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Depredation Claim Behavior and Tolerance of Wildlife in Wyoming

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ABSTRACT

Wyoming Game and Fish Department depredation payments were established to increase landowner tolerance toward, and thus the supply of, certain types of wildlife. This study examined how socio-economic and demographic characteristics of farmers and ranchers in Wyoming relate to tolerance toward wildlife and depredation claim submission. The severity of depredation and landowner satisfaction with the depredation policy were evaluated. The financial stability and economic intent of farmers and ranchers significantly influenced tolerance toward wildlife. Landowners tended to be less tolerant of depredation ensuing from elk. The complexity of the submission process was a deterrent to damage claim submissions.

Key Words: *depredation, probit model, wildlife.*

Wildlife in Wyoming, as in other states, are held in trust by the State. The Wyoming Game and Fish Department (WGFD) along with the Wyoming Game and Fish Commission establishes big game population objectives. Population levels are both habitat and politically dependent. Natural habitat, hunting access and landowner tolerance of wildlife are included in setting target population numbers (Van Tassell, Phillips and Hepworth).

Landowner tolerance has become a crucial factor in determining the expanse of wildlife habitat. Craven *et al.* suggest that tolerance, not habitat, may be the limiting factor that imposes population bounds on big game. Public tolerance of wildlife damage is especially low in many western states where public lands act as reservoirs from which big game move to feed upon private resources (Davis, Parsons and Randall; Conover). In a survey of southwestern Montana landowners, Lacey *et al.* estimated that big game consumed a yearly average of 511 animal unit months (AUMs)[1] per landowner at a cost of $5,616. While many landowners are willing to tolerate some damage because of moral obligations or the aesthetic, recreational and economic benefits wildlife provide, tolerance levels quickly diminish as a landowner's economic dependence on the land increases (Lacey *et al.*).

Big game depredation also has been a problem throughout the United States. Conover reported that 89 percent of respondents in a national survey alleged wildlife damage on their agricultural operations and 53 percent stated that the losses exceeded their tolerance. Fifty-five percent purposely provided habitat for wildlife by including cover near fields,

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[1] An AUM is the amount of forage required to feed a mature cow or equivalent for one month.

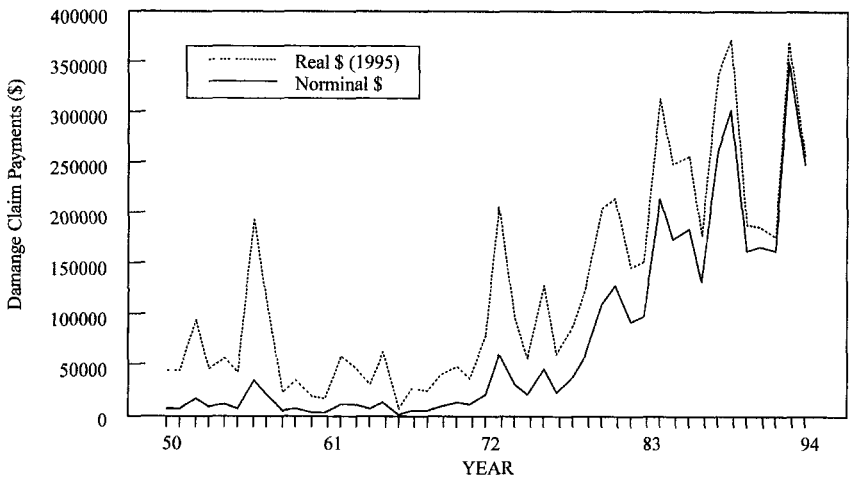

Figure 1. Damage claim payments paid by Wyoming Game and Fish Department, 1950–1995

leaving crop residue, providing a water source, or leaving a portion of the crop unharvested. Yet, 38 percent stated that the damage was "so severe that it reduced their willingness to provide wildlife habitat on their property" (Conover, p. 99).

To increase landowner tolerance, and thus the supply of wildlife, the WGFD is authorized to compensate individuals for damage caused by big or trophy[2] game animals and game birds (Wyoming Game and Fish Department, 1993). The Wyoming Legislature first authorized reimbursement for game animal depredation in 1925 and the first wildlife damage compensation law was adopted in 1929. Claims were historically paid from the general operating budget of the WGFD. In 1980, the Wyoming Legislature authorized diversion of the $5.00 nonresident license application fee to develop a $500,000 depredation fund. Once the $500,000 was collected, 25 percent of the nonresident application fee was authorized for maintenance of the fund. In recent years, approved claim payments have been too large for the fund to be maintained merely with application fees. Money that would normally be used for other departmental programs has been used to pay damage claims because depredation remuneration limits are not tied to the solvency of the fund.

Wyoming's depredation policy prohibits the WGFD from considering claims less than $100[3] or from landowners that do not permit hunting on their private land. The damage law also stipulates that landowners must notify the Department no later than 15 days after the damage is discovered and must present a verified claim that specifies the damage and amount claimed no later than 60 days after the last item of damage is discovered. A "verified claim" is a claim that the claimant has signed and sworn to be accurate before a person authorized to administer oaths. Claims are to be investigated, processed and paid (if approved) by the Department within 90 days of submission. If the Department fails to act within 90 days, the claim, including interest, will be allowed. An appeals procedure has also been established if a claim is disallowed (Wyoming Game and Fish Department, 1993).

Lacey *et al.* found that damage claim submissions in Montana increased with the severity of winter and the financial condition of ranchers. Current increases in depredation claim payments (Figure 1) have been concerning to WGFD officials, especially when considering what may transpire if all regions in

[2] The WGFD defines big game to include deer, elk, antelope and moose. Trophy game includes black bear, grizzly bear and mountain lion.

[3] Since this study was undertaken the WGFD dropped the $100 minimum damage requirement.

Wyoming experienced a severe winter coupled with low farm income. Changing demographic and socio-economic characteristics of Wyoming farmers and ranchers also are disconcerting. It is unknown if current trends in damage claim submissions are due to increased wildlife depredation, changing landowner tolerance or a combination of factors.

Experience has shown that failure to consider and be responsive to landowner feelings and attitudes in wildlife-related issues can lead to potential landowner resistance (Kruckenberg). Resistance can include political actions, hunting restrictions, land posting and disregard of laws designed to facilitate management. Given current trends of suburbanization, wildlife habitat losses will likely continue. There is little doubt that private lands will continue to be important to wildlife prosperity (Davis, Parsons and Randall). Understanding the attitudes of landowners is one of the first steps in gaining their cooperation in wildlife management.

This study sought to identify landowner socio-economic and demographic characteristics that influence damage claim submission and wildlife tolerance. The severity of depredation, the tolerance level of landowners, and their satisfaction with the depredation policy administered by the WGFD also were evaluated.

Model Specification

A landowner's decision regarding wildlife tolerance and depredation claim submission can be considered within the conceptual framework of utility maximization. Consider a set of T wildlife tolerance alternatives (e.g., submit depredation claims) facing J landowners, with each alternative t ($t = 1, \ldots, T$) providing utility to landowner j ($j = 1, \ldots, J$). In the decision-making process, landowner j chooses an alternative t, which maximizes his/her utility. Maximum utility, U_{tj}, attainable for landowner j given each alternative t can be expressed as:

$$(1) \quad U_{tj} = u(M_{tj}, W_{tj}), \qquad t = 1, \ldots, T; \quad j = 1, \ldots, J,$$

where M_{tj} is a vector of management/personal characteristics for individual j associated with alternative t and W_{tj} is a vector of wildlife/depredation conditions facing individual j given alternative t.

Landowners evaluate the utility and obligations associated with the presence of wildlife and ascertain the level of wildlife that maximizes utility. Because wildlife are declared to be held in trust by each State, the landowner holds no property right with respect to wildlife and has limited control on wildlife numbers. When wildlife numbers are less than or equal to those that maximize U_{tj}, tolerance of wildlife (e.g., don't submit depredation claims) is expressed. The opposite occurs when wildlife levels exceed those represented by U_{tj}.

Tolerance or depredation claim behavior can be represented by a yes or no response, i.e., the event in question is undertaken if the landowner's expected utility is "large enough". *Large enough* is assessed by an unobservable utility index variable, I_i and a critical value I_i^* associated with each landowner. When $I_i > I_i^*$ the event occurs and when $I_i \leq I_i^*$ the event does not occur. Given the assumption of normality, the probability that I_i^* is less than or equal to I_i can be computed from the cumulative normal density function as:

$$(2) \quad P_i = Pr(I_i^* \leq I_i) = F(I_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{I_i} e^{-z^2/2}\, dt$$

where, z is the standard normal density. By design, P_i will lie in the interval (0, 1). A probit model[4] based on utility theory as de-

[4] A popular alternative to the probit specification is the logistic specification. The logit model is based on the cumulative logistic probability function. The two distributions are similar except the logistic is heavier in the tails. When the values of $X'\beta$ are intermediate in size (e.g., -1.2 to $+1.2$) the logit and probit specifications provide similar results (Greene, 1993). Greene (1993, p. 638) states that "it is difficult to justify the choice of one distribution or another on theoretical grounds". Amemiya expresses similar views. Both formulations have been used extensively in the

veloped by McFadden can specify the relationship implied by equation (1). The probit model can be estimated by the maximum likelihood method as:

$$(3) \quad Y_i = \begin{cases} 1 & \text{if } X_i'\beta + \epsilon_i > I_i^* \\ 0 & \text{if } X_i'\beta + \epsilon_i \leq I_i^* \end{cases}$$

where Y_i is the observed decision by the landowner which is ordinal in nature, X_i is a matrix of explanatory variables, β is a vector of unknown parameters, ϵ_i is an independently distributed disturbance term with zero mean and unit variance, i.e., $\epsilon_i \sim N(0, 1)$, and I_i^* is the critical value. Parameter estimates for the β vector can be obtained from the statistical package LIMDEP (Greene, 1989). For this study, a significance level of $\alpha \leq 0.10$ was used to determine the statistical significance of the β parameters.

The parameters of the probit model, like other nonlinear regression models, are not necessarily the marginal effects generally obtained from linear regression models. In the binary setting, marginal effects in a probit model can be calculated as:

$$(4) \quad \frac{\partial P}{\partial X} = \frac{\partial F(X_i'\beta)}{\partial X} = f(X_i'\beta)\beta.$$

Marginal effects are related to the values of X_i which are generally calculated at the means of the regressors. This approach is appropriate for continuous variables, but is not valid for evaluating the effects of dummy variables. A dummy variable is generally analyzed by comparing the probabilities that result when the variable takes on its two values with those that occur while other variables are held at their sample means. The marginal effects of all variables in the specification should sum to zero (Greene, 1993). A significance level of $\alpha \leq 0.10$ was used to determine the statistical significance of the marginal probability parameters.

All models were tested for heteroscedasticity (Greene, 1993), with all likelihood ratio statistics rejecting heteroscedasticity ($\alpha \leq 0.10$). A separate analysis also was conducted to test for multicollinearity using condition indices (Belsley), with all condition indices being less than 19, indicating no collinearity.

The landowner's utility was hypothesized to be conditional upon his/her personal attributes or socioeconomic characteristics and on the characteristics related to the wildlife species and depredation. To aid in the discussion of the independent variables included in the empirical models, variables were organized as landowner characteristics, management characteristics, wildlife species, level of damage and landowner's attitudes concerning wildlife.

Owner Characteristics

Experience managing a farm or ranch is hypothesized to have a positive influence on landowner tolerance and a negative relationship with damage claim submissions. Years of age, a measure of experience, has been shown to be positively associated with the adoption of conservation practices and integrated pest management practices (Ervin and Ervin; Korsching *et al.*; McNamara, Wetzstein and Douce). With experience, a landowner may learn to coexist with wildlife and should be more aware of the importance of passing this natural heritage onto the next generation.

The level of education is hypothesized to have a positive relationship with landowner tolerance and a negative relationship with damage claim submissions. Kellert found that individuals with a Ph.D. ranked high on attributes showing an ecosystem emphasis and an interest in the physical attributes and biological functioning of animals. These individuals also ranked low on attributes portraying a primary concern for the material values of animals and the satisfaction derived from mastery and control over animals. Adams, Newgard and Thomas compared human wildlife orientations between high school and college stu-

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literature. The binary response model regression was used to construct the Lagrange multiplier test for the probit versus the logit model for data used in this study (Greene, 1993). The chi square (χ^2) values ($P < 0.10$) indicate that the probit and logit model estimates were not statistically different. Because the probit and logit formulations yielded similar results, the probit specification was arbitrarily chosen for this research.

dents. Their study indicated that college students held a more positive orientation than did high school students concerning attitudes, perceptions and activities with regard to wildlife. As the education level of landowners increases, landowners may be less intimidated by the damage claim submission process, but their tolerance level of wildlife also should increase, causing their damage claim submissions to decrease.

An increasing number of ranch owners are obtaining their main source of income from off-farm activities. This lack of dependence upon agriculture for their livelihood may impact landowners' tolerance toward wildlife. In the current study, landowners whose main source of income is off-farm are hypothesized to be more tolerant of wildlife and less inclined to submit damage claims.

Residency of landowners is hypothesized to have an effect on their tolerance toward wildlife and their damage claim submission practices. If the landowner does not reside on the ranch, his or her tolerance level is hypothesized to be higher since exposure to wildlife will be diminished. Likewise, damage claim submissions should be less frequent.

Decker and Brown found that tolerance of wildlife damage varied with the ability to withstand economic consequences of damage. Hackett (p. 309) commented that, "to the farmer, in the midst of a personal economic disaster one deer may seem too many." In the present study, a landowner's assessment of financial stress is used as a measure of economic tolerance. As financial stress increases, landowner tolerance towards wildlife is expected to decrease while damage claim submissions are expected to be more common.

A landowner's exposure to wildlife may be related to the size of the operation (i.e., the total forage base)[5]. Thus, as the total forage base increases, wildlife exposure should increase and negatively impact the tolerance level of the landowner while increasing damage claim submissions. Using this reasoning, the assumption is made that all resources are fully employed regardless of the size of operation so that depredation should not have a greater impact on a landowner with a smaller forage base.

Management Characteristics

Reason for purchasing or maintaining ownership in a farm or ranch is another factor that may influence a landowner's tolerance of wildlife and damage claim submission behavior. A landowner may purchase a ranch for economic reasons, such as to provide a source of income or as an investment. Ownership could be for noneconomic motives, such as obtaining recreation benefits or to provide a good environment in which to raise a family. If the reasons for owning a ranch are economic, wildlife tolerance should decrease and damage claim behavior increase. The opposite relationship is hypothesized if the ranch is purchased for noneconomic reasons.

Wildlife Species and Level of Damage

Preference for certain species and the type of damage created by a particular species may affect individual attitudes toward big and trophy game depredation. Previous studies show that human preferences toward wildlife vary with each species (Kellert; More). Wildlife sentiment is generally directed at species that have prominent anthropomorphic qualities (Killert) and are relatively less abundant (More). Certain big game, such as elk, can damage fences and consume more forage because of their size. Elk are often viewed as intruders because they are more nomadic and do not continually reside on a landowner's property. It is hypothesized that tolerance will decrease and landowners will be more likely to submit damage claims when depredation is caused by elk rather than by deer, antelope or more novel species such as moose. There should also be a negative relationship between tolerance and damage caused by trophy game.

[5] To provide an overall ranch size measurement, the value of the forage base was created using a weighted sum of acreage values based on 1992 Wyoming real estate prices (Bastian, Foulke, and Hewlett). Individual values were $493/acre for hayland, $661/acre for cropland, $59/acre for rangeland, and $43/AUM for federal permits.

Previous studies show that tolerance decreased as the perceived amount of damage or severity of damage increased (Brown, Decker and Huston; Decker and Brown; Stoll and Mountz). In this study, the perceived amount of damage is hypothesized to have a negative relationship with landowner tolerance of wildlife and a positive relationship with damage claim submissions.

Attitudes

Two attitudinal variables are included to test how landowners' attitudes influence their tolerance towards wildlife and their damage claim behavior. First, landowners who feel a moral obligation to care for big game should have increased tolerance levels and be less likely to submit damage claims. Second, economic disincentives ensuing from the "general inconvenience" of big game should decrease landowner tolerance and increase damage claim submissions. General inconveniences may include demands associated with hunters or recreationists, the possibility of disease being transmitted from wildlife, or the inconvenience of using preventative measures to reduce big game damage.

Data

A split sample designed mail survey was conducted during 1995 to obtain ranchers' perspectives concerning depredation. The survey population consisted of 505 individuals who had submitted damage claims to the WGFD during the previous five years and 2913 Wyoming Farm Bureau Association members engaged in agriculture. From these two populations, a sample of 300 individuals who had submitted damage claims and 300 individuals who had not submitted damage claims was drawn. Of those who had submitted damage claims, 133 were Farm Bureau members. Statistical tests were conducted to examine the difference between non-Farm Bureau members and Farm Bureau members. Chi-square (χ^2) tests were used to examine differences between categorical variables, while paired *t*-tests were used for continuous variables. No significant differences were detected between Farm Bureau members and non-Farm Bureau members or Farm Bureau claimants and non-Farm Bureau claimants at the 0.05 level for all descriptive variables.

Identical questionnaires were sent to all individuals in the sample. A reminder postcard was sent two weeks after the initial mailing. If the returned questionnaire was not received after three weeks, a second survey was sent. A response rate of 59 percent was obtained, including 182 respondents who had submitted damage claims and 170 who had not submitted damage claims. Of those submitting damage claims, 90 were Farm Bureau members and 92 were not.

Results and Discussion

The majority of respondents permanently resided on the ranch (89 percent) and obtained their main income from ranching (76 percent). Average management experience was 25 years. Most respondents had a high school education or more. Over half had received some education above the high school level and 12 percent had graduate or professional training.

Respondents were asked to rate the financial stress they were currently experiencing in their ranching operation. Slightly over half of the respondents described their financial stress as "average", whereas 23 percent indicated they were experiencing "above average" financial stress.

When asked to indicate their reasons for keeping or purchasing their ranch, 73 percent of respondents stated they did so to provide a source of income or as an investment. Outdoor recreation benefits appear to be subsidiary to economic benefits for most respondents, as 28 percent ranked recreation as a major reason, and 36 percent ranked life style as an argument for purchasing or maintaining ownership of their ranch.

The typical ranching operation had 402 acres of hay, 178 acres of crops, 5912 acres of rangeland, and 866 federal animal unit months (AUMs). For livestock, an average of 231 head of mother cows, 154 head of yearlings and 250 head of ewes existed in the sam-

Table 1. Damage Losses ($) and Maximum Tolerable Losses ($) by Big and Trophy Game Species Reported by Respondents, by Type of Loss

	Mean	S.D.	Min	Max
Fence damage	304	489	0	4,000
Stacked hay loss	331	1,287	0	20,000
Standing forage crop loss	1,279	5,323	0	54,000
Grain crop loss	223	1,273	0	17,500
Loss of rangeland forage	1,234	5,138	0	72,000
Other	565	4,483	0	75,000
Total without range forage loss	2,769	7,259	0	75,100
Total with range forage loss	4,044	10,000	0	95,000
Amount of damage respondent would tolerate before submitting a damage claim	1,422	2,427	0	20,000

ple. Almost 44 percent of respondents were involved in farming crops other than hay, and over 76 percent were involved in some type of livestock enterprise. Approximately 34 percent of respondents had some combination of crop (other than hay) and livestock enterprises. Average value of the forage base was $830,539 with a standard deviation of $1,015,514.

Ranking Damage Sources by Wildlife Species

Respondents were asked to rank species that caused the most damage to their deeded lands. Mule deer (68 percent), antelope (54 percent), elk (35 percent) and white-tailed deer (34 percent) were the species most frequently cited by respondents as the major perpetrators of damage. Trophy species were mentioned by 10 percent of respondents and "other" species such as moose and waterfowl were also listed by 10 percent of respondents as originators of depredation. Survey results mirrored the experience of the WGFD. According to WGFD records from 1970 to 1989, the majority of depredation submissions were due to large herbivores. Mule deer were involved in 37 percent of all damage claims and were more often cited in claims than any other species. Elk were linked with 26 percent of damage claims, though the average value of an individual elk claim was smaller than for deer or antelope. Antelope were involved in almost 15 percent of claims and white-tailed deer were involved in 10 percent.

Depredation Magnitudes

Respondents were asked to assess the average amount of damage per year that big game animals caused to their property (Table 1). Standing crop forage incurred the greatest amount of damage ($1279), followed closely by rangeland forage ($1234). Current regulations do not allow the WGFD to compensate for forage loss on private rangelands unless the damage meets the standard of "extraordinary damage to grass" as defined by Wyoming Game and Fish Commission regulations. Based on the 1995 average rate for grazing cattle on private, non-irrigated land in Wyoming of $11.30 per AUM (Wyoming Agricultural Statistics Service), rangeland forage depredation loss reduced the average cow herd size by 109 AUMs or approximately nine cows. Fence damage, grain crop losses and stacked hay loss were considerable lower than standing forage loss in hay field or on rangelands. Other types of damage listed by respondents averaged $565 per operation and included tree, vegetable, silage, seed, salt and building damage, along with human injuries. Total damage averaged $4,044 per operation including rangeland forage losses and $2,769 when these losses were excluded. Lacey *et al.* sampled seven southwestern Montana counties during 1989–1990 and found that consumption and damage to forage crops by big game, along with damage to stored hay and fences, amounted to $6185 per rancher, almost one-third more than found in this sample.

Respondents were asked to state the amount of wildlife damage they would incur before submitting a damage claim. The average maximum tolerance of wildlife damage was $1422, making the average reported damage almost two-fold the respondents' tolerance level. When arranged according to respondents who had submitted damage claims and those who had not, the average difference between reported damage and the amount they would tolerate before submitting a damage claim was $1558 for respondents who had submitted damage claims. For respondents who had not submitted a damage claim, the amount they would tolerate before submitting a damage claim exceeded the reported damage by $523. Apparently, most landowners whose reported damage exceeded their tolerance level were getting some consolation from the WGFD.

Tolerance Towards Wildlife

Almost 95 percent of respondents reported that game or trophy wildlife species used their private land. Respondents who had wildlife using their land were asked whether they considered the use of their private lands by big game or trophy wildlife species to be tolerable or intolerable based on their previous five years of experience. Fifty-seven percent of respondents considered game use of their private lands tolerable. A list of predefined explanations of why game and trophy wildlife use of their property was tolerable was included on the questionnaire. Respondents were permitted to check more than one category. The majority (60 percent) of respondents who were tolerant of game animals believed that the presence of wildlife on private property was part of nature that comes with owning land. Thirty-nine percent gave benefits of hunting as a reason to tolerate big game and trophy wildlife species. A similar percentage (38 percent) of private landowners considered the visual and aesthetic value worth more than the costs big game and trophy wildlife species impose. Nearly 18 percent of respondents indicated their tolerance was linked to guiding and outfitting services they provided and 14 percent tolerated big game because of light and infrequent use. Twenty-six respondents made additional comments explaining their tolerance for wildlife. "Just tolerate" was the most common comment. Other comments in descending order of frequency were "Wyoming Game and Fish Department pays damage", "wouldn't own land without wildlife", "environmentalists" and "protection of private lands keeps animals from extinction".

Table 2 contains results from the probit equation used to analyze factors influencing landowner tolerance of wildlife. The model correctly classified 79 percent of respondents in the sample. Eight variables were significant in segmenting the respondents.

Several economic factors were significant in classifying respondents as to their wildlife tolerance. Respondents with severe financial stress (STRESS1) were less likely to indicate wildlife use on their private lands was tolerable. Marginal effects indicate the probability of big game use being tolerable was reduced by 34 percent if a landowner fell into the severe financial stress group. The reported damage occurring to crops and fences (DAMAGE) was not significant in determining if wildlife use was tolerable, but the general inconvenience of wildlife (INCONVEN) was significant. The probability of big game use being tolerable was reduced by 47 percent if the respondent felt their income was adversely affected by the "general inconvenience" of big game. Perhaps this result occurs because the WGFD will compensate landowners for most categories comprising DAMAGE, but not for the general inconvenience of wildlife. If this is true, the damage claim submission process is at least partially successful in increasing landowner tolerance of wildlife.

Management characteristics also were important factors in determining if wildlife use was tolerable. If the ranch was purchased or retained as a source of income or as an investment, the landowner was more reluctant to tolerate the presence of wildlife. If recreational purposes were a major factor in maintaining the ranch, wildlife use was more tolerable. Purchasing or retaining farms/ranches for economic reasons reduced the probability of tol-

Table 2. Maximum Likelihood Estimates for the Probit Model Used to Analyze Factors Influencing Landowner Tolerance of Wildlife[a]

Independent Variable[b]	Estimated Coefficient[c]	Standard Error	Change in Probability[c,d]	Standard Error
INTERCEPT	1.321*	0.7102	0.508*	0.2702
EXPERIENCE	−0.005	0.5000	−0.002	0.0040
ED/COLLEGE	−0.352	0.0100	−0.135	0.1154
ED/GRADUATE	−0.155	0.4697	−0.059	0.1788
RESIDENCE	−0.070	0.4118	−0.027	0.1588
INC/SOURCE	0.232	0.3412	0.089	0.1309
STRESS1	−0.883*	0.5075	−0.340*	0.1965
STRESS2	−0.338	0.2991	−0.130	0.1140
STRESS4	−0.133	0.4433	−0.051	0.1700
STRESS5	0.247	0.5881	0.095	0.2262
SIZE	−0.00003	0.00013	−0.00001	0.00004
PUR/ECON	−0.741**	0.0318	−0.285**	0.1223
PUR/REC	0.564*	0.3398	0.217*	0.1307
PUR/LIFE	0.305	0.2699	0.117	0.1035
ELK	−0.570**	0.2664	−0.219**	0.1028
MULEDEER	−0.367	0.3033	−0.141	0.1165
WHITEDEER	0.498*	0.2782	0.192*	0.1073
ANTELOPE	0.243	0.2531	0.094	0.0979
TROPHY	0.942*	0.5233	0.363*	0.2006
OTHER	0.239	0.3145	0.092	0.1211
DAMAGE	−0.048	0.0902	−0.018	0.0149
MORAL	0.638**	0.2573	0.246**	0.1000
INCONVEN	−1.229***	0.2713	−0.473***	0.1019

[a] Total number of observations = 177; χ^2 with 22 degrees of freedom = 82.85; Pseudo R^2 = 0.62; correct predictions= 74%.

[b] EXPERIENCE = number of years landowner had been managing a farm/ranch; ED/COLLEGE = 1 if education level of landowner was past high school graduate, but no graduate work; 0 otherwise; ED/GRADUATE = 1 if education level of landowner was beyond a 4-year college degree; 0 otherwise; RESIDENCE = 1 if landowner resides on the ranch; 0 otherwise; INC/SOURCE = 1 if landowner resides on the ranch; 0 otherwise; STRESS1 = 1 if landowner ranked financial stress severe; 0 otherwise; STRESS2 = 1 if landowner ranked financial stress above average; 0 otherwise; STRESS3 = 1 if landowner ranked financial stress average; 0 otherwise (omitted from the equation to avoid singularity); STRESS4 = 1 if landowner ranked financial stress slight; 0 otherwise; STRESS5 = 1 if landowner ranked financial stress insignificant/none; 0 otherwise; SIZE = Value ($1,000) of total forage base; PUR/ECON = 1 if a major reason for purchasing the ranch was economic; 0 otherwise; PUR/LIFE = 1 if a major reason for purchasing the ranch was for the way of life; 0 otherwise; ELK = 1 if elk were one of the top 3 species causing damage; 0 otherwise; MULEDEER = 1 if mule deer were one of the top 3 species causing damage; 0 otherwise; WHITEDEER = 1 if whitetail deer were one of the top 3 species causing damage; 0 otherwise; ANTELOPE = 1 if antelope were one of the 3 species causing damage; 0 otherwise; TROPHY = 1 if trophy animals were one of the top 3 species causing damage; 0 otherwise; OTHER = 1 if other animals were one of the top 3 species causing damage; 0 otherwise; DAMAGE = Average value ($1,000) of damage caused by big game per year (excluding rangeland forage); MORAL = 1 if landowner felt a moral obligation to care for big game; 0 otherwise; INCONVEN = 1 if landowner felt their income was adversely affected by the "general inconvenience" of big game; 0 otherwise.

[c] *, **, and ***, indicate significance levels at α = 0.10, 0.05 and 0.01, respectively.

[d] Calculated at mean values of the independent variables. For dummy variables, the change in probability is calculated as the variable takes on its two values (0,1).

erable big game use by 29 percent, while purchasing for recreational purposes increased the probability by 22 percent. If trends in purchasing ranches for recreational purposes continue, wildlife depredation should become less of a concern for WGFD officials. Antithetically, increased land prices stemming from the increased demand for ranches in Wyoming

will make economic survivability an even more important factor to career ranchers entering ranching.

Tolerance of wildlife was associated with the respondent feeling a moral obligation to care for big game. When a landowner felt this moral obligation, the probability of big game use being tolerable increased by 25 percent. This moral consciousness concerning the balance of nature and the landowner's role in that balance appears to be an important factor in defining the tolerance of landowners towards wildlife. Comparison of the change in probability between MORAL and some of the economic variables suggests, though, that a moral obligation to care for wildlife may be subsidiary to the landowners economic dependency on the land as suggested by Craven *et al.*

Results indicated that tolerance toward wildlife depredation was species specific. Damage initiated by elk was less tolerable than other species and decreased the probability of the damage being tolerable by 22 percent. The presence of white-tailed deer, contrarily, increased the probability by 20 percent of the landowner stating that damage was tolerable. WGFD statistics denote the average value of an individual elk claim is smaller than deer or antelope claims, indicating that the landowners' lack of tolerance for elk is distinctive and not necessarily associated with the amount of damage being created. Deer, particularly white-tailed, are more apt to forage close to the farmstead and have an aesthetic value. The aesthetic value of deer may also be related to their being targets of anthropomorphism.

The positive sign accompanying the coefficient for TROPHY was different than hypothesized. While landowners were originally thought to be less tolerant to damage perpetrated by mountain lions or bear, fair depredation settlements may partially account for the tolerance of landowners toward trophy game. According to WGFD statistics, 96 percent of claims for mountain lions are related to depredation on domestic sheep and are confined geographically. Although some livestock depredation is difficult to substantiate, the WGFD has attempted to be extraordinarily fair in these settlements. The WGFD has recognized the rancher's inability to document all livestock depredation claims and has at times designated special compensation areas for lion damage to livestock (Iverson). Depredation settlements in these special compensation areas have been based on a formula where the rancher is reimbursed for confirmed kills plus a percent of all missing ewes and lambs. Thus, relatively liberal depredation settlements may partially account for the landowners' tolerance of trophy game.

Damage Claims Submissions

Over half the respondents (54 percent) had submitted wildlife damage claims during the last five years based on the WGFD wildlife damage submission list. Respondents who submitted claims were asked how many claims they had submitted over the previous five years, how many claims were accepted, how many were rejected and reasons for rejections. One-hundred and six respondents said they submitted a total of 237 damage claims over the previous five years, an average of 2.24 claims per submittent. Maximum damage claims submitted by a single landowner was 10, while the majority (67 percent) had only submitted one or two damage claims. Two hundred and seven damage claims submitted by 95 respondents were accepted, an average of 2.18 claims per submittent. Of those who had submitted damage claims, 68 percent had at least one claim accepted and 25 percent had at least one rejected.

Respondents who had borne intolerable wildlife damage but had not submitted damage claims were questioned why they had not submitted damage claims. Almost 64 percent of the respondents said the submission process was more trouble than it was worth. Six percent said they were not eligible because damage was less than the $100 minimum, while three percent were ineligible because they did not allow hunting on their private land. None of the respondents were ineligible because they failed to meet the submission deadline. Almost one-half of nonclaimants offered comments or gave other reasons for not submitting

claims. Lack of knowledge concerning damage claim procedures or policies, "too hard to prove", and "WGFD does not pay for standing rangeland forage depredation" were the major reasons for not submitting claims.

Four descriptive variables were significant in classifying respondents as to who had or had not submitted damage claims to the WGFD (Table 3). The estimated probit model correctly classified 74 percent of respondents in the sample.

Respondents with at least some graduate training beyond their college degree were 29 percent less likely to submit damage claims. Landowners with higher education levels have generally been found to foster a positive orientation to wildlife presence (Adams, Newgard and Thomas; Kellert).

Landowners' lack of tolerance toward elk was again manifest in their tendency to submit damage claims for elk depredation. If elk were involved in the depredation, there was a 25-percent higher probability that a damage claim would be submitted.

The economic stress the respondent was experiencing was not a significant factor influencing submission of damage claims. The amount of damage incurred and the "general inconvenience" experienced were significant indicators. Each $1000 of reported damage increased the probability of a damage claim being submitted by 3.4 percent and if the landowner felt his or her income was adversely affected by the "general inconvenience" of big game, the probability of submitting a damage claim was increased by 27 percent. Because the WGFD does not pay depredation claims on the "general inconvenience" created by wildlife, results indicate damage claim submissions may be affected by the general annoyance associated with the presence of big game.

If respondents felt a moral obligation as a landowner to care for big game, results have shown they were generally more tolerant of wildlife depredation. Moral obligation, though, did not significantly alter the probability that a damage claim would be submitted to compensate the landowner for the damage caused by wildlife. Additionally, reasons why the landowner purchased the ranch did not significantly influence the submission of damage claims. Neither were damage claim submissions associated with the size of the ranch where the damage was occurring.

Summary and Implications

Maintaining or increasing the supply of wildlife has been a motivation behind depredation payments made by state wildlife agencies. With the encroachment of residential areas onto big game winter range and increased demand for big game species, deeded agricultural land is a key component in maintaining free roaming, publicly owned wildlife herds. With landowner tolerance being a major factor influencing the expanse of wildlife habitat, augmenting that tolerance is a major interest of state wildlife agencies.

Results showed that slightly over half of the ranchers/farmers surveyed in Wyoming felt wildlife depredation on their property was tolerable. The financial stability and economic purpose of the agriculture enterprise significantly influenced this tolerance. While individuals maintaining agricultural operations for recreation purposes may be more tolerant of wildlife depredation, their intents may not always coincide with WGFD management objectives. For example, one of the few wildlife population management tools available to the WGFD is the ability to control the number of hunting licenses authorized in a particular area. If landowners do not allow hunting access, the harvest desired by WGFD may not be accomplished. This particularly compounds the depredation problem when wildlife move onto another landowner's property after the hunting season. Licensing programs that encourage a more uniform harvest (e.g., harvesting overpopulated females), especially for out-of-state hunters typically in search of trophy animals, can assist in meeting population objectives.

Because of the relationship found between tolerance and the economic status or intent of the rancher, policies that financially reward landowners for succoring big game should be effective in maintaining or increasing wildlife

Table 3. Maximum Likelihood Estimates for the Probit Model Used to Analyze Factors Influencing Damage Claim Submission

Independent Variable	Estimated Coefficient	Standard Error	Change in Probability[c]	Standard Error
INTERCEPT	−1.088*	0.6078	−0.426*	0.2407
EXPERIENCE	0.007	0.0087	0.003	0.0037
ED/COLLEGE	−0.208	0.2701	−0.081	0.1066
ED/GRADUATE	−0.733*	0.4164	−0.287*	0.1640
RESIDENCE	0.065	0.3823	0.025	0.1471
INC/SOURCE	−0.162	0.3057	−0.064	0.1208
STRESS1	0.263	0.4962	0.103	0.1943
STRESS2	0.218	0.2725	0.085	0.1062
STRESS4	0.133	0.4156	0.052	0.1625
STRESS5	−0.243	0.4418	−0.095	0.1727
SIZE	0.0001	0.0001	0.00005	0.00005
PUR/ECON	0.384	0.2803	0.151	0.1110
PUR/REC	−0.158	0.2981	−0.062	0.1170
PUR/LIFE	−0.105	0.2442	−0.041	0.0953
ELK	0.627**	0.2508	0.246**	0.0988
MULEDEER	0.179	0.2632	0.070	0.1029
WHITEDEER	−0.354	0.2458	−0.139	0.0965
ANTELOPE	0.043	0.2263	0.017	0.0895
TROPHY	0.217	0.4173	0.085	0.1634
OTHER	0.212	0.2865	0.083	0.1107
DAMAGE	0.082*	0.0497	0.032*	0.0190
MORAL	0.088	0.2444	0.035	0.0972
INCONVEN	0.699***	0.2479	0.274***	0.0982

[a] Total number of observations = 177; χ^2 with 22 degrees of freedom = 53.57; Pseudo R^2 = 0.62; correct predictions = 74%.

[b] EXPERIENCE = number of years landowner had been managing a farm/ranch; ED/COLLEGE = 1 if education level of landowner was past high school graduate, but no graduate work; 0 otherwise. ED/GRADUATE = 1 if education level of landowner was beyond a 4-year college degree; 0 otherwise; RESIDENCE = 1 if landowner resides on the ranch; 0 otherwise; INC/SOURCE = 1 if landowner resides on the ranch; 0 otherwise; STRESS1 = 1 if landowner ranked financial stress severe; 0 otherwise; STRESS2 = 1 if landowner ranked financial stress above average; 0 otherwise; STRESS3 = 1 if landowner ranked financial stress average, 0 otherwise (omitted from the equation to avoid singularity); STRESS4 = 1 if landowner ranked financial stress slight; 0 otherwise; STRESS5 = 1 if landowner ranked financial stress insignificant/none; 0 otherwise; SIZE = Value ($1,000) of total forage base, PUR/ECON = 1 if a major reason for purchasing the ranch was economic; 0 otherwise, PUR/LIFE = 1 if a major reason for purchasing the ranch was for the way of life; 0 otherwise; ELK = 1 if elk were one of the top 3 species causing damage; 0 otherwise; MULEDEER = 1 if mule deer were one of the top 3 species causing damage; 0 otherwise; WHITEDEER = 1 if whitetail deer were one of the top 3 species causing damage; 0 otherwise; ANTELOPE = 1 if antelope were one of the 3 species causing damage; 0 otherwise; TROPHY = 1 if trophy animals were one of the top 3 species causing damage; 0 otherwise; OTHER = 1 if other animals were one of the top 3 species causing damage; 0 otherwise; DAMAGE = Average value ($1,000) of damage caused by big game per year (excluding rangeland forage); MORAL = 1 if landowner felt a moral obligation to care for big game; 0 otherwise; INCONVEN = 1 if landowner felt their income was adversely affected by the "general inconvenience" of big game; 0 otherwise.

[c] *, **, and ***, indicate significance levels at α = 0.10, 0.05 and 0.01, respectively

[d] Calculated at mean values of the independent variables. For dummy variables, the change in probability is calculated as the variable takes on its two values (0,1).

tolerance. Several policies aimed at accomplishing this task have been proposed over the past decade. One suggested policy is to allow landowners to market a portion of big game licenses within a hunt area to patrons hunting on their land or land that is accessed through their property. This policy has proven to be effective in increasing landowner tolerance to-

ward wildlife and enlisting landowners in increasing the supply of big game (Dagget). By requiring landowner to participate in this program to provide hunting access to a specified number of general license hunters, land access problems also may be reduced. However, an advisory team established in December 1995 was unable to reach a consensus on any such recommendation. They surmised that "any proposal to reallocate licenses ... will not meet the task force's own criteria of fairness and acceptability to the Wyoming public" (Rea and Winner, p. E2). Further examination of this alternative is recommended as it provides entrepreneurial opportunities to ranchers while encouraging a more active role in the management of wildlife.

Elk were found to be at the heart of the wildlife tolerance and damage claim submission controversy. Elk contributed to decreased landowner tolerance and increased damage claim submissions. Wyoming elk numbers have grown from 23,000 in 1923 to 102,439 in 1995 (Wyoming Game and Fish Department, 1995). While elk were shown to be the most unpopular big game species among Wyoming landowners, they are popular among hunters. Developing equilibrium between supply (landowner tolerance) and demand for elk will probably necessitate a more thorough landowner compensation system such as the reallocation of licenses previously discussed. The WGFD has tried to curb elk depredation by purchasing several private properties for use as wintering grounds. This is a controversial practice because many opponents feel it takes land out of productive use and decreases the economic activity and tax base of the local economy.

Results showed that the complexity of the submission process was a deterrent to many respondents who were experiencing wildlife depredation but had not submitted a damage claim. Educational or training seminars may be beneficial if the intent of the WGFD is to further improve landowner tolerance of wildlife through depredation payments.

Few factors other than the degree of damage itself were significant in categorizing respondents as to whether they had submitted damage claims. This indicated that alternative motives, other that the dislike of elk depredation, generally did not influence damage claim submissions. For example, the damage claim policy apparently was not abused by landowners experiencing financial difficulty, not by those not residing in Wyoming, and not by those with varying motives for purchasing their property.

The issues of wildlife tolerance and private landowner compensation will not quickly disappear. In fact, as one of the members of the 1995 WGFD advisory team recently observed, the relationships between sportsmen, landowners and the WGFD may be at "an all-time low" (Rea and Winner, p. E2). While the WGFD depredation program has done much to increase the supply of wildlife in Wyoming, new avenues still need to be explored.

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