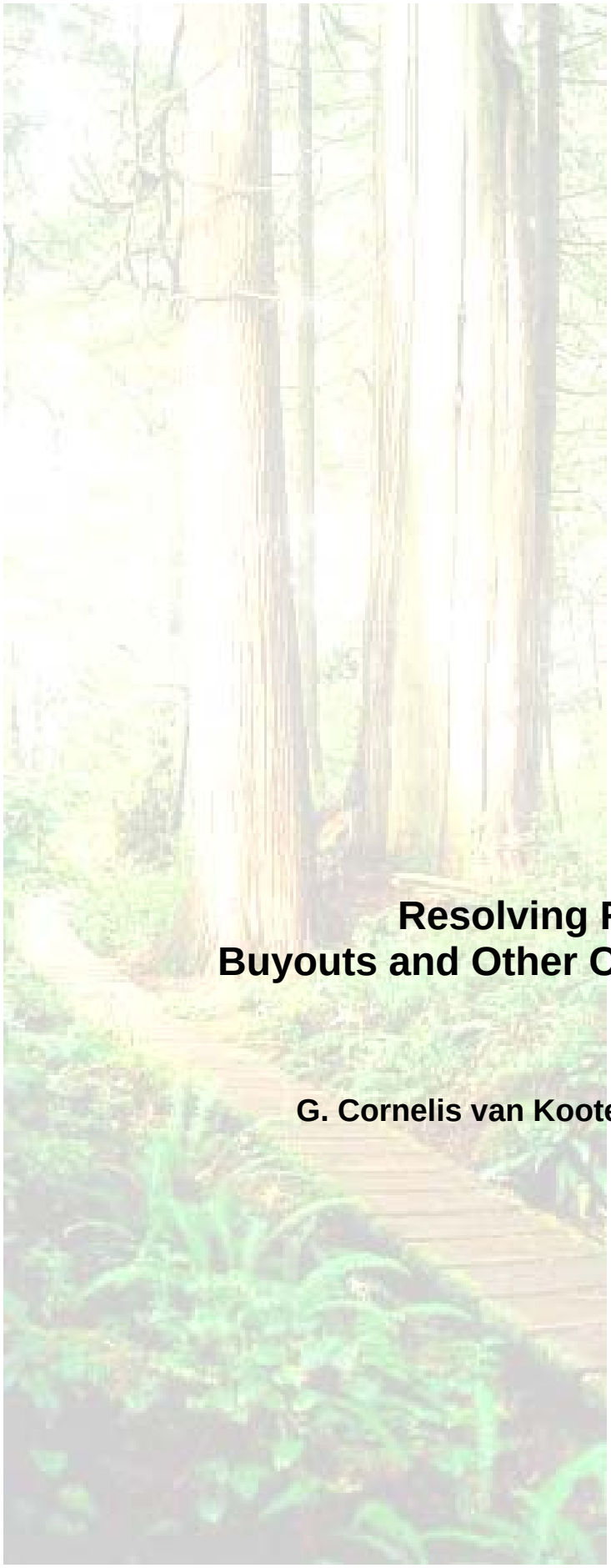

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# Resolving Range Conflict in Nevada? Buyouts and Other Compensation Alternatives

**G. Cornelis van Kooten, Roy Thomsen and Tom Hobby**

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# Resolving Range Conflict in Nevada?
# Buyouts and Other Compensation Alternatives

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**Abstract**

To mitigate adverse effects on ranchers from reduced access to public forage, financial or other forms of 'compensation' may be required. In this paper, we use results from a survey of Nevada ranchers to examine ranchers' willingness to sell grazing permits and participate in other schemes that enable them to continue ranching in spite of declining access to public forage. On average ranchers demand $255 per AUM to sell grazing permits, while support for other programs, some of which are performance based, depends on whether respondents trust public agencies and intend to pass their ranch on to an heir.

**Keywords:** Compensation for grazing rights; environmental services; range economics

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## Background

Ranchers have increasingly come under pressure from environmental groups because livestock grazing on public lands is seen to be a contributing factor to environmental degradation. Access to public grazing has fallen over time, threatening the viability of ranchers' operations. For example, public grazing in Nevada decreased by 32.7% (or some 540,000 AUMs) between 1981 and 2002, resulting in estimated direct annual losses of more than $12 million to the livestock industry and $25 million to the Nevada economy (Resource Concepts Inc.). To address the external impacts of livestock grazing on public lands, Congress is considering compensating ranchers for loss of grazing services, primarily by purchasing ranchers' grazing permits. Under the proposed Voluntary Grazing Permit Buyout Act (HR 3324, 16 October 2003), for example, Congress would have made available $100 million to purchase grazing permits from ranchers for an offered price of $175 per AUM. Such legislation has not yet been passed, however, partly because rural lobby groups oppose buyouts as this implies an irrevocable loss of access to public range and a decline in the number of ranchers and the rural community, while some environmentalists argue that the budget is inadequate to stop the continued deterioration of public lands.

A pro-ranch view of public land management had ranchers and public land managers working together to improve rangeland, until numerous environmental laws enacted in the 1970s and 1980s led the public land managers to devote less time to building relationships with ranchers and more to complying with federal regulations.[1] It considers reductions in AUM allocations as a naïve response by public land managers to demands to protect non-commercial values of the range. While some of the reductions were considered valid due to

evidence of deteriorating range quality, managers were often viewed as making range management decisions based on inadequate information, resulting from too little staffing, funding or experience, leading to poor range decisions and systematic AUM reductions;[2] apparently insufficient time was spent seeking effective solutions to range problems (Resource Concepts Inc., pp.62-63). This led to a reduction in the ranch community's social capital (Putnam), particularly as trust between ranchers and the land agents declined. Consequently, little has been done cooperatively to resolve grazing problems on public range, with little investment in activities that increase social capital and reduce the transaction costs of sustainable range management (van Kooten et al.).

In this paper, we investigate factors that might affect the political acceptability of several schemes to compensate ranchers for reduced access to public lands. Among factors we consider are ranchers' opinions about range management and the level of trust that exists between ranchers and the public land agencies in Nevada. For this purpose, we employ responses to a survey of ranchers, using these to examine various economic and social aspects related to the acceptance of alternative grazing options. The options considered include sale of all rights to future grazing and several schemes that enable ranchers to maintain their incomes and lifestyles despite lost grazing opportunities.

The survey was mailed to the entire population of BLM and US Forest Service grazing permit holders in Nevada between March 29, 2002 and July 5, 2002. The design and mailing procedures were based on Dillman. The survey was reviewed and pre-tested by various University of Nevada Reno faculty members, Nevada extension specialists and others at the university involved in ranching. The first mailing was sent on March 29, 2002 with a second mailing to non-respondents on May 21, 2002. Follow-up telephone calls were

subsequently made throughout June to all ranchers who had not responded to either mailing. The response rate was 47.9 percent, or 246 completed surveys (Thomsen).[3]

As indicated in table 1, on average respondents owned nearly 9,000 acres of their own land and utilized 5,037 AUMs of public grazing. Respondents were predominantly male (206 of 244), 53 years of age with nearly 38 years of ranching experience (not all as the operator), and with slightly more than one year post-secondary education. Annual income from all sources averaged about $53,400, with some one-third reportedly coming from off the ranch.[4] If one compares income, age and levels of education with 2000 Census Data for Elko, White Pine, Eureka and Humboldt Counties, those in which the majority of respondents are located, no statistical differences between ranchers and other rural residents are discernable.[5] Hence, we have no reason to suspect that the exclusion of non-respondents would lead to bias in the statistical analyses that follow.

<Insert Table 1 about here>

Respondents to the Nevada ranch survey were asked two types of questions dealing with potential compensation. First, they were asked to provide a 'yes'/'no' response to a proposed payment in exchange for permanently retiring their grazing rights. Then they were asked to provide their opinions (on a five-point likert scale) regarding three alternative mechanisms that might enable them to mitigate losses from reduced access to grazing. A random utility maximization framework is appropriate for analyzing binary ('yes'/'no') responses, while an order-logit model is typically used when responses are categorical.

We begin in the next section by employing the standard random utility maximization

framework to examine ranchers' stated willingness to accept monetary compensation for selling grazing rights. Then, we examine responses to three alternative means of compensating ranchers using an ordered-logit model. While the focus of the research is to investigate methods for compensating ranchers for loss of grazing privileges, we also investigate the impact on compensation of ranchers' opinions about their relations with the public land agencies (trust, levels of disagreements, opinions on the role of livestock grazing, etc.) and personal characteristics. Our conclusion is that relations between ranchers and the land agencies, and ranchers' personal situations, have an important impact on compensation levels and the design of compensation schemes.

**Compensating Ranchers by Purchase of Grazing Permits**

The 1978 Public Rangelands Improvement Act established that grazing fees would be calculated as a base fee of $1.23 per AUM (established in 1966 using a cost of production approach). The base fee is adjusted using indexes of private grazing values, livestock market prices and rancher operating costs, but with the proviso that the fee not decline below $1.35/AUM (Torell et al.; Dietz and Rothenberg). The grazing fee reached a high of $2.36/AUM in 1980 falling to $1.35 in 1985, never again to exceed $2 per AUM; the grazing fee was $1.43 in 2002 (the year of our survey), falling back to $1.35 in 2003 where it had been for most of the previous decade. Private alternatives for grazing averaged $11 per AUM in 1997 (Dietz and Rothenberg). In Oregon, private grazing was valued at an average of $9.23 per AUM in 2004, and an average $8.83/AUM in the two most southeasterly counties in the State, Malheur ($2.53/AUM) and Harney ($12.43/AUM) counties, which border Nevada.[6]

Based on the 2002 grazing fee and assuming that southern Oregon's private fee of $8.83/AUM includes benefits of $2.91/AUM (or one third of the private fee) not available on public range (see Bartlett et al.), the capitalized value of a grazing permit in Nevada amounts to some $89.80 per AUM if a discount rate of 5% is employed.[7] This might be considered the benefit that continued access to public forage confers upon ranchers.

Respondents to the Nevada ranch survey were asked whether they would be willing to accept a certain level of compensation to retire their grazing rights permanently, an idea first proposed by Gardner (1962, 1963). Ranchers were given randomly generated WTA amounts ranging from $5 to $200 per AUM, with 8.4% of respondents indicating a willingness to accept the stated amount. To determine the average expected compensation required, we use the random utility maximization (RUM) framework to depict a rancher's decision about whether or not to accept a particular offer to sell grazing rights.

*RUM Model*

The RUM approach to analyzing dichotomous choice responses to a valuation question is well known. We briefly describe it in the context of the current study. Assume rancher *i*'s indirect utility is a function of access to public forage (indicator variable *I*), income that depends on the availability of public forage, $m(I)$, and a vector of observable characteristics *s*. Suppose that the indirect utility function can be specified as having a deterministic component, $v_i(I, m, s)$, and an additive stochastic component: $u_i(I, m(I), s) = v_i(I, m(I), s) + \varepsilon_{i,I}$, where $I$=1 if the individual wishes to continue to access public forage and 0 otherwise, and $\varepsilon_{i,0}$ and $\varepsilon_{i,1}$ are iid random variables with zero mean and variance $\sigma^2$ (Greene).

When offered an amount of money, *B*, to forego perpetual access to an annual AUM of public forage, rancher *i* will sell her grazing permit as long as $v_i(0, m+B, s)+\varepsilon_{i,0}>v_i(1, m, s)$

$+\varepsilon_{i,1}$. Since utility is a random variable, the probability that a rancher chooses to accept the offer can be written as (suppressing subscript *i*):

(1) $$\Pr(y_{wta}=\text{yes}) = \Pr\{v\,(0, m+B, s)+\varepsilon_0 > v\,(1, m, s)+\varepsilon_1\}$$

$$= \Pr\,\{(\varepsilon_0 - \varepsilon_1) > -[v\,(0, m+B, s) - v\,(1, m, s)]\}.$$

Let $\Delta v=[v(0, m+B, s) - v(1,m, s)]/\sigma$ and $\varepsilon=(\varepsilon_0 - \varepsilon_1)/\sigma$, where $\varepsilon$ is iid (because $\varepsilon_1$ and $\varepsilon_0$ are iid) and distributed as a logistics function. This yields the logit model:

(2) $$\Pr(y_{wta}=\text{yes}) = \Pr(\varepsilon > -\Delta v) = F_\varepsilon\,(\Delta v),$$

where $F_\varepsilon(.) = \dfrac{e^{(.)}}{1+e^{(.)}}$ is the cumulative logistics distribution function and $\Delta v(B, s) = \beta'\, x_{wta}$, where $x_{wta}$ includes the buyout offer and other attributes.

The ranchers' minimum WTA compensation, denoted $B^*$, is determined as the amount of money needed to keep the rancher indifferent between accepting the bid and retaining cattle on public land (Hanemann). One can express this indifference by setting the probability of accepting a bid to 0.5 and solving for $B^*$,

(3) $$\Pr(a=1) = \Pr\{\, v_1(m+B^*, s) + \varepsilon_1 > v_0(m, s) + \varepsilon_0\} = 0.5.$$

From (3), the probability of accepting the bid, $B^*$, is the same as the probability of rejecting it. Thus, the median willingness to accept compensation can be considered a basic welfare measure, which is found by solving (3) for $B^*$.

*Empirical Results: Ranchers' Willingness to Accept (WTA) Compensation*

The estimated logit regression equation explaining the WTA compensation for retiring

grazing rights is provided in table 2, as is our estimate of average WTA. A log-likelihood ratio test is used to determine whether the variables included in the final (restricted) regression model are statistically preferred to those included in the general model, which includes all the variables available for explaining acceptance of the WTA amount, namely, those provided in table 1.[8] Only the final model results are presented in table 2.

<Insert Table 2 about here>

The WTA variable has a positive coefficient as anticipated, indicating that as the WTA payment offer increased the likelihood of a 'yes' response also increased. The median WTA determined from the results in table 2 is $255.36. This is the compensation demanded that would make ranchers indifferent between the bid and staying in ranching, namely, Pr('yes')=Pr('no')=0.5. Although the compensation bids in the Nevada ranch survey ranged from $5 to $200, the $255 predicted median WTA is above the $90.83 average WTA of the 8.4 percent of respondents who would take the offered amount. The estimated RUM model takes into account the fact that more than 90 percent of respondents are unwilling to accept the proposed buyout, which explains why the estimated median and mean levels of compensation exceed $200. Nonetheless, given the confidence interval about the estimated median, it turns out that the offer of $175 per AUM found in the proposed buyout legislation falls within a 95% confidence interval of the estimated median compensation demanded. Nonetheless, the high compensation demanded value appears to indicate that ranchers want to hold on to their grazing rights and few are likely to accept an offer of $175 per AUM. Yet, only a small proportion of ranchers in the western United States need to accept this offer and

the proposed $100 million budget will be exhausted.

We calculated that grazing permits in Nevada might be worth $89.80/AUM when compared to private rates in Oregon and using a 5% discount rate. From the RUM model, we estimated that compensation demanded might be some $255, suggesting that ranchers are likely using a much lower discount rate than 5% – a crude calculation suggests it is about 1.7% (see also Bartlett et al.). This is surprising because one would expect the value of a grazing permit to be discounted at a much higher rate than even 5%, perhaps in the range of 20% (which would imply a value of $22.40/AUM), because of uncertainty about ranchers' future ability to access public forage. It is likely that ranchers view the grazing fee (current access) as an expense to be kept as low as possible, while long-term access to public lands, which is what a buyout program addresses, is something different. Ranchers value grazing rights highly because it not only gives them the ability to graze cattle, but it enables them to pursue a particular lifestyle. That income was not significant in the WTA model provides some support for the idea that the decision to sell grazing rights is clearly more than just an economic one.[9] Future research is required to address this issue.

Now consider the other explanatory variables in table 2. The significant variables are ranching experience, owned land, amount of public forage, and whether or not the rancher plans to pass the ranch to an heir. Those with more private land are less likely to accept the offered compensation, because they are in a better position to hold out for higher offers – they are better able to weather reductions in public forage, all else equal. This is not true of ranchers with a greater dependence on public range, as indicated by their greater willingness to accept a particular bid. Respondents with more ranch experience are also more willing to accept an offer to sell permits, perhaps because they are more knowledgeable about the

future direction of livestock access to public lands or they are ready to quit the sector. What is surprising is that those who were more likely to pass the ranch to an heir are also more likely to sell grazing permits. Indeed, compared to the other variables, the 'heir' variable has the most significant impact on a respondent's acceptance of the offered bid as determined by the marginal effect (see table 2). Perhaps those who had intended to pass the ranch onto an heir are also more willing to consider other financial ways of benefiting one's offspring, such as using the money to purchase more private land. Further research into this relationship is also warranted.

Also surprising is that neither our financial stress nor trust variables are statistically significant. A rancher who is under financial stress is not more or less likely to accept a bid to sell grazing permits than one who is not stressed. A possible explanation is that, because all ranchers in the sample rely on public land and thus most would have little wealth, the financial stress variable captures nothing more than feelings of optimism/pessimism. Trust between ranchers and public agencies does not play a role, perhaps because respondents to the survey realize that decisions about range use are political in nature and often outside the control of the public land agencies.

**Alternative Options for Compensating Nevada Ranchers**

To address the environmental concerns associated with livestock grazing, public managers have reduced AUMs of forage available from the land. Increased grazing fees (with greater flexibility to reduce stocking rates but without losing ability to utilize AUMs in the future) are one option for bringing about reductions in utilization of public lands by domestic livestock, but other options have also been suggested. To investigate some of these, the

Nevada ranch survey asked respondents to consider potential means by which they might be 'compensated' for a one-quarter reduction in public forage. Respondents were asked to value each of the following options on a likert scale of 1 (bad idea) to 5 (good idea):

1. "Differentiated grazing fees will be used to reward or penalize ranchers for their efforts to improve range quality and/or make available environmental amenities (e.g., better sagebrush habitat) on public land."
2. Ranchers would "be allowed to collect fees for use of public lands by hunters and recreationists, and for providing guiding services."
3. Ranchers would "be allowed to access AUMs of grazing as before, but when grazing permits are transferred use will be reduced."

Because of the likert scale, ordered-logit models are used to analyze responses.

*Ordered-Logit Model*

Ordered-logit models are used when the dependent variable is categorical and values are ordered. Since ranchers were asked to express their opinions using a five-point likert scale, an ordered-logit model can assist in determining those variables that increase our prediction that ranchers would see a given alternative as a good idea (positive estimated coefficient) or a bad one (negative coefficient). For a model with three categorical variables (or three outcomes), ordered-logit probabilities are calculated as follows (Greene, p.876):

$$
\begin{aligned}
&\Pr(y=0) = 1 - \mathrm{F}_{\varepsilon}(\beta x)) \\
&\Pr(y=1) = \mathrm{F}_{\varepsilon}(\mu - \beta x) - \mathrm{F}_{\varepsilon}(\beta x) \\
&\Pr(y=2) = 1 - \mathrm{F}_{\varepsilon}(\mu - \beta x)
\end{aligned} \tag{4}
$$

where $\mathrm{F}_{\varepsilon}$ represents the logistic cumulative distribution function of the error term, $x$ is a

vector of explanatory variables, and $\beta$ is a vector of parameters to be estimated. Again, a log-likelihood ratio test is used to determine whether the restricted (final) regression model is statistically preferred to the general model that includes all of the available explanatory variables in table 1 that might affect the dependent variable.

*Differentiated Grazing Fees to Reward Environmental Improvements*

The mean response to this survey question was a likert score of 1.27 with a standard deviation of 0.78 (table 1). This suggests that respondents do not generally like this idea. The likert scores were regressed on the available explanatory variables, with estimation results for the restricted model reported in table 3.

<Insert Table 3 about here>

Consider first variables that increase the chance that differentiated grazing fees are viewed as a good idea. As expected, those with a higher education appear more receptive to the use of differential grazing fees to reward environmentally sound range management practices. It may be that more educated ranchers feel they are better able to manage the range and are willing to be paid for their expertise in improving the ecosystem. Further, when trust between ranchers and pubic land managers increases, differentiated grazing fees have a higher chance of being considered a good idea. Finally, although support for differentiated grazing fees is also related to income and the opinion that ranchers should have more rights to wildlife (as expected), the estimated coefficients are not statistically different from zero.

The variables that decrease the likelihood of viewing differentiated grazing fees as a good idea are the respondent's age, proportion of income accounted for by off farm work,

AUMs of public forage, favorable opinions regarding the role of domestic livestock in improving range quality and the role of ranchers in mitigating range degradation, and whether the rancher had disagreements with the public land agencies. However, only the proportion of income coming from off the ranch, amount of public forage and the opinion that livestock enhances range quality are statistically significant at the 10% level or better. Those who have a higher proportion of off farm income likely have less time to spend on activities that enhance environmental performance, and thus are less likely to favor differentiated grazing fees that depend on such performance. Likewise, as the amount of public grazing a rancher employs goes up, the more onerous it will be for the rancher to meet environmental performance standards. This appears to be tempered somewhat as the size of a respondent's private holdings increases in combination with higher levels of public forage, although the marginal impact of the cross product term in table 3 is almost insignificant. Finally, ranchers who view livestock grazing as already contributing to range improvements are less likely to think that differentiated fees related to environmental performance are needed, because the very activity of grazing livestock is seen to improve the environment. They see no need to change an existing fee system that has worked well in the past.

An examination of the marginal effects of regressors indicates that, of the statistically significant explanatory variables, only educational attainment, public forage utilized, trust and the opinion that livestock grazing has a positive effect on range quality have a significant marginal impact on the idea that differentiated fees can be used to reward environmental performance. A one unit increase in each of these regressors results in very little change in the opinion ranchers hold about differentiated fees, because the marginal effects nearly offset one another. Unfortunately, policy cannot affect these explanatory variables in direct fashion

and it is not clear how it might be done indirectly.

*Ranchers Attain the Right to Sell Non-grazing Services*

Should ranchers be allowed to collect fees for use of public lands by hunters and recreationists, and for providing guiding services? While some ranchers already provide guiding services, the idea of allowing ranchers to benefit from user fees may be beyond the realm of political feasibility. It is nonetheless possible to give ranchers greater property rights to certain environmental products of the range (namely wildlife), thereby encouraging them to be better public land stewards. The mean response to this idea was 2.66 with a standard deviation of 1.41 (table 1), suggesting that, while still a bad idea, it is considered an improvement over the idea of differentiated grazing fees. The results of the ordered-logit regression are provided in table 4.

<Insert Table 4 about here>

The rancher's age, proportion of income coming from off the ranch, whether the rancher is likely to pass the ranch to an heir, trust in public land agencies, and the opinion that ranchers should have more rights to wildlife are all positively correlated with a respondent's view that ranchers should be compensated for lost access to public forage by being able to collect fees from other public rangeland users. With the exception of off ranch income and trust, these variables are highly statistically significant (at the 5% level or better). Not surprisingly, the results suggest that, as ranchers get older, they appear to feel that they have more 'rights' to the public range that extend beyond their use of range for grazing their livestock. However, whether the respondent intends to pass the ranch onto an heir and the

respondent's strength of opinion regarding ranchers' greater right to wildlife are statistically the most important explanatory variables and the ones with the greatest marginal impact on the preference for this form of compensation for lost forage (see table 4). Not unexpectedly, those intending to pass the farm to an heir and those who feel they should have greater rights to wildlife (perhaps because they perceive that they provide monitoring and other services as a result of their utilization of public range) are more favorable to the idea of benefiting from user fees charged non-ranch, rangeland users.

Ranchers with higher AUMs of public forage are less likely to consider the right to sell the non-grazing services of the public range a good idea, perhaps because they are concerned about the negative impact that other users of public range might have on their own use, with any compensation provided insufficient to overcome the externality effects. They may also perceive this suggestion as an attempt to turn their operation into a 'dude' ranch, or tourist attraction, thus destroying their way of life. Again, this is tempered by the interaction of public forage with private landownership. In any event, the overall marginal impact of the public forage variable is small compared to the effects indicated above. Finally, while the same negative relationship holds for those with higher incomes and for ranchers who consider themselves to be under financial stress, neither of these regressors is statistically different from zero.

*Reducing Grazing upon Permit Transfer*

The final suggestion is one that allows ranchers to maintain their current AUM use, but to lose access to public forage when ranches are transferred. This effectively reduces the rancher's wealth while maintaining current levels of use. Again, ranchers were not keen to see their wealth reduced and considered this option to be a rather bad idea, as indicated by a

mean response on a 5-point likert scale of 2.77 with a standard deviation of 1.40. Nonetheless, this option was considered more favorably than the other two, if only slightly so. To determine which factors affect responses, an ordered logit model was estimated, with estimation results provided in table 5.

<Insert Table 5 about here>

With the exception of operator age and AUMs of public grazing, the explanatory variables in the restricted regression model all increase the likelihood that this idea is favorably perceived. All of the regressors are statistically significant at the 5% level or better, with the exception of age (7.1%) and income (11.2%). Women and more educated respondents are more likely to favor the idea of delaying reductions in access to public forage until the ranch is transferred, perhaps because these groups see the benefits of changing the current grazing system and thus are more open to new ideas concerning the survival of ranching and the political pressure to reduce livestock grazing on public lands. Gender appears to be more important than education (based on the relative magnitudes of the estimated coefficients and the marginal effects), although this could be partly the result of gender being a dummy variable.

Surprisingly, respondents who are more likely to pass along the ranch to an heir are also more likely to accept the notion of losing access to public forage at the time the ranch is transferred. The effect of this variable is greater than that of any other, as evidenced both by its marginal impact (although note the high negative marginal impacts in the strongly disagree and disagree categories) and the magnitude of the estimated coefficient. Perhaps

respondents are discounting the future at a high rate or feel that, by dealing lost access to public forage, they can earn enough money to overcome the future loss of public forage.

As trust increases, it seems reasonable that retirement of grazing rights would be more acceptable to ranchers as they would trust land managers to develop new programs to resolve range utilization conflicts. Also, as a respondent's attitude toward the positive role of livestock in contributing to improved range quality increases, their acceptance of lost grazing services at the time a ranch is transferred also rises. This latter view is at odds with what we might expect, but perhaps here too the respondent is hoping that, as time passes and more knowledge about the usefulness of livestock grazing becomes available, the chance of losing access to public forage also declines.

**Discussion and Conclusions**

Reduced access to public forage has had a negative financial impact on the livestock sector and economy of Nevada, and it has reduced social capital in the State's ranch community (van Kooten et al.; Thomsen). Based on data from a survey of Nevada ranchers, the empirical results presented in this study indicate that the most significant variables predicting the possibility of accepting compensation to stop grazing on public lands, or to consider other means of 'compensation' that enable ranchers to earn a living from the public lands despite reduced public forage, relate to ranchers' desires to pass on the ranch to their progeny, their opinion about the role of livestock grazing on the environment and gender. While the perceived level of trust in the public land agencies, opinion about 'rights' to public range, education, age and/or experience, financial stress, and the extent to which ranchers utilize public forage are statistically significant explanations of one or more compensation options,

their overall importance is small in comparison. While it is not clear that AUM reductions are an effective method of improving range ecosystems, the expressed opposition by ranchers to any change in current arrangements suggests that it may be difficult to find politically feasible means of resolving range conflicts – making it more difficult to find acceptable means of compensating ranchers for lost access to public lands. This view is reinforced by our regression analyses that find a variety of personal and ranch characteristics, opinions, and other factors influencing the chances that ranchers will accept policy changes.

In the final analysis, it appears that only large buyouts can resolve the conflict between the environmental or public good aspects of the public range and the perceived right to graze domestic livestock on public lands. In this regard, the WTA compensation regression results suggest that grazing permits are valued at about $255 per AUM. If this amount were offered to ranchers in Nevada, one would expect about half of them to accept the offer, thereby exhausting the $100 million budget proposed in the Voluntary Grazing Permit Buyout Act. Even if the federal government offered to pay ranchers across the western states $175 per AUM for grazing permits, it is likely that the proposed budget would be quickly exhausted.

**Notes**

1. This view is seen, for example, in the report by Resource Concepts Inc. (2001) from which we take some of the information in this paragraph.
2. For example, more than two-thirds of the AUM reductions in Nevada were left unexplained, resource related (presumably to protect the range ecosystem, although this is not specified), or the result of permit violations.
3. This response rate is high compared to those of other farm surveys. A telephone survey of farmers conducted for the Canadian government by the Environics Research Group, for example, reported a response rate of 12%, about the same as that reported by Bell et al. in their study of farmers' participation in Tennessee's Forest Stewardship Program.
4. Values are approximate because education, age, experience and income were elicited using categorical responses. The survey failed to elicit information on household size.
5. See http://www2.library.unr.edu/dataworks/NVdemog/index.htm#profiles (viewed April 7, 2005). The Census Data do not differentiate between those living on farms and in towns.
6. U.S. Department of Agriculture data for 2004 reported by Barry Adam and viewed 1 June 2004 at <http://www.oregonstatelands.us/rangeland_audit_response.pdf>. The disparity between costs of private forage in these counties is surprising. Data for Lake County (the county to the immediate west of Harney) were not available for reasons of confidentiality.

7. The capitalized value is found as: ($8.83–$2.91–$1.43) per AUM divided by 0.05. The use of 5% is only illustrative of a reasonable real rate of return on investment, although Bartlett et al. find that returns to ranchers are 1-3%. The values provided here are only meant to be illustrative. Some range economists argue that grazing permits have value only because the value reflects a willingness to protect lifestyle (Bartlett et al.).
8. In each iteration, the variable with the least statistical significance was removed from the model (although both trust and income were 'forced' to remain in the model). This continued until the Wald $\chi^2$ statistic fell below a critical significance level of 10%, in which case the restricted model is preferred to the general one.
9. Evidence from Canada's supply managed commodities suggests that uncertainty about future government policy causes current use of quota to sell at prices of about one-quarter to one-fifth of the value of the quota, implying very high discount rates (Rick Barichello, pers comm, 30 April 2005). As to the insignificance of the income variable, this could just as well indicate that the marginal utility of income is constant, so that income enters the indirect utility function in linear fashion (see Hanemann).

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**Table 1: Descriptive Statistics, 2002 Nevada Ranch Survey**

| Variable | Obs | Mean | Std.Dev. | Min. | Max. |
|---|---|---|---|---|---|
| **Dependent Variables** | | | | | |
| WTA (1=yes) | 238 | 0.0840 | 0.2780 | 0 | 1 |
| Reward ranchers for environmental performance with differentiated fees[a] | 239 | 1.2720 | 0.7814 | 1 | 5 |
| Ranchers collect fees from other rangeland users[a] | 238 | 2.6555 | 1.4079 | 1 | 5 |
| AUM reductions occur only when ranch transferred[a] | 237 | 2.7722 | 1.3957 | 1 | 5 |
| **Control Variables** | | | | | |
| Gender of respondent (1=male) | 244 | 0.8440 | 0.3630 | 0 | 1 |
| Operator age (categorical)[b] | 243 | 4.1730 | 1.2000 | 1 | 6 |
| Ranching experience (categorical)[c] | 241 | 4.7260 | 1.3260 | 1 | 6 |
| Operator education (categorical)[d] | 242 | 3.7850 | 1.7390 | 1 | 8 |
| Income (categorical)[e] | 221 | 3.8869 | 1.9214 | 1 | 6 |
| Off farm income (% of total) | 243 | 32.6502 | 36.9824 | 0 | 100 |
| Owned acres ('000s) | 244 | 8.9548 | 28.9383 | 0 | 270 |
| AUMs of public grazing ('000s) | 240 | 5.0367 | 9.6700 | 0 | 75 |
| **Explanatory Variables** | | | | | |
| WTA offer ($ per AUM) | 238 | 89.9370 | 53.4239 | 5 | 200 |
| Plan to pass on ranch to heir[f] | 244 | 0.2049 | 0.3349 | 0 | 1 |
| Rancher under financial stress[g] | 238 | 0.9496 | 1.0217 | -2 | 2 |
| Trust public land agencies[g] | 241 | -1.0705 | 1.0404 | -2 | 2 |
| Ranchers should have more rights to wildlife[g] | 241 | 0.5021 | 1.1333 | -2 | 2 |
| Grazing livestock enhances range quality[g] | 241 | 1.6017 | 0.7181 | -2 | 2 |
| Ranchers are the solution, not the problem, to range degradation[g] | 242 | 1.5289 | 0.7630 | -2 | 2 |
| Had disagreement with a public land agency (1=yes) | 243 | 0.8066 | 0.3958 | 0 | 1 |

[a] Five categories ranging from 1='bad idea' to 5= 'great idea'.
[b] Age categories: 30 or less, 31-40, 41-50, 51-60, 61-70 and over 70 years of age.
[c] Ranching experience categories: 5 or less, 6-10, 11-20, 21-30, 31-40, >40 years experience.
[d] Education categories: grade school, high school, some college or technical school, technical training in the armed forces, completed college, completed some graduate classes, completed Masters degrees, and completed Ph.D.
[e] Income categories: < $30,000, $30-$45,000, $45,000-$60,000, $60,000-$75,000, $75,000-$90,000, >$90,000
[f] Three responses coded as: 0 = 'no', ½ = 'don't know', 1 = 'yes'.
[g] Categorical responses to opinion statements: -2 ('strongly disagree'), -1 ('disagree'), 0 ('neutral'), +1 ('agree'), +2 ('strongly agree')

**Table 2: Logit Regression of Ranchers' Willingness to Accept a Lump Sum Payment to Sell Grazing Permits, Nevada, 2002 (n=207)**

| Explanatory variable[a] | Estimated coefficient[b] | Marginal effect[c] |
|---|---|---|
| WTA offer ($ per AUM) | 0.0242 | 0.0004 |
| | (0.000) | |
| Ranching experience | 0.5039 | 0.0058 |
| | (0.066) | |
| Income | -0.0729 | -0.0023 |
| | (0.645) | |
| Owned acres ('000s) | -0.1810 | -0.0034 |
| | (0.060) | |
| AUMs of public grazing ('000s) | 0.2211 | 0.0040 |
| | (0.003) | |
| Plan to pass on ranch to heir | 3.1666 | 0.0564 |
| | (0.000) | |
| Rancher under financial stress | -0.3548 | -0.0061 |
| | (0.270) | |
| Trust public land agencies | -0.3682 | -0.0053 |
| | (0.322) | |
| Constant | -8.5478 | |
| | (0.000) | |
| Log likelihood | -40.3609 | |
| Pseudo $R^2$ | 0.3642 | |
| Wald $\chi^2(8)$ | 46.23 | |
| | (0.000) | |
| Median WTA | $255.36 | |

[a] Variable descriptions are provided in Table 1.

[b] Levels of statistical significance of estimated coefficients (or p-values) are provided in parentheses and are based on z-tests.

[c] The estimated marginal effect is simply $dy/dx$, or $\Delta y/\Delta x$ for a dummy explanatory variable. See Greene (pp. 815-816) for discussion of how the marginal effects are calculated for logit models. Marginal effects are calculated at means using Stata 8.0. Marginal effects can be interpreted as probabilities: For example, the probability that a rancher will accept a lump sum payment for their grazing permits increases by 5.64% if they plan to pass the ranch on to an heir, *ceteris paribus*.

**Table 3: Ordered-logit Regression of Proposals that Nevada Ranchers be Rewarded for Environmental Performance using Differentiated Grazing Fees (n=211)**

| | | Marginal effects[d] | | | | |
|---|---|---|---|---|---|---|
| Variable[a] | Estimated coeff[c] | Strongly disagree | disagree | neutral | agree | Strongly agree |
| | | 0.9156[e] | 0.0557 | 0.0123 | 0.0079 | 0.0084 |
| Operator age | -0.2742 (0.170) | 0.0212 | -0.0135 | -0.0032 | -0.0021 | -0.0023 |
| Operator education | 0.2316 (0.063) | -0.0179 | 0.0114 | 0.0027 | 0.0018 | 0.0019 |
| Income | 0.1345 (0.270) | -0.0104 | 0.0066 | 0.0016 | 0.0010 | 0.0011 |
| Off farm income (% of total) | -0.0161 (0.033) | 0.0012 | -0.0008 | -0.0002 | -0.0001 | -0.0001 |
| AUMs of public grazing | -0.145 (0.030) | 0.0112 | -0.0072 | -0.0017 | -0.0011 | -0.0012 |
| AUMs × owned acres | 0.0010 (0.013) | -0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Trust public land agencies | 0.3966 (0.055) | -0.0306 | 0.0196 | 0.0047 | 0.0031 | 0.0033 |
| Ranchers should have more rights to wildlife | 0.2845 (0.191) | -0.0220 | 0.0140 | 0.0034 | 0.0022 | 0.0024 |
| Grazing livestock enhances range quality | -0.5863 (0.051) | 0.0453 | -0.0290 | -0.0069 | -0.0045 | -0.0049 |
| Ranchers are the solution, not the problem, to range degradation | -0.3875 (0.196) | 0.0299 | -0.0191 | -0.0046 | -0.0030 | -0.0032 |
| Had disagreement with a public land agency | -0.7056 (0.195) | 0.0656 | -0.0411 | -0.0102 | -0.0068 | -0.0074 |
| Boundary 1[b] | -0.7517 | | | | | |
| Boundary 2[b] | 0.3858 | | | | | |
| Boundary 3[b] | 0.9603 | | | | | |
| Boundary 4[b] | 1.6325 | | | | | |
| Log likelihood = | -102.810 | | | | | |
| Pseudo $R^2$ | 0.1756 | | | | | |
| Wald $\chi^2$ | 43.79 (0.000) | | | | | |
| [degrees of freedom] | [11] | | | | | |

[a] See Table 1 for description of variables

[b] These refer to the estimated boundaries between the effects reported in the last five columns.

[c] Statistical significance of coefficients (p-values) are provided in parentheses, based on z-tests.

[d] The estimated marginal effect is $dy/dx$, or $\Delta y/\Delta x$ for non-continuous explanatory variable. See Greene (pp. 876-877) for method for calculating marginal effects; here they are calculated at the means using Stata 8.0. Marginal effects are probabilities – e.g., the probability that a rancher strongly disagrees with the proposal increases by 2.12% with each increase in age category, *ceteris paribus*.

[e] A number directly below an opinion statement, such as that below 'strongly disagree', refers to the probability that a respondent will have the indicated opinion, in this case 91.56%.

**Table 4: Ordered-logit Regression of Proposals that Ranchers be Compensated for Lost Access to Public Forage by being able to Collect Fees from Other Rangeland Users in Nevada (n=207)**

| | | Marginal Effects[d] | | | | |
|---|---|---|---|---|---|---|
| Variable[a] | Estimated coeff.[c] | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
| | | 0.2624[e] | 0.1508 | 0.3569 | 0.1123 | 0.1176 |
| Operator age | 0.3120 (0.008) | -0.0604 | -0.0153 | 0.0204 | 0.0229 | 0.0324 |
| Income | -0.0484 (0.488) | 0.0094 | 0.0024 | -0.0032 | -0.0036 | -0.0050 |
| Off farm income (% of total) | 0.0050 (0.156) | -0.0010 | -0.0002 | 0.0003 | 0.0004 | 0.0005 |
| AUMs of public grazing | -0.0559 (0.037) | 0.0108 | 0.0027 | -0.0037 | -0.0041 | -0.0058 |
| AUMs × owned acres | 0.0003 (0.078) | -0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Plan to pass on ranch to heir | 1.2794 (0.001) | -0.2476 | -0.0626 | 0.0837 | 0.0938 | 0.1328 |
| Rancher under financial stress | -0.2020 (0.148) | 0.0391 | 0.0099 | -0.0132 | -0.0148 | -0.0210 |
| Trust public land agencies | 0.1324 (0.307) | -0.0256 | -0.0065 | 0.0087 | 0.0097 | 0.0137 |
| Ranchers should have more rights to wildlife | 0.7468 (0.000) | -0.1445 | -0.0365 | 0.0489 | 0.0547 | 0.0775 |
| Boundary 1[b] | 0.2805 | | | | | |
| Boundary 2[b] | 0.9631 | | | | | |
| Boundary 3[b] | 2.5229 | | | | | |
| Boundary 4[b] | 3.3296 | | | | | |
| Log likelihood = | -285.842 | | | | | |
| Pseudo $R^2$ | 0.0925 | | | | | |
| Wald $\chi^2$ | 58.25 (0.000) | | | | | |
| [degrees of freedom] | [9] | | | | | |

[a] See Table 1 for description of variables

[b] These refer to the estimated boundaries between the effects reported in the last five columns.

[c] Levels of statistical significance of estimated coefficients (or p-values) are provided in parentheses and are based on z-tests.

[d] The estimated marginal effect is simply $dy/dx$, or $\Delta y/\Delta x$ for non-continuous explanatory variable. See Greene (pp. 876-877) for a discussion of how the marginal effects are to be calculated; here marginal effects are calculated at the means using Stata 8.0. Marginal effects are probabilities. For example, the probability that a rancher will strongly disagree with the proposal falls by 14.45% with each quantum increase in a rancher's acceptance of the notion that ranchers should have more rights to wildlife, *ceteris paribus*.

[e] A number directly below an opinion statement, such as that below 'strongly disagree', refers to the probability that a respondent will have the indicated opinion, in this case 26.24%.

**Table 5: Ordered-logit Regression of Proposals that Reductions in Public Forage Occur only at Time Ranch is Transferred (n=209)**

| | | Marginal Effects[d] | | | | |
|---|---|---|---|---|---|---|
| Variable[a] | Estimated coeff[c] | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
| | | 0.2161[e] | 0.1680 | 0.2961 | 0.2020 | 0.1179 |
| Gender | 0.8283 | -0.1625 | -0.0402 | 0.0443 | 0.0893 | 0.0691 |
| | (0.024) | | | | | |
| Operator age | -0.1968 | 0.03333 | 0.0132 | -0.0037 | -0.0223 | -0.0205 |
| | (0.071) | | | | | |
| Operator education | 0.1520 | -0.0258 | -0.0102 | 0.0029 | 0.0173 | 0.0158 |
| | (0.048) | | | | | |
| Income | 0.1076 | -0.0182 | -0.0072 | 0.0020 | 0.0122 | 0.0112 |
| | (0.112) | | | | | |
| AUMs of public grazing | -0.0865 | 0.0147 | 0.0058 | -0.0016 | -0.0098 | -0.0090 |
| | (0.000) | | | | | |
| AUMs × owned acres | 0.0006 | -0.0001 | 0.0000 | 0.0000 | 0.0001 | 0.0001 |
| | (0.003) | | | | | |
| Plan to pass on ranch to heir | 1.0777 | -0.1825 | -0.0724 | 0.0205 | 0.1224 | 0.1120 |
| | (0.007) | | | | | |
| Trust public land agencies | 0.4282 | -0.0725 | -0.0288 | 0.0081 | 0.0486 | 0.0445 |
| | (0.001) | | | | | |
| Grazing livestock enhances range quality | 0.6234 | -0.1056 | -0.0419 | 0.0119 | 0.0708 | 0.0648 |
| | (0.002) | | | | | |
| Boundary 1[b] | 0.0867 | | | | | |
| Boundary 2[b] | 0.9030 | | | | | |
| Boundary 3[b] | 2.1300 | | | | | |
| Boundary 4[b] | 3.3884 | | | | | |
| Number of observations | 211 | | | | | |
| Log likelihood = | -102.810 | | | | | |
| Pseudo $R^2$ | 0.1756 | | | | | |
| Wald $\chi^2$ | 43.79 | | | | | |
| | (0.000) | | | | | |
| (degrees of freedom) | (11) | | | | | |

[a] See Table 1 for description of variables

[b] These refer to the estimated boundaries between the effects reported in the last five columns of the table.

[c] Levels of statistical significance of estimated coefficients (or p-values) are provided in parentheses and are based on z-tests.

[d] The estimated marginal effect is simply $dy/dx$, or $\Delta y/\Delta x$ for non-continuous explanatory variable. See Greene (pp. 876-877) for a discussion of how the marginal effects are to be calculated; here marginal effects are calculated at the means using Stata 8.0. Marginal effects are probabilities. For example, the probability that a rancher will strongly agree with the statement increases by 4.45% with each quantum increase in a rancher's expressed trust of the public land agencies, *ceteris paribus*.

[e] A number directly below an opinion statement, such as that below 'strongly disagree', refers to the probability that a respondent will have the indicated opinion, in this case 21.61%.