assessments of mathematical probabilities. When those probabilities of risk are uncertain, people must turn to something else to make a decision, and in this case, it appears to be their own values and the opinions of others that they turned to rather than their expertise.

Another important difference to mention between this sample of experts and those USFWS might select for written review of a rule, is that this sample of experts were able to provide their judgments in anonymity. Anonymity is not provided to experts who participate in official listing determinations and participants may feel substantial scrutiny for judgment they provide. This type of non-anonymous review may actually intensify pressure to reach a judgment that conforms with their peers (professional norms, as measured in this study). The apparent disproportionate amount of times the peer review process has ever expressed disagreement with the rule (Wymyslo, 2009) *might* suggest that the listing decision proposed was already biased by the agency's beliefs on the situation prior to seeking independent review. Wymyslo, (2009) suggested that agencies select individuals to provide a review more in the form of a testimony to support the agency's decision than as a true peer review which should provide a validly check - that is, a critical assessment of the agency's characterizations of the threats. Indeed, the results from this study demonstrate that norms already affect their decision even in a situation where scientists respond anonymously, and lack of anonymity would likely only increase that pressure.

However, advocating for complete anonymity in the process is extremely cautioned. Having your name or professional reputation tied to written judgments provided for a scientific and public audience can also allow for greater accountability. While anonymous review might lesson some of the pressure provided to conform to the perceived norm, it has the potential to lessen the pressure to do a thorough job and put extra effort into attempting to adequately review and process the information in a systematic fashion, thereby coming to a reasoned judgment. Therefore, there may be a tension between two important goals of the scientific peer review process - i.e. the desire for a thorough, systematic review, and the desire to minimize the pressure to conform to social expectations (norms) or bow to political pressure.

Statistical limitations. Logistic regression is a method that "determines the impact of multiple independent variables presented simultaneously to predict membership of one or other of the two dependent variable categories" that is regularly used when there are only two categories of the dependent variable such as this studies interested in what pushes a listing decision over the line between listed or not listed

(Burns & Richard, 2009). However, despite the point of most relevant interest being between a dichotomous choice, the collapsing of the categories of endangered and threatened into a single category of listed does lose some of the detail that may have been considered if categories were not collapsed. It could be advantageous to also investigate the differences between multiple listing status judgments rather than the more broad view analyzed here between only two more general categories. That being said, the strongest difference in policy consequences for a species is centered around the line between the two categories investigated here (listed or not listed).

Second, while regression analysis can reveal relationships among variables, it is not the strongest technique to determine causation (Tabachnick & Fidell, 2007; Constantine, 2012). The use of cross-sectional survey data, rather than a tightly-controlled experiment means that any apparently strong relationships could possibly be a result of variables external to the model. More stringent evidence would be needed in order to strengthen the idea that the associative relationships found in this study might be causal relationships. Using an experimental approach, having consistency of these relationships held up across similar studies, and other studies done to rule out alternative explanations, all could serve to strengthen (not make indisputable) any causal claims (Hill, 1965; Constantine, 2012).

An additional improvement that would be beneficial to the methodological aspects of this research would include use of a random sampling approach. Due to the lack of an established sample frame of grizzly bear experts it was not possible to identify accurate contact information for all individuals I would have liked to survey. Even among those who were successfully sent the survey, there is likely a degree of bias based on those who chose to not respond to the survey. Experts expressing opinions on an important policy decision has been a source of concern and debate in listing decisions before (i.e., initial exclusion of a large number of gray wolf experts to review the gray wolf rule), and it is likely that the nature of the topic of the survey led to a systematic non-response bias that may have been more heavily skewed towards a heavily academic/under represented agency member panel.

CHAPTER 7
CONCLUSION

This research investigated six heuristics that might potentially influence expert listing status determinations for the GYE grizzly bear population. Experts with a wide variety of experiences (both academic and managerial) with grizzly bears were sampled through a web survey that asked them to provide their beliefs about the appropriate listing status for the GYE grizzly population, an assessment of the degree of threat they believed faced this population, and measures of their own individual value, attitudes, and beliefs that may have influenced those judgments. A clear majority of experts indicated the GYE grizzly should remain listed under the ESA. The data also indicate that there is a great deal of uncertainty regarding the threats facing the GYE grizzly. Indeed, their beliefs about the appropriate listing status were influenced more by their individual values and normative beliefs than their assessment of risk of extinction currently facing the population.

Implications for the ESA

The Endangered Species Act is critical for the conservation and preservation of imperiled species. In the first 40 years of the Act's existence it has "directly prevented the extinction of approximately 200 species and stabilized previously declining populations of several hundred more" (Evans, Goble, & Scott, 2013). The ESA provides a mechanism to mitigate threats facing at-risk species. Growing human populations, expanding economic activity, and changing land use patterns drive threats of habitat loss and degradation, invasive species, pollution, and climate change, which makes it even more important that the application of the Act's principles be examined for opportunities to better execute its purpose.

Recently, scholars have noted the need for better assessments of species' extinction risk when making decisions regarding endangered species (Evans, Goble, & Scott, 2013). Other authors have noted weaknesses in both the text of the Act (in terms of its ambiguous definitions) and in the processes through which it is implemented (Vucetich, Nelson, & Phillips, 2006; Goble, 2009). The ESA is meant to be a flexible statute that can evolve as ecological and social conditions change (Evans, Goble, & Scott, 2013). This flexibility shows that while we recognize the value of objectivity and the necessity of a scientific and rational basis on which to ground important decisions, we also acknowledge the fact that decision making is a human activity that takes place in quickly changing and often uncertain environments which ultimately tie these choices to human values and bias.

This study demonstrated some of that uncertainty in the substantial differences with which experts assessed the threats facing the GYE grizzly population. In an atmosphere of uncertainty, it is more likely that experts will resort to a greater use of heuristics to make a decision. This was evident in our sample, as the decision that most participants made in favor of grizzlies retaining their federal protections was one that was influenced more by their individual values and normative beliefs than their threat assessment.

Evidence of bias in decision making is problematic because we turn to experts to make decisions like these when policy decisions require a high degree of technical understanding and involve a great deal of uncertainty and high risk consequences. Developing methods to correct for the use of such biases is critical to ensuring the continued relevancy of the ESA. Several steps can be taken to mitigate the influence of biases in ESA decisions.

Policy guidance

Before any strategies can be employed to remove bias from a decision making processes, biases must first be indentified and their role acknowledged. This research sought to identify the heuristics employed by experts, and also, to highlight a part of the decision making process that is not currently explicitly acknowledged or appreciated by those in charge of making listing status determinations - the question of acceptability. The current approach that emphasizes the strict science mandate in listing determinations, does not fully acknowledge the entire aspect of what affects decision making (heuristics as well as science), or the full extent of the question a status determination entails (risk assessment and the desired acceptability of that risk); in effect, this is asking experts to make these decisions partially blind. That blindness may be partially responsible for the controversy over recent ESA listing decisions (e.g., grey wolf, spotted owl, GYE grizzly bear) and inconsistencies in listing status decisions across taxa (Wilcove et al., 1993).

If the conversation can open to include ethical considerations along with the threat assessment, then this would allow decision makers to address the question of acceptability of extinction more transparently. As was demonstrated in a previous case regarding controversy over DPS designations, the USFWS can develop more detailed policy direction when it is deemed necessary (61 Fed, Reg.4722 (Feb. 7, 1996)). This research points to a need to address a similar gap in the language of the ESA to provide guidance for how decision makers should address questions about the acceptability of the risk of extinction.

Managing the influence of heuristics

Structured decision making (SDM) is a tool that can be very effective for making decisions that take into account both values (on which experts may be currently basing their decision, and on which the idea of acceptability of a certain amount of risk of extinction is based) and science. Additionally, many of the steps in SDM are designed to reduce linguistic uncertainty (Gregory & Long, 2008) which is something that would be beneficial for the application of the principles of the ESA due to the fact that so many of the terms defined by ESA are purposefully vague in order to allow for differences between species. SDM could act as a decision aid that could help create a framework that could be used to clarify how the question of acceptability should be answered and map out how decisions should be best made under varying elements of uncertainty. By creating a systematic process to follow that would allow for individual elements (such a values and normative pressure) to be explicitly identified and discussed, this would provide a level of clarity and consistency currently lacking. Additionally, it would forcibly engage the cognitive system of thought thereby helping to counter affective and heuristic only based outcomes. By creating guidelines for a way decision makers can address the question of acceptability, the decision process can be made more transparent and understandable, which should promote greater accountability and consistency across judgments. With a clearer process, any additional biases would be more easily identified and minimized.

Overall, this study provides a snapshot of some of the subjective elements that were previously hidden behind the opaque curtain provided by ESA's mandate to use solely the best available science to make these decisions. Not only is it not possible to make a determination "solely" on the best available science, it expects too much of experts to act totally rationally when it is established that human cognitions are a part of every human decision making process. By removing part of the curtain, and acknowledging a more complete picture of the influences that affect judgments required by the ESA, the agencies responsible for such decisions can take steps to address the use of heuristics and lay out an appropriate and transparent process to handle their presence. By making the process more effortful and transparent, USFWS can minimize and control the role these heuristics play in the listing status determinations thereby helping to reinforce the validity and significance of the conclusions presented in the administrative process that governs the federal protections of endangered species.

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APPENDICES

Appendix A - Contact Letters

First contact:
Dear <<First Name, Last Name>>,

I am writing today to ask for your cooperation in a study about the conservation and management of grizzly bears in the western United States. The primary purpose of this study is to quantify expert opinion regarding potential threats to grizzly bears populations in the Greater Yellowstone Ecosystem (GYE), and determine the extent to which experts support the removal of bear populations from Endangered Species Act protections.

You were selected for participation in this study based upon your previously-published, peer-reviewed research on grizzly/brown bear conservation and management.

Results from this study will be used to examine the extent to which expert consensus exists on factors that potentially threaten grizzly bears in the GYE, and will be useful for planning conservation interventions designed to mitigate these threats. Importantly, we are interested in your personal, professional judgments and opinions, which we recognize may differ from the agencies, organizations or professional societies you represent.

If you are interested in participating, please follow the link below to the survey, which will take less than 10 minutes to complete.

Follow this link to the survey: {Link}

Or copy and paste the URL below into your internet browser:
{ SurveyURL}

Your participation in this study is voluntary, you may to quit the study at any time or skip any questions that make you feel uncomfortable. If you stop participating there will be no penalty to you, nor will your decision affect your future relationship with The Ohio State University.

If you have any questions about this study, please feel free to call me at 614-247-2118 or e-mail me directly at bruskotter.9@osu.edu. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If you would like to opt out of the survey and not receive any further contact, please click on this link: {opt out link}

Thank you very much for your time and assistance!
Sincerely,

Jeremy Bruskotter

Second Contact:
Dear <<First Name>>,

A few days ago, I emailed you to request your participation in a study about the conservation and management of grizzly bears in the western United States. According to my records, we have not heard back from you.

The primary purpose of this study is to quantify expert opinion regarding potential threats to grizzly bears populations in the Greater Yellowstone Ecosystem (GYE), and determine the extent to which experts support the removal of bear populations from Endangered Species Act protections.

You were selected for participation in this study based upon your previously-published, peer-reviewed research on grizzly/brown bear conservation and management.

Results from this study will be used to examine the extent to which expert consensus exists on factors that potentially threaten grizzly bears in the GYE, and will be useful for planning conservation interventions designed to mitigate these threats.

If you are interested in participating, please follow the link below to the survey, which will take less than 10 minutes to complete.

Follow this link to the survey: {Link}

Or copy and paste the URL below into your internet browser:
{ SurveyURL}

Your participation in this study is voluntary, you may to quit the study at any time or skip any questions that make you feel uncomfortable. If you stop participating there will be no penalty to you, nor will your decision affect your future relationship with The Ohio State University.

If you have any questions about this study, please feel free to call me at 614-247-2118 or e-mail me directly at bruskotter.9@osu.edu. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If you would like to opt out of the survey and not receive any further contact, please click on this link: {opt out link}

Thank you very much for your time and assistance!

Sincerely,

Jeremy Bruskotter

Third Contact:
Dear <<First Name>>,

A few days back, I emailed you regarding a study we're conducting about the conservation and management of grizzly bears. So far, we haven't heard from you, and just wanted to drop you a note to let you know that we value your opinion, and hope that you will participate.

As a reminder, the purpose of this study is to quantify expert opinion regarding potential threats to grizzly bears populations in the Greater Yellowstone Ecosystem (GYE), and determine the extent to which experts support the removal of bear populations from Endangered Species Act protections.

You were selected for participation in this study based upon your previously-published, peer-reviewed research on grizzly/brown bear conservation and management.

Results from this study will be used to examine the extent to which expert consensus exists on factors that potentially threaten grizzly bears in the GYE, and will be useful for planning conservation interventions designed to mitigate these threats.

If you are interested in participating, please follow the link below to the survey, which will take less than 10 minutes to complete.

Follow this link to the survey: {Link}

Or copy and paste the URL below into your internet browser:
{ SurveyURL}

Your participation in this study is voluntary, you may to quit the study at any time or skip any questions that make you feel uncomfortable. If you stop participating there will be no penalty to you, nor will your decision affect your future relationship with The Ohio State University.

If you have any questions about this study, please feel free to call me at 614-247-2118 or e-mail me directly at bruskotter.9@osu.edu. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If you would like to opt out of the survey and not receive any further contact, please click on this link: {opt out link}

For those choosing not to participate…If you feel you were wrongly selected or are otherwise unqualified to participate in this study, or if you don't feel comfortable answering we would greatly appreciate knowing why. You can let us know by clicking the following link, which allows you to provide feedback on why you've chosen to opt out of the study. To opt out: {Opt out link}

Thank you very much for your time and assistance!

Sincerely,
Jeremy Bruskotter

Appendix B - Additional Tables

Correlation Matrix

	Status judgment - listed/ not listed	Threat perception	Wildlife value orientation - mutualism	Wildlife value orientation - dominance	Ambiguity tolerance	ESA Risk Tolerance	Attitude	Norms - professional	Norms - public	Trust and confidence	Expertise level (direct GYE knowledge/experience or indirect GYE knowledge/experience)
Status judgment - listed/ not listed	1.000	0.458	0.230	-0.423	0.053	-0.068	0.273	0.609	0.322	0.452	-0.196
Threat perception	0.458	1.000	-0.323	-0323	-0.034	0.011	0.365	0.483	0.182	0.474	-0.045
Wildlife value orientation - mutualism	0.230	0.128	1.000	-0.133	0.026	0.064	0.204	0.49	0.052	0.094	0.012
Wildlife value orientation - dominance	-0.423	-0.323	-0.133	1.000	-0.010	0.080	-0.273	-0.423	-0.279	-0.359	0.092
Ambiguity tolerance	0.053	-.034	0.026	-0.010	1.000	0.053	0.099	0.006	-0.025	-0.080	-0.046
ESA Risk Tolerance	-0.068	0.011	0.064	0.080	0.053	1.000	-0.053	-0.037	-0.029	0.001	-0123
Attitude	0.273	0.365	0.204	-0.273	0.099	-0.053	1.000	0.353	0.278	0.251	0.099
Norms - professional	0.609	0.483	0.049	-0.423	0.006	-0.037	0.353	1.000	0.375	0.384	-0.270
Norms - public	0.322	0.182	0.052	-0.279	-0.025	-0.029	0.278	0.375	1.000	0.254	0.012
Trust and confidence	0.452	0.474	0.094	-0.359	-0.080	0.001	0.251	0.384	0.254	1.000	-0.001
Expertise level (direct GYE knowledge/experience or indirect GYE knowledge/experience)	-0.196	-0.045	0.012	0.092	-0.046	-0.123	0.099	-0.270	0.012	-0.001	1.000

Appendix C - Questionnaire

qualtrics

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Q1.1. **Study: Expert Opinion on the Conservation of Grizzly Bears in the Greater Yellowstone Ecosystem**

Before you begin...

This survey asks for the professional judgments and opinions of bear experts--specifically, those who have participated in the research or management of grizzly bear populations. The purpose of this study is to (a) quantify expert opinion regarding the threats to grizzly bears populations in the Greater Yellowstone Ecosystem (GYE), and (b) examine factors that may influence expert's judgments. It should take less than 10 minutes to complete, but you can take as long as you wish. This study is being conducted by researchers in the School of Environment & Natural Resources at The Ohio State University who are familiar with endangered species listing status determinations under the ESA.

Q1.2.
Your rights as a participant...

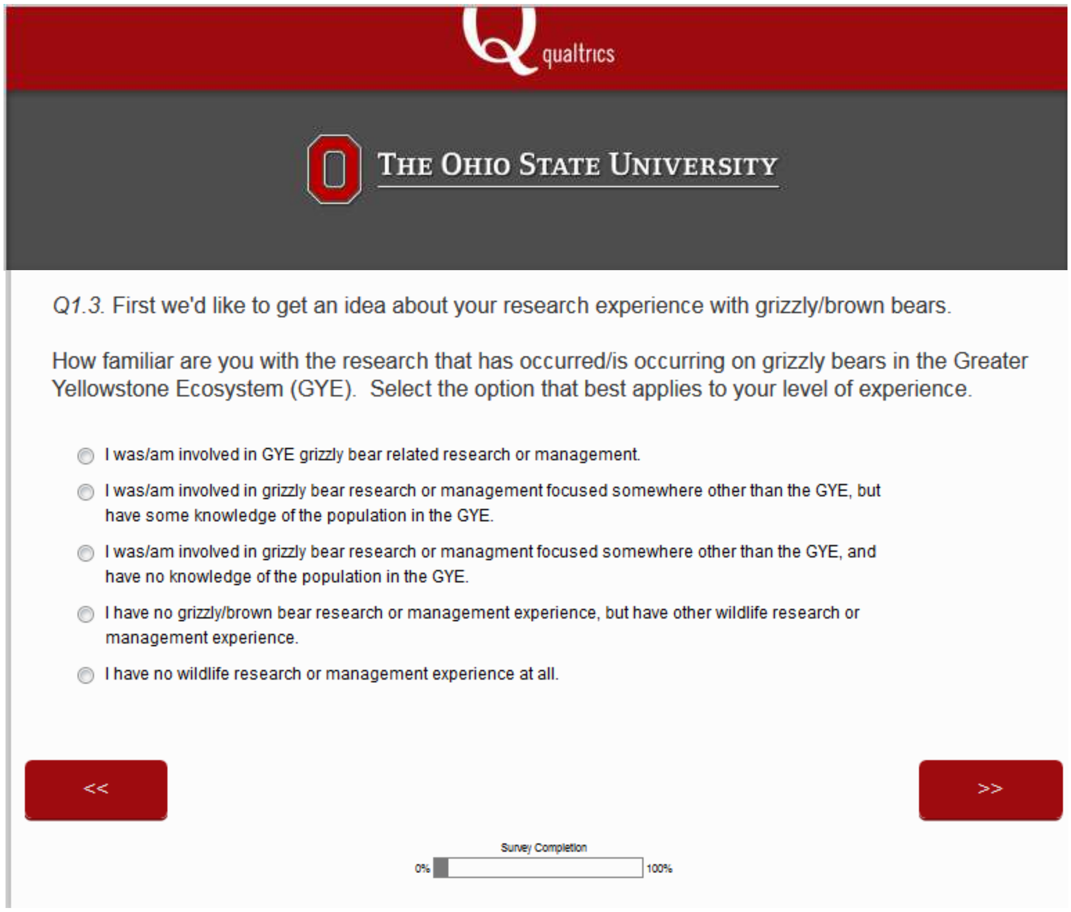
Your participation in this study is voluntary. You may quit at any time, or choose not to answer any question that makes you feel uncomfortable. If you decide to stop participating in the study, there will be no penalty to you, nor will your decision affect your future relationship with The Ohio State University. We will work to make sure that no one sees your survey responses without approval; but, because we are using the Internet, there is a chance that someone could access your online responses without permission. In some cases, this information could be used to identify you. Your name and e-mail address used to contact you for this study will be deleted as soon as the data is collected and therefore responses will not be linked to individuals. For questions, concerns, or complaints about the study you may contact Dr. Jeremy Bruskotter at 614-247-2118 or bruskotter.9@osu.edu. For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

Thank you again for your help and participation!

>>

Survey Completion

0% 100%



qualtrics

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Q1.3. First we'd like to get an idea about your research experience with grizzly/brown bears.

How familiar are you with the research that has occurred/is occurring on grizzly bears in the Greater Yellowstone Ecosystem (GYE). Select the option that best applies to your level of experience.

- I was/am involved in GYE grizzly bear related research or management.
- I was/am involved in grizzly bear research or management focused somewhere other than the GYE, but have some knowledge of the population in the GYE.
- I was/am involved in grizzly bear research or managment focused somewhere other than the GYE, and have no knowledge of the population in the GYE.
- I have no grizzly/brown bear research or management experience, but have other wildlife research or management experience.
- I have no wildlife research or management experience at all.

<< >>

Survey Completion

0% 100%

qualtrics

The Ohio State University

Q1.4. We're interested in your views about the various factors that potentially threaten grizzly bear populations in the GYE. Please indicate your opinion about the **likelihood** that **each threat will occur** for the grizzly bears in the Greater Yellowstone Ecosystem over the next 10 years (on a scale of 0 to 10, where 0 indicates no chance that grizzly bears will be threatened by this factor, 5 indicates a 50-50 chance, and 10 indicates a 100% chance).

Then, indicate the **severity of the consequence** should the threat occur (0 indicating no harm at all caused, and 10 indicating extreme harm to the population).

Note: Seperating likelihood from severity allows us to account for the fact some factors may be highly likely, while having little consequence to the population (and vice-versa).

Q1.5.

Threat: Decrease in abundance of grizzly's natural food source.

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

Q1.6. **Threat: Loss of habitat to human development.**

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

Q1.7. **Threat: Habitat modification on public lands (e.g. forest harvest, logging roads, oil & gas, recreation).**

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

Q1.8. **Threat: Human caused grizzly mortality (i.e. human-bear conflict resulting in bear loss or legal or illegal hunting).**

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

Q1.9. **Threat: Lack of genetic diversity and connectivity to other populations.**

	0	1	2	3	4	5	6	7	8	9	10
likelihood											
Severity											

Q1.10. **Threat: Lack of support for grizzly bear conservation.**

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

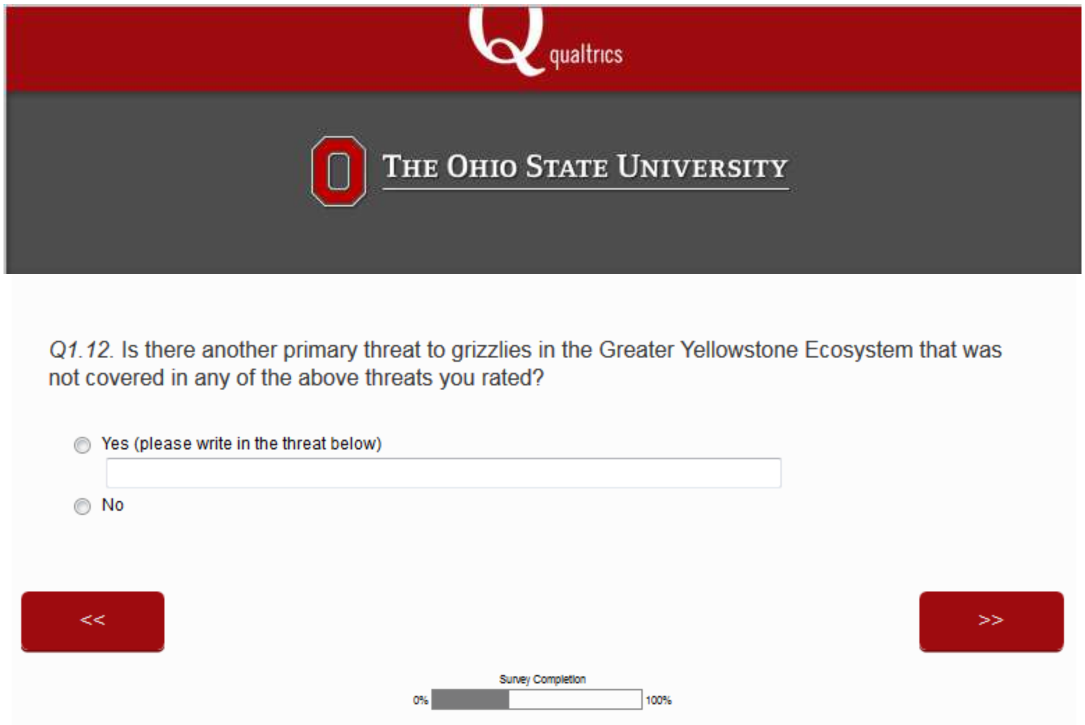
Q1.11. **Threat: Shifting ecological conditions due to climate change.**

	0	1	2	3	4	5	6	7	8	9	10
Likelihood											
Severity											

<< >>

Survey Completion

0% 100%



qualtrics

THE OHIO STATE UNIVERSITY

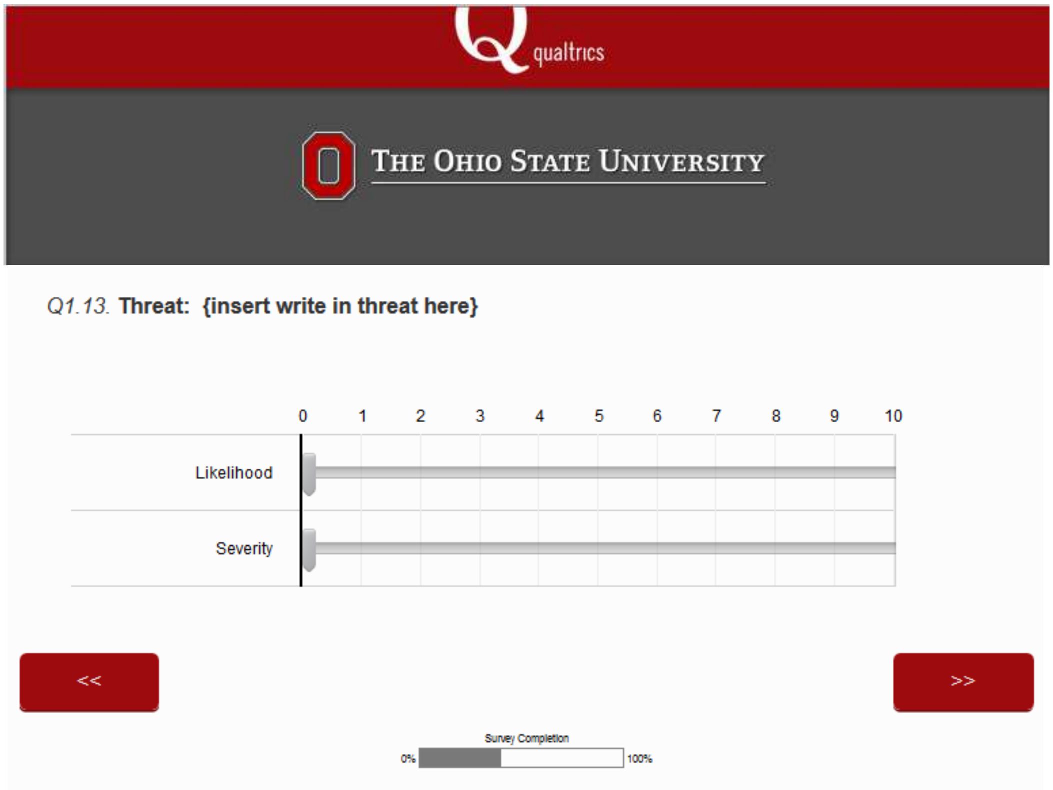
Q1.12. Is there another primary threat to grizzlies in the Greater Yellowstone Ecosystem that was not covered in any of the above threats you rated?

- Yes (please write in the threat below)
- No

<< >>

Survey Completion

0% 100%


qualtrics
The Ohio State University
Q1.13. Threat: {insert write in threat here}
0 1 2 3 4 5 6 7 8 9 10
Likelihood
Severity
<<
>>
Survey Completion
0%
100%


qualtrics

THE OHIO STATE UNIVERSITY

Q1.14. What, in your opinion, is the appropriate listing status for this population under the federal Endangered Species Act?

- Listed as endangered (highest level of legal protection)
- Listed as "threatened" (slightly less protection)
- Not listed (neither threatened nor endangered)
- Unsure

<<   >>

Survey Completion

0% 100%

qualtrics

THE OHIO STATE UNIVERSITY

Q1.15. Please indicate your level of agreement to each of the statements below. Note, there are no right or wrong answers, we are merely interested in your opinions.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I feel a strong emotional bond with animals.	○	○	○	○	○
Wildlife have inherent value above and beyond their utility to people.	○	○	○	○	○
I value the sense of companionship I receive from animals.	○	○	○	○	○
Wildlife are only valuable if people get to utilize them in some way.	○	○	○	○	○
The needs of humans should take priority over wildlife protection.	○	○	○	○	○
Wildlife are on earth primarily for people to use.	○	○	○	○	○
I take comfort in the relationships I have with animals.	○	○	○	○	○
It is acceptable for people to kill wildlife if they think it poses a threat to their property.	○	○	○	○	○
Humans should manage wildlife populations so that humans can benefit.	○	○	○	○	○

<< >>

Survey Completion

0% 100%

qualtrics

THE OHIO STATE UNIVERSITY

Q1.16. Please indicate the extent to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I don't like to work on problems unless there is a possibility of coming out with a clear-cut and unambiguous answer	○	○	○	○	○
Practically every problem has a solution	○	○	○	○	○
There's a right way and a wrong way to do almost everything	○	○	○	○	○
A problem has little attraction for me if I don't think it has a solution	○	○	○	○	○
It bothers me when the implications of my research are unclear	○	○	○	○	○

<< >>

Survey Completion

0% 100%

qualtrics

The Ohio State University

Q1.17. Please indicate the extent to which you agree or disagree with each statement.

	Strongly disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Local conservation efforts are rarely adequate to mitigate risks to threatened and endangered species	○	○	○	○	○
When there is uncertainty regarding a species status, we should err on the side of caution (i.e., greater protection)	○	○	○	○	○
Species should only be listed under the Endangered Species Act as a last resort, after all other conservation efforts have failed	○	○	○	○	○
We should only list species as threatened or endangered when they are at risk of worldwide extinction, as opposed to local/regional extinction	○	○	○	○	○
When it comes to recovery of imperiled species, it is best to be cautious and attempt to minimize, rather than simply reduce risks to a species	○	○	○	○	○

Q1.18. In your view, what is the highest level of risk of extinction that is acceptable for a species NOT listed under the Endangered Species Act? That is, a level of risk that, if exceeded, would require a species to be listed as threatened under the Endangered Species Act.

Very Low Probability — Equal Chance — Very High Probability

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Probability of extinction in the next 100 years

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Survey Completion

0% 100%

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Q1.19. **For the following items, you will be asked to rate several characteristics of a series of statements. Please rate each of the subsequent statements according to the subsequent characteristics.**

Instructions: Make your ratings by checking the appropriate space. For example, if you believe that expanding grizzly bear populations would be extremely harmful to bears in the GYE (i.e., lead to decreased tolerance), then you would answer the first question as follows...

Generally speaking, I think expanding the range of grizzly populations in the GYE is...

Example: Harmful	◉	○	○	○	○	○	○	Beneficial

Q1.21.
Generally speaking, I think expanding the range of grizzly populations in the GYE is...

Harmful	○	○	○	○	○	○	○	Beneficial
Foolish	○	○	○	○	○	○	○	Wise
Dangerous	○	○	○	○	○	○	○	Safe
Bad	○	○	○	○	○	○	○	Good
Worthless	○	○	○	○	○	○	○	Valuable

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Survey Completion
0% 100%

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Q1.22.
Most **scientists** with whom I interact believe that grizzly bear populations in the GYE should be...

Removed from ESA Protections	○	○	○	○	○	○	○	Protected by the ESA
Hunted	○	○	○	○	○	○	○	Protected from hunting

Q1.23.
Most **wildlife managers** with whom I interact believe that grizzly bear populations in the GYE should be...

Removed from ESA Protections	○	○	○	○	○	○	○	Protected by the ESA
Hunted	○	○	○	○	○	○	○	Protected from hunting

Q1.24.
Most of **the lay-public** with whom I interact believe that grizzly bear populations in the GYE should be...

Removed from ESA Protections	○	○	○	○	○	○	○	Protected by the ESA
Hunted	○	○	○	○	○	○	○	Protected from hunting

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Survey Completion
0% 100%

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Q1.25.

Generally speaking, how important is it for you to do what other grizzly bear experts think you should do?

Not at all important ○ ○ ○ ○ ○ ○ ○ Very Important

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Survey Completion

0% 100%

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Q1.26. Please indicate your level of agreement with each statement below.

If grizzly bears in the Greater Yellowstone Ecosystem were to be removed from Endangered Species Act protection...

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I trust state fish and wildlife agencies to take the long term health of grizzly populations into account when planning grizzly management actions.	○	○	○	○	○
I believe state fish and wildlife agencies will communicate honestly about the risks to grizzly bears.	○	○	○	○	○
Should it turn out that there are substantial risks to grizzly populations, I believe state fish and wildlife agencies will openly and honestly inform the public.	○	○	○	○	○
I believe state fish and wildlife agencies possess the competence to mitigate threats to grizzly populations.	○	○	○	○	○
I believe state fish and wildlife agencies have the knowledge and capacity to ensure grizzly bears in the Greater Yellowstone Ecosystem are not threatened with extinction again.	○	○	○	○	○
I believe that state fish and wildlife agencies will manage grizzly bears in a way that minimizes risks to grizzly populations.	○	○	○	○	○

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Survey Completion

0% 100%

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Q1.27. Please indicate your wildlife/animal/environment employment history.

	Job Type? (Choose one)		Is this employment current or past? (Choose one)		Number of years employed in this job?
		Job Title	Current	Past	Years
1					
2					
3					
4					
5					
6					
7					
8					

Q1.28. Are you a member of the Interagency Grizzly Bear Committee (IGBC)?

- Yes
- No

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Survey Completion

0% 100%

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Q1.29. Please indicate any professional organizations you are associated with or have been associated with in the past. Select all that apply.

- ☐ Ecological Society of America
- ☐ American Association of Zoo Veterinarians
- ☐ The Wildlife Society
- ☐ Society for Conservation Biology
- ☐ North American Association for Environmental Education (NAAEE)
- ☐ The Society for Marine Mammalogy
- ☐ American Society of Mammalogists
- ☐ Western Foundation of Vertebrate Zoology (WFVZ)
- ☐ Association of Zoos and Aquariums (AZA)
- ☐ International Union for Conservation of Nature (IUCN)
- ☐ Other ____________

Q1.30. To what extent do you identify with each of the following groups:

	Not at all	Slightly	Moderately	Strongly	Very Strongly
Wildlife Advocate	○	○	○	○	○
Hunter	○	○	○	○	○
Animal Rights Advocate	○	○	○	○	○
Conservationist	○	○	○	○	○
Gun Rights Advocate	○	○	○	○	○
Environmentalist	○	○	○	○	○
Property Rights Advocate	○	○	○	○	○
Other ____	○	○	○	○	○

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Survey Completion

0% 100%


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We thank you for your time spent taking this survey.
Your response has been recorded.
Survey Completion
0%
100%