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Explaining Reported Puma-Related Behaviors and Behavioral Intentions Among Northern Arizona Residents

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*Management of pumas in the American West is typified by conflict among stakeholders plausibly rooted in life experiences and worldviews. We used a mail questionnaire to assess demographics, nature-views, puma-related life experiences and behaviors, and support for puma-related policies among residents of northern Arizona. Data from the questionnaire (*n = *693 respondents) were used to model behaviors and support for policies. Compared to models based on nature-views and life experiences, those based on demographics had virtually no support from the data. The Utilitarian/Dominionistic nature-view had the strongest effect of any variable in six of seven models, and was associated with firearms and opposition to policies that would limit killing pumas. The Humanistic/Moralistic nature-view was positively associated with non-lethal behaviors and policies in five models. Gender had the strongest effect of any demographic variable. Compared to demographics alone, our results suggest that worldviews provide a more meaningful explanation of reported human behaviors and behavioral intentions regarding pumas.*

Keywords cougars, mountain lions, nature-view, perspectives, policies, *Puma concolor*

Introduction

Puma (*Puma concolor*) management in the western United States is characterized by conflict among stakeholders that is fueled in part by their responses to puma attacks on people and perceptions of how puma predation affects populations of prey such as deer (*Odocoileus* spp.) and bighorn sheep (*Ovis canadensis*; Mattson & Clark, 2010a). The policy process is typified by litigation, ballot initiatives, inflammatory incidents, and public incivility (Mattson & Clark, 2010a). Written disagreements have often focused on the merits of lethal management methods, whether for harvest, depredation control, or human

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safety, although conflict likely originates at the deeper level of participants' perspectives on proper relations between people and wildlife. Hunters, wildlife managers, animal protection advocates, and environmentalists have been the most consistent participants in puma management. Of these, hunters and managers have tended to support lethal methods rooted in anthropocentric perspectives, whereas animal protection activists and environmentalists have tended to espouse the existence and ecological values of pumas (Mattson & Clark, 2010b).

Since the 1960s, biocentric or "mutualist" perspectives have become widespread in the United States (Dunlap & Scarce, 1991; Kellert, 1996; Manfredo, Teel, & Henry, 2009). This trend has changed and diversified people's demands regarding the outcomes of puma and other wildlife management, sometimes in stark contrast to historical demands based on utilitarian views that shaped the cultures of most wildlife management bureaus (Kellert, 1996; Wolch, Gullo, & Lassiter, 1997; Teel & Manfredo, 2009). Biocentric perspectives tend to be disproportionately common among women, urban dwellers, better educated people, and those not employed in agriculture or extraction of natural resources (Kellert, 1996; Teel & Manfredo, 2009). Urbanization, the emergence of new economic sectors, and the related proliferation of biocentric perspectives promise to continue throughout puma range (Manfredo, Teel, & Bright, 2003; Otterstrom & Shumway, 2003). As a result, there will likely be less support for hunting and other lethal management methods among the general public, as is already evident even in less urbanized states such as North Dakota (Gigliotti & Harmoning, 2004). Issues such as puma management could become even more contentious, especially if wildlife agency personnel continue to hold predominantly utilitarian views (Mattson & Clark, 2010a; Teel & Manfredo, 2009).

These broad trends are evident in Arizona north of the Mogollon Rim, which has been one of several epicenters of conflict over puma management. Northern Arizona has also been a microcosm of other changes occurring throughout the western United States, including urbanization in Flagstaff, Payson, and the Verde Valley and declines of extractive industries such as ranching and logging (e.g., Keegan et al., 2006). An incident occurred near Flagstaff during the winter of 2002 during which some individuals, who expressed animal protection and environmentalist perspectives, reacted strongly against plans by state wildlife and federal land managers to kill pumas that had threatened hikers in a popular recreation area at the urban–wildland interface (Mattson & Clark, 2011). This incident foreshadowed one with even greater statewide political impacts near Tucson during 2004–2005 (Perry & deVos, 2005), as well as similar upwelling of discontent among biocentric stakeholders in response to agency plans for sport hunting of pumas in the Jackson Hole area of Wyoming (Clark & Munno, 2005) and in the Black Hills of South Dakota (Love, 2005).

Given this history of conflict set against broad-scale socioeconomic change, civil and durable puma management will depend on the emergence of policy alternatives that can garner broad public support (Mattson & Clark, 2010a). The most promising alternative approaches will include non-lethal options that are supported by biocentric stakeholders, yet address the needs and concerns of diverse other participants. This policy-related consideration was one impetus for a study, reported here, which we designed to explain differences in support among northern Arizona residents for prospective non-lethal or modified lethal approaches to puma management, considering both conceptual and practical relevance. More fundamentally, we were interested in explaining puma-relevant behaviors and perspectives among people who were attentive to puma management in our study region. We intended our results to provide insights regarding causes of both conflict and common ground in puma management, as well as likely future trends in support for lethal versus non-lethal methods.

Conceptual Considerations

The human population of relevance to these policy-related matters was contingent and ill-defined, but logically comprised of those who were attentive to and active in puma management. Levels of activity vary across a continuum, and for most participants, activity probably waxes and wanes with time. Large numbers of participants are involved temporarily, presumably motivated by the salience of immediate events (i.e., incidents involving pumas) (Mattson & Clark, 2011). Given our interest in explanation, we considered the "attentive public" (*sensu* Dunlap, 1989) to be our target population, realizing that this group of people is not clearly bounded in concept and, moreover, logistically not feasible to define in practice. Nonetheless, history shows that almost all the participants in puma management are adults and most self select on the basis of the salience of the issue (Mattson & Clark, 2010b), suggesting that there is some degree of prospective congruence with a sample population of heads-of-household motivated to respond to a mailed questionnaire. In an explanatory modeling paradigm, such as we adopted, "populations" are those identified with the modeled categories, and bias arises to the extent that ranges of variation in perspectives are disproportionately sampled within those categories (Dawid, 1979; Kyburg, 1969). Under these circumstances, bias is largely governed by the conceptual and statistical adequacy of the explanatory models and by the degree to which the models assure the conditional independence of the data.

Previous explanations or associative descriptions of perspectives among those involved in puma management have taken several conceptual forms. By far the most common has been to associate puma-related knowledge or perspectives, or support for puma-related management practices, with demographic measures. These measures have typically included sex (i.e., gender), age, level of education, place of residence (urban versus rural), length of residence, income, and whether respondents had hunted or fished (Casey, Krausman, Shaw, & Shaw, 2005; Gigliotti, 2006; Meadow, 2004; Peña, 2002; Teel, Krannich, & Schmidt, 2002; Thornton & Quinn, 2009). The premise has been that these variables indicate or affect more meaningful phenomena such as values, worldviews, attitudes, and behavioral intentions (Vaske, Donnelly, Williams, & Jonker, 2001). Demographic variables are useful because they are comparatively unambiguous, easy to measure, and commonly used by public agencies to monitor social trends. For these reasons they are policy relevant. However, at best they suggest rather than directly address central social and psychological dynamics that are ultimately at the heart of providing meaningful explanations.

There have been many attempts to reduce human cognition to discrete concepts and categories, but these have generally been frustrated by the sheer complexity of how humans orient to themselves and the world (Donald, 2001). Notions such as attitudes, preferences, worldviews, and values have been notoriously ambiguous in application, despite attempts to achieve definitional closure (e.g., Chaikem & Stangor, 1987; Dietz, Fitzgerals, & Scwom, 2005; Hitlin & Piliavin, 2004). A number of schemes have been correspondingly developed to describe the ways that people orient to wildlife and nature, represented as values, value orientations, and attitudes. Most are one-dimensional gradients, ranging from utilitarian or anthropocentric to mutualist or bio- or ecocentric extremes (e.g., Fulton, Manfredo, & Lipscomb, 1996; Teel, Dayer, Manfredo, & Bright, 2005; Thompson & Barton, 1994). Kellert developed the most diverse schematic, which he has variously related to values, attitudes, and worldviews, comprising eight to ten categories (Kellert, 1985, 1989, 1996).

We chose to use Kellert's schematic, along with life experiences and demographic variables, to explain the variation we observed in responses to a questionnaire sent to residents of forested regions in northern Arizona about behaviors and prospective non-lethal and

modified lethal practices for managing pumas. Kellert's categories have been used most notably by Reading and others in the West (Reading & Kellert, 1993; Reading, Clark, & Kellert, 1994) and by Bjerke and Kaltenborn in Scandinavia (Bjerke & Kaltenborn, 1999; Bjerke, Odegarstuen, & Kaltenborn, 1998a; Bjerke, Reitan, & Kellert, 1998b; Vittersø, Kaltenborn & Bjerke, 1998). We interpreted Kellert's schematic primarily as nature-views, encapsulating elements of belief about how the natural world both is and should be, specific to wildlife and nature but also expressing people's basic anxieties and value orientations (Mattson & Clark, 2010a). Throughout, we use "perspective" or "nature-view" as a general term encapsulating psychodynamics at the interface of self and the external world, including worldviews, attitudes, and value orientations (Clark, 2002).

Methods

Geographic Frame and Questionnaire

We used a mail questionnaire to assess perceptions and knowledge of pumas, puma-related life experiences and behaviors, support for prospective management policies, and nature-views among residents of our northern Arizona study area. Our puma-focused study was undertaken in tandem with a study focused on forest restoration. Because of this joint interest we prioritized reaching residents who lived in ponderosa pine (*Pinus ponderosa*) forests. This population was also appropriate for puma-focused research because it encompassed people who live in landscapes typical of those where both pumas and puma–human conflict occur in the western United States (Murphy & Ruth, 2010; Sweanor & Logan, 2010). We defined our geographic frame as the 35 postal zip code regions contained within the ponderosa pine forest ecosystem in northern Arizona (Figure 1).

Our target respondents were adult (>18yrs old) seasonal or permanent residents defined as having lived in the region one year or longer. We purchased a random sample of 1,729 residents likely to meet these criteria from Genesys Sampling in Fort Washington, Pennsylvania, of which 1,664 were validated by the United States Postal Service. During 2003 we sent four mailings to candidate respondents, including a pre-notice letter, questionnaire, reminder postcard, and replacement questionnaire, consistent with Dillman's (2000) mail survey methods. The questionnaire can be obtained by contacting the authors. We assessed congruence between respondent and non-respondent perspectives by phone contacts with a sample of non-respondents during the winter of 2003–2004. We asked non-respondents a subset of questions from each section of the questionnaire for comparison to the respondent sample.

We developed the mail questionnaire to be self-administered and to reveal nature-views, knowledge and experiences of pumas, behaviors, and support for puma management policies. We provided a scale ranging from one to five (one being strongly agree/favor and five being strongly disagree/oppose) for responses to statements designed to elucidate nature-views and levels of support for policies. Three indicated ambivalence or indecision about the statement. We refined the questionnaire through several test applications involving students, who provided feedback on how easy questions were to read and understand, as well as the logic of how we sequenced the questions.

Response Variables

Our seven response variables pertained to lethal versus non-lethal behaviors and behavioral intentions toward pumas. We asked (a) whether or not respondents had hunted during the

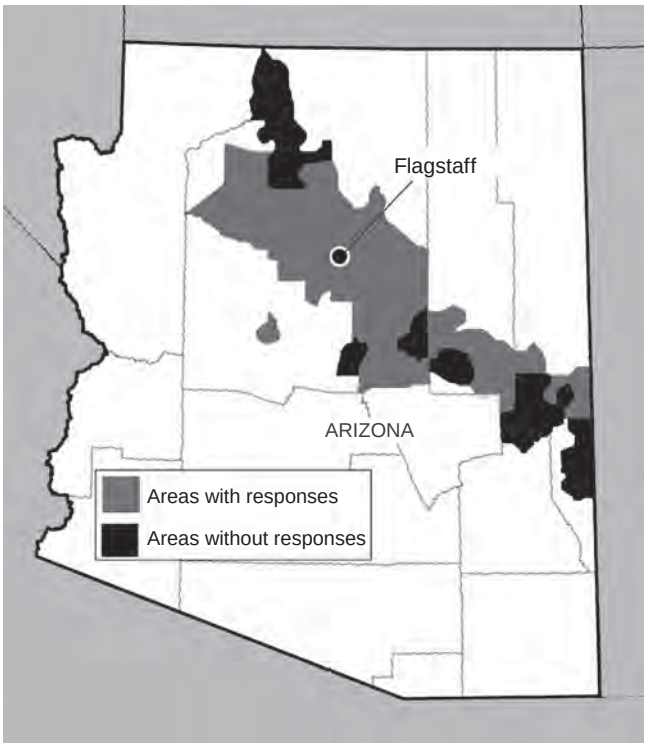

Figure 1. The state of Arizona showing postal code areas where we mailed our study questionnaire. We obtained responses from areas shaded dark gray, and no responses from areas shaded black.

preceding year, (b) whether or not they had ever killed a puma, and (c) whether or not they preferred to carry a firearm for self-protection when in puma habitat. The first two of these three variables unambiguously pertained to behaviors, the third to both behavior and behavioral intention given that the question did not ask specifically whether they had carried a firearm for protection or merely preferred to in principle. We also asked respondents whether or not they preferred no device for self protection or to carry an air horn or "pepper" (capsaicin) spray, but did not model these responses because they were strongly negatively correlated with the response to preference for a firearm.

We asked about level of support for four prospective policies: (a) prohibit sport hunting of juvenile pumas; (b) limit sport hunting of adult female pumas; (c) relocate rather than kill pumas involved in conflicts with humans; and (d) protect puma habitat from human development. There are currently no area limits on harvest of pumas in Arizona other than a prohibition against killing spotted kittens and lactating females (Arizona Game & Fish Department, 2010). Pumas involved in conflicts are also routinely killed. We considered levels of support for prospective policies to be "behavioral intentions" given that support, in practice, would be manifest as voiced or written perspectives and other behaviors (Vaske & Donnelly, 1999).

We assessed the salience of puma management to our respondents in terms of the intensity of their support for our four policy alternatives. Our intensity metric (Salience) ranged from 0 to 4 and was derived by summing the number of instances for each respondent where they had responded with either agree to strongly agree or disagree to strongly

disagree. We interpreted Salience = 0 to indicate considerable ambivalence about pumas and puma management and Salience = 4 to indicate considerable interest and strength of opinion.

Explanatory Variables

Our explanatory variables fell into three broad categories: demographics; life experiences; and nature-views. Demographics included: gender; age (four ordinal groups); number of years lived in northern Arizona; place of residence (urban vs. rural); level of education (three ordinal categories); level of income (eight ordinal categories); and type of occupation (six categories). Life experiences included: whether or not the respondent thought he or she had ever seen or heard a puma; whether or not the respondent thought a puma had killed a domesticated animal owned by the respondent or by someone the respondent knew; the respondent's level of worry about harm from pumas (five-part ordinal scale); the respondent's level of outdoors activity (number of times active in "the forest" during the preceding year); and the respondent's knowledge of puma ecology and management (correct score, 0–100%, on seven questions). We considered beliefs to be part of nature-views and, in addition to questions specifically designed to score nature-views (see below), we also asked respondents to respond to the following belief-related statements: Is it important to know that pumas exist? (five-part ordinal scale); and, Pumas play an important role in nature (true false).

We created nature-view scales from Kellert's (1978) wildlife values survey instrument, with permission from the author. Forty-six statements made up our nine scales, which was a shortened version of Kellert's original instrument. Upon return of our survey we subjected statement responses to factor analysis to assure that the nine scales were measuring the appropriate orientation. Factor analysis revealed 11 factors with eigenvalues >1, explaining 54.4% of the variance. An inspection of the screeplot suggested eight factors should be retained for further investigation. We rotated the factors orthogonally and obliquely by varimax rotation and direct oblimin rotation, respectively. Both rotated solutions revealed that some of the statements in the original scales were not measuring the appropriate orientation because they were not clustering with other statements of the same scale. To remedy this discrepancy, we reduced Kellert's original scales from nine to four by consolidating six scales into three and dropping two scales altogether. The four derived scales were based on eight to eleven statements each and labeled: Negativistic; Utilitarian/Dominionistic (U/D); Scientific/Ecologistic (S/E); and Humanistic/Moralistic (H/M). Cronbach's α exceeded the acceptable level of 0.7 for all derived scales (Nunnally, 1978). We standardized scores on each scale from 0 to 100 for easier interpretation.

Explanatory Statistical Analyses

We modeled the reported behaviors as binary responses (yes vs. no) and converted the Likert-scaled responses to our policy options to binary variables by consolidating "agree" and "strongly agree" and scoring them as "1" and by consolidating "disagree" and "strongly disagree" and scoring them as "0." We used logistic regression to specify models that discriminated between these more extreme (or non-neutral) responses in the case of support for policy options or between involvement and non-involvement in the case of behaviors. Our approach to modeling support for policies was consistent with our interest in focusing on respondents who were more attentive to or engaged with pumas and puma management. We used area under the receiver operating characteristic (ROC) curve, Cox and Snell R^2, the

score test, and the Hosmer-Lemeshow goodness-of-fit test to evaluate our logistic regression models (Hosmer & Lemeshow, 2000). We used multiple linear regression to specify models that explained nature-view scores and levels of Salience. We used the F statistic, R^2, and root mean square error (*MSE*) to evaluate overall performance of these models (Weisberg, 1985).

We specified our models according to the methods of information theory. We estimated coefficients by maximum likelihood and evaluated models on the basis of Akaike's sample-size corrected information criterion (AIC_c). We evaluated the relative importance of model variables by the change in AIC_c (Δ AIC_c) and, in the case of logistic regression, change in deviance (Δ -2lnL) with deletion of each variable, in turn, from the best model (Burnham & Anderson, 2002). We similarly judged the relative likelihood of models minus each variable by Akaike weights (w; Burnham & Anderson, 2002).

We screened our cases for missing data prior to conducting regression analyses and determined the presence and effects of outliers. We excluded cases with missing data for specific models, which is more conservative than estimating missing values. We retained candidate outliers because none of them exhibited a Mahalanobis distance with $p < .001$, and no differences in model specifications were detected including or excluding outliers.

Results

We obtained 693 completed questionnaires of the 1,617 that were sent and deliverable, which was a 43% return rate. We obtained at least one response from 22 of the 35 zip codes included in our mailing (Figure 1). The zip codes from which we did not obtain responses were characterized by resident populations $\leq$2,000 and with less than average housing unit occupancy (U.S. Bureau of the Census, 2000).

We attempted to contact 174 non-respondents by phone to assess differences between respondents and non-respondents. Twenty-two people participated, 37 refused, 44 phone numbers were disconnected or wrong, 3 respondents were deceased, and 66 numbers did not yield responses even after repeated calls. The sample of non-respondents was too small to statistically compare to respondents. However, characteristics of both samples were superficially similar, with the exception that mean length of residency in northern Arizona was 23.1 years for non-respondents compared to 17.2 years for respondents.

Issue Salience

Of our respondents, 66% expressed polar responses to all of our policy options (Salience = 4) and 84% expressed polar responses to three or more options (Salience $\geq$ 3). Only 7% expressed ambivalence about three or more prospective policies (Salience = 0 or 1). The salience of pumas and puma management to our respondents was positively related to their level of outdoor activity (number of trips to "the forest") and their H/M and S/E scores. Level of outdoor activity had by far the greatest influence in this model (Δ $AIC_c = 13.7$ and $w = .0008$ with deletion of this variable) compared to either H/M or S/E scores (Δ $AIC_c = 5.48$ and $w = .051$, and Δ $AIC_c = 3.15$ and $w = .163$, respectively). Overall, the model had a low probability of occurring by chance ($F = 20.6$, $df = 3/644$, $p < .0001$), but explained little variance in Salience ($R^2 = .087$). Level of outdoor activity was positively correlated with S/E scores, knowledge of pumas, and participation in hunting (partial Spearman correlation coefficients [r_s] = .220, .178, and .129, respectively).

Comparative Performance of Categories of Explanatory Variables

Compared to our best models, the data offered virtually no support for models based on demographics alone ($w < .0001$ in all cases; Table 1), and a wide range of support for models based on nature-view and life experience variables alone (w ranged from $<.0001$ to .999 and averaged $.340 \pm .456$ *SE*; Table 1). Our best models explaining whether a respondent had ever killed a puma and level of support for limiting development in puma habitat were identical to our models based on nature-view and life experience variables. Of the models based on demographics alone, six of seven contained a gender effect, five contained the effect of years lived in northern Arizona, and three contained an effect of age (but only pertaining to behaviors for this last variable, and negative in all instances). Being male versus female was positively associated with hunting, having killed a puma, and preferring a firearm for defense, and was negatively associated with support for limiting hunting of female pumas, prohibiting hunting of juveniles, and protecting puma habitat.

Best Models

Our best models were characterized by adequate to excellent diagnostics. Area under the ROC curve was $>.7$ in all cases, $>.8$ for five models, and $>.9$ for one (likelihood of having killed a puma; Tables 2 and 3). The Hosmer-Lemeshow test suggested that there was excellent fit of models to the data in four instances and poor fit in two (support for prohibiting hunt of juveniles and limiting hunt of adult females).

The U/D nature-view score had a dominant effect in six of our seven models: positively associated with probability of having hunted, killed a puma, and preferring a firearm for protection from pumas, and negatively associated with probability of supporting limiting hunting of female pumas, prohibiting hunting of juveniles, and limiting human development in puma habitat (Tables 2 and 3). The probability of having hunted and of preferring to carry a firearm reached near certainty at high U/D scores (Figure 2). The H/M nature-view also contributed substantially to explaining responses in four models: positively associated with support for prohibiting hunting of juvenile pumas, translocating (rather than killing) problem pumas, and limiting development in puma habitat, and negatively associated with preferring to carry a gun for self defense (Tables 2 and 3, Figure 2). The belief that pumas play an important role in nature also contributed substantially to explaining support for translocation.

Although Negativistic scores were not included in any models, level of worry about pumas likely functioned as a surrogate to some degree. Controlling for hunting and H/M scores, the partial correlation of worry and Negativistic scores was $r_s = .210$. Higher levels of worry were weakly positively associated with support for translocating problem pumas and limiting development in puma habitat.

Overall, life experiences contributed little to explaining support for policies, but were substantially associated with behaviors. Knowledge of pumas was positively associated with hunting and having killed a puma; experiences of depredation by pumas were positively associated with preference for carrying a firearm; and experiences with encountering pumas were positively (and tautologically) associated with having killed a puma (Table 2). Of the demographic variables, gender (being male vs. female) was most consistently included in best models, and had substantial positive effects on probability of having hunted and preferring to carry a firearm for protection, and a negative effect on probability of supporting limits on hunting adult female pumas (Tables 2 and 3). In other words, compared to women, men were more likely to have hunted, to prefer a firearm, and to be less

Table 1

Variables and signs of coefficients contained in the best models (by AIC criteria) explaining puma-related behaviors, behavioral intentions, and support for prospective puma-related policies, differentiating models based solely on demographic variables from models based solely on nature-view and life experience variables. Akaike weights (*w*) are given for the best models containing all types of variables versus models containing only demographic or only nature-view and life experience variables, along with change in log-likelihood (Δ -2lnL) from the best models to models based only on demographics or nature-views and life experiences

	Modeled response						
Model parameters	Hunted during the last year	Killed a puma during the last year	Would prefer a gun for self-defense against puma	Limit hunting of female pumas	Prohibit hunting of juvenile pumas	Translocate problem pumas	Limit development in puma habitat
Variables in demographic model	(+) sex (male)	(+) sex (male)	(+) sex (male)	(–) sex (male)	(–) sex (male)	no model	(–) sex (male)
	(+) Years lived in AZ	(+) Years lived in AZ	(–) residence (urban)	(–) Years lived in AZ	(–) Years lived in AZ		(+) residence (urban)
	(–) Age	(–) Age	(–) Age				(–) Years lived in AZ
	(–) Level of education		(+) Permanent resident (yes)				
			Occupation (6 categories)				
Variables in worldview/ experience model	(+) Utilitarian/ Dominionistic	(+) Utilitarian/ Dominionistic	(+) Utilitarian/ Dominionistic	(–) Utilitarian/ Dominionistic	(–) Utilitarian/ Dominionistic	(+) Humanistic/ Moralistic	(–) Utilitarian/ Dominionistic
	(+) Experienced puma depredation	(+) Encountereda puma	(–) Humanistic/ Moralistic	(+) Scientific/ Ecologistic	(+) Humanistic/ Moralistic	(+) Belief: Pumas play important role in nature	(+) Scientific/ Ecologistic

(*Continued*)

Table 1
(Continued)

Model parameters	Modeled response						
	Hunted during the last year	Killed a puma during the last year	Would prefer a gun for self-defense against puma	Limit hunting of female pumas	Prohibit hunting of juvenile pumas	Translocate problem pumas	Limit development in puma habitat
	(+) Knowledge of pumas	(+) Knowledge of pumas	(+) Experienced puma depredation	(–) Knowledge of pumas	(–) Encountered a puma	(–) Knowledge of pumas	(+) Humanistic/ Moralistic
	(–) Level of worry about pumas	(+) Experienced puma depredation				(+) Level of worry about pumas	(+) Belief: important to know pumas exist
							(–) Level of worry about pumas
w best model	.981	.999	.999	.964	.786	.885	.999
w worldview/ experience model	.019	(.999)	<.001	.036	.214	.115	(.999)
w demographic model	<.001	<.001	<.001	<.001	<.001	no model	<.001
Δ -2lnL worldview/ experience model versus best model	11.9	0.0	18.4	8.6	4.6	6.1	0.0
Δ -2lnL demographic model versus best model	122.8	32.0	120.2	59.6	127.3	no model	113.0

Table 2
Parameters for the best-performing logistic regression models explaining puma-related behaviors or behavioral intentions in terms of nature-views, experiences, and demography for respondents living in forested regions of northern Arizona during 2003. Bolded values of ΔAIC_c are >4, which indicates an effect substantial enough to warrant consideration (Burnham & Anderson, 2002)

	Modeled response											
	Hunted during the last year				Had killed a puma				Would prefer a gun for self-defense against puma			
Variables and model statistics	β sign	Δ AIC_c	Δ -2lnL	w	β sign	Δ AIC_c	Δ -2lnL	w	β sign	Δ AIC_c	Δ -2lnL	W
(Best model)		0	0	.907		0	0	.740		0	0	.947
Utiltarian/Dominionistic	+	**76.3**	78.3	<.001	+	**21.0**	23.0	<.001	+	**88.4**	98.4	<.001
Humanistic/Moralistic									–	**6.3**	8.3	.041
Experienced puma depredation (yes)	+	3.8	5.8	.051	+	2.8	4.8	.180	+	**8.8**	10.8	.012
Knowledge of pumas	+	**22.4**	24.4	<.001	+	**6.0**	8.0	.036				
Encountered a puma (yes)					+	**5.7**	7.7	.044				
Sex (male)	+	**6.0**	8.0	.017					+	**16.7**	18.7	<.001
Age	–	**6.9**	8.9	.011								
Years lived in AZ	+	**6.3**	8.3	.015								
Score test	$\chi^2 = 196.8$, $df = 6$, $p < .0001$				$\chi^2 = 71.8$, $df = 4$, $p < .0001$				$\chi^2 = 177.7$, $df = 4$, $p < .0001$			
R^2_L	.480				0.378				0.404			
Area under ROC curve	.874				0.920				0.837			
Hosmer-Lemeshow test	$\chi^2 = 14.02$, $df = 8$, $p = .081$				$\chi^2 = 3.93$, $df = 8$, $p = .862$				$\chi^2 = 8.35$, $df = 8$, $p = .400$			
n	590				620				592			

Table 3

Parameters for the best logistic regression models explaining support for prospective puma-related policies in terms of nature-views, experiences, and demography for respondents living in forested regions of northern Arizona during 2003. Bolded values of ΔAIC_c are >4, which indicates an effect substantial enough to warrant consideration (Burnham & Anderson, 2002)

	Modeled response															
	Limit hunting of female pumas				Prohibit hunting of juvenile pumas				Translocate problem pumas				Limit development in puma habitat			
Variables and model statistics	β sign	Δ AIC_c	Δ -2lnL	*w*	β sign	Δ AIC_c	Δ -2lnL	*w*	β sign	Δ AIC_c	Δ -2lnL	*w*	β sign	Δ AIC_c	Δ -2lnL	*W*
(Best model)		0	0	.796		0	0	.757		0	0	.613		0	0	.584
Utiltarian/ Dominionistic	–	**37.5**	39.5	<.001	–	**68.9**	70.9	<.001					–	**29.9**	31.9	<.001
Scientific/Ecologistic	+	**4.9**	6.9	.070									+	2.7	4.7	.154
Humanistic/Moralistic					+	**22.4**	24.4	<.001	+	**19.8**	21.8	<.001	+	**7.0**	9.0	.017
Belief: pumas play important role in nature									+	**13.8**	17.8	<.001				
Belief: Important to know pumas exist													+	3.5	5.5	.103
Encountered a puma (yes)					–	**5.9**	7.9	.040								
Knowledge of pumas									–	2.1	4.1	.218				
Level of worry about pumas									+	3.9	5.9	.089	+	2.8	4.8	.141
Sex (male)	–	**8.0**	10.0	.015												
Age									+	**4.1**	6.1	.008				

Years lived in AZ	– 3.8 5.8 .119	– 2.6 4.6 .202		
Score test	$\chi^2 = 99.6$, $df = 4$, $p < .0001$	$\chi^2 = 157.7$, $df = 4$, $p < .0001$	$\chi^2 = 70.2$, $df = 6$, $p < .0001$	$\chi^2 = 123.2$, $df = 5$, $p < .0001$
R^2_L	0.333	0.469	0.189	0.336
Area under ROC curve	0.824	0.868	0.770	0.803
Hosmer-Lemeshow test	$\chi^2 = 21.93$, $df = 8$, $p = .005$	$\chi^2 = 24.95$, $df = 8$, $p = .002$	$\chi^2 = 7.72$, $df = 8$, $p = .461$	$\chi^2 = 4.47$, $df = 8$, $p = .812$
N	480	482	543	494

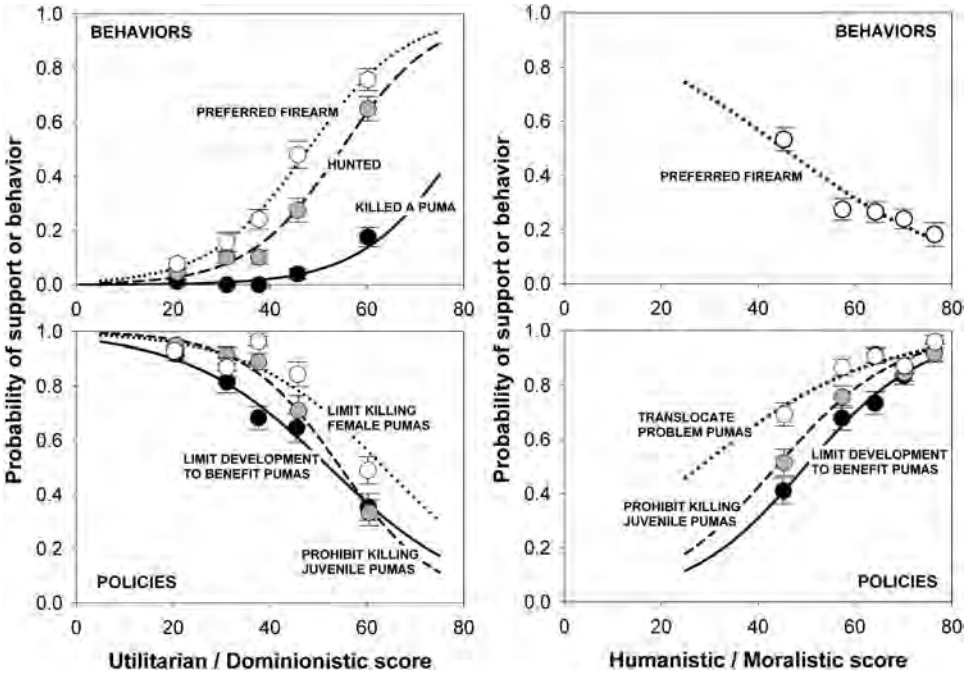

Figure 2. Univariate relations between probability of puma-related behaviors or support for puma-related policies and Utilitarian/Dominionistic and Humanistic/Moralistic nature-view scores for 480–620 respondents (depending on the relationship and corresponding number of missing responses) to a self-administered questionnaire mailed to residents of forested regions in northern Arizona. Dots and bracketing bars denote means and standard errors for quintiles of the data.

supportive of limits on hunting adult female pumas. Age also had a negative effect on having hunted and a positive effect on support for translocating problem pumas. These demographic effects were evident even after controlling for nature-views and life experiences.

Relations Between Nature-View and Demographic Variables

Models relating nature-views to demographics had little probability of occurring by chance alone ($p < .0001$ in all instances), but explained relatively little variation ($R^2 = .050$ to .161; Table 4). Gender had the strongest effect of any demographic variable in all three models: compared to females, males tended to have higher U/D scores and lower H/M and S/E scores. Age also had substantial effects in all three models and was negatively related to all three nature-view scores. Like males, respondents who had lived longer in northern Arizona tended to have lower H/M (and S/E) scores and higher U/D scores. Urban residents and better educated respondents tended to have lower U/D scores and higher S/E scores, whereas urban residents had a tendency toward higher H/M scores.

Discussion

Our goal was to explain puma-related behaviors and behavioral intentions (including support for prospective policies) among those likely to comprise the public attentive to and

Table 4
Parameters for best models explaining nature-views in terms of demography for respondents living in forested regions of northern Arizona during 2003. Bolded values of ΔAIC_c are >4, which indicates an effect substantial enough to warrant consideration (Burnham & Anderson, 2002)

	Modeled response											
	Utilitarian/Dominionistic				Humanistic/Moralistic				Scientific/Ecologistic			
Variables and model statistics	β sign	Δ AIC_c	Δ MSE	w	β sign	Δ AIC_c	Δ MSE	w	β sign	Δ AIC_c	Δ MSE	W
(Best model)		0	0	.999		0	0	.548		0	0	.538
Sex (male)	+	**30.0**	9.25	<.001	–	**18.3**	3.82	<.001	–	**7.3**	1.59	.014
Age	–	**22.6**	7.00	<.001	–	**4.0**	0.98	.073	–	**4.7**	1.09	.051
Years lived in AZ	+	**7.6**	7.65	<.001	–	**9.9**	2.14	.004	–	2.9	0.74	.127
Residence (urban)	–	**14.8**	4.66	<.001	+	0.8	0.34	.375	+	2.8	0.73	.130
Level of education	–	**15.4**	5.14	<.001					+	**6.1**	1.55	.025
Occupation										3.1	1.54	.115
F-test	$F = 19.12$, $df = 6/597$, $p < .0001$				$F = 7.76$, $df = 4/586$, $p < .0001$				$F = 7.83$, df = 11/581, $p < .0001$			
R^2	.161				.050				.129			
Root MSE	13.25				10.74				10.64			
n	604				591				593			

engaged in puma management. We considered explanation of this type to be particularly useful for understanding policy-related dynamics, including sources of conflict and bases for common ground. Our focus was unlike that of many natural resources-related surveys that have aspired to make inferences to the universal "public" within a specific study area. Unlike survey studies, our basis for inference was the conceptual and statistical adequacy of explanatory models rather than a random sample of the survey population. Independence was conditional in our study on the extent to which model-based vectors of coefficients delineated multiple populations (i.e., specific combinations of nature-views, life experiences, and demographics) within which observations could be considered independent (Dawid, 1979; Kyburg, 1969). Given these considerations, our basis for inference was comparatively strong for all responses except those regarding support for translocating problem pumas.

Our results clearly demonstrated the superiority of nature-views and life experiences over demographics alone for explaining puma-related behaviors and behavioral intentions among our respondents. Compared to models based on nature-views and life experiences, those based on demographics had virtually no support from the data, although most models based on nature-views and life experiences were improved by adding something about demography. The explanatory superiority of nature-views is consistent with Wesley Salmon's thesis of statistical explanation (Salmon, Jeffrey, & Greene, 1971). All explanatory variables can be considered surrogates for processes conceptually nearer in the causal chain to the phenomenon of interest. Variables representing processes that are causally proximal are likely to produce models with superior statistical performance compared to processes that are causally distal, which was the case for nature-views compared to demographics. On the other hand, proximal processes such as nature-views are often harder to measure and monitor compared to distal processes such as gender, age, and place of residence. This trade-off motivated us to include demographic measures in our questionnaire and in our explanations of nature-views. Even so, the small amount of variation in nature-views explained by demographics was instructive. Whatever the demographic trends and whatever the associations of demography with attitudes in an area such as northern Arizona, our results suggest that assumptions about nature-views or life experiences from demographics should be made only cautiously.

Perhaps our strongest and most striking result was the centrality of Utilitarian/Dominionistic (U/D) nature-view scores to explaining behaviors and support for prospective policies in six of seven models. U/D scores consistently performed better than our hunting variable in all of the models explaining support for policies. Respondents with higher U/D scores were much more likely to have hunted, killed a puma, and preferred a firearm for defense from pumas, and much less likely to support limiting killing of female pumas, prohibiting killing of juveniles, and limiting human development for the benefit of pumas. Outcomes in all of these models approached near certainty ($p = 0$ or 1, depending on the nature of the relationship) at high U/D scores.

This dominance of the U/D nature-view in our explanation for almost all of the behaviors and behavioral intentions featured in our study led us to reflect on the broader context and implications of this particular nature-view. Our results suggest that preferences for lethal practices and policies are rooted in the extent to which individuals adhere to the U/D view of relations between humans and pumas. The U/D nature-view was unambiguously and consistently identified with behaviors and policies that featured killing or, more to the point of our results, in opposition to policies or practices that would limit killing. At some level, this theme is not surprising given that domination is expressly identified by hunters with the act of killing prey (Floyd, 1997), which is consistent with a nature-view

holding that proper relations between humans and nature should be one of domination (Kellert, 1996).

Although hunting was strongly identified with the U/D nature-view, this view did not translate into support for protecting habitat to benefit pumas. This pattern is at variance with common claims that hunters are broadly supportive of protecting habitat to benefit wildlife (e.g., Reiger, 2001). Our results suggest that hunters who strongly adhered to the U/D nature-view made a distinction between pumas and other wildlife. The large majority of big game hunters in the western U.S. hunt ungulates, especially deer and elk (*Cervus elaphus*; e.g., Arizona Game & Fish Department, 2010), which are also the principal prey of pumas (Murphy & Ruth, 2010). We hypothesize that those who strongly adhere to the U/D nature-view are inclined to see pumas as competitors for ungulate hunting opportunities rather than as creatures of intrinsic value, which is consistent with the instrumental tenets of the U/D nature-view (Kellert, 1996). This hypothesis is testable, but requires data that we did not collect.

We were intrigued by the strong positive relationship between gender and the U/D nature-view, as well as the effect of gender, as such, in three of our seven best models. Bjerke et al. (1998a) and Kellert and Berry (1987) also documented more pronounced U/D nature-views among men, which is consistent with a large body of research showing strong effects of gender on environmental perspectives (e.g., Czech, Devers, & Krausman, 2001; Zinn & Pierce, 2002). Accounting for nature-views, males also more often had hunted, preferred to carry a firearm for defense, and opposed limiting the killing of female pumas. The first two effects had an explicit link to firearms. The third effect pertained explicitly to the treatment of females. These results are consistent with other research that has shown an affinity among males for weapons and that males tend to be more aggressive and domineering than females (Bettencourt & Miller, 1996; Ellison, 1991), apparently as effects of both testosterone (Bock, Starzyk, & Qunsey, 2001) and culture (Bankston, Thompson, Jenkins, & Forsyth, 1990). Again, accounting for nature-views, we hypothesize that females tended to more often support limiting the killing of female pumas because of an affinity for animals—especially mammals—of the same gender.

The U/D nature-view was also positively associated with living in rural areas and having less education. Given recent demographic trends in the western United States, this profile could be considered an historical legacy. The western United States has become more urbanized and better educated (Manfredo et al., 2003). Hunters, who tend to hold the most pronounced U/D nature-views, have also proportionately declined during recent decades (U.S. Fish & Wildlife Service & U.S. Bureau of the Census, 2008). Because the U/D nature-view is so strongly related to support for lethal practices, which are the norm of current puma management (Anderson & Lindzey, 2010), we predict that public acceptance of these practices will diminish, as has apparently occurred in states such as California and Utah (Teel et al., 2002; Wolch et al., 1997). If so, this trend could undercut support for state wildlife management bureaus. On the other hand, the salience of puma management is apparently strongly contingent on levels of outdoor activity. If urban-dwelling, better educated, and non-hunting residents are not engaged with wildlife and the outdoors, then broader demographic trends may have little effect on puma management other than through declining sales of hunting licenses.

Knowledge of pumas had little or no effect on support for policies, although hunters tended to be more knowledgeable. Similarly, the Scientific/Ecologistic (S/E) nature-view, although positively related to greater education, provided little or no explanation for behaviors or support of policies. These results suggest that knowledge about pumas and puma ecology did not substantially affect behaviors or perspectives among our respondents.

Taking this result further, we hypothesize that educating people about pumas would not have much effect on how they choose to behave when around pumas or the kinds of puma management they would support. Hunters' greater knowledge of pumas is consistent with previous research showing that hunters tend to be among those who are most interested in natural history, and is also consistent with hunters learning from their outdoors experiences and from reading hunting-related literature (Kellert, 1996).

As a final point regarding nature-views, the Negativistic score did not contribute to explaining any behaviors or behavioral intentions. However, level of worry about pumas plausibly served as a weak surrogate for Negativistic perspectives. We had expected that worry or Negativistic leanings would manifest as opposition to non-lethal practices and policies. They did not. Instead, worry was positively (although weakly) associated with an interest in policies that would keep pumas and people separate (i.e., translocating rather than killing problem pumas, and limiting human development in puma habitat). Apparently, those who were fearful of pumas were not necessarily hostile toward pumas, nor did they desire to kill them. That said, we did not note whether respondents were parents of dependent children, which could have been an additional variable mediating and potentially complicating an explanation of relations between worry, Negativistic views, and perspectives of pumas (Zinn & Pierce, 2002).

Our results support several provisional conclusions. Foremost, our results suggest that nature-views are superior to demographics in statistically (and otherwise) explaining behaviors and behavioral intentions among people holding pronounced views on puma-related management. Of the nature-views, the U/D view seems to be a primary determinant of how people orient to puma-related behaviors and policies. The strength of this nature-view largely determines how people perceive lethal practices and policies. Behaviors and support for policies have some direct relation to life experiences, but none that are definitive, at least for our population of respondents. Overall, the small or undetectable effect of knowledge and the S/E view (which reflects level of education) does not suggest a large role for education is changing peoples' practices or perspectives. Finally, worry about the physical threat posed by pumas does not seem to play a major role in shaping either peoples' behaviors or support for puma-related policies.

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