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Western Washington Elk-Hunting: Analyzing Willingness To Pay and Economic Benefits

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WESTERN WASHINGTON ELK-HUNTING

Analyzing Willingness To Pay and Economic Benefits

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Abstract

This study will attempt to establish an estimate of willingness to pay for elk hunted in Western Washington, with the intent of informing policymakers of the potential economic benefit of elk hunting in the state. The research uses travel cost analysis to estimate variable cost associated with hunting, and controls for macroeconomic fluctuations in hunting demand as well as quality metrics for the specific GMUs in question. The study found that expected willingness to pay for an elk hunting trip in 2013-2015 was approximately $140, which is a lower-bound estimation of travel expenditures, an important component used to estimate overall hunter utility. The study's findings support the notion that improvements to hunting quality could generate large economic returns for rural areas of Washington State.

Introduction

Hunting is an integral part of our country's history as both a natural resource and a recreational pastime. Hunting has historically provided both a means of sustenance and a source of entertainment, with spending by hunters acting as a massive driver for economic growth in rural areas. According to a survey by the US Department of the Interior, hunters spent an average of $1,100 per hunting trip in 2006, generating significant economic windfalls for communities reliant on outdoor recreation as a means of economic survival. (US DOI, 2006.)

State regulation of hunting was minimal prior to the 20th Century, when legislation was enacted throughout the US to limit the impact of hunting on species populations. Permit hunting systems have been put in place in all 50 states, and typically charge state residents a reduced price for the privilege of hunting various species of game compared to out-of-state hunters. License sales make up a substantial portion of state budgets dedicated to conservation and law enforcement, with Washington State's fiscal year 2018 revenues projected to be near $65 million (DFW, 2016.) Yet in spite of the financial windfall provided by license sale revenues, Washington's Department of Fish and Wildlife relies heavily on local and state government funding to continue to protect hunting and fishing opportunities in the state and estimates a budgetary requirement of $437.6 million for fiscal years 2017-2019 (DFW, 2016.) At the same time, rising enforcement and operating costs are making it more difficult for the agency to meet its existing obligations using traditional revenue streams, meaning lawmakers will likely need to allocate even more funding from the general budget in order to maintain the agency's future effectiveness.

Though wildlife conservation activities should be considered categorically desirable, the lack of quantitative measures of the tangible impacts of conservation efforts and natural resource utilization may lead lawmakers to undervalue protection of wildlife in the presence of more immediate budgetary concerns. This paper will attempt to provide quantitative evidence of the beneficial impact of conservation on Washington State's economy by estimating the willingness to pay of elk hunters in two Western Washington game management units using travel cost methodology (TCM.) While TCM has been used in several other notable studies, very little of the existing literature is specific to Washington State, and this research will attempt to fill a gap in the knowledge base to present Washington policymakers with recent, applicable statistical analysis on the potential economic windfalls associated with the provision of high-quality hunting opportunities.

The broader objective of this study is to encourage policymakers to devote more resources to conservation, specifically the prevention of poaching. Regulated hunting is beneficial because it prevents animal populations from growing out of control and provides a source of revenue for conservation projects (DFW, 2017). Since the settlement of Washington State by farmers and ranchers in the 1800s, the number of predatory species in the state has been decimated by extermination campaigns intended to protect livestock (Cornwall, 2014.) Cougar and bear populations dropped drastically after settlement, and wolf populations are just now starting to recover with the help of state wildlife biologists. The lack of predators has allowed the populations of deer and elk to grow with very few structural limits, even as increased human habitation has continued to restrict their habitat. When the populations of prey species grow too large, the local environment is unable to sustain the number of herbivores in the habitat, and the overpopulated species overharvests and destroys natural areas, as has occurred in Rocky Mountain National Park since the extermination of predatory species in the early 20th Century

(Hermans et al., 2014.) Overpopulation is also bad for the species themselves, as crowding makes them more susceptible to mortality from disease or proximity with humans.

Hunting of herd-species can help to reduce the issues associated with overpopulation, but unregulated hunting tends to allow hunters to overharvest and drive those species toward extinction. In order to maintain a stable population level, hunting needs to be limited to a level at which the herd can replenish its lost numbers annually, but maintains a stable level to prevent overburdening the habitat (Hermans et al., 2014.) Such regulation is only effective if properly enforced by state governments, but budgetary restrictions impede the state of Washington from allocating enough resources toward enforcement to adequately address the issue. Hunters themselves contribute to the resolution of this issue by paying for hunting licenses, the sale of which comprises a large portion of the state's annual conservation budget; however, license sales are not sufficient to act as the sole funding source for hunting enforcement.

In spite of the benefits, state governments do not give enforcement agencies high enough budgets to adequately enforce existing laws, as evidenced by a Washington State Senate press release describing the Department of Fish and Wildlife as, "an agency in crisis" (Caster, 2017.) My hope is that providing policymakers with a quantitative measure of the benefits afforded by high-quality elk hunting opportunities could increase their incentives to allocate resources toward enforcement. Elk hunting provides significant economic and environmental benefits to local communities and to the state as a whole, but without a strong method by which to measure these benefits it is unlikely policymakers will prioritize resource protection when funding is scarce.

Literature Review

Several previous studies have used travel-cost analysis to estimate willingness to pay for elk hunting, though existing literature focuses on areas outside Washington State, and has typically not been specific to elk. Contingent valuation studies have been historically less popular than revealed preference due to inherent skews in the data and lack of veracity for study findings (Swanson et. Al., 1989), though several entities (most notably the U.S. Water Resources Council) has recommended the use of CV. Previous contingent valuation models were found to be subject to nonresponse bias, as verified by Heberlein et. al. (1978), who offered criticisms of both contingent valuation and travel cost models for assessing willingness to pay in recreational economic models. According to Heberlein, individuals surveyed in contingent valuation models often change their responses based upon their desire to demonstrate financial capability to the surveyor or in an attempt to influence policymakers to lower prices (Heberlein et al., 1978.) Heberlein's critique of travel cost analysis focuses mainly on omitted variable bias, arguing "potential sources of bias exist if there are substantial differences in the recreationists' tastes and preferences, access to substitutes, and income levels at varying distances from the recreation site. It is fairly straightforward to control statistically for differences in income. Potential problems relating to tastes and substitute availability are much more difficult" (Heberlein et. Al, 1978.) Although travel cost analysis provides a more direct quantitative methodology by which to estimate hunter utility than stated preference models, the inherently subjective nature of individual utility calculations and the lack of a unifying structure under which to analyze individuals' preferences makes it difficult to calculate utility with a high degree of accuracy. Even with these concerns in mind, Heberlein seems to give preference to travel cost models because the data reported by the model is not based on arbitrary reports from individuals. Overall, the biases present in travel cost analysis seem easier to control for than the biases in contingent valuation, which appears to be Swanson's primary reason for using TCM over CV, and the methodology used for this study attempts to control for income and consumer tastes using statewide license sales as a proxy for market demand for hunting overall.

Another method used in the literature to analyze consumer utility from a given hunting site is the random utility model, under which consumers decide on a specific hunting area based upon the utility they would receive from visiting that area (Pendleton, 2000.) Pendleton's paper contrasts the random utility model (RUM) with hedonic travel cost to ascertain which methodology provides the most accurate estimation of demand curves for recreational goods, and finds that the veracity of either model is highly dependent upon the assumptions made in how hunters select hunting sites. Under a TCM model, hunters are assumed to select hunting sites by comparing the costs of travel among several different sites, selecting the site with the highest potential payoff based upon their knowledge of the area and associated costs. According to Pendleton, the largest limitation of the TCM model is the requirement for a two-stage demand curve estimation, which risks omitting data from the calculation even if the first cost curve can be predicted accurately (Pendleton, 2000.) The random utility model does not require a two-stage calculation to estimate demand, but assumes that the relationship between costs and marginal utility is linear, limiting the model's efficacy for use in estimating utility when a large number of datasets are at play. Pendleton's overall conclusion was that both TCM and RUM are based upon similar mathematical modeling and differ primarily in their assumptions about site selection; and because both models suffer from methodological shortcomings, my research will prefer TCM over RUM because the existing body of literature on the subject seems to prefer to use TCM to conduct this kind of analysis, especially given the limited nature of my dataset for demonstrating alternative options for surveyed hunters.

The Swanson study's travel cost analysis measured the number of hunters in their target area divided by the number of overall residents for any given origin site, and used average round-trip distance to the target area as their primary independent variable while controlling for socioeconomic conditions, availability of substitutes, and hunting quality of target area (Swanson et. Al, 1989.) Swanson used success rate, environmental factors, and hunting season length to estimate hunting site quality, while explicit and implicit travel costs (in terms of gas expenditures and time costs associated with travel) were used as the independent variable.

Another study which implemented travel cost to estimate willingness to pay for elk was conducted by researchers at the University of Minnesota. Sorg and Nelson's analysis was very similar to Swanson's in that both used trips per capita as their dependents and utilized travel costs, quality controls, substitute availability, and macroeconomic variables to estimate willingness to pay. The primary difference between the two studies was how they calculated the availability of substitutes. In the Minnesota study, the authors contrasted the attractiveness of the given site with other comparable sites directly, comparing harvest to mile-driven between sites and assessing that a higher harvest-per-mile site would be more cost effective as a hunting location (Sorg & Nelson, 1984.) In computing total travel cost, Sorg and Nelson computed both the implicit and explicit costs associated with travel, estimating explicit costs by calculating total travel time and multiplying by one-third of the average US wage rate during the study time period, while Swanson did not seem to integrate time cost into their analysis of total travel expenditures. My analysis will integrate time cost into the estimation of total expenditures, as it seems reasonable that travel time would play a role in site selection for hunters and existing literature on the subject seems to prefer this methodology to an analysis which focuses solely on explicit costs.

Sorg's regression to calculate trips per capita also differed from Swanson's in that, to measure quality of hunting opportunities, they used the total elk harvest for the time period rather than using rate of hunt success. Swanson's two statistically significant quality variables were total number of hunter days onsite, indicating preference toward a specific hunt site, and average harvest per hunter-day as an indicator of success rate (Swanson et al., 1989.) Both studies hypothesized that higher hunt quality would be correlated with more trips-per-capita.

In both cases, the authors concluded that travel cost analysis was preferable to contingent valuation because of the difficulties associated with generating reliable survey data and the logistical difficulties of administering an effective survey. Both studies also found positive relationships between hunt quality and trips-per-capita, while travel expenditures were negatively correlated with utilization. One factor neither study discussed was whether higher hunting quality could drive up average travel cost to the target area, as hunters are likely willing to travel farther to reach more promising hunting grounds. The fact that travel costs may act as a dependent variable related to hunting site quality introduces endogeneity bias into their models, with the sign of the coefficient for travel cost indicating whether total hunter trips are more responsive to hunting site quality or expenditures.Methodology

The overall objective of the study is to estimate the costs associated with hunting trips to game management units 612 and 615 in Western Washington as an approximation of willingness to pay. The data was collected on an annual basis between 2013 and 2015. In addition to costs directly associated with travel, my analysis incorporates control variables for hunting site quality. The model is:

$$Y = a + \beta x_1 + \theta x_2 + \lambda x_3 + \varepsilon x_4$$

Where Y represents total number of hunters in the target GMU during the year studied, x_1 is estimated average total travel cost, x_2 is the average number of days required for a successful hunt, x_3 is the average success rate for hunters in the target GMU, and x_4 is the total number of licenses sold in Washington State each year of the study.

Swanson uses per-capita visits to individual hunting sites from specific locales as the dependent variable to for hunting site quality while measuring the impact of a cost increase on the number of hunters (Swanson et al., 1984.) My mechanisms to control for site quality are the success rate for hunters in the target GMU during the study year and the average number of days it took successful hunters to harvest an elk, both of which measure site quality as a function of individual investment required to take an elk. Since I did not have access to data on the populations of each place of origin for the hunters in my study and have separate controls to ascertain site quality, my analysis will use the total number of hunters travelling to the GMU in question as the dependent variable instead of using a per-capita metric.

My study focuses on travel cost analysis to provide a basic framework for interpreting willingness to pay based on revealed consumer preference. The dataset primarily focused on accounting for the number of hunters in the study GMUs, the ratio of successful hunters, place of origin, and metrics specific to the harvested animals during the study period. Of this data, the most useful was the data involving place of origin. The survey conducted by DFW recorded individual hunters' origin at the zip code level, which allows the analysis to assess with a strong degree of accuracy the distance travelled by each hunter from their home to the center of the GMU, which we estimated using the zip code of the largest city in each area. Having established distance travelled, I estimated the amount of gas required for a round trip from the start point to the target GMU based on the average MPG for vehicles in the US during the target year. Finally, I estimated gas expenditure by multiplying the total gallons of gas by average Washington State gas prices during the hunting seasons in which each hunter travelled to the target GMU. The analysis makes the simplifying assumption that the average fuel efficiency of vehicles utilized by hunters does not deviate significantly from the population average, though this assumption has the potential to introduce some bias since it is likely that hunters would demonstrate a preference for larger vehicles to accommodate their gear. This bias means that the gas expenditures reported in my analysis are a lower-bound estimate of willingness to pay: in the real world, it is plausible that hunters are willing to pay more for travel in order to use less fuel-efficient vehicles. If gas/travel expenditures are a significant consideration for hunters travelling to the target GMU, I would expect that higher travel expenditures would be negatively correlated with hunter utilization. This hypothesis may be confounded by the fact that high-quality hunting sites are likely to draw in hunters from a wider area and, thus, generate higher travel costs. My goal is to use the quality metrics to control for these to generate a realistic estimation of the demand curve based on travel costs.

Also included in my calculation of total travel cost was the opportunity cost of time spent travelling. To estimate implicit cost of travelling, I used Sorg's methodology of taking the median income for Washington State residents in the study years, dividing the income by an estimated 120,000 minutes (2,000 hours) worked per year, and dividing that result by three to capture the assumption of an average eight-hour work day (Sorg, 1986.) This calculation, multiplied by travel time, estimated the foregone income from travelling to the hunting site, and was added to explicit travel costs to create a total estimate of expenditures relating to travel. For hunters originating in the target GMU, total travel time was estimated at 90 minutes assuming a maximum distance travelled of 30 miles.

The primary factor confounding the analysis from a distance-travelled perspective was the fact that a significant portion of the hunters in the study were from in or around the GMU in which the data was collected, resulting in a total distance travelled of zero for many hunters and creating significant right-skew in the dataset. To combat this trend, my analysis estimates the distance travelled for individuals whose area of origin was within the target GMU with the simplifying assumption that hunters started travelling at the main city and drove, at maximum, to the opposite edge of the GMU in search of a desirable hunting location. This distance was estimated at approximately 60 miles per round-trip for GMU 612 and 90 per round-trip for GMU 615. This assumption makes sense because the population distribution in the target GMUs seems to be concentrated around the main town areas, and the distance from the center of the town to the farthest edge of the study area should provide a reasonable upper limit on the distance travelled for individuals living in the study area. The location of Forks, WA on the northern edge of GMU 612 also validates this assumption, as many hunters would either have to travel from Forks to their hunting site or would have to go to the city to gather supplies for the trip. As a result of this simplifying assumption, the data should be seen as providing a lower-bound estimate on willingness to pay.

In order to estimate travel costs, my analysis assumes that most or all of the individuals surveyed drove to the GMU for their hunting trip as opposed to flying. This assumption makes sense given the small proportion of survey respondents who reported living out-of-state, which made the distances travelled by these individuals statistical outliers. The assumption that individuals drove to the GMU in question even makes sense for out-of-state respondents given the logistical challenges of packing weapons, ammunition, and camping equipment onto an airplane. Furthermore, the distances traveled by out-of-state hunters in most cases were short enough to have been accomplished at a similar (or potentially even lower) cost by driving than by flying into Seattle, especially considering that access to the GMUs from Seattle entails a four to six hour drive (see Appendix II for distribution.)

In order to control for site quality (which likely interacts with hunter willingness to pay for travel), I introduced variables measuring the relative success of hunters in the target GMUs. Success rate for hunters in the study GMU acts as a control variable for hunting quality, and the analysis would expect to see an increase in willingness to pay with increased rates of success. Success rate was calculated as the average number of days spent in the GMU hunting for individuals who successfully harvested an animal. Using days required for a kill as a quality metric is similar to the method used by Sorg, and a lower number of days required to harvest an elk should correlate to higher utilization. As such, we would expect a negative correlation between days-to-kill and site utilization.

Costs for travel do not comprise the total costs associated with hunting for elk – hunters also need to invest in weapons, training, general licenses, transportation, gear, and a variety of other things when preparing for and executing a hunting trip. The variables studied were selected primarily because we can reasonably assume that these purchases took place during the target study years in or near the study areas, with a significantly higher percentage of travel costs being incurred in the state of Washington as a whole. Weapons and training were excluded from the analysis because they are likely to be one-time purchases which can last for years or decades with no need for renewal, and are not specifically purchased for the purpose of hunting elk – they can be applied to a wider spectrum of activities and thus do not represent willingness to pay for elk specifically. The same logic applies to general hunting gear and transportation, since most of it can be used to hunt a variety of game or for non-hunting purposes. As the purpose of this study is to estimate the willingness to pay specifically for elk hunts in the target GMUs, omitting fixed costs not associated with one particular harvest should not have a significant impact on the veracity of the results.

The study uses a revealed-preference model to estimate willingness to pay because the lack of stated preference data from within the study area makes stated preference analysis impossible. Even if the data were available, stated preference models can be subject to hypothetical bias because individuals are unlikely to report their actual willingness to pay with any degree of accuracy. Individuals in stated preference studies often provide an arbitrary estimate of their willingness to pay in the hypothetical scenario because they feel pressured by the survey conditions to provide an immediate response rather than conducting a thorough analysis of their own behavior. They are also likely to over-report their own willingness-to-pay so as to appear more generous or economically advantaged to the surveyor. Revealed preference surveys tend to provide more accurate data for specific sets of variables which can be utilized as proxies for willingness to pay, so the lack of stated-preference data is acceptable in the context of this study.

Table 1 describes the data points used in the regression.

GMU	Year	Average Gas Cost	Average Time Cost	Average Travel Cost	Days To Kill	Success Rate	Hunter Count	Licenses Sold
612								
	2013	$88.59	$28.94	$117.53	3.911	0.09	175	68,752
	2014	$113.09	$34.67	$147.76	4	0.1	140	66,607
	2015	$116.27	$61.43	$177.7	4.688	0.0738	130	68,012
615								
	2013	$48.89	$36.29	$85.18	3.911	0.09	411	68,752
	2014	$49.51	$38.15	$87.66	5.08	0.084	449	66,607
	2015	$39.8	$39.3	$79.1	4.69	0.119	511	68,012

Results

	(1) Hunter Count	(2) Hunter Count	(3) Hunter Count	(4) Hunter Count
Average Total Cost	-3.90 (0.016**)	-4.03 (0.011**)	-4.72 (0.014**)	-4.86 (0.092*)
Days To Kill		109.07 (0.133)	57.90 (0.300)	40.69 (0.604)
Success Rate			2439.57 (0.156)	2728.35 (0.298)
License Sold				-0.017 (0.639)
Constant	753.14 (0.003**)	283.4 (0.331)	344.75 (0.169)	1549.27 (0.564)
R^2	0.8029	0.9179	0.9764	0.9832

Both the average implicit and explicit travel costs were negatively correlated with utilization of the hunting locations studied ($p < 0.092$.) The model explains almost 99-percent of variance ($R^2 = 0.9832$.) The control variables for quality did not show statistically significant relationships with the number of hunters in the study GMU, and the directionality of days-to-kill runs counter to the prediction that less time required to take an animal would increase utilization. The positive coefficient on days-to-kill likely reflects endogeneity inherent in travel-cost models for predicting hunter demand, while the positive correlation between a higher success rate and higher utilization aligns with our expectation that site quality increases utilization. The data, however, does not provide enough basis to definitively determine the impact of site quality on hunter utilization. The coefficient on licenses sold was slightly negative, but was statistically insignificant.

Thus, the demand function for hunters travelling to GMUs 612 or 615 is:

$$Y = 1549.27 - 4.86x_1 + 40.69x_2 + 2728.35x_3 - 0.017x_4$$

The inverse demand equation is:

$$P = 318.78 + 8.37x_2 + 561.39x_3 + 0.003x_4 - 0.21Q$$

Where P is average total travel cost and Q is the number of hunters travelling to the target area.

The coefficients on the independent variables demonstrate the impact of a change by one unit of measure on total hunter utilization. Individual license sales appear to have the smallest impact on total utilization in the study GMU's, which is predictable given the large number of annual license sales and relatively small number of hunters in the areas studied. Success rate shows a very large coefficient, but since the success rate was measured as the proportion of hunters who successfully took an elk it makes more sense to look at this variable in terms of percentage-point increases to success. Per the coefficient, a one-percentage point increase in the success rate in the target GMUs should cause the number of hunters to grow by between 20 and 30 hunters, though the dataset was not large enough to create a datapoint. The coefficient on the days-to-kill variable is also fairly large, with an increase in the number of time spent hunting by one day predicted to increase the number of hunters by around eight, though this is likely an issue of reverse causation – more hunters mean it takes longer to successfully capture an elk. Furthermore, the results were not statistically significant enough to reject the null that site quality does not impact utilization.

The primary study variable, travel cost, had a coefficient of -4.86. This coefficient likely overstates the impact of increased variable costs on hunter demand, confounded by the fact that reductions to hunter numbers over the study period can also be attributed to decreased demand for hunting overall. As such, demand analysis likely underestimates willingness to pay among hunter travelling to the GMUs in question. The results here were statistically significant across all regressions, meaning we can safely assume that travel costs are negatively correlated with utilization.

Discussion

In addition to the regressions shown above, I also tested using hunting trips per-capita as the dependent variable (calculated by dividing the number of hunters in each GMU by the total number of licenses sold each year.) The analysis found that using a per-capita measure did not greatly impact the veracity of the model's predictions, nor did it make any of the control variables for hunting site quality statistically significant. I also ran regressions separating gas and time costs into distinct variables, and found that neither was individually significant under most models; the results were primarily significant when gas and time costs were considered as one variable (see Appendix III for the relevant regression tables.)

Gas costs for GMU 612 were much higher, on average, than for hunters in GMU 615. This is likely attributable to the presence of a number of high outliers in the 612 dataset, with the much smaller overall hunter population magnifying the impact of the outliers. Time costs were also more widely varied in the 612 data. Though a significant portion of the data were outliers, the fact that individuals were willing to travel long-distances to hunt in this specific area could present some evidence for perceived site quality, though more analysis would need to be done in order to make this claim with any level of assurance. Success rates in each GMU stayed fairly constant at around 10-percent for all three study years, as did the number of days needed to take an animal. These statistics, though limited by the lack of data on other jurisdictions, could imply that hunting site quality did not vary significantly over the study period.

Total hunting licenses sold dropped between 2013 and 2014 before rebounding slightly in 2015. This was expected given the national downward trend in hunter participation recorded over the last decade (Brady, 2017.) Because the analysis incorporates hunter success rate into the utility calculation, the demand curve can be interpreted as the expected value from an elk hunting trip. Table 3 shows average willingness to pay calculations based upon the data above.

Year	Average Travel Cost	Days To Kill	Success Rate	Average Hunters	Average License Sales	WTP
612	$147.66	4.20	0.09	148	67,790	$168.78
615	$83.98	4.56	0.10	457	67,790	$112.44
All	$115.82	4.38	0.09	303	67,790	$140.61

Average estimated willingness to pay for an elk hunting trip based upon travel cost analysis is $140.61 for both GMUs, with slightly higher WTP in GMU 612 than in 615. As stated previously, this is a lower-bound estimate on the amount individuals are willing to spend in implicit and explicit travel costs based upon the quality of the selected hunting site. Other costs associated with hunting trips, including food/lodging, license prices, and hardware investments represent additional costs undertaken by hunters which contribute both to the state economy and to law enforcement revenue streams.

To calculate estimated consumer surplus, I used the average values for the control variables during the study period and estimated the area under the resulting inverse demand curve (P = 615.51-0.21Q.) As such, estimated consumer surplus based solely on travel cost is approximately $902,029.47. This surplus represents the amount the target population would be willing to pay for travel above what they currently pay, indicating that the DFW could likely raise significantly more revenue from the subject group through increases to other expenses, such as licenses, which are able to generate revenue for the state.

This analysis represents a lower-bound estimate on willingness to pay for several reasons. First, not all potential costs are measured in the analysis, as detailed above. Licenses, which range from $60 to around $500 depending on residency status (DFW, 2017), also make up a portion of the cost, as do incidental variable costs such as food and lodging. This is likely why my estimate for costs is so much lower than the 2006 estimate cited above, which included a variety of other fixed and variable costs. Second, the dataset utilized only contained three years and two Game Management Units, which limited the study's ability to predict outcomes for improvements to hunting site quality. Third, willingness to pay for gas costs was likely underestimated due to the model's assumption that hunter vehicles do not significantly deviate from the mean gas mileage for the total population – it is conceivable that hunters would prefer larger vehicles and, thus, be willing to spend more on gas.

Conclusion

Average elk hunter willingness to pay for travel costs to the studied Game Management Units for the 2013-2015 time period was $140.61. This is a lower-bound estimate, meaning that actual willingness to pay is likely significantly higher, especially given that the analysis did not include many other incidental costs of hunting. Though this study did not find a significant relationship between hunting site quality and utilization based upon the metrics chosen, past studies with broader datasets have consistently found that hunting site quality is positively correlated with willingness to pay and expected value for elk hunters. As such, the Department of Fish and Wildlife should endeavor to improve the quality of hunting experiences so as to generate the maximum level of economic returns from recreational hunting.

In order to improve hunting quality, the DFW will need to increase its level of enforcement to prevent poaching and ensure fair play in all hunted areas. This study did not analyze the impact of license prices on hunting demand for three reasons. First, licenses are a fixed cost associated with the general desire to take hunting trips, making the expenditure an external consideration given that the methodology utilized examines variable cost. Third, past research indicates that elasticity of demand for hunting licenses is fairly inelastic (Poudyal, 2007), meaning the DFW could likely increase the price of licenses to a fairly significant degree without reducing revenue as a result of lost sales. And third, hunter utilization has decreased over the past decade despite the fact that hunting license prices have not changed since 2011, indicating that sociological factors are more likely to influence demand for hunting experiences than the price of licenses. Given that hunting license prices in Washington State have not changed since the Great Recession, inflation is likely also degrading the agency's real revenues from license sales, so the DFW would be fully justified in increasing license prices to accommodate higher funding demand.

The DFW should also conduct further research into elk hunting demand on a statewide level to further analyze demand for hunting experiences and generate a more generalized estimate of willingness to pay. The estimates from this study are limited by the small time period and the use of only two Game Management Units, yet even in the presence of such limitations the study found a statistically significant relationship between travel cost and hunter utilization. A study conducted using a broader database could provide even more significant evidence in favor of increased hunting enforcement, as well as further educate lawmakers on the economic benefits of high-quality hunting experiences for rural communities.

Appendix I: Personal Motivation

Before my family moved to the Pacific Northwest from Chicago, my father worked for a company called World Book, a publisher of a popular encyclopedia set. As a result, we always had a set of World Book encyclopedias lying around the house. In the days before Google rose to prominence the presence of an encyclopedia set in one's home opened up a world of surface-level knowledge which I found enthralling as a small child. I spent hours tearing through those encyclopedias, either with my parents or alone, looking up random facts so I could understand more about the world around me. Every time a question was answered, I moved on to another one. As a result, I learned from a very young age to always pursue more data and information to create a broader, more comprehensive picture of the truth.

Though I was raised Catholic, I never felt a particular affinity for the Church or the beliefs there enshrined. Sunday school was always unbearably boring, and the lack of substantive or helpful information combined with the hyperactive and irritating nature of my classmates led me to associate church attendance with completely wasting a perfectly good Sunday morning. As a teenager I gained exposure to a whole new understanding of Christian doctrine through my participation in a national forensics league administered by Evangelical Christian homeschooling families. The Christianity taught there was far more militant than the Christianity of my childhood, and I found its dogmatic adherence to conservative Christian ideals both disturbing and antithetical to the purported objectives of Christianity itself. Rather than drawing people toward a loving, accepting Christian community which made people into better versions of themselves, the militancy of their framework espoused tribalism and marginalized anyone who did not adhere to the cultural norms of the collective. I became very good at using such

"Christian" beliefs to leverage judges into voting for my position, often arguing in favor of a side which I opposed personally and, in some cases, morally.

I came to SPU hoping to find an understanding of Christianity which was less dogmatic and tribalist than the ones I had seen growing up. Though I did not particularly subscribe to any specific set of beliefs upon entering my freshman year, I made it a mission to explore the many possible ways of interpreting Christian doctrine in the way I thought it should be interpreted. At first glance, Christianity at SPU seemed to provide many of the answers for which I had searched: they focused heavily on community while promoting a more tolerant and accepting mindset. What I found instead was that Christianity left me with even more unanswered questions, and I eventually realized that I would never be able to identify my own beliefs with those upheld in the Christian paradigm.

Having somewhat rejected the philosophical underpinnings of my upbringing, I spent the next two years establishing my framework for understanding reality and human existence. The belief structure I have devised is heavily influenced by Kierkegaardian existentialism and some of the earlier works of Michel Foucault, as well as Michael Polanyi's ideas about the duality of objective and subjective reality. Rather than adhering to an objective understanding of morality and ethics, I have come to believe that every person develops their own set of subjective ethical values and rules based upon their own personal experiences and cultural conditioning. The individual finds their own moral principles to be more relevant than any externally-imposed framework, to the extent that "objective" morality only matters insofar as the individual believes it to be objective. This, in itself, is a subjective position, meaning objectivity is simply an instance of the individual asserting their own position as being universally normative.

Marsden would disagree strongly with my position, as he argued in *The Outrageous Idea of Christian Scholarship* that the lack of any objectifying framework leaves intellectuals unable to consistently hold their beliefs as relevant (Marsden, Loc. 1089.) He writes, "Without theism, in a world where all moral systems are seen as simply constructions of interested groups, many people find it difficult … to defend the moral claims of one group over those of another. Ultimately, as Nietzche long ago recognized and many postmoderns have reaffirmed, the only effective arbiter of contested moral claims is power" (Marsden, Loc. 1089.) Marsden advocates the inclusion of, and perhaps dominance of, the Christian framework in mainstream scholarship because he believes it to be the only mechanism by which thinkers can hold any personal beliefs while maintaining internal consistency. My first critique of Marsden's thinking is that he fails to recognize his own fundamental subjectivity – the fact that he appeals to his God as a moral power is just as arbitrary as my choice to appeal to my own subconscious. I also think his argument falls prey to his own criticism because, in arguing that God decides what is moral, he implicitly buys Nietzche's argument that power determines morality – the fact that God is the power structure upon which he bases his argument for morality makes his morals no less based on power than any other social framework. As a result, I find Marsden's argument in favor of "objective" morality in scholarship wholly unconvincing and just as ostensibly fascistic as the paradigms he seeks to criticize.

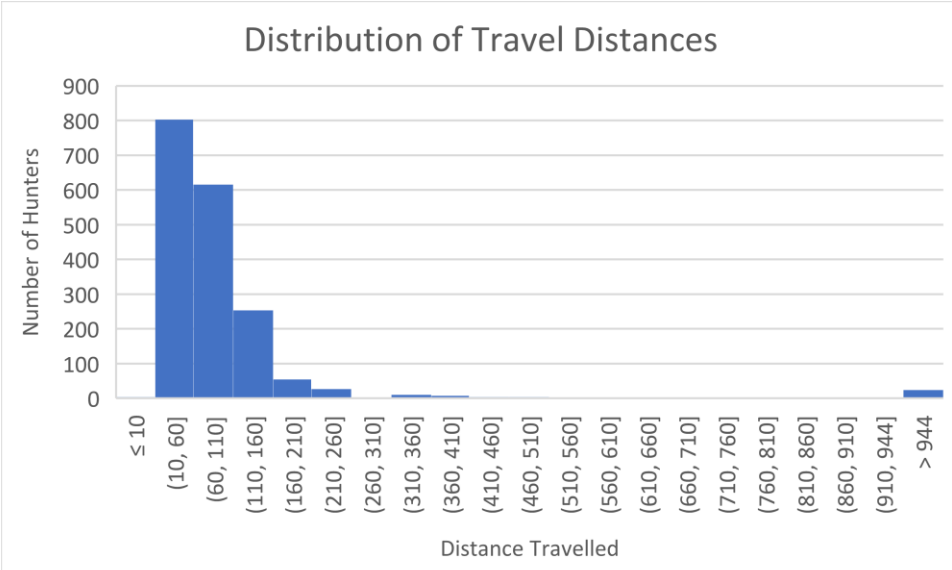
A semi-Christian model for the application of Christian belief which I find more compelling is that utilized by Paul Farmer. Though raised Catholic, Farmer does not seem to identify strongly with his religious upbringing. He does, however, see strong application for liberation theology in his work as a doctor in Haiti, and the mission statement of Partners in Health includes mention of the "preferential option for the poor" (Newman, 2016.) Though he no longer strongly practices his Catholic faith, Farmer drew much of his inspiration for his work from his upbringing and the influence of liberation theology, including his organization's practice of immersing volunteers in the local conditions by refusing to insulate them from the hardships of living in a heavily impoverished country. Yet Farmer does not seek to impose his belief system on those outside his organization – he simply abides by his own core principles and uses them as inspiration to continue his work. Though one could critique some of Farmer's methods, I found his philosophy far more palatable than that of Marsden because it stems from his own personal value system and does not try to appeal to an objective power structure as a basis for its legitimacy.

In most Christian circles I have encountered, I noticed an implicit assumption that without God, life is meaningless. Finding a reason for existence is contingent upon the presence of a Creator with a broad plan for the "objective" of the created order, and without such a Creator life devolves into misery, chaos, and despair. For awhile I ascribed to this belief, and the search for objective meaning made my slow progression away from Christianity that much more painful. When I finally accepted that reality is subjective and meaning is assigned by the individual, however, I found the concept to be empowering rather than frightening. This understanding has allowed me to feel validated in my emotions and view of the world, as well as the ideas I value. The fact that my core assumptions are based upon incomplete data and may be subject to change given the presence of new information allowed me to open myself to new ways of being and thinking in a way I had never experienced, and empowered me to hold my beliefs strongly even as I questioned them.

A very large part of my childhood was spent outdoors. From a young age my parents took me hiking and sent me to classes on wilderness survival. At the age of 15, I joined the local volunteer Search and Rescue Team, and at eighteen I learned to hunt and fish as part of a year-long course in ethical hunting practices. These experiences have instilled in me an appreciation for nature and the outdoors, and as a result I care deeply about protecting the environment from destruction by humans. When I was approached with the prospect of conducting this study, I was excited because I saw it as a perfect way to combine my studies in economics with my passion for protecting the outdoors.

In *Every Good Endeavor*, theologian Timothy Keller discusses the importance of one's work to their sense of self-worth and the theological implications of contributing to society through labor. Though I disagree with Keller's analysis in a few key areas, I enjoyed his discussion of the motivations by which people seek certain career paths. Keller discusses at length the inherent dignity of work as a mechanism by which to further God's creation, yet our society splits the motivation for career selection into three basic categories: jobs which earn money, jobs which help society, and jobs that have a "cool" factor (Keller, 108.) All three of these motivations are ultimately self-centered in that they focus on building the self-image of the individual rather than on making a contribution to society. Keller's solution is to accept a framework under which work is the mechanism by which individuals contribute to God's continuing development of creation, though personally I find it more compelling to conclude from his argument that one should find work that is both personally meaningful and helpful to society. This is highly applicable to my project, as the research enables me to behave as a scholar in a way that both promotes my personal beliefs and encourages the improvement of the world as a whole.

Appendix II: Distribution of Travel Distances



Descriptive Statistics	
Mean	115.692
Standard Error	6.475274
Median	73
Mode	47
Standard Deviation	275.9409
Sample Variance	76143.37
Kurtosis	76.25241
Skewness	8.503525
Range	3009.6
Minimum	9.4
Maximum	3019
Sum	210096.7
Count	1816

Appendix III: Alternative Regression Models

Y = Hunters per capita

	(1) Hunter Count	(2) Hunter Count	(3) Hunter Count	(4) Hunter Count
Average Total Cost	-.0000574 (0.017**)	-.0000595 (0.011**)	-.0000691 (0.016 **)	-.0000714 (0.091*)
Days To Kill		.0016846 (0.114)	.0009771 (0.271)	.0006738 (0.564)
Success Rate			.0337286 (0.185)	.0388181 (0.305)
License Sold				-2.97e-07 (0.582)
Constant	.0110966 (0.003**)	.0038412 (0.354)	.0046894 (0.205)	.025918 (0.521)
R^2	0.7971	0.9228	0.9740	0.9837

Split Gas, Time Cost

	(1) Hunter Count	(2) Hunter Count	(3) Hunter Count	(4) Hunter Count
Average Gas Cost	-5.183398 (0.002**)	-5.062209 (0.017 **)	-5.006863 (0.098*)	-
Average Time Cost	2.236467 (0.214)	1.515517 (0.613)	-1.309671 (0.838)	-
Days To Kill		20.06952 (0.743)	29.91996 (0.720)	-
Success Rate			1388.454 (0.613)	-
License Sold				-
Constant	609.7108 (0.002**)	539.5546 (0.113)	462.2949 (0.322)	.-
R^2	0.9745	0.9762	0.9840	-

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