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# Paying for Tolerance: Rural Citizens' Attitudes toward Wolf Depredation and Compensation

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**Abstract:** *As wolf (Canis lupus) populations recover in Wisconsin (U.S.A.), their depredations on livestock, pets, and hunting dogs have increased. We used a mail-back survey to assess the tolerance of 535 rural citizens of wolves and their preferences regarding the management of "problem" wolves. Specifically, we tested whether people who had lost domestic animals to wolves or other predators were less tolerant of wolves than neighboring residents who had not and whether compensation payments improved tolerance of wolves. We assessed tolerance via proxy measures related to an individual's preferred wolf population size for Wisconsin and the likelihood she or he would shoot a wolf. We also measured individuals' approval of lethal control and other wolf-management tactics under five conflict scenarios. Multivariate analysis revealed that the strongest predictor of tolerance was social group. Bear (Ursus americanus) hunters were concerned about losing valuable bounds to wolves and were more likely to approve of lethal control and reducing the wolf population than were livestock producers, who were more concerned than general residents. To a lesser degree, education level, experience of loss, and gender were also significant. Livestock producers and bear hunters who had been compensated for their losses to wolves were not more tolerant than their counterparts who alleged a loss but received no compensation. Yet all respondents approved of compensation payments as a management strategy. Our results indicate that deep-rooted social identity and occupation are more powerful predictors of tolerance of wolves than individual encounters with these large carnivores.*

El Impacto de la Depredación y de los Pagos Compensatorios en las Actitudes de Ciudadanos hacia Lobos

**Resumen:** *A medida que las poblaciones de lobo (Canis lupus) se recuperan en Wisconsin (E. U. A.), ha aumentado su depredación sobre ganado, mascotas y perros de caza. Utilizamos una encuesta por correo para evaluar la tolerancia de 535 ciudadanos hacia los lobos y sus preferencias en relación a la gestión de "lobos problema." Específicamente, probamos si la gente que había perdido animales domésticos a raíz de lobos u otros depredadores era menos tolerante a los lobos que los residentes que no habían perdido animales domésticos y si los pagos compensatorios mejoraron la tolerancia hacia los lobos. Evaluamos la tolerancia usando medidas relacionadas con el tamaño poblacional de lobos preferida para Wisconsin y la probabilidad de que un individuo disparase contra un lobo. También medimos la aprobación de individuos del uso de control letal y otras tácticas de manejo de lobos bajo cinco escenarios de conflicto. El análisis multivariado reveló que el predictor más robusto de tolerancia fue el grupo social. Los cazadores de osos (Ursus americanus) estuvieron más preocupados por la pérdida de perros valiosos por lobos y tendieron a aprobar el control letal y la reducción de la población de lobos en mayor proporción que los productores de ganado, que mostraron más preocupación que los residentes en general. En menor grado, el nivel de educación, la experiencia de pérdida y el género también fueron significativos. Los productores de ganado y cazadores de osos que habían sido compensados por sus pérdidas no fueron más tolerantes que sus contrapartes que adujeron pérdidas pero no recibieron compensación. No obstante, todos los respondientes aprobaron los pagos compensatorios*

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como una estrategia de manejo. Nuestros resultados indican que la identidad social de raíces profundas y la ocupación son predictores más robustos de la tolerancia a lobos que los encuentros individuales con estos carnívoros mayores.

## Introduction

In the wake of the U.S. Endangered Species Act and other legal protections, wolves (*Canis lupus*) and other large carnivores are recovering in many areas of North America and Europe (Mech 1995; Linnell et al. 2001). As their populations expand or humans encroach on their habitats, carnivores more frequently encounter and prey on domestic animals. Such encounters are costly and can undermine carnivore recovery programs (Thompson 1993; Bangs et al. 1998; Mech 1998; Parsons 1998). When faced with an irate public, wildlife managers typically resort to removing problem carnivores and compensating people for losses.

Compensation programs offer a means to redress the inequitable distribution of costs and benefits associated with restoring large-carnivore populations. Most U.S. citizens support carnivore conservation, and many enjoy the environmental, aesthetic, and economic benefits of restoring wolves, grizzly bears (*Ursus arctos*), and mountain lions (*Puma concolor*) (Williams et al. 2002). However, the direct costs of conserving these animals fall on a minority of individuals in rural areas who lose livestock or pets to carnivores. Wildlife managers hope that direct compensation payments will improve these individuals' tolerance for carnivores and dissuade them from killing carnivores in retaliation. For these purposes, the merits of compensation are less certain. Compensation programs are routinely criticized for being inadequate, fraudulent, or cumbersome (Saberwal et al. 1994; Kaczensky 1999; Treves et al. 2002; Montag 2003). Others worry that compensation payments remove incentives for ranchers and farmers to change their animal husbandry practices so as to lower their risk. Missing from the debate are data on the impact of compensation payments on peoples' attitudes and behavior. Does losing a calf increase the hostility of a rancher toward wolves? If ranchers are compensated, will they be more likely to tolerate wolves on their land? More broadly, we lack an understanding of how individual experience and economic self-interest shape tolerance for carnivores and approval for management and conservation.

We used a public survey to evaluate how direct encounters with wolves, including attacks on livestock, hunting dogs, and pets, shape individual attitudes toward wolf recovery in the state of Wisconsin (U.S.A.). We then tested whether compensation payments improved rural citizens' tolerance for wolves. We also evaluated the influence of standard predictors of support for wolves, such

as education level, affluence, and occupation, alongside the impact of direct encounters with wolves. In this way, we illuminate the relative importance of individual experience and economic self-interest versus social identity in forming attitudes toward wolves. We used the same survey instrument to present respondents with hypothetical scenarios describing encounters of humans or domestic animals with wolves and to assess respondents' approval of four management tactics that could potentially resolve the conflict. We present these data to guide the management of "problem" wolves (cf. Manfredo et al. 1998).

## Previous Research on Public Attitudes toward Wolves and Wolf Recovery

Wolves stir people's emotions and attract public attention far out of proportion to their numbers (Bangs et al. 1998; Linnell et al. 2001). Correspondingly, there is a sizeable body of research documenting public attitudes toward wolves (for a review of 38 surveys, see Williams et al. 2002). Evidently, support for wolves is strongest among young to middle-aged, college-educated, affluent urban residents, and among women (Kaltenborn et al. 1999; Williams et al. 2002; but regarding rural support for wolves see Forbes et al. 1998). Hunters also generally support wolf conservation (Kellert 1985). In all studies, the most hostile attitudes toward wolves were found among farmers and ranchers living near wolf populations or proposed reintroduction sites (Kellert 1985; Bright & Manfredo 1996; Bjerke et al. 1998a; Montag & Patterson 2001). Some authors predict that as wolf numbers increase, support will decline as more people directly experience the costs of living with wolves (Williams et al. 2002). Two studies have documented a decline in local support for large carnivores over time (Duda et al. in Montag & Patterson 2001). However, both studies examined only attitudes toward proposed reintroductions and suggested that negative publicity about the hypothetical costs of carnivores increased opposition. The impact of direct experience with wolf depredation on individual attitudes has seldom been examined.

Political values also shape people's attitudes toward wolves. To many rural citizens, wolves are symbols of unwelcome federal intervention. Nie (2001) explains that struggles over wolf conservation in the western United States may play a surrogate role for broader conflicts over

land use and the future of rural places. For example, many citizens living near Yellowstone view wolf restoration as a ploy for more intrusive federal regulation in land management and a threat to private property rights (Wilson 1997; Nie 2001). The fact that wolves were deliberately reintroduced to Yellowstone by a federal agency (U.S. Fish and Wildlife Service) heightens local resentment (Nie 2001). Similar conflict emerged over the reintroduction of the endangered Mexican wolf (*Canis lupus baileyi*) to the American southwest (Montag & Patterson 2001). In both cases, opposition centered on the unfair economic hardship that would be incurred by local ranchers who lost animals to wolves. Compensation payments at these sites seem not to have mollified opponents, some of whom viewed such payments as a clever public relations ploy that does not truly offset the cost of living with carnivores (Nie 2001). Other observers counter that compensation programs are politically popular and essential for building public acceptance of wolves (Van Tassell et al. 1999).

The "quiet" recovery of wolves in Wisconsin offers an opportunity to test how direct encounters with wolves (e.g., depredation) and specific management strategies (e.g., compensation payments) shape individual attitudes (Manfredo et al. 1998; Nie 2001). Federal land is scarce in Wisconsin, and wolves recovered naturally without reintroduction amid livestock producers and hunters (Wydeven et al. 1995). These conditions shift the controversy over wolf management away from struggles over federal control and clarify how the direct costs of conservation shape individual tolerance for carnivores and the management of wildlife generally.

## Methods

### Study Site

Following extirpation in the late 1950s, wolves recolonized Wisconsin from Minnesota, and in 2002 there were 323 adults and yearlings spread across 21 northern counties (Wydeven et al. 1995; Wydeven et al. 2002). The majority of state residents support wolf conservation in Wisconsin (Wisconsin Department of Natural Resources 1999). But as wolves have spread, their attacks on domestic animals have increased (Treves et al. 2002). Since 1982, the Wisconsin Department of Natural Resources (WDNR) has paid for damage caused by any animal listed as endangered or threatened in the state. Drawing on funds from the state Endangered Resources Fund (created from individual voluntary contributions on tax returns) and the sale of special wolf license plates, the WDNR has compensated livestock producers and game farmers and has paid bear hunters if wolves harm their hounds while on public land (Treves et al. 2002). Compensation depends on field investigations by U.S. Depart-

ment of Agriculture Wildlife Services to verify that wolves were involved in the loss. Between 1976 and 2002, the WDNR offered compensation for 121 verified incidents, 42% for attacks on livestock (cattle, sheep, horses), 4% for attacks on farm deer, and 48% for attacks on pet dogs or hunting hounds (Treves et al. 2002; WDNR, unpublished data).

The value of the compensation payment was set by the projected fall market price of the animal (e.g., \$602/calf in 2002) even if the animal was killed in the spring. There was no cap on the amount paid to an individual citizen, but there were general limits per animal. Compensation for a hunting hound was generally capped at \$2500, whereas commercial game were valued according to their market value as trophy animals (as high as \$4000–5000 each) or meat (\$200 for venison), depending on the type of operation. More than \$263,085 was paid between 1984 and 2002 (plus \$22,700 offered to but refused by one operation). The highest single payment of \$48,000 was paid for commercial deer killed by wolves. Compensation payment times averaged 80 days from the first report of depredation (Treves et al. 2002), a period comparable to those of other U.S. programs (Montag & Patterson 2001).

Depredation complaints and compensation payments have increased over time, along with increases in wolf numbers (Treves et al. 2002). A law enacted in 2000 stipulates that the WDNR would continue to pay for damages even after wolves are removed from the list of threatened species. To date there has been no systematic evaluation of the Wisconsin compensation program, despite public controversy over who should receive payment.

### Sample Design and Survey Administration

In October 2001, we sent a mail-back questionnaire to 658 individuals belonging to four groups: (1) landowner complainants, individuals who had registered complaints with the state authorities of wolf depredation on livestock ( $n = 83$ ), commercial game ( $n = 3$ ), or both pets and livestock ( $n = 2$ ) on their private property; (2) randomly sampled landowners, a random sample of individuals living in the same counties as those in group 1 ( $n = 399$ ); (3) bear hunter complainants, bear hunters who had registered complaints of wolf depredation on hounds while hunting on public land ( $n = 50$ ); and (4) randomly sampled members of the WI Bear Hunters' Association ( $n = 124$ ), individuals from this nonprofit group with 2895 registered members in 2001 (B. Kohn, WDNR, personal communication). We selected members of the WI Bear Hunters' Association because they were at greater risk of suffering a loss to wolves as a result of their hunting tactics. Compared with the general population of bear hunters in Wisconsin (78% use bait to hunt bears; Dhuey et al. 1999), the majority of Wisconsin Bear Hunters'

Association members use hounds (90.1% of our respondents used hounds).

We included a \$2 incentive with the survey and a cover letter in which we guaranteed respondents' anonymity and provided evidence that our study had been approved by the Wisconsin Bear Hunters' Association, the Wisconsin Cattleman's Association, and the WDNR. Two weeks later we sent a reminder postcard to the nonrespondents, and 1 month later we sent a second survey and cover letter to all remaining nonrespondents. We made personal phone calls to nonrespondents among the complainant groups to increase response rates in these small and particularly important groups. Our total response rate was 81.6% and was highest among bear hunter complainants and random members of the Wisconsin Bear Hunters' Association (Table 1).

After data tabulation, we singled out livestock producers (reported that livestock is now or once was a major source of income) and bear hunters (reported hunting bears in the past 2 years) within our random sample of landowners. Recognizing that these individuals likely face an elevated risk of losing animals to wolves, we reclassified our respondents into four cohorts: (1) livestock producers ( $n = 112$ , including 55 from the WDNR's list of complainants, 54 from the random sample of rural residents, and 3 anonymous respondents); (2) bear hunters ( $n = 124$ , including 32 from the DNR list of complainants, 64 from the random sample of the Wisconsin Bear Hunters' Association, 24 from the random sample of landowners, and 4 anonymous respondents); (3) both bear hunters and livestock producers ( $n = 74$ , including 36 from the Wisconsin Bear Hunters' Association, 15 from the WDNR list of bear hunter complainants, 11 from the WDNR list of landowner complainants, 10 from the random residents, and one anonymous respondent); and (4) general residents ( $n = 224$  from the random sample who were neither livestock producers nor bear hunters). Finally, 5 respondents from the randomly sampled population left out critical information, which barred their assignment to a cohort. These were discarded whenever a cohort effect was examined.

**Table 1. Response rates for a public survey on wolf management in Wisconsin.**

Group	Surveys mailed	Surveys received	Response rate (%)
Landowner complainants	86	67	77.9
Random landowners	399	312	78.2
Bear hunter complainants	49	48	98.0
Random members of WBHA <sup>a</sup>	122	535	81.6
Anonymous <sup>b</sup>	—	7	—
Total	656	535	81.6

<sup>a</sup>Wisconsin Bear Hunter's Association.

<sup>b</sup>Surveys were discarded from analyses comparing groups because these individuals elided survey identification numbers, thereby concealing the group to which they belonged.

Forty-four individuals in our random samples alleged a loss to wolves or other predators but had not registered a formal complaint. When testing the impact of depredation on attitudes, we categorized these individuals as having suffered a loss, even though they did not appear on the WDNR's list of official complainants.

### Survey Instrument

In addition to requesting socioeconomic information (sex, age, years of formal education, income, landholding size, number of livestock), we asked respondents to report on their individual encounters with wolves and other wild predators, including depredation events. We also included questions about individual experiences with wildlife management agencies and compensation payments. The survey text included the following passage:

According to the DNR, Wisconsin's wolf population has grown from 25 animals in 1980 to approximately 250 wolves in 2001. Throughout these years wolves were strictly protected as an endangered species. We would like your opinion on various possible strategies for managing wolves in the future.

Public citizens' estimates of wolf populations often vary widely, and this can shape attitudes about management (Bjerke et al. 1998a). By reporting the official wolf count for Wisconsin, we provided a common reference point, although several respondents wrote us notes indicating that they did not agree with the WDNR estimates. The wolf count for Wisconsin has special political significance because it determines when wolves will be downlisted from endangered to threatened. Federal reclassification of wolves to threatened status occurred in 2003 (U.S. Fish & Wildlife Service 2003). Agents from the U.S. Department of Agriculture Wildlife Services may now kill wolves around verified depredation sites (WDNR 2002). But during our study, wolves were classified as endangered and could be captured and translocated only if they attacked domestic animals two or more times on private property.

In the survey, we included four questions as proxy measures for tolerance. (1) Preferences for wolf population size in Wisconsin: "In your opinion, the population of wolves in Wisconsin should be (a) eliminated, (b) reduced, (c) maintained at its current level, or (d) increased" (Bjerke et al. 1998a; Jonker et al. 1998; Kaltenborn et al. 1999). (2) "The wolf population in Wisconsin should be kept below (a) 100 individuals, (b) 250 individuals, (c) 350 individuals, (d) 500 individuals, or (e) no cap should be placed on the number of wolves living in Wisconsin" (these are the target numbers that have been discussed in public meetings; WDNR, unpublished data). Reported propensity to shoot a wolf: (3) "I would shoot a wolf if it threatened my pets. (a) strongly agree, (b) agree, (c) neutral, (d) disagree, or (e) strongly

disagree" (Kellert 1985). (4) "If I were hunting a deer and saw a wolf, I might shoot it. (a) strongly agree, (b) agree, (c) neutral, (d) disagree, or (e) strongly disagree" (Kellert 1985).

In addition to these four measures of tolerance, we also investigated respondents' preferred management strategies for dealing with "problem" wolves in five human-wolf conflict scenarios (as per Manfredo et al. 1998). For each scenario, respondents selected one of the following management strategies as most appropriate: take no immediate action but monitor the situation; capture and relocate the wolf; frighten the wolf away or deter it; or destroy the wolf. The five scenarios were as follows: (1) if a wolf is sighted in a rural area, (2) if a wolf kills livestock, (3) if a wolf kills a family pet, (4) if a wolf kills a hunting dog on public land, (5) if a wolf approaches a human.

### Data Analysis

We ran a series of univariate analyses ( $\chi^2$  and Mann-Whitney *U* tests) to identify associations between our hypothesized predictors—experience with wolves and compensation—and our measures of tolerance for wolves and approval of tactics for managing problem wolves. Because results for our first two questions about preferred wolf population size were identical, we report results only for the first question (Table 2). Similarly, because so few individuals favored frightening wolves as a strategy for dealing with problem wolves (range 4–10% for the five scenarios), we analyzed data for only three of the four tactics: (1) monitor wolf, (2) capture and relocate wolf, and (3) destroy wolf. Specifically, we matched experience with depredation against how many times an individual indicated "destroy wolf" as the preferred management intervention when he or she was presented with the five conflict scenarios.

To test whether certain individuals were more likely to file an official complaint of depredation, we compared the socioeconomic attributes of those individuals who registered an official complaint to those of individuals who alleged a loss but never contacted a state or federal agent. We also partitioned our sample to examine the effect of compensation. For this test, we examined attitudes only among those reporting a loss and compared attitudes among those who were compensated and those who were not (either because they made no official claim or because there was inadequate evidence).

Finally, we ran multivariate analyses incorporating the following predictors of the response variables described above: losses (no loss, alleged loss to a wolf, or alleged loss to other predator), cohort (general rural resident, livestock producer, bear hunter, or both livestock producer and bear hunter), age (years), sex, education (number of years of formal education), landholding (number of

**Table 2. Public tolerance for wolves in northern Wisconsin based on four survey questions.**

Survey questions and responses	Responses (%)*			
	bear hunters	livestock producers	general residents	all (%)
In your opinion, the population of wolves in Wisconsin should be				
eliminated	31.5	12.5	6.3	16.4
reduced	47.8	30.8	20.5	32.2
maintained at current level	16.3	43.3	50.4	37.0
increased	4.5	13.5	22.8	14.4
The wolf population in Wisconsin should be kept below				
100 individuals	71.7	36.7	27.7	45.0
250 individuals	15.6	35.7	28.2	25.3
350 individuals	4.0	6.1	8.6	6.5
500 individuals	2.9	7.1	7.3	5.7
no cap	5.8	14.3	28.2	17.5
I would shoot a wolf if it threatened my pets				
strongly agree	42.3	23.0	16.0	26.6
agree	26.9	30.0	38.2	32.6
neutral	17.7	18.0	23.6	20.4
disagree	10.3	25.0	15.1	15.4
strongly disagree	2.9	4.0	7.1	5.0
If I were hunting a deer and saw a wolf, I might shoot it				
strongly agree	8.1	3.1	4.4	5.4
agree	5.8	2.0	8.4	6.3
neutral	32.0	21.4	13.7	21.6
disagree	31.4	44.9	38.9	37.5
strongly disagree	22.7	28.6	34.5	29.2

\*Respondents who were both bear hunters and livestock producers were grouped with the bear hunters (resulting in a sample size of 198) because they conformed to this group in all measures of tolerance but differed significantly from livestock producers (107) in all measures of tolerance. General residents (224) were neither bear hunters nor livestock producers.

acres), and income (total family annual pretax income). Because our predictors were a mix of nominal, ordinal, and continuous variables, we used an analysis of covariance (ANCOVA). Each response variable was tested in two steps. First, all predictors were included plus the interaction of cohort and losses. Those predictors with  $F < 1.0$  were discarded, and significance was reported for the remaining predictors. This procedure preserved degrees of freedom and power of the test. As a result, sample sizes varied across the response variables, depending on which predictors survived and how many respondents answered each question. We treated our ordinal response variables as if they were continuous. We tested for departures from constant variance and found none (Manfredo et al. 1998).

### Weighting for Gender

All four sample groups were heavily weighted toward male respondents: 79% of landowner complainants, 85% of bear hunter complainants, 77% of random residents, and 92% of random members of the Wisconsin Bear Hunters' Association. We weighted responses to correct

for sex-based response bias in the random sample of rural residents and the random sample of the Wisconsin Bear Hunters' Association (Manfredo et al. 1998). It was not necessary to weight the complainant samples because we sampled the entire population (DNR list of complainants) and because both male and female members of a household often reported complaints.

For the random sample of rural residents, we used data from the 2000 census of the U.S. Census Bureau to determine the sex ratio of the population. The average of the 13 sample counties was 50.1% female. The ratio of our sample to this population required a weighting value of 2.131 for female respondents and 0.653 for male respondents. For the Wisconsin Bear Hunters' Association sample, we used the numbers of men and women randomly selected from the membership list to determine our expected sex ratio (86.4% male, 13.6% female). From this ratio we derived a weighting value of 1.679 for women and 0.940 for men. We used these weights for our univariate analyses only. For multivariate tests, we included gender as a possible predictor to account for potential bias.

## Results

### Respondent Characteristics

Survey respondents were mostly male (81%), with an average age of 52 years (range 17–90, SD 14.5 years). The median household income was \$48,000–56,000. Half the respondents had at least some college education (29% some college, 14% B.A. or equivalent, 8% M.A. or advanced degree), and 42% were high school graduates (8% did not graduate from high school). Most respondents came from a rural background: 32% grew up in communities with <500 residents and 25% grew up in communities with 500–2000 residents. Most respondents continued to live in small towns: 34% in communities with <500 residents and 31% in communities with 500–2000 residents.

The majority of respondents were small landowners: 36% held <4 ha, 25% held 4–20 ha, 25% held 20–81 ha, and only 14% held >81 ha. A majority of the respondents were hunters: 73% had hunted in the past 2 years, and 11% had hunted previously. The random sample of rural residents alone contained 76% hunters.

Most of the respondents reported direct experience with wolves, including seeing or hearing a wolf in the wild (85%), seeing or hearing a wolf on their own land (45%), or having a domestic animal injured or killed by a wolf (20%). Ten percent reported losing a domestic animal to another predator (bear, mountain lion, coyote [*Canis latrans*], dog [*C. familiaris*], fisher [*Martes pennanti*], wolf-dog hybrid).

Not all individuals were equally likely to register a formal complaint about a loss. Among respondents who reported a depredation event on the survey, those with

more land, more cattle, and higher formal education were more likely to have registered an official complaint than other respondents (107 official complainants vs. 50 that did not officially complain, Mann-Whitney  $U$ , landholding size:  $Z = 2.71$ ,  $p = 0.0066$ ; number of cattle:  $Z = 3.12$ ,  $p = 0.0018$ ; years of education:  $Z = 2.36$ ,  $p = 0.018$ ).

### Tolerance for Wolves

We found moderate support for wolf recovery in Wisconsin. Only 17.4% of respondents indicated they wanted wolves to be eliminated ( $n = 535$  responses), whereas 33.1% wanted the wolf population reduced, 36.5% wanted it maintained, and 13.0% wanted it expanded. Most respondents (85%) wanted a cap placed on the state's wolf population.

Individuals reporting a loss to a wolf or other predator were more likely to favor reducing or eliminating Wisconsin's wolf population (favored by 80% of those losing to wolves, 62% of those losing to predators other than wolves, and 38% of those reporting no loss;  $\chi^2 = 60.4$ ,  $p < 0.0001$ ). People who reported losing an animal to a wolf or other predator were more likely to agree that they would shoot a wolf if it threatened their pet (Mann-Whitney  $U$ ,  $Z = 3.53$ ,  $p = 0.0009$ ) or that they might shoot a wolf they encountered while they were hunting deer ( $Z = 3.77$ ,  $p = 0.0002$ ). We found no significant difference in tolerance measures between individuals who had lost an animal to a wolf versus those with a loss attributable to another wild predator.

People who had been compensated were more likely to vote for reducing the wolf population than those who had not been compensated ( $Z = -2.58$ ,  $p = 0.01$ ) (this latter group included people who filed an official complaint but were not compensated and those who reported a loss on our survey but did not ever officially file a complaint). Similarly, those who had received compensation replied that they might shoot a wolf they encountered while hunting deer slightly more often than those who were not compensated ( $n = 57$  compensated,  $n = 46$  not compensated,  $Z = 1.85$ ,  $p = 0.065$ ). This difference was significant only for bear hunters ( $n = 36$  compensated vs. 21 uncompensated bear hunters,  $Z = 2.20$ ,  $p = 0.028$ ).

The cohorts showed significant difference in their tolerance for wolves. Bear hunters were most likely—to favor reducing or eliminating Wisconsin's wolf population, compared with 44.8% of livestock producers and 28.5% of the general rural population (Kruskal-Wallis  $H = 107.7$ ,  $p < 0.0001$ ). This held for all three other proxy measures of tolerance (numerical limit on wolf population,  $H = 80.6$ ,  $p < 0.0001$ ; would shoot wolf if threatened pet,  $H = 19.6$ ,  $p = 0.0002$ ; might shoot wolf while hunting,  $H = 46.1$ ,  $p < 0.0001$ ). In all cases, bear hunters and individuals who were both bear hunters and livestock producers had similar responses (eliminate, reduce, maintain, or increase wolf population, Mann-Whitney  $U$ ,  $Z =$

**Table 3.** Bear hunters' ( $n = 198$ ), livestock producers' ( $n = 107$ ), and general rural residents' ( $n = 224$ ) opinions about compensation policies for losing domestic animals to wolves.

	Bear hunters (%) <sup>a</sup>	Livestock producers (%)	General residents (%) <sup>b</sup>	Total (%) <sup>c</sup>
I. Compensation for livestock loss				
A. If an individual believes he/she has lost a farm animal to a wolf				
Should be compensated for loss no matter how he/she is managing livestock.	69.1	66.7	26.0	49.3
Should be compensated for loss only if following best management practices.	24.6	29.5	62.6	42.6
Should not be compensated.	6.3	3.8	11.5	8.1
B. If an individual believes he/she has lost a farm animal to a wolf:				
Should be compensated for loss whether or not he/she can produce evidence of a wolf.	25.0	23.4	10.5	18.1
Should be compensated for loss only if government agents find evidence of a wolf.	68.8	70.2	77.6	73.1
Should not be compensated.	6.3	6.4	11.9	8.8
II. If an individual believes his/her hunting dog has been injured or killed by a wolf while it was on public land				
Should be compensated for loss whether or not he/she can produce evidence of a wolf.	23.2	16.7	10.2	16.0
Should be compensated for loss only if government agents find evidence of a wolf.	65.5	46.1	52.2	55.6
Should not be compensated.	11.3	37.3	37.6	28.3
III. A cap on individual compensation payments should be made when claimed losses exceed:				
\$2,000	13.6	14.9	32.7	22.3
\$5,000	8.3	7.4	14.4	10.8
\$10,000	7.1	8.5	11.5	9.3
\$50,000	4.1	4.3	1.9	3.2
No cap should be made on compensation payments.	66.9	64.9	39.4	54.4

<sup>a</sup> Respondents who were both bear hunters and livestock producers were grouped with the bear hunters, because they did not differ significantly from bear hunters on any attitude measures.

<sup>b</sup> Neither bear hunters nor livestock producers.

<sup>c</sup>  $n = 529$ .

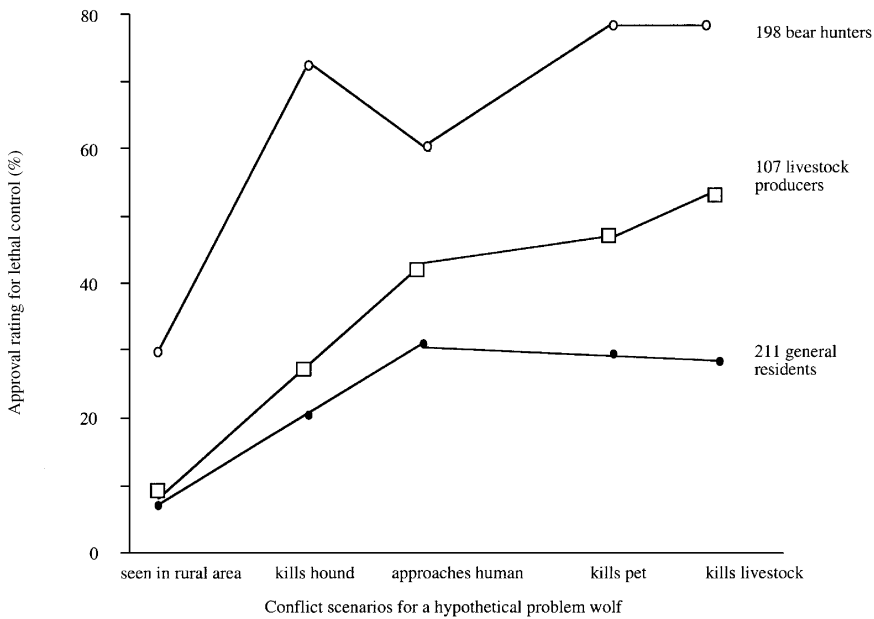
$-0.93$ ,  $p = 0.351$ ; numerical limit on wolf population,  $Z = -1.84$ ,  $p = 0.066$ ; would shoot wolf if threatened pet,  $Z = -0.29$ ,  $p = 0.772$ ; might shoot wolf while hunting,  $Z = -0.66$ ,  $p = 0.507$ ). Thus, we pooled these two groups (Table 2).

In response to general questions about compensation, most respondents approved of payments for domestic animals lost to wolves (Table 3). However, the cohorts disagreed about conditions under which compensation payments should be made. Bear hunters and livestock producers were more likely than general rural residents to favor compensation payments for people who lost farm animals to wolves, regardless of livestock management practices ( $\chi^2 = 90.4$ ,  $p < 0.001$ ) and regardless of whether evidence of a wolf was found ( $\chi^2 = 17.6$ ,  $p = 0.001$ ). However, bear hunters were significantly more favorable toward compensation for loss of hunting dogs on public lands than were livestock producers (Mann-Whitney  $U$ ,  $Z = -7.074$ ,  $p < 0.001$ ). A majority of bear hunters (67%) and livestock producers (65%) believed there should be no cap on individual compensation payments, compared with only 39% of general rural residents

( $\chi^2 = 41.8$ ,  $p < 0.001$ ). Many respondents doubted they would be compensated in the future should they suffer a loss (68% of those who were not compensated and 35% of those who were compensated,  $\chi^2 = 11.3$ ,  $p = 0.023$ ).

#### Preferred Management Strategies for Problem Wolves

Respondents' opinions regarding strategies for managing "problem" wolves varied according to the kind of human-wolf conflict scenario with which they were presented. In the case of a wolf being sighted in a rural area, the majority of respondents (59.5%) preferred that authorities take no immediate action and monitor the situation (vs. capture and relocate, 22.7%; destroy, 17.4%; scare, 4%;  $n = 529$  responses,  $\chi^2 = 151.1$ ,  $p < 0.0001$  compared with chance probabilities). If a wolf kills livestock or a family pet, however, 52.5% approved of destroying the wolf (vs. capture and relocate, 32.6%; monitor, 8.5%; scare, 6.4%;  $n = 530$  responses,  $\chi^2 = 158.1$ ,  $p < 0.0001$ ). Fewer individuals (41.2%) approved of destroying wolves that had killed a hunting hound.



*Figure 1. Approval for lethal control within five conflict scenarios. Approval rating is the percentage of respondents preferring lethal control over three alternative management tactics: take no immediate action and monitor the situation, capture and relocate, or scare. Each line depicts the response of a different group of residents of northern Wisconsin.*

Respondents who reported a depredation by a wolf voted for destroying the wolf in  $2.8 \pm 1.8$  conflict scenarios ( $n = 105$ , range 0–5). Those who reported losses to predators other than wolves voted for destroying the wolf in  $2.7 \pm 1.8$  scenarios ( $n = 54$ ), and those suffering no loss voted for destroying the wolf in  $1.8 \pm 1.9$  scenarios ( $n = 373$ ). For this test, there was a significant difference between those suffering no losses and those suffering losses to wolves or other predators (other predator: Student's unpaired  $t = 3.35$ ,  $p = 0.0009$ ; wolf:  $t = 5.12$ ,  $p < 0.0001$ ). There was no significant difference in preference for lethal control among those who had received compensation payments versus those who had not ( $2.8 \pm 1.8$  for 57 compensated vs.  $2.5 \pm 1.8$  for 46 not compensated,  $t = 0.85$ ,  $p = 0.40$ ).

Approval ratings for lethal control also varied by cohort (Fig. 1). For livestock killed, 77% of bear hunters, 45% of livestock producers, and 32% of general residents approved of destroying the wolf. Similarly, for pets killed, 77% of bear hunters, 42% of livestock producers, and 32% of general residents approved of destroying the problem wolf.

#### Relative Impact of Individual Experience with Wolves versus other Socioeconomic Indicators

When we compared the effect of individual experience with wolves to the various socioeconomic predictors of tolerance derived from the literature, we found that an individual's cohort (i.e., identity or occupation as a bear hunter, livestock producer, or general resident) and education level were strongly significant predictors of tolerance for wolves, whereas losses to wolves and other predators, and the sex of the respondent were less powerful but also significant (Table 4). In post hoc analysis, bear hunters were significantly less tolerant than livestock

producers (Fisher's probable least-squares difference [PLSD] = 0.54,  $p = 0.0001$ ), who were less tolerant than general residents (PLSD = 0.31,  $p = 0.0016$ ). Bear hunters who were also livestock producers scored the same tolerance as bear hunters (PLSD = 0.13,  $p = 0.28$ ) but were less tolerant than other livestock producers (PLSD = 0.67,  $p = 0.0001$ ). Losing a domestic animal to a wolf or other predator was also a significant predictor, but not consistently (Table 4). Respondents alleging a loss to a wolf showed similar tolerance to those alleging a loss to another carnivore on some measures (e.g., number of scenarios in which the respondent would opt to destroy a wolf: PLSD = 0.17,  $p = 0.56$ ) but were less tolerant on other measures (e.g., wolf population limit, PLSD = 0.33,  $p = 0.021$ ). Those two groups always had significantly lower tolerance than those who alleged no loss ( $p < 0.01$  in all cases).

#### Discussion

Our results indicate that people who had lost a domestic animal to any predator were less tolerant of wolves than their rural neighbors who had not. They were also more likely to favor lethal control of wolves. More important than whether or not an individual had lost an animal to wolves was his or her identity as a bear hunter, livestock producer, or general resident. This result is not surprising given that rural citizens who care for and depend on domestic animals face greater risks than their neighbors who do not. Perceived risk is likely as important as actual experience with depredation in shaping rural attitudes toward wolves in Wisconsin, a result found in similar studies in disparate settings (Naughton-Treves 1997; Knight 2000; Montag & Patterson 2001).



**Table 4.** Relative impact of individual experience with wolves versus other socioeconomic indicators (multivariate analysis, *F* values).<sup>a</sup>

<i>Experience with wolves and socioeconomic indicators</i>	<i>df</i>	<i>Preferred wolf population size</i>	<i>Limit on wolf population</i>	<i>Preferred management techniques for "problem" wolves</i>			<i>Propensity to shoot wolf</i>		
				<i>monitor problem wolf</i>	<i>scare off problem wolf</i>	<i>capture and relocate</i>	<i>destroy wolf</i>	<i>shoot wolf threatening pet</i>	<i>shoot wolf while deer hunting</i>
Age	1	4.57*				2.99	2.03	3.52	
Sex	1	2.87	8.39**			2.01	6.62*	8.79**	12.23***
Size of childhood community	6	1.12				2.91	3.70		
Formal education	1	13.36***	12.58***	22.21***			9.11**	1.61	22.74***
Social group <sup>b</sup>	3	14.51***	10***	7.74***	3.43*	5.92***	17.79***	1.39	8.97***
Income	1				1.43				
Landholding size	9	2.03	2.22	2.52		1.81			3.02
Loss of domestic animal	2	3.45*	4.82**	1.09		1.38	3.69*	3.09*	1.57

<sup>a</sup>Cells without an *F* value are not significant, otherwise, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.

<sup>b</sup>Social group is livestock producer, bear hunter, or general resident.

Kaltenborn et al. (1999) offered another explanation for the impact of occupation on attitudes toward wolves: individuals are socialized into different professional cultures. Attitudes toward wolves are established early in life, are deep rooted and value laden (Wilson 1997; Bjerke et al. 1998b; Knight 2000), and are connected to individual lifestyles and views of the place of humans in nature (K. De-Boer, cited in Nie 2001). For many people, therefore, an experience with wolf depredation may not significantly alter their deeply entrenched attitudes.

As at many other study sites, years of education were correlated with greater tolerance of wolves and disapproval of lethal control. Causal arguments are elusive here. Education may broaden people's perspective on wolves, but education may be confounded with occupation (e.g., ranchers and farmers likely rely on practical experience and technical knowledge more than on academic training). Nevertheless, our multivariate analysis allowed us to control for cohort and education simultaneously, and it revealed that within cohorts (bear hunters, livestock producers, and general residents) individuals with more formal education were more tolerant. Formal education was also correlated with a greater propensity to register a complaint of loss. Not all citizens were equally likely to register a complaint. Those with more land, more cattle, and more years of formal education proved more likely to demand redress from the government for their loss than were other individuals experiencing a loss.

### Managing Problem Wolves

Among the five human-wolf conflict scenarios, respondents seemed most concerned with depredation on livestock and family pets, as reflected in the high approval rate for lethal control in such situations (Fig. 1). Responses were more disparate regarding wolf depredation on hounds on public lands. Not surprisingly, bear hunters

were greatly concerned, and the majority approved of lethal control in this scenario. In recent public meetings, bear hunters have explained that their hounds are valuable, highly trained animals that are the result of years of careful breeding. One bear hunter said, "We are not losing a dog. We are losing a companion, and money will not replace the time and friendship we are losing" (D. Samuels, personal communication). Claims for these bear-hunting hounds reach \$10,000 (R. Jurewicz, WDNR, personal communication). Hound users represent about 21% of Wisconsin bear hunters (Dhuey et al. 1999).

Other respondents (not bear hunters) were less likely to approve of lethal control of wolves killing hounds on public land. The WDNR's recent decision to continue compensating hunters who lose their hounds but not destroy wolves involved in hound depredation provoked protest from both sides. Bear hunters threatened to boycott public meetings about wolves sponsored by the WDNR because they thought their concerns were ignored. Animal rights activists in turn demanded that no tax dollars be spent to reimburse bear hunters for lost hounds (Lott 2002). This issue may become polarized given public controversy over bear-hunting practices and the power of the bear hunters' lobby in the WDNR. Fifty-six thousand state residents applied for bear permits in 2002, representing approximately 7.3% of the state's hunters (B. Kohn, personal communication). The WDNR issued approximately 12,800 bear permits in 2002, bringing in \$332,500 in revenue (1% of total WDNR hunting license revenue; R. Jurewicz, personal communication). Wolf managers are concerned that bear hunters have more opportunity than most hunters to affect wolf population viability because they often encounter wolves in remote areas during the months when pups are reared (Wydeven et al. 2003).

Lethal control proved more popular among the respondents in this survey than in studies elsewhere. Capture

and relocate has been the most popular approach among urban or suburban citizens elsewhere (Kellert 1985; Manfredo et al. 1998). Rural residents with a strong hunting heritage were more likely to favor lethal control for dealing with problem wildlife. Our respondents may also be aware of the high mortality rate for relocated wolves. Between 1991 and 2002, 38 wolves were captured at sites of depredation in Wisconsin. Four died during capture or captivity, and 34 were released an average of 156 km from the capture site (A. Wydeven, unpublished data). Of those translocated, 14 died, and 11 others have been free for <6 months. Therefore, mortality rates for captured and translocated wolves exceed 47% (cf. with a mortality rate of 23% for resident, radiocollared animals,  $n = 118$ ; or 30% mortality for radiocollared dispersers,  $n = 78$ ; WDNR, unpublished data).

Lethal control also faces criticism on several fronts. Most techniques that kill depredating carnivores are not selective (Sacks et al. 1999). Research on bears and coyotes suggests that 11–71% of the carnivores killed by trained wildlife-control agents showed no evidence of having been involved in depredations (Treves & Woodroffe 2003). The limitations of techniques to manage problem animals should be addressed in future public-opinion research to avoid perpetuating the myth of humane relocations and/or precision killing of “guilty” carnivores.

### Whether to Compensate

Compensation payments apparently do not improve individual tolerance toward wolves or people’s approval of lethal control. The bear hunters who were compensated were more likely to approve of lethal control (whether by state agents or themselves). This result again likely reflects how attitudes toward wolves are formed early in life and persist (Bjerke et al. 1998b). Additionally, we learned in informal conversations with complainants (livestock producers and bear hunters) that people consider compensation payments inadequate, given the emotion and years invested in each animal. People also hated to think about the suffering of their animals killed by wolves. Many livestock producers feel strong affection for their animals. As one beef cattle producer said, “Come spring, my wife and I can barely sleep at night imagining the terror our animals will feel [if attacked by wolves].” Finally, many respondents were discouraged by the WDNR’s requirement of definitive evidence of wolf attack (some complainants estimated that for every calf proven killed by a wolf, another was also killed but with no evidence). These three lines of complaint have emerged in other studies of compensation (Montag & Patterson 2001; Linnell & Brøseth 2003; Nemptzov 2003). Relative to other North American carnivore compensation programs, the WDNR’s payment rates and protocol are typical (Montag & Patterson 2001). That is, given sufficient evidence, the WDNR pays fall

market price for calves, even if calves are killed in the spring. However, the WDNR’s policy of paying for hunting hounds is atypical: no other state or privately funded compensation program pays for hounds injured or killed by carnivores on public land (Montag & Patterson 2001).

Although compensation did not ameliorate individuals’ grievances against wolves, it would be a mistake to cut off the program. These payments are supported and expected by the broad public. Research elsewhere (Bangs et al. 1998) suggests that ceasing compensation payments causes retaliation and increased hostility. Some experts suggest that compensation programs offer a means to buy off broader public constituencies and earn support from state-level political representatives (D. Wilcove, personal communication).

With the 2003 federal reclassification of wolves as threatened and delisting scheduled for 2004, it will be necessary to locate more funds for compensation, and as wolf numbers increase, compensation will likely become more expensive. Wisconsin’s compensation program is indirectly affected by the state budget crises. A general downturn in the economy will also decrease voluntary donations to the Endangered Resources Fund and sales of endangered resources license plates, the sources of compensation monies.

### Wolf Tolerance and Population Size

We were unable to test directly the effect of time and growing wolf numbers on attitudes (Williams et al. 2002). However, the fact that social group (bear hunter vs. livestock producer vs. general resident) was a more powerful predictor of attitudes than individual encounters with wolves suggests that attitudes are not highly sensitive to wolf numbers or depredation frequency. A more fundamental process of social change in northern Wisconsin may ultimately influence support for wolf recovery. The proportion of rural landowners who come to the Northwoods for recreation is rising dramatically. Livestock producers are selling land to developers of vacation and retirement homes. If the pool of nonlivestock-producing, nonbear-hunting population rises, we predict increasing tolerance for wolves in northern Wisconsin. Ironically, although these newcomers’ higher tolerance may reduce the risk of illegal killing of wolves, the increased development associated with these new residents may further degrade and reduce wild habitat, which may undermine the long-term well-being of wolves.

Government agencies charged with restoring and protecting wolves and other large carnivores face a daunting challenge. Amidst acrimonious public debate, they must reconcile the strong mandate by the general public to conserve wolves while protecting rural citizens vulnerable to losses, especially livestock producers and bear hunters using hounds. These citizens are also those most able to influence wolf survival by poisoning or

shooting wolves. Although as many as 13% of the general residents in northern Wisconsin might consider killing a wolf encountered while hunting, the majority support maintaining or increasing wolf numbers (73%). This suggests that if the WDNR can maintain the population at acceptable levels, most residents will support wolf conservation. The future survival of wolves in Wisconsin depends on effective political negotiation and publicly palatable methods of controlling wolf depredations and compensating individuals for wolf-related losses.

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