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# The Economic Benefits of Elk Viewing at the Jewell Meadows Wildlife Area in Oregon

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*In this study a travel cost model is used to estimate the value of elk viewing at the Jewell Meadows Wildlife Area in Oregon. Jewell Meadows was originally established to provide winter browse and supplemental feeding for elk to reduce damage to nearby agricultural and forest land. However, because visitors are virtually guaranteed the opportunity to see large numbers of elk at close range, Jewell Meadows has also become a popular wildlife viewing site. We estimated total access value for the 2007 winter feeding season to be \$6.5 million, which exceeds Jewell Meadows' annual operating budget of approximately \$200,000. Results suggest that visitors highly value the assured wildlife viewing that Jewell Meadows offers.*

**Keywords** elk, wildlife viewing, Jewell Meadows, travel cost method

## Introduction

In 1969, the State of Oregon established the Jewell Meadows Wildlife Area to provide winter habitat and supplemental feeding for Roosevelt elk. Although the primary reason for doing so was to reduce damage to nearby forest and agricultural lands, Jewell Meadows has become a popular destination for wildlife viewing. During the winter feeding season, visitors to Jewell Meadows are almost guaranteed to see large numbers of elk at relatively close range. Little is known, however, about the economic benefits of wildlife viewing at Jewell Meadows.

Economic benefits of wildlife viewing accrue from both expenditures made by wildlife viewers in the region and from utility viewers derive from the experience (i.e., nonconsumptive-use benefits).<sup>1</sup> In this study we focus on the latter. Consideration of wildlife viewing benefits, in addition to the reduction in the damage to forest and agricultural land, allows for a more thorough understanding of the benefits of the supplemental winter feeding program.<sup>2</sup> Given that nonconsumptive-use values do not have a market price, the travel cost model was used to estimate the benefits of wildlife viewing at the Jewell Meadows Wildlife Area and to identify factors that influence these benefits.

## Literature

Values associated with consumptive use of wildlife (e.g., hunting) are well documented (Livengood, 1983; Creel & Loomis, 1992; Sarker & Surry, 1998), but fewer studies

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have estimated nonconsumptive use values such as wildlife viewing. Such benefits, however, can be substantial. Rosenberger and Loomis (2001), for example, estimated the average value of U.S. big game hunting at approximately \$45 per person per activity day and the value of wildlife viewing at approximately \$30 per person per activity day. Wildlife viewing estimates, however, differ substantially across wildlife species, location, and study. Shafer, Carline, Guldin, and Cordell (1993), for example, used the travel cost method (TCM) and contingent valuation (CV) to estimate nonconsumptive values. Estimated net economic values ranged from a low of \$3.57 per visitor day for observing waterfowl to \$20.43 per visitor day for viewing elk to a high of \$44.50 per visitor day for catch and release trout fly fishing. Clayton and Mendelson (1993) estimated that visitors to McNeil River, a bear watching sanctuary in Alaska, were willing to pay between \$228 and \$277 per person for a 4-day permit to visit the sanctuary. McCollum and Miller (1994) estimated gross value for day trips to view a variety of animal species in Alaska. Results varied for hunters and non-hunters and by species. Viewing grizzly bears had the highest mean values (\$485) with non-hunters willing to pay more (\$621) than hunters (\$414). The opportunity to view whales, wolves, and caribou was also highly valued with mean gross values per day trip of \$338, \$309, and \$300 respectively. In general, the willingness to pay estimates were higher for non-hunters than hunters.

Some studies have focused on the attributes of the wildlife viewing experience rather than the value. Manfredo and Larson (1993) examined the opinions of Denver-area residents about wildlife viewing and concluded that (a) people prefer different types of wildlife viewing and (b) wildlife managers should offer a range of wildlife-viewing opportunities. Wildlife viewing in Montana attracts 1.5 million visitors annually (McCool, 1996). He suggested that wildlife viewing may offer economic development opportunities to communities that have lost extractive-industry jobs. Lee and Miller (2003) surveyed residents of Flagstaff, Arizona about their attitudes toward elk management. Respondents said that they enjoyed seeing elk in an urban environment but were also willing to travel to nearby forests to view them. Overall, wildlife viewing provides substantial benefits. Better understanding the magnitude of the benefits can inform management decisions that impact the attributes of the wildlife viewing experience.

## **Study Area**

The Jewell Meadows Wildlife Area is approximately 65 miles northwest of Portland in Oregon's Coast Range. The wildlife area covers approximately 1,200 acres with an additional 2,000 acres under contract with private and public landowners to serve as a buffer to the refuge. The area is temperate, coniferous rainforest, which receives an average of 82 inches of rain a year primarily between October and April. The mission of the Jewell Wildlife Area is threefold: (a) provide and enhance habitat to benefit native wildlife species, (b) reduce wildlife damage to adjacent properties, and (c) provide wildlife viewing opportunities. The facilities at Jewell Meadows consist of several parking lots, one set of bathrooms, and some informational signs. The wildlife area's herd of Roosevelt elk is the most popular wildlife viewing opportunity. In 2007, there were approximately 250 elk in the herd. To reduce damage to adjacent private properties, supplemental feedings for the elk are provided in December, January, and February, which are the months with lowest browse. Seventy-five to 200 elk congregate in the meadows for the feedings. Every day the staff at Jewell Meadows provides a 1-hour

tour on a trailer to feed the elk. These tours must be reserved in advance and fill up quickly.

### The Travel Cost Model

Elk viewing at Jewell Meadows Wildlife Area falls into the realm of nonmarket goods and as such can be valued using one of several established nonmarket valuation techniques (Champ, Boyle & Brown, 2003). In general, nonmarket valuation techniques involve the use of either revealed or stated preference data. Stated preference techniques directly elicit individual preferences for the nonmarket good of interest. Revealed preference techniques allow for values to be inferred from market transactions. The travel cost method is a revealed preference technique commonly used to value recreational uses of the environment (Freeman, 2003; Parsons, 2003). A travel cost model uses data on the number of visits to a site and the cost of travel to the site to estimate demand for the site. One of the most basic travel cost models is the single-site model, which considers the number of trips to a site taken by an individual over a season and the trip cost in terms of time and out of pocket expense. To value elk viewing at Jewell Meadows Wildlife Area, we estimated a single-site travel cost model. The travel cost approach involves two steps. First, a regression model relating the number of trips made by visitors to travel costs and other explanatory variables was estimated. The estimated coefficients were then used to calculate the “access value” or the maximum amount an individual would be willing to pay for the number of trips he took minus trip costs.

A typical travel cost model is formulated as follows:

$$r_i = f(X; \beta) \text{ where:} \quad (1)$$

$r_i$  = the number of trips of the  $i^{\text{th}}$  visitor;

$X$  = a matrix of explanatory variables, including travel costs;

$\beta$  = a vector of regression coefficients.

Because the dependent variable,  $r_i$ , can only take on positive integral values, and it is desirable to have a model where predicted values can only be positive, a count data model is best suited for such data. The two count data models most commonly used to estimate single-site travel cost models are the Poisson and the Negative Binomial regression models (Greene, 2000). The conditional mean of the distribution is modeled as:

$$E(r_i | x) = \mu = \exp(X\beta) \text{ where:} \quad (2)$$

$$X\beta = B_0 + B_{tc}tc + B_{x1}x_1 + B_{x2}x_2 + \dots + B_{xn}x_n$$

In addition to the individual's travel cost ( $tc$ ), explanatory variables that are likely to shift demand for the number of trips to a site are included ( $x_i$ 's). Demand shifters can include demographic variables, measures of experience or related behaviors, or attitudinal variables. Any explanatory variable with a sound theoretical basis for inclusion in the model can be incorporated in the travel cost model; however, in practice most travel cost models are relatively parsimonious.

The vector of coefficients ( $\beta$ ) in the model are fitted using the maximum likelihood method (Haab & McConnell, 2002; Hilbe, 2007). Travel cost models used in recreation research often depend on the sampling plan. For on-site sampling,  $r_j \geq 1$  (i.e.,  $r_i \neq 0$ ), and zero-truncated forms of the Poisson or Negative Binomial models are used to account for this restriction in the range of the dependent variable. Individuals who visit more frequently are more likely to be included in the sample. This is referred to as endogenous stratification (Haab & McConnell, 2002). A specialized form of the zero-truncated Negative Binomial model has been constructed to account for this unequal probability of selection (Englin & Shonkwiler, 1995).

The travel cost variable has two components: vehicle cost and time cost. In the Jewell Meadows elk viewing travel cost model, we used a rate of 48.5 cents a mile to calculate vehicle cost, which was the rate used by the federal government in 2007. Respondents' home zip codes were input into MapQuest to calculate travel distance. If there were more than one person in a vehicle, we attributed the appropriate fraction of vehicle cost to the respondent. We used one-third of a respondent's hourly wage rate to calculate time cost for travel plus time spent at the site. Although previous studies have used one-third of a respondent's hourly wage as a lower bound on the value of a respondent's leisure time, there is little theoretical justification for this practice (Feather & Shaw, 1999). Using the lowest generally accepted fraction of hourly wage to calculate the value of leisure time provided a conservative estimate of the value of elk viewing at Jewell Meadows.

The second step in the travel cost approach is to use the coefficient estimates to estimate mean access value (Haab & McConnell, 2002):

$$\bar{A} = \frac{\bar{r}}{B_{tc}} \quad (3)$$

where  $\bar{A}$  denotes mean access value,  $\bar{r}$  denotes the mean number of trips in the season for the sample, and  $B_{tc}$  is the coefficient on the travel cost variable. Using access value as a measure of recreation value gives the loss in consumer surplus a person would experience if they did not travel to the recreation site.

## Data and Model Fitting

Data for estimating Equation (1) were obtained from an onsite survey of visitors to Jewell Meadows. Because there are seldom more than a few groups of visitors at Jewell Meadows at one time (20,000 people visited during the 3-month winter feeding season in 2006), and these visitors are often not concentrated in one area, a random sampling protocol was not feasible. Instead, volunteers who work at the wildlife area surveyed the visitors they encountered. Volunteers collected surveys at all times of the day on 31 different days during the winter feeding season.

We estimated three models described in Hilbe (2007), Zero-truncated Poisson model, Zero-truncated Negative Binomial model, and Zero-truncated Negative Binomial model with endogenous stratification. The models were fit by the maximum likelihood method using the NLMIXED procedure in SAS v.9.2. The log likelihood functions ( $ll$ ) for the three models are as follows:

Let:  $\mu = \exp(x\beta)$ ; and

log represent the natural (base e) logarithm.

Then

1. For the zero-truncated Poisson:

$$ll = r_i \log(\mu) - \mu - \log \Gamma(r_i + 1) - \log(1 - \exp(-\mu))$$

2. For the zero-truncated Negative Binomial:

$$ll = r_i \log\left(\frac{\alpha\mu}{1 + \alpha\mu}\right) - \frac{\log(1 + \alpha\mu)}{\alpha} + \log \Gamma(r_i + a^{-1}) - \log \Gamma(r_i + 1) \\ - \log \Gamma(a^{-1}) - \log(1 - (1 + \alpha\mu)^{-a^{-1}})$$

3. For the zero-truncated Negative Binomial with endogenous stratification:

$$ll = r_i \log(\alpha) - (r_i - 1) \log(\mu) - (r_i + \alpha^{-1}) \log(1 + \alpha\mu) + \log \Gamma(r_i + \alpha^{-1}) - \log \Gamma(r_i + 1) \\ - \log \Gamma(\alpha^{-1}) + \log(r_i)$$

### The Survey<sup>3</sup>

The survey was divided into four sections. Respondents were first asked about past, current, and future trips to Jewell Meadows. These questions included their home zip code and the length of time they planned to spend at Jewell Meadows on their current visit. Responses to these questions were used to calculate respondents' travel costs. Respondents were asked about their past visitation history, as past studies have shown that visitation history can influence future visitation patterns (Shafer et al., 1993). The second section asked about respondents' experience with elk and other wildlife. Specifically, we asked if they had applied for an elk hunting license in the last five years, if they had been on any other wildlife viewing trips in the last 12 months, if they were a member of any fish or wildlife organizations, and if they regularly watched wildlife programs on television. Level of experience with a recreational activity, or related activities, has been shown to influence visitation patterns (Loomis, 1995). In the third section, respondents rated (strongly agree to strongly disagree) statements about their level of concern with the use of tax dollars for protecting wildlife, hunting animals for sport, the influence of environmentalists on wildlife management, preferences for informational signs at wildlife viewing areas, crop damage from elk, and whether wild animals have emotions similar to human emotions. These questions determined if respondents' environmental views influenced the number of trips they took to Jewell Meadows. These questions elicited respondents' views on broad environmental and animal welfare issues as well as their views on crop damage—an issue particularly relevant to Jewell Meadows. These attitudinal variables can influence visitation patterns (Liston-Heyes & Heyes, 1999). The final section included demographic questions such as age and income.

### Results

Between December 1, 2006, and February 28, 2007, we collected 157 useable surveys from visitors to Jewell Meadows. Following other travel costs studies, we only included the 143 respondents who made sole-purpose trips to Jewell Meadows. Most respondents (64%) worked full time and were male (69%). The average age was 47 with an annual household income of \$77,000. Nearly all (97%) were on a day trip to Jewell Meadows and traveled, on average, 135 miles round trip. Most (54%) had visited at least once the

previous year during the elk feeding season (December–February) and had been visiting the Jewell Meadow for eight years on average.

Many respondents had applied for an elk hunting license in the last five years (47%). Few (30%) had been on any other wildlife viewing trips in the last year. However, 90% regularly watch nature-based programs on the television. Many of the visitors surveyed were interested in wildlife even if they were not active wildlife viewers or hunters (Table 1). Almost all participants (89%) thought protecting wildlife habitat a good use of tax dollars, approved of hunting game animals for sport (78%), and preferred viewing wildlife in designated areas (80%). While most approved of hunting, 66% also agreed that wild animals have emotions similar to human emotions. Respondents were split on thinking environmentalists have too much influence on wildlife management (55% agreed, 45% disagreed). Likewise, 42% were concerned about the damage elk do to crops (58% disagreed).

Three regression models were estimated. The final models included the standard travel cost variable as well as some expected demand shifters, AGE, measures of experience (HUNT and ENV-ORG), and attitudinal variables (TAX and SIGN). Variables were eliminated by backwards selection if they had  $p$ -values greater than 0.2.

Table 2 shows the regression for the zero-truncated negative binomial model with endogenous stratification. This model was used to calculate access value, because our data was over dispersed,<sup>4</sup> zero-truncated, and endogenously stratified. Table 3 summarizes the results from all three models. The fit of the zero-truncated Poisson model was poorer than the two negative binomial models. The two negative binomial models differed only modestly in the log likelihood values, the Akaike Information Criterion (AIC) statistic and the coefficients on travel cost. Consistent with previous studies, correcting for zero truncation obviated the need for further correcting for endogenous stratification (Martinez-Espineira, Amoako-Tuffour, & Hilbe, 2006).<sup>5</sup>

Consistent with the economic theory that individuals take fewer trips as costs increase, the coefficient on TRAVEL COST was significant and negative. The coefficient for HUNT (1 = respondent applied for an elk-hunting permit in the last five years)

**Table 1**  
Distribution of responses to survey attitude items

	Strongly agree	Moderately agree	Moderately disagree	Strongly disagree
I think protecting habitat for wildlife is a good use of tax dollars	88%	10%	1%	0%
I approve of hunting game animals for sport	55%	23%	14%	8%
I think environmentalists have too much influence on wildlife management	28%	27%	24%	21%
I prefer viewing wildlife in designated areas where there are informational signs and knowledgeable staff	41%	39%	17%	3%
I am concerned about the damage elk do to crops	12%	31%	37%	21%
Wild animals have emotions (love, fear, etc.) similar to human emotions	35%	31%	17%	18%

**Table 2**  
Results for the zero-truncated Negative Binomial model  
with endogenous stratification ( $n = 143$ )

Variable	Dependent variable: Number of completed and expected visits during the winter feeding season (December–February)		
	Coefficient	Std. error	<i>p</i> -value
Intercept	-5.31	4.06	0.194
TRAVEL COST	-0.00726	0.00285	0.012
HUNT (1 = applied for an elk hunting license in last 5 years; 0 = otherwise)	0.882	0.24	0
ENV-ORG (1 = member of an environmental organization; 0 = otherwise)	-0.503	0.244	0.041
TAX (1 = strongly agree that protecting habitat for wildlife is a good use of tax dollars; 0 = otherwise)	1.07	0.376	0.005
SIGN (1 = strongly agree that prefer viewing wildlife in designated areas with informational signs)	-0.365	0.24	0.129
alpha	200	812	0.806

**Table 3**

Fit statistics and estimated travel cost parameter for all three regression models ( $n = 143$ )

Model	-2(Log Likelihood)	AIC	Travel cost coefficient estimate (Std. error)
Zero-truncated Poisson	595	607	-0.00512
Zero-truncated Negative Binomial	464	478	-0.00784
Zero-truncated Negative Binomial with endogenous stratification	467	481	-0.00726

indicated that hunters visit Jewell Meadows more often and suggests that hunting and wildlife viewing are not mutually exclusive. The coefficient for ENV-ORG (1 = respondent was a member of a wildlife organization) indicated that members of wildlife organizations made fewer visits to Jewell Meadows relative to study participants who were not members of wildlife organizations. Members of wildlife organizations may prefer to view wildlife in a more natural setting than Jewell Meadows, where visitors are almost guaranteed a chance to see dozens of elk without leaving their cars. The final two variables in the model were attitude variables. Respondents who strongly agreed with the statement “I think protecting habitat for wildlife is a good use of tax dollars” (TAX) took more trips to Jewell

Meadows. Respondents who strongly agreed with the statement “I prefer viewing wildlife in designated areas where there are informational signs” took fewer trips to Jewell Meadows. Although this may seem counterintuitive, the Jewell Meadows viewing experience is informal. Visitors do not pay an entry fee and most will not encounter a member of staff. This result suggests that more frequent visitors wish to have a relatively unstructured visit and do not need signs to educate them about the elk.

Using the coefficients from the model in Table 2, we estimated a sample mean per day access value of \$369. Based on traffic counter data, an estimated 19,148 people visited Jewell Meadows between December 1, 2005, and February 28, 2006. Assuming that 92% of visitors made sole-purpose trips (the same proportion as our sample), the total access value was approximately \$6.5 million. The operating budget for the Jewell Meadows was approximately \$200,000.

## Discussion

Given the magnitude of the viewing benefits, managers may wish to emphasize wildlife viewing at Jewell Meadows. Capturing these benefits, however, may be challenging. Currently, there is no fee for access to Jewell Meadows, and the nature of the area, multiple parking areas, might make implementing a fee difficult. The one exception is the daily hay rides. However, if managers are looking for an additional source of revenue, they could solicit donations from visitors. Given high surplus values visitors currently enjoy, donations may be substantial.

Jewell Meadows has some unique features, which made it amenable to using the TCM. Elk viewing at Jewell Meadows, for example, is not dispersed; most visitors are confined to a small area. These same features, however, imply that care should be taken interpreting the results and generalizing to other wildlife viewing areas. In addition, our sample was relatively small. It is clear, however, that the benefits of elk viewing at Jewell Meadows exceed the costs. In addition, our results suggest that visitors like the opportunity to view elk in a setting that is not overly structured.

The elk viewing opportunities at Jewell Meadows are largely a function of the winter feeding program, which almost guarantees visitors the chance to see dozens of elk at close range. The relatively high access values we estimated are likely a function of the assured nature of wildlife viewing at Jewell Meadows. It would be unwise to generalize the access values we present here to situations with a small probability of seeing wildlife. However, our results suggest that where there are good seasonal opportunities to view wildlife—migrating birds or spawning salmon, for example—a relatively modest investment in infrastructure may yield significant benefits.

## Notes

1. An example of an economic impact of wildlife viewing study would be Loomis and Caughlan (2004). They estimate the economic impacts of different elk and bison management strategies in Grand Teton National Park and the adjacent National Elk Refuge and found that a no supplemental feeding management option would reduce visitation by 20% and would reduce local employment by 11%.
2. The feeding of wildlife to reduce agricultural damage is not unique to Jewell Meadows (there are two other programs in Oregon alone), so understanding the benefits associated with wildlife viewing would be useful to other wildlife management agencies, which operate, or may begin to operate, supplemental feeding programs.
3. Copies of the survey are available from the corresponding author.

4. Poisson models assume that the mean and the variance of the dependent variable are the same. In our data, the mean of number of trips is 2.6, whereas the variance is 11.4. Estimating a Poisson model when the data are over dispersed will result in the standard errors being underestimated (Haab & McConnell, 2002).
5. One final point on model estimation: we had some trouble getting the zero-truncated negative binomial model with endogenous stratification to converge. In addition, estimates of the intercept and the dispersion parameter, alpha, were sensitive to the starting values specified in the maximum likelihood routine, and, in some cases, alpha took on an extremely high value. Hilbe (2007, p. 166) experienced similar problems with this model but does not comment. The convergence problems we experienced persisted with a mean-only model, which implies that the problem may stem from the fundamental formulation of the model adjusting for both zero-truncation and endogenous stratification and not ill-structured data as Hilbe (2007) suggests. Although the estimation problems we experienced were somewhat troubling, the parameters of interest were very stable and varied little from the zero-truncated negative binomial model. Therefore, we feel confident using the coefficient estimates from the zero truncated and endogenously stratified negative binomial model to calculate access value.

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