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Original Research

Should Grizzly Bears be Hunted or Protected? Social and Organizational Affiliations Influence Scientific Judgments

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Abstract

Accelerating threats to biodiversity increases the number of species requiring listing status judgments under the United States Endangered Species Act. Understanding that complex environments allow for heuristics to influence (and perhaps bias) cognitive decision processes, we hypothesized that scientific expert judgments may be biased when dealing with decisions under uncertainty. More specifically, we surveyed scientists (n=593) to examine how belonging to different social groups may be associated with the scientists' perceived norms amongst peers, their personal wildlife value orientations, and ultimately, listing status judgments for the Greater Yellowstone Ecosystem population of grizzly bears (*Ursus arctos horribilis*). Overall, a majority (74%) of scientists recommended continued

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Endangered Species Act protections for Greater Yellowstone Ecosystem grizzly bears. Scientists' professional affiliation (government agency vs. academia) was strongly associated with listing status recommendations; agency experts were 7.3 times more likely to recommend delisting grizzlies. Additionally, identifying strongly as "hunter" or "animal rights advocate" and membership in certain professional societies (e.g., The Wildlife Society) were significantly related to listing status judgments, wildlife value orientations, and expert norms. These results indicate that expert judgment regarding imperiled species may not always be determined solely by the best scientific data available. The simplest way to counteract these potential biases in conservation decision-making is to ensure scientific experts are (a) aware that such social and professional biases exist, and (b) construct groups with decision-making authority so that they have a more heterogeneous composition.

Key Words: Bias, Grizzly Bears, Heuristics, Listing Status Determinations, Organizations, Social Identity, Value Orientations.

INTRODUCTION

Mounting evidence suggests that earth is entering a sixth mass extinction (Barnovsky *et al.* 2011; Ceballos *et al.* 2015) largely attributable to human causes (Holland *et al.* 2009). Though conservationists are working hard to stem losses to biodiversity, conditions more conducive to preserving threatened taxa are not anticipated in the near term. As such, government agencies will face increasing pressures to make judgments about which species and populations require special protections to prevent extinction and perpetuate their ecological function.

In the United States, decisions about which species are threatened with extinction, and therefore entitled to federal protection, are made by the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Services (NMFS). 'Listing decision' authority was delegated to these agencies by Congress via the federal Endangered Species Act (ESA; 16 U.S.C. §1531), which seeks to protect and conserve species threatened with extinction. Ostensibly, these decisions are apolitical, and result from a scientific analysis of risk (Lieben 1997). However, in practice, such decisions are rendered in an increasingly polarized political environment that is often fraught with uncertainty and saturated with interest groups, corporations, and professional societies − all attempting to pressure agencies to reach decisions that align with the interests of their members. The pressure brought to bear can be considerable, especially when it involves large, charismatic species, which capture the interest and imagination of the public.

ESA listing decisions and uncertainty

The ESA mandates that listing decisions be based on the 'best available' commercial and scientific data. Even in the best of cases, the best available science regarding threatened species is rife with uncertainty. Research on scientific judgment under uncertainty consistently finds that scientific experts are not purely objective, and expert decision-making is frequently swayed by heuristics and related biases (Tversky and Kahneman 1974; Slovic *et al.* 2005) and cannot always be trusted in complex, unpredictable environments (Kahneman and Klein 2009). That simple existence of uncertainty is not necessarily detrimental to decision-making processes, and at least in some degree, uncertainty is practically inevitable. However, the ubiquity of uncertainty in this particular context requires a careful assessment of potential biases in the decision-making process, and the application of decision support tools (see Discussion for further information) to ensure that judgments are based on a logical assessment of the objectives at stake, and the likelihood of achieving those objectives with a given option.

In practice, determining the listing status of a species involves answering 2 seemingly straightforward questions: (a) what is the probability, or risk, that a species will go extinct? and (b) is the estimated probability of extinction (or risk) acceptable? (Enzler and Bruskotter 2009; Freyfogle and Goble 2009). In addressing the first question, agency experts review the scientific literature to best estimate how each of 5 potential statutorily-defined threats (16 U.S.C. §1531) is likely to impact a species' extinction risk (Wymyslo 2009). The second question, however, is implied in the ESA, and fundamentally normative − science cannot give us the appropriate answer (Vucetich *et al.* 2006; Doak *et al.* 2015; Darimont 2017). The combination of (a) the uncertainty inherent in determining the risk of extinction, and (b) the implied, though equally important subjective judgment of acceptable risk, together create a decision environment well-suited for the use of biases and heuristics.

Theoretical foundation and hypotheses

Heeren *et al.* (2016) surveyed more than 200 experts who published papers on grizzly bears (*Ursus arctos horribilis*) and collected detailed information on (a) how these experts evaluated risks posed to the Greater Yellowstone Ecosystem (GYE) grizzly population, (b) experts' decisions concerning the appropriate status of GYE grizzlies, as well as (c) a

variety of factors that potentially bias these judgments (e.g., value orientations, norms, etc.). They found experts' assessments of risk (or threats) to the grizzly bear population were not a significant predictor of listing decision when potential biases were controlled. Rather, experts' wildlife value orientations (WVOs; Manfredo *et al.* 2009) and expert norms (the decision they believe their peers would render) were the only significant predictors of listing judgments.

Heeren *et al.* (2016) provides evidence that internal, cognitive factors unrelated to risk can bias scientific judgments about the appropriate status of potentially imperiled species. However, an equally compelling question is: why do experts hold differing norms, values, and risk perceptions in the first place? We reasoned that experts' social environments differ appreciably depending on their professional affiliation (government agency vs. academia), and likewise, the types of groups with whom they identify (e.g., environmentalist, hunting, animal rights advocate, etc.). Put simply, insomuch as the communities with which one associates are intrinsically composed of more homogenous members than one would find in the public at large, an expert's identity and affiliation may bias his or her judgments and decision-making.

The intent of the current study is to determine the extent to which the judgment of scientific experts depends upon such professional and social groups. Insight concerning how social groups influence the attitudes, norms, and beliefs of their members comes from social identity theory (SIT; Tajfel and Turner 1979; Tajfel 1982). Tajfel and Turner (1979) originally argued that people join and hence come to identify with social groups because those groups make them feel positively about themselves. However, identification with groups can also impact what people think and how they behave (Hornsey 2008; Van Zomeren *et al.* 2008). SIT predicts that individuals, through their in-group interactions, come to form 'prototypes' of social group members. These prototypes represent idealized members of groups that, in essence, describe what it means to be a group member and characterize the attitudes, beliefs, emotions, and behaviours deemed appropriate (Hornsey 2008). Ultimately, psychological research on group norms and conformity indicates that strong identification with in-group members and idealized prototypes leads to conformity with perceived group expectations and norms (Jetten *et al.*. 2002; Hornsey 2008).

Prior research into the effect of identity on wildlife-related attitudes and beliefs amongst the general public suggests that identification with various wildlife-related interest groups (e.g., hunters, environmentalists, animal rights advocates, etc.) can have powerful effects on what different stakeholders believe (Bruskotter *et al.* 2009; Lute *et al.* 2014). Essentially, these groups serve as reference points via which individual members judge the correctness of the attitudes and beliefs they express. Accordingly, we reasoned that experts' social identities and professional affiliations may impact their interpretations and assessments of relevant science, thereby leading to divergent judgments in decision-making. Ultimately, scientific experts are not immune to biases inherent in human judgment and decision-making − especially under conditions of uncertainty (Tversky and Kahneman 1974).

We hypothesized that the extent to which scientific experts identify with 3 key interest groups (i.e., social identities) − animal rights advocate, hunters, environmentalists − would be associated with experts' judgments regarding the appropriateness of GYE grizzly bear delisting. We also hypothesized that these same judgments would be related to respondents' professional affiliations (academia vs. government agency).

STUDY CONTEXT

The GYE is a 23,827 km^2 expanse that includes numerous protected areas within parts of Wyoming, Idaho, and Montana (Reading *et al.* 1994). GYE grizzly bears were listed as 'threatened' in 1975 (Knight and Eberhardt 1985). Because of subsequent lengthy and intensive recovery efforts and ESA protections, the GYE grizzly bear population has exhibited a positive annual rate of increase (Harris *et al.* 2007) despite persistent threats of human-induced mortality (Treves and Karanth 2003; Schwartz *et al.* 2010), habitat destruction (Gude *et al.* 2007), and fragmentation (Proctor *et al.* 2005). Current population estimates place abundance near 600 individuals and meets recovery goals outlined in the Grizzly Bear Recovery Plan (USFWS 1993; Servheen 1998). Though some scientists question the validity of sampling methods due to detectability and other concerns (Higgs *et al.* 2013; Doak and Cutler 2014), there is unanimity that population abundance has steadily increased for several decades (Haroldson *et al.* 2012).

USFWS issued a 2006 Final Rule (71 C.F.R. § 37525) removing GYE grizzlies from federal ESA protections; however, a Federal Court overturned the delisting in 2010 due to uncertainties regarding the effect of climate on important food sources (Felicetti *et al.* 2003; 75 C.F.R. § 14496).

In July 2017, USFWS again removed GYE grizzlies from federal ESA protection and placed the population under state oversight (82 C.F.R. § 30502). As in the 2006 delisting, uncertainty and debate have plagued the 2017 decision. Some scientists and managers support the current ruling on grounds that recovery goals have been met for population

abundance and "threats to this population and its habitat have been sufficiently minimized" (82 C.F.R. § 30502). Others urge caution and believe that the GYE grizzly delisting could potentially jeopardize the population's recovered status (Higgs *et al.* 2013).

Throughout recent decades, the leading cause of GYE grizzly mortality was human-caused mortality (e.g., lethal conflict mitigation, vehicle collisions, illegal poaching; Schwartz *et al.* 2010) in spite of vast protected areas throughout the bears' range (Mattson *et al.*.1996; Merrill *et al.* 1999). This suggests that human tolerance for grizzlies, similar to other large carnivores, is the primary limiting factor to the GYE grizzly (Bruskotter and Wilson 2014; Treves and Bruskotter 2014); yet, very little is known about factors affecting tolerance for grizzly bears in the GYE.

As state management plans are implemented, human-caused mortality will likely increase beyond existing levels (Schwartz *et al.* 2010) due to limited recreational harvest outside of core protected zones (Wyoming Game and Fish 2016; 82 C.F.R. § 30502). Opponents to delisting cite concerns intrinsic to state management plans (e.g., lethal control and legal hunting) coupled with additional uncertainties regarding the future effects of climate change on important food resources (Felicetti *et al.* 2003; Logan *et al.* 2010), and the response of local residents to changes in the bears' status.

The ongoing controversy culminated in another USFWS review (82 C.F.R. § 57698) of the 2017 GYE grizzly bear decision − on this occasion focused on a precedent established by a D.C. District Court of Appeals ruling in late 2017 (Humane Society of the United States *et al.* v Zinke *et al.* 2017). The court's ruling cited concerns that delisting the Western Great Lakes gray wolf (*Canis lupus*) 'distinct population segment' ignored potential impacts to surrounding wolf populations. USFWS is reviewing the 2017 GYE grizzly bear delisting in light of keen similarities with the recently overturned Western Great Lakes gray wolf population status (82 C.F.R. § 57698).

MATERIAL AND METHODS

To select a panel of potential participants for our internet-based survey, we searched the database Academic Search Complete for authors and co-authors who published grizzly bear research between 2004−2014 (search terms: "Ursus arctos", "brown bear", "grizzly bear"). The search identified 1,345 persons that we supplemented with 90 listed members of the Interagency Grizzly Bear Committee (IGBC; http://www.igbconline.org/). Our method of defining experts was intended to be as inclusive as possible, as we intended to contact individuals with varying levels of experience with grizzly bear research. Based on this approach, we identified email addresses for 1,216 experts. Of these, we successfully delivered emails to 593 recipients and asked them to complete a brief online questionnaire about the Greater Yellowstone grizzly population. Survey non-respondents were contacted twice additionally by email following the initial solicitation. For those who felt they lacked sufficient qualifications, we provided an opt-out option. Human research was conducted under the overview, and complied with the policies, of The Ohio State University's Institutional Review Board (Protocol# 2014E0617).

We asked respondents to rate a list of 7 potential threats (as previously identified by the USFWS; e.g., "human-caused grizzly mortality (i.e., human-bear conflict resulting in bear loss or legal or illegal hunting", "lack of genetic diversity and connectivity to other populations") to GYE grizzly bears along 2 dimensions. First, experts gauged the likelihood that the threat would occur over the next 10 years (0 indicated "not likely to happen", 10 indicated "certain to happen"). Second, respondents assessed the severity of that threat to grizzly population viability were it to occur (0 indicated "no harm at all", 10 indicated "extreme harm to the population"). After the threat assessment, respondents indicated whether they believed the GYE grizzly bear population should be listed as endangered, threatened, not listed, or if they were unsure. Importantly, the survey was conducted in 2014 when GYE grizzly bears still had ESA protection.

We calculated WVO scores for 2 belief domains −mutualism and domination −by averaging responses to a series of items designed to characterize individuals' fundamental beliefs about the appropriate relationship between humans and wildlife (see Manfredo *et al.* 2009; Teel and Manfredo 2010). Briefly, a domination or "mastery" orientation is characterized by the idea that wild animals should be in a subordinate position to humans, and are valuable primarily insomuch as they advance the needs of humans. In contrast, a mutualism orientation reflects the influence of egalitarian ideology on beliefs about wildlife, and characterizes wild animals as deserving of care and compassion. Domination WVO was measured using 5 items (e.g., "Humans should manage wildlife populations so that humans can benefit" and "It is acceptable for people to kill wildlife if they think it poses a threat to their property"), and mutualism WVO was measured using 3 items (e.g., "I feel a strong emotional bond with animals").

Norms were assessed following Ajzen's (1991) recommendations. Respondents were prompted with the statement "most scientists with whom I interact believe that grizzly bear populations in the GYE should be…" and then asked to respond along 2 scales ranging from 1 to 7 and

anchored by opposing statements (i.e., "…removed from the ESA" (=1) to "…protected under the ESA" (=7) and "…hunted" (=1) to "…protected from hunting" (=7). The paired items were repeated substituting "most wildlife managers" for "most scientists". Each expert's responses to the paired items "most scientists" and "most wildlife managers" were averaged to generate a scaled measure for expert norms.

Respondents were asked to indicate relevant employment history (e.g., professional affiliations), professional society memberships (e.g., Society of Conservation Biology), and the extent to which they identified as "animal rights advocate" or "hunter" or "environmentalist" (1-not at all to 5-very strongly). Employees of state, federal, or other government agencies were pooled, and academics were identified as those possessing a postdoctoral research or higher appointment.

We measured the extent to which experts' social identities (animal rights advocate, hunter, or environmentalist), professional affiliation (academic or government or co-affiliation) and the extent to which professional society memberships (e.g., The Wildlife Society) were related to 1) listing status recommendation (excluding those who indicated "unsure"), 2) WVOs, and 3) expert norms between experts' identity and professional affiliation. We conducted an ANOVA and assessed differences between strengths of identities or professional affiliations (when significant) with the Games-Howell post-hoc test. Pearson's Chi-square test was used to test for independence in listing status judgments, and we examined differences in factors related to professional society membership (2 groups: members and non-members) using Welch's 2-sample *t*-test. Significance was evaluated at the 0.05 alpha level.

RESULTS

Of the 593 individuals who opened the survey, nearly 40% (*n*=234) completed it. Of those who did not complete the survey, many (*n*=158; 27%) sent emails to explain that they did not feel they had sufficient knowledge or experience to complete the questions. We censored 22 additional respondents who reported limited experience with wildlife research and management.

Overall, 60% of respondents indicated that GYE grizzlies should continue to receive ESA protection. Approximately 20% of respondents believed the population should be delisted, and the balance was unsure. Among respondents who felt knowledgeable enough to provide a listing status recommendation (*n*=172), 2.8 times (95% confidence interval=2.0-4.0 times) as many experts recommended continued ESA protections (threatened or endangered status) over delisting for the GYE grizzly bear population.

Fifty-eight percent of respondents reported an academic affiliation (minimum post-doctoral experience; *n*=111), and 42% (*n*=82) were employed by a state or federal agency. Notably, 27 of 82 (33%) government employees were co-affiliated with academia either past or present. Remaining experts worked with non-profit organizations (*n*=35) or zoo/captive breeding programs (*n*=10); these individuals were included in all analyses except for professional affiliations, which focused on scientists employed by government and academia. Of experts identifying moderately or more strongly as an environmentalist (*n*=153), 47% co-identified as a hunter. Individuals identifying moderately or more strongly as an animal rights advocate (*n*=54) shared far greater overlap with environmentalists (93%, *n*=50); however, only one-third of environmentalists also identified with animal rights. Almost half of respondents indicated professional society membership in The Wildlife Society (TWS; *n*=101), followed by the Society for Conservation Biology (*n*=68). We pooled individuals serving on the IGBC or indicating membership with the International Association for Bear Research and Management (*n*=44). The Ecological Society of America, International Union for Conservation of Nature (IUCN), and American Society for Mammalogists shared similar membership among respondents (range: 36-41).

Amongst survey respondents who provided information regarding professional affiliation and who rendered a listing status judgment, recommendations varied by employment (χ^2_4=26.70, P<0.01). Experts who reported only an agency affiliation were 7.3 times more likely to recommend delisting than those who reported only an academic affiliation, and joint affiliate respondents were 4.7 times more likely than academics to do the same (Figure 1-A). Expert norms (e.g., a respondent's expectation of peers' assessments) differed by professional affiliation ($F_{2,141}$=12.0, P<0.01), and post hoc analyses using the Games-Howell criterion (unequal sample sizes) indicated norms differed between academics and government employees (P<0.01) (Figure 1-A). Differences between academics and those experts holding joint academic/agency affiliations were close to significant (P=0.063). Similarly, mutualistic WVOs were close to significantly different between co-affiliated scientists and state/federal agency experts ($F_{2,206}$=2.93, P=0.056), but similar to academics. Domination orientations differed by professional affiliation ($F_{2,201}$=8.41, P<0.01) and were strongest for government agency respondents who differed significantly from academics (P<0.01) and nearly differed from co-affiliated experts (P=0.059) (Figure 1-A).

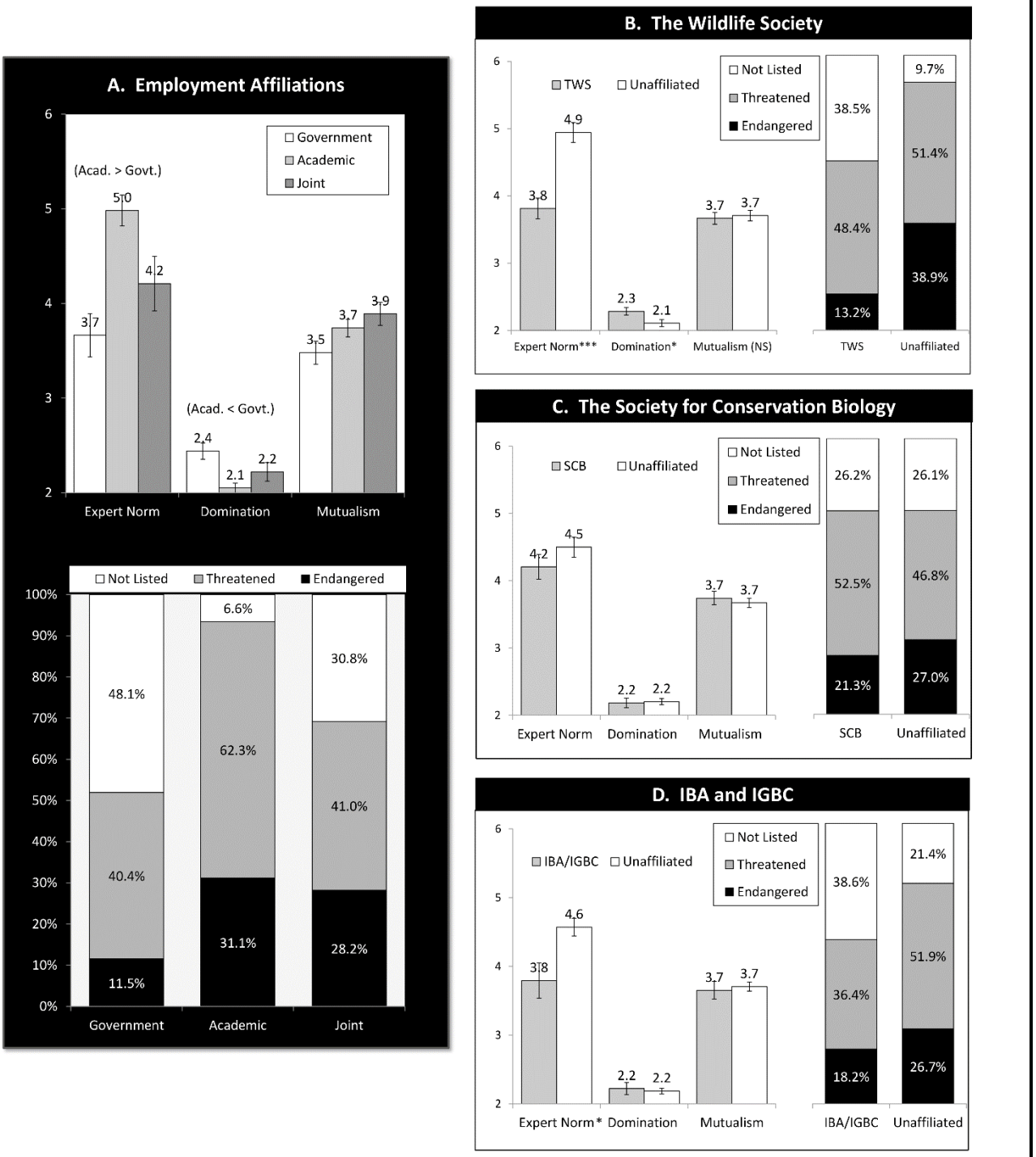

Figure 1. Expert Norms, Wildlife Value Orientations, and Listing Decisions by Professional Society Membership and Employment Affiliation. Figures on the left show mean values based upon society membership; error bars are 1 standard error; WVOs and expert norms were measures on scales ranging from 1 (low WVO, norm favoring delisting) to 7 (high WVO, norm favoring continued listing). Figures on the right show mean values based upon employment affiliation for government (state/provincial and federal agencies), academia, and joint (i.e., government and academia).

In terms of social identities, only mutualism differed according to an expert's strength of identity with animal rights advocates ($F_{4,189}$=5.68, P<0.01) (Figure 2). Predictably, individuals identifying more strongly as animal rights advocates scored higher on mutualism (Figure 2-C). Though trends were apparent when expert norms and WVOs measures were plotted by strength of expert identity as environmentalist, the ANOVA tests did not reveal significance. Looking across all 3 social identities examined in our analyses, the effect of one's identification as a hunter was strongest. Hunters identifying at the highest level ("very strongly") reported that their peers were more likely to favor delisting (expert norm) than nearly all other groups ("none", P<0.01; "slightly", P<0.01; "moderately", P<0.01; "strongly", P=0.067) (Figure 2). "Moderate" (P=0.02) and "strong" hunters (P<0.01) also had different expectations of peers' assessments than did experts who did not identify as hunters ("none"). Mutualist WVOs did not differentiate amongst experts with varying strength of identity as hunters ($F_{4,191}$=1.60, P=0.18; Figure 2-C); however, domination orientations were more evident in experts identifying "moderately", "strongly", or "very strongly" as hunters than those respondents indicating "none" or "slightly" ($F_{4,\ 191}$= 15.84, P<0.01; P<0.01 for each pairwise post-hoc tests; Figure 2-B). ESA listing status judgments for GYE grizzly bears differed between hunter identity levels (χ^2_8=33.22, P<0.01) (Figure 3-C). More specifically, experts not identifying as hunters were roughly 4 times less likely to recommend delisting than respondents at "slightly" or "moderate" levels. "Strong" and "very strong" hunters were 6.3 and 9.1 times as likely to recommend delisting, respectively, than scientists failing to identify with hunter at all (Figure 3-C).

Of professional societies, only membership in TWS (χ^2_2 = 23.78, P<0.01) and IBA/IGBC (χ^2_2=6.53, P=0.04) were associated with recommended listing status judgment (Figure 1-B). Over 90% of TWS non-members recommended GYE grizzly bears be listed as threatened or endangered, but 38.5% of TWS members recommended delisting. Experts belonging to the IGBC or IBA recommended delisting in 41.4% of cases, whereas 4 of every 5 non-members recommended continued ESA protection (Figure 1-D). Though WVO mutualism scores did not differ between TWS members and non-members, domination WVOs were more evident in TWS members (t= -2.29, df = 201, P=0.02; Figure 1-B). Expert norms differed between TWS members and non-members as well (t=-5.47, df = 176, P<0.01). In a similar pattern, IBA/IGBC members interacted more closely with peers indicating GYE grizzly bears' ESA protection should be lifted and potentially hunted than non-members (t = -2.72, df = 60, P<0.01; Figure 1-D). Society of Conservation Biology members did not differ from non-members with regards to expert norms, mutualism or domination WVOs (Figure 1-C).

DISCUSSION

Disagreements concerning the best means of conserving species are commonplace in conservation, and given the uncertainty inherent in the listing process, we anticipate that reasonable people could disagree about the appropriate status of a species. Nevertheless, by exploring factors that potentially bias scientific judgment, investigations such as ours not only provide insight into how such disagreements arise, but also, how they may be avoided.

We reasoned that experts working within governmental agencies face different pressures than those working in an academic environment. Indeed, our analyses found those with only government affiliations were more than 7 times as likely to recommend delisting (48.1%) than those with only academic affiliations (6.6%). Scientists who work for governmental agencies can face strong 'top-down' pressure from within their organizations (which are inherently hierarchical) to reach particular decisions, while academics that work within universities are at least partially shielded from these pressures by tenure. Put simply, in most cases, academics are likely less bound by institutional expectations of conformity − especially given the value that is currently placed on novel findings.

The pressure to conform to the social expectations of one's peers may be amplified when leaders within one's peer group seek to sway opinion—as when an organization with which one affiliates issues a position statement. In this case, at least 3 professional societies issued official positions concerning the listing of GYE grizzly bears: TWS supported GYE grizzly delisting (Parker and Feldpausch-Parker 2013), while the American Society of Mammalogists (ASM) and the Society for Conservation Biology (SCB) opposed delisting (Lacey and Carroll 2016). We found mixed support for the idea that scientists' affiliations with professional organizations impact their listing decisions. Specifically, members of TWS were roughly 4 times as likely as non-members to recommend delisting bears, whereas the listing decisions of SCB members did not differ from non-members (we did not evaluate ASM members due to low sample sizes).

Psychologists have long understood that people are profoundly affected by their social environment; indeed, the field of social psychology arose, in large part, to understand such effects (Baumeister and Finkel 2010). Numerous studies have shown that individuals tend to conform to the expectations of their peers (Asch 1956; Cialdini and Trost

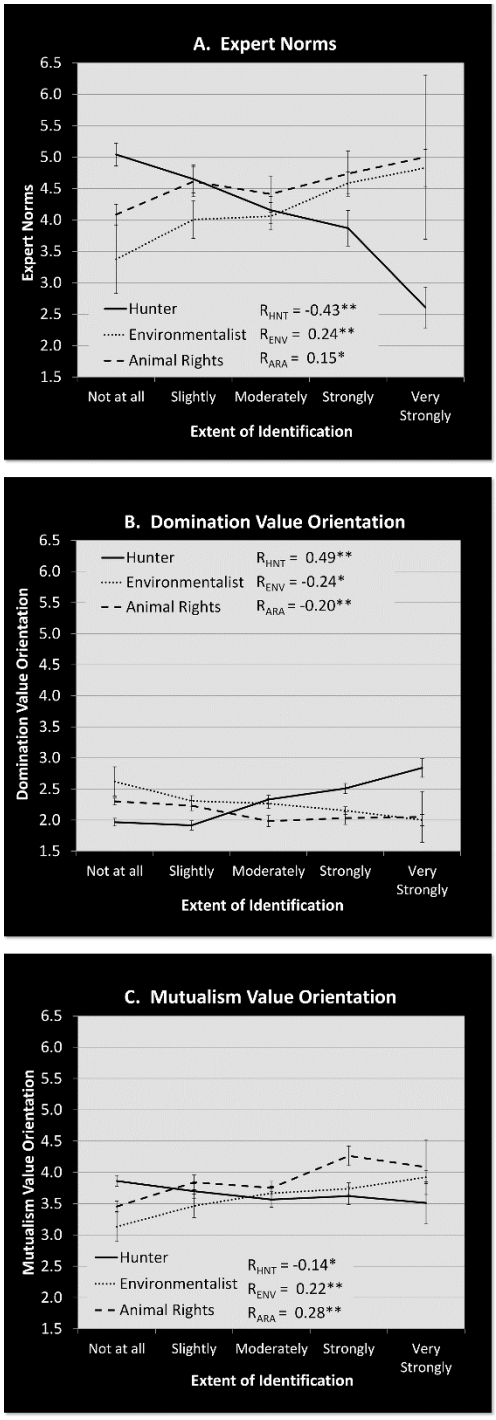

Figure 2. Expert Norms, and Wildlife Value Orientations by Respondents' Social Identities. Figures show mean values based upon the extent to which respondents identified as a (i) hunter, (ii) environmentalist, and (iii) animal rights advocate; error bars are 1 standard error; WVOs and expert norms were measures on scales ranging from 1 (low WVO, norm favoring delisting) to 7 (high WVO, norm favoring continued listing). Statistical association is measured via Pearson's R; * P<0.05, ** P<0.01, *** P<0.001.

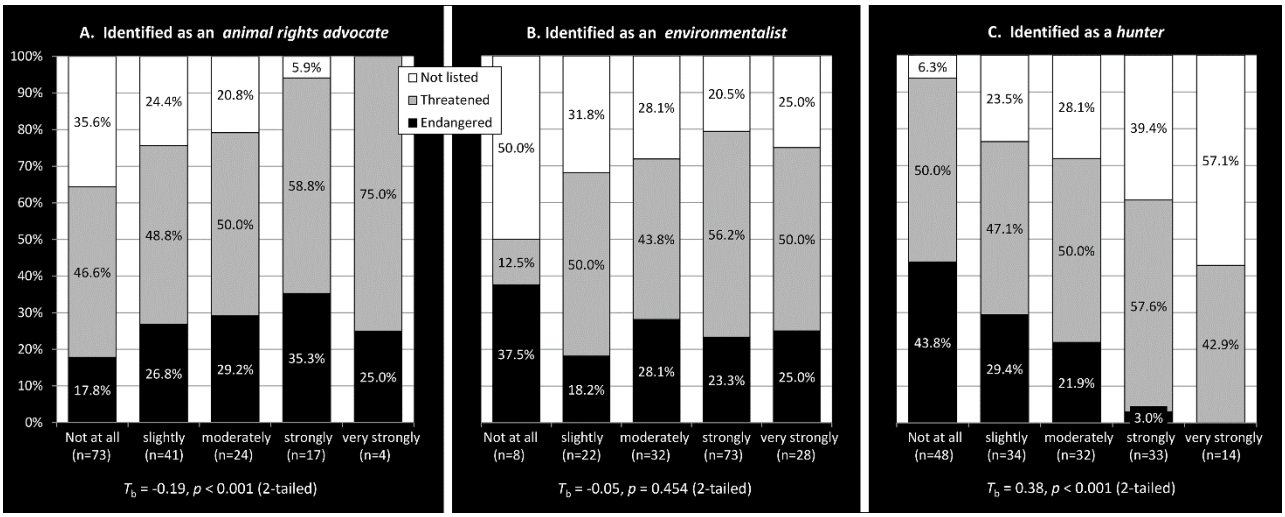

Figure 3. Listing Status Recommendations for GYE Grizzly Bear Population by Respondents' Social Identities. The association between recommendation and social identity is measured via Kendall's tau-*b* (2-tailed test).

1998). In what is now considered a classic experiment, Asch (1956) found that people will even provide obviously wrong answers to questions when under the sway of their peers. However, our subjects faced no such pressures − their answers were provided anonymously. Our results suggest that even scientific experts given the opportunity to respond anonymously may be swayed both by their professional affiliations as well as the groups with which they identify.

Of course, while the social groups with which we interact can affect our judgments and decisions, it is also true that we choose to align and interact with groups that share and reflect the ideas we embrace. Thus, the relationship between groups and our attitudes, beliefs and norms is reciprocal. In any case, our concern is that ostensibly 'scientific' judgments may be heavily influenced by social groups. For clarity, while it is not intrinsically problematic that such judgments are impacted by scientists' affiliations, it becomes problematic when the individuals charged with providing guidance on the conservation of species are comprised of a homogenous group. In the case of GYE grizzly recovery, the Interagency Grizzly Bear Committee, which is comprised entirely of individuals affiliated with federal and state agencies (IGBC 2018).

Notwithstanding the potential for bias among experts, ESA listing decisions are statutorily-required to be based solely on the best scientific information available, which raises the question: Is there a way to at least minimize bias in listing decisions? Scholarly research in the field of judgment and decision-making provides some guidance. Experts in this field have long-recognized implicit biases as problematic and have developed strategies to 'debias' judgments and decisions. Some of these strategies are quite simple; for example, simply making experts aware of their own biases can sometimes bolster more objective decision-making (Soll *et al.* 2015). Taken a step further, recognition of systemic biases within the scientific community gives added urgency to at least consider more intensive frameworks (e.g., Structured Decision Making or Bayesian approaches) that prioritize empirical data without ignoring value-based trade-offs (Gerber *et al.* in review). Our purpose is not to elaborate on the many methodological and procedural options that exist (see for examples, O'Hagan and Oakley 2004; Arnell *et al.* 2005; Clark *et al.* 2006; Kunhert *et al.* 2010; Speirs-Bridge *et al.* 2010; Burgman *et al.* 2011), but rather, to note that the presence of social bias need not paralyze agencies.

While such approaches can assist decision-makers in negotiating bias and uncertainty, they are not without perils. A primary concern is that processes that depend upon the selection of a broad group of stakeholders can be readily manipulated by limiting participants to a like-minded group (López-Bao *et al.* 2017). Indeed, if nothing else our data demonstrate why homogenous stakeholder groups can be problematic − i.e., they create an environment where the pressure to conform may be more acute (Asch 1956).

Though we contend that our data demonstrate the potential for biased decision-making in the case of the GYE grizzly

bear, there are important contextual differences between the decision processes faced by our subjects and those faced by the individuals with the USFWS who authored the proposed rule. First, inclusion criteria for potential survey respondents were broader than those used in actual USFWS (de)listing decisions. This is not to insinuate that broadening the scope of experts would necessarily be detrimental to ESA status determinations; in fact, consulting a wider range of experts may yield a more complete picture of a wildlife population's current status. Rather, we make this point to note that the sample pool contacted in our study were, on the whole, undoubtedly less familiar with the case of the GYE grizzly.

Second, the threat assessment included in our survey was not as extensive as an actual ESA review; nevertheless, the 3 threats rated highest by our participants (habitat loss, habitat modification, and human caused grizzly mortality) are in concordance with other literature assessing the GYE population (USFWS 1993; Servheen 1998; Treves and Karanth 2003; Gunther *et al.* 2004; Proctor *et al.* 2005).

Third, individuals who contribute to actual ESA listing determinations are not granted the same anonymity as our study's survey. Anonymity, or lack thereof, may influence outcomes in a couple of different directions. Non-anonymous review may actually intensify pressures to reach a conclusion that conforms to one's peers, and thus, increase the influence of normative pressure (Asch 1951, 1956). Conversely, anonymity may lessen one's commitment to thoroughness and due diligence in ESA determinations as expert participants may not perceive accountability for their decisions. Herein lies the tension between 2 important goals of any scientific peer review process – to demand a thorough and systematic review and to minimize pressure to conform to social or political expectations (Ruhl 2004). Requiring reviewers to publicly acknowledge potential conflicts of interest is a proper step towards resolving that struggle (Hires 2016). Despite prohibiting experts affiliated with the USFWS, IGBC, Wyoming, Montana, and Idaho from formally reviewing the 2017 ESA delisting of the GYE grizzly bear population, other experts reviewing the delisting decision for GYE grizzlies are not immune to their own sets of biases (82 C.F.R. § 30502).

Our results have potentially important implications for listing determinations of many imperiled species. The USFWS is currently obligated to complete reviews for a backlog of nearly 800 petitioned species by 2018 following litigation settlement with the Center for Biological Diversity in 2011. Given the anticipated near-term flurry of listing determinations, and pressure to show successes through recovery (and subsequent delisting), the USFWS is likely to face numerous delisting decisions in the immediate future, thus underscoring the importance of identifying processes and procedures that minimize bias. We encourage the USFWS to include more and diverse experts on review panels and assemble external peer review panels earlier in the review process (before the public comment period begins). Greater diversity of external experts would encourage adequate accounting of the uncertainty inherent in threat assessments in the final listing decision. Using peer review earlier would help alleviate suspicions that experts are called upon to affirm previously determined listing decisions rather than rigorously and independently review proposed judgments.

The divergent values and judgments of experts belonging to different social groups or professional entities suggest substantial disagreement within the conservation community regarding the status of GYE grizzly bears. Given the complex nature of ESA decision-making and review processes, greater transparency of uncertainty in listing status recommendations would be useful for understanding when non-relevant factors are likely to bias expert judgments (Andelman *et al.* 2004; Martin *et al.* 2012). To the degree that our study lends insights into potentially systemic biases that may influence scientific experts, we anticipate that lessons learned from the GYE grizzly bear population can be applied to future ESA listing determinations.

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