WILLINGNESS TO PAY FOR AN ELK LICENSE IN COLORADO: A CONTINGENT VALUATION EXAMINATION

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Abstract

Hunting licenses do not represent the true value of the sport for hunters. This study examines the monetary value hunters, resident and non-resident, place on elk hunting in Colorado and which factors affect their valuation. The contingent valuation method is used to determine this information through a survey that was posted on several internet hunting forums. A hypothetical fee increase in hunting licenses from an improvement in elk habitat is used in the survey. To elicit a response, this study uses a two part question for willingness to pay, which is different from previous studies. First, intervals are presented and then the respondent answers an open-ended question. The data obtained from the survey is analyzed using the Tobit regression method. Separate regression equations are used for resident and non-resident hunters. The study finds that Colorado resident and non-resident hunters have differing views on the amount of license fee increase they would accept and base their decision on different factors.

KEYWORDS: (Contingent Valuation Method, Willingness to Pay, Elk, Hunting, Colorado)

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UNAUTHORIZED AID ON THIS THESIS

Signature

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CHAPTER I

INTRODUCTION

> One does not hunt in order to kill; on the contrary, one kills in order to have hunted. If one were to present the sportsman with the death of the animal as a gift he would refuse it. What he is after is having to win it, to conquer the surly brute through his own effort and skill with all the extras that this carries with it: the immersion in the countryside, the healthfulness of the exercise, the distraction from his job.[1]

Hunting is an activity embraced by many. It is a time when an individual can self-reflect, avoid the distractions of modern society, and enjoy nature at its best. Hunting also has links to our ancestors. It has been means of providing food, shelter, clothing, tools, and more to people since prehistoric times.[2] Although hunting today is not as critical in providing food for people as it was in the past, it remains a popular sport, especially here in Colorado. Hunting also serves the function of a game management tool to keep animal populations sustainable in the animal's habitat.

Elk is the focus because it is the most sought after big game animal in the state. The vast majority of big game hunters in Colorado (88.5%) pursued elk in 2006.[3] Elk are

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[1] Ortega, Jose and Gasset. *Meditations on* Hunting. As found on High Country News, "One does not hut in order to kill," available from https://www.hcn.org/issues/49/1497; Internet; accessed March 31 2009.

[2] Dale E. Toweill, Steven T. Buccola and Daniel P. Metz, *North American Elk: Ecology and Management* (Washington D.C.: Smithsonian Institute Press, 2002), 121

[3] U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce and Bureau of the Census, 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 24

greatly more populous in Colorado and the western states than in the rest of the country. This paper examines hunters' willingness to pay (WTP) for an elk license in the State of Colorado. Willingness to pay is defined as the maximum sum of money an individual would be willing to pay for an improvement.[4] The fees of hunting licenses do not represent the true monetary value that people place on hunting. This paper aims to find the WTP of resident and non-resident hunters in pursuit of elk in Colorado. Research of the development of the Colorado Division of Wildlife and the structure of the organization, a contingent valuation survey, and regression analysis will be used to determine willingness to pay and which variables affect the amount.

Development of the Colorado Division of Wildlife

Hunting plays a key role in the history of Colorado. The price of beaver pelts brought in many fur traders and trappers and the rich minerals, especially gold, drove in miners[5]. With the increasing population growth, market hunters came to feed the miners and settlers. Millions of animals, especially bison, were killed in just a few years to feed the people that flooded into the Rocky Mountain region to prosper and settle. The citizens of Colorado overhunted many areas and eventually realized that food is a greater necessity than prospering from the sales of animal hides, horn, and other trophy parts.[6]

The overharvesting of wildlife in Colorado eventually led to game management. The first law protecting wildlife in Colorado was passed on November 6, 1861 by

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[4] Patricia Champ, Kevin J. Boyle, and Thomas C. Brown, *A Primer on Nonmarket Valuation* (Dordrecht; Boston: Kluwer Academic Publishers, 2003), 12.

[5] Pete Barrows and Judith Holmes, *Colorado's Wildlife Story* (Denver, Colo.: Colorado Division of Wildlife, 1990), 2, 8.

[6] Ibid., 13.

Colorado's first Legislative Assembly making it "unlawful to take trout by seine, net, basket or trap."[7] Trout and other fish species were the main focus of early laws addressing wildlife issues as their numbers were significantly affected by the population growth of settlers. Laws protecting big game animals did not pass until 1874 when the legislature prohibited "people from wasting or unlawfully killing buffalo, elk, deer, mountain sheep, antelope or fawns."[8] These laws protecting wildlife are milestones because they are the first proactive measures to secure the future of sport animals and fish in Colorado. The downside is enforcing the regulations. At this point in time, there was no agency specifically enforcing the wildlife laws.

Unfortunately, it was not until 1882 that legislature provided the means of enforcing these wildlife protection laws. On May 17, 1882, the Colorado Game and Fish Protective Association was formed to enforce game and fish laws.[9] By this time, legislation had been passed that established closed seasons for big game animals to promote herd growth. The first commissioner of the agency, J. S. Swan saw the profit and conservation associated with shorter hunting seasons when he "thought a short season of two weeks would 'attract many persons and much money here that now annually goes to other states.'"[10] Over time, the idea of game management became increasingly refined. On April 27, 1899, legislation established the Colorado Department of Game and Fish which hired five chief game wardens along with up to fifty deputy

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[7] Ibid., 15.

[8] Ibid., 17.

[9] Ibid., 25.

[10] Ibid., 31.

game wardens.[11] The state knew that enforcing game and fish laws required increasing numbers of policing officers and did so by hiring the deputies. In 1899, hunting in Colorado was regarded as a means of subsistence, so no fees to take game were imposed.

One of the most important contributions to game management in Colorado was the introduction of hunting licenses by John M. Woodard, the Game and Fish Commissioner. The Colorado legislature approved this measure on April 13, 1903.[12] The revenues from the sales were distributed among different branches in the Colorado Department of Game and Fish, which allowed Woodard to hire extra game wardens.[13] The extra funds also increased revenues to spend towards habitat conservation and stocking programs for fish. Minimum fines were also set in 1903 enabling the agency to further increase the efforts of management and conservation.[14] The pricing on the licenses discriminated between residents and nonresidents; Colorado residents paid one dollar for a hunting license while nonresidents had to pay twenty five dollars.[15] The price discrimination, which continues today, is an effective tool for protecting against overhunting while providing additional revenue from out of state hunters willing to pay for the privilege of hunting in Colorado. Hunting licenses remain a key source of funds for the Colorado Division of Wildlife.

Game management in Colorado has been very successful. Although animal populations in Colorado were hurt from overhunting in the 1800's and early 1900's,

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[11] Ibid. 33.

[12] Ibid., 34-35.

[13] Ibid.

[14] Ibid.

[15] Ibid.

today the populations are strong. Colorado has the largest elk population in the United States and plentiful numbers of deer, pronghorn, and bear. Unfortunately, wild bison were wiped out by the early 20th century.

Hunting in Colorado

Hunting remains an important recreational activity and game management tool in Colorado. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation-Colorado, 259,000 hunters above the age of 16 hunted in Colorado that year. Residents comprised 49% and nonresidents 51% of this total. Of these, 208,000 hunted big game with 184,000 pursuing elk.[16] It is obvious that elk is the largest attraction drawing hunters to Colorado as 71% of all hunters and 88.5% of big game hunters were after elk. While this is a significant number, it has been declining over the years. Ten years earlier in 1996, there were 454,000 hunters licensed in Colorado. Thus, there was a decline of about 195,000 hunters, a 43% drop.[17] Surprisingly, this decline is greater than the national trend; in 1996 there were 14 million hunters in total[18] and 12.5 million in 2006[19], which is only about an 11% decrease. Colorado may have experienced this sharp decrease in hunters due to the increasing price of hunting licenses.

According to the 2006 annual report by the Colorado Division of Wildlife, the agency accumulated $74.5 million of its $104.2 million total revenue during the 2005-06

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[16] 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Colorado, 24, 28.

[17] Ibid., 14.

[18] Ibid., 22.

[19] Ibid.

seasons from the sale of both hunting and fishing licenses.[20] Although these revenue figures are not broken down by species, applying the cost of licenses in 2006 of $22 for 90,160 residents and $496 for the 93,840 non-residents, elk hunting provided $48.5 million in revenues for the Division of Wildlife.[21] Even though this is not an exact number, it shows the importance of elk hunting to the funding of the game management and wildlife law enforcement programs.

Colorado has the largest population of elk of any state in the United States. After the 2007 season, the Division of Wildlife estimated 291,960 elk living within the state.[22] This is significantly more than the populations in other states as estimated by the Rocky Mountain Elk Foundation as reflected in Figure 1.1.[23]

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[20] Colorado Division of Wildlife, "2006 Annual Report"; available from http://wildlife.state.co.us/NR/rdonlyres/3E816697-6016-4347-B0C0-D82CC9639645/0/06AnnualReport.pdf; Internet; accessed 28 November 2008, 8.

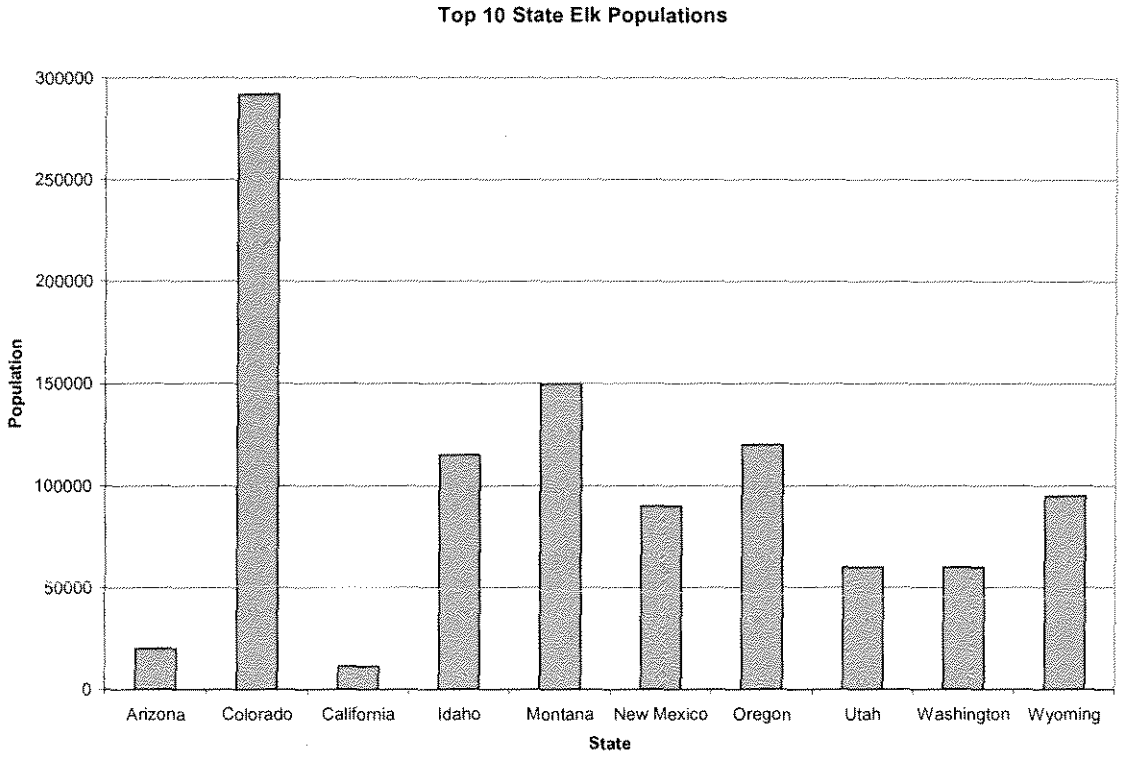
[21] Colorado Division of Wildlife, "License Agents"; available from http://wildlife.state.co.us/NR/rdonlyres/2059FC49-51B4-4681-8FE4-8625DE4C460D/0/Ch15CPI.pdf; Internet; accessed 11 December 2008.

[22] Colorado Division of Wildlife, "2007 Elk Post Hunt Population Estimates"; available from http://wildlife.state.co.us/NR/rdonlyres/6B36EF03-130A-40FC-9804-66A251DFDE6D/0/2007posthuntElkpopulationestimates.pdf; Internet; accessed 11 December 2008, 1.

[23] Rocky Mountain Elk Foundation, "2008 Elk Hunt Forecast"; available from http://www.rmef.org/Hunting/Features/Articles/Forecast.htm; Internet; accessed 13 November 2008.

FIGURE 1.1

Top 10 State Elk Populations



The success of Colorado's game management program for elk is reflected in the fact that there were fewer than 2,000 elk left in the state at the beginning of the 20th Century.[24]

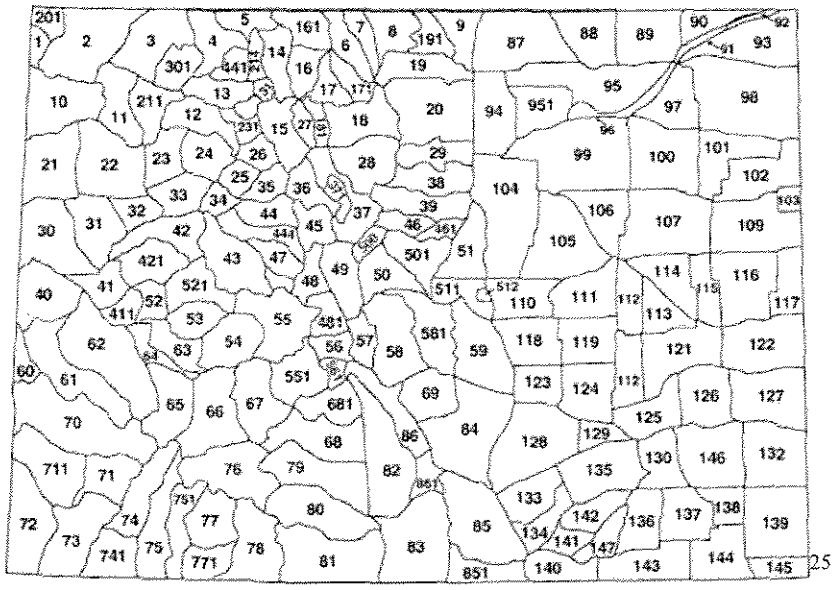
In order to promote game management, the Colorado Division of Wildlife established Data Analysis Units (DAU's) by dividing the state into sections. Each DAU consists of multiple Game Management Units (GMU). Separating the state into multiple DAU's allows management officers to be more area-oriented in their conservation efforts for elk. The number of licenses available for each unit depends on the estimated elk population and a set maximum population depending on the condition of the area. These

[24] The Hunter's Network, "Wildlife commission Approved Big Game Licenses"; available from http://www.biggame-hunting.com/library/colorado_big_game_season.htm; Internet; accessed 13 November 2008.

maximums are established based upon the availability of food, water, and available land. There are 184 GMUs across the state.

FIGURE 1.2

Colorado Game Management Unit Map



To hunt elk in Colorado, a hunter must pass a hunter education course or bow hunter education course (for bow licenses) if he or she was born on or after January 1, 1949, in order to apply for or purchase a license.[26] This is important in maintaining a safe hunting environment. Once the course is completed, the individual has various options when deciding which license to purchase. Colorado offers archery,

[25] Colorado Wilderness, "Colorado's Game Management Units"; available from http://www.coloradowilderness.com/gameunit.html; Internet, accessed 13 November 2008.

[26] Colorado Division of Wildlife, "Big Game Brochure"; available from http://wildlife.state.co.us/RulesRegs/RegulationsBrochures/BigGame.htm; Internet, accessed 13 November 2008, 1.

muzzleloader, and rifle seasons for elk. In 2008, there is one season for archery, running from August 30 through September 28, and also only one season for muzzleloaders, September 13 through 21. There are four main seasons for rifle hunters with a couple additional dates which include areas with early and late seasons, units inside military bases, and private land only areas.[27] The typical season is nine days long; Saturday of one week through the following Sunday.

Elk licenses include a limited-license lottery system as well as an over-the-counter unlimited (OTC) tag. GMU's with limited licenses have set numbers of licenses available for each season mentioned above. The lottery system is the method by which the Division of Wildlife allocates the limited licenses. Each year a hunter can apply for this type of license for each manner of take: archery, muzzleloader, and rifle. Limited licenses are a management tool used in order to set the number of licenses sold based on population, trophy animals, and other important determinants in individual game management units. Colorado has preference points (PP) which are used so the hunter can have a greater chance of success in the lottery drawing. One PP is accumulated each year the hunter is unsuccessful in drawing a license in the lottery or is requested by the hunter instead of entering the lottery. The points are accumulated and saved until a hunter uses them in obtaining a more desirable GMU, which requires more points. Some GMUs take as many as 16 preference points in order to obtain a license for the area as it may have a higher success rate or more trophy animals. If a hunter is unsuccessful in drawing a license, he or she has the opportunity to purchase any leftover limited licenses or an unlimited over-the-counter tag. OTC unlimited licenses are available for the second and third rifle seasons as well as the archery season. These are only valid for certain game

[27] Ibid., 26.

management units and there is no maximum to the number that can be sold. The OTC license allows the take of an antlered elk in a large number of the game management units across the state or an either-sex license for the plains region in eastern Colorado. Colorado is known for its over-the-counter bull tag as it is the only state that has an OTC license available for both residents and non-residents.[28] This is very attractive to hunters, especially nonresidents, because drawing a tag in the lottery system is not guaranteed and difficult to plan around.

Hunters are important in the management of elk in Colorado. With the disappearance of most natural predator populations, such as the wolf, hunters fill the gap in maintaining sustainable populations of elk. Every year, Colorado hunters experience about a 20% success rate in harvesting an animal, with a record high rate of 27% in 1990 and low of 16% in 1995.[29] The Division of Wildlife uses the harvest results from the previous years as well as other determinants such as winter conditions, other environmental factors, as well as estimates of post-hunt populations in order to determine the number of licenses to be sold in each GMU in the following season. Wildlife agents use the information at hand as best they can in order to predict the upcoming seasons to keep the elk population balanced and sustainable.

Hunting also provides significant benefit for the Colorado economy. Having almost 200,000 hunters in the state translates to profit for many businesses. Even with the decreased number of hunters, their expenditures have actually increased since 2001

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[28] Glenwood Springs Colorado Chamber and Resort Association, "Hunting"; available from http://www.glenwoodchamber.com/Earth/Hunting.html; Internet; accessed 28 March 2009.

[29] Rocky Mountain News, "Elk Success Rate Dropping"; available from www.rockymountainnews.com/news/2008/mar/19/dentry-elk-success-rate-dropping/; Internet; accessed 13 November 2008.

by approximately $8 million to $444 million in 2006 on items such as licenses, lodging, food, firearms, ammunition, and other general hunting trip costs.[30]. This influx of money from out of state is particularly important to the businesses in rural areas that otherwise do not have an inflow of customers.[31] Restaurants, sporting good stores, and inns see a huge jump in their revenue. Hunters provide an encompassing benefit to Colorado during the elk seasons.

[30] 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Colorado, 15.

[31] Barrows and Holmes, *Colorado's Wildlife Story*, 399.

CHAPTER II

THEORY AND LITERATURE REVIEW

Consumer Theory

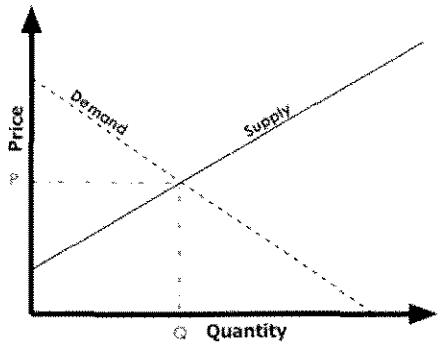
Many goods are sold in perfectly competitive markets. Perfect competition is defined as "a market structure in which there are many buyers and sellers, the product is standardized, and sellers can easily enter or exit the market."[1] The market is large, so each individual and firm must take the price and quantity as given by the market.[2] Supply (suppliers) and demand (buyers) curves determine the price of the good being sold in the market. Price is determined where the two curves intersect, the equilibrium point. An example of this is in Figure 2.1.

[1] Robert E. Hall and Marc Lieberman, *Microeconomics: Principles and Applications* (Cincinnati Ohio: South-Western College Publishers, 2001), G-4.

[2] Ibid., 50.

FIGURE 2.1

Perfectly Competitive Market



[3]

The quantity demanded is the amount of the good an individual would buy at a given price. There can be movement along or a shift in the curve depending on how the market changes. If the price of a good increases or decreases there will be movement along the curve. An increase in price will cause movement upwards on the curve, decreasing the quantity demanded. A shift can occur from changes such as a change in an individual's income.[4] An increase in income, for a normal good, will shift the demand curve outwards (to the right). Equilibrium will be reached again from any change to reach a new price. Compliments, another good that is used in conjunction with the given good, will also cause a shift in the demand curve. An example is a rifle and ammunition. If the price of ammunition increases, the quantity demanded for rifles will decrease. This is due to shooting becoming more expensive. Graphically, this would be a shift inwards of the demand curve. Substitutes act differently. A substitute is a good that will replace the current good. Shotguns can be seen as a substitute of rifles. If the price of shotguns

[3] Stock Investing for Beginners, "Supply and Demand: The Important Factor that Moves Stock Prices"; available from http://www.stock-investing-for-beginners.com/images/supplyanddemand1.png; Internet; accessed 1 April 2009.

[4] Hall, *Microeconomics*, 55.

changes the demand for rifles will also change. If shotguns become more expensive, people will switch towards rifles so rifle demand increases. This will be a shift outwards in the demand curve.

Supply is the quantity of a good that is produced at a given price. An increase in price will cause an increase in supply, as firms want to sell their goods at the highest price. Similarly to demand, movement along or a shift can occur in the supply curve. Price shows movement along the curve. A change such as an increase in inputs will cause a shift in the supply curve.[5] If an input becomes more expensive, the supply curve of a firm will shift inwards (to the left).

Hunting licenses act differently than a perfectly competitive market. This is an advantage of the contingent valuation method as it is suitable for measuring the benefits of goods similar to hunting licenses.[6] A hunting permit is a good that has individual property rights, can exclude consumers, and is not freely traded in competitive markets.[7] Its price is determined by the state (Colorado Division of Wildlife) and not through supply and demand of a market. Colorado has an infinite supply of hunting licenses, from the unlimited OTC tags, but a specific demand curve. The intersection of these two curves could possibly determine the price of an elk license, depending if the Division of Wildlife finds the fee to be suitable for the public and the department's revenue. When considering this method, a hunter's willingness to pay should be the peak of the demand

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[5] Ibid., 63.

[6] Mitchell *et al*, *Using Surveys*, 57.

[7] Ibid.

curve; a price greater than the fee of a hunting license. Other methods measuring benefits are limited in their ability to evaluate hunting permits.[8]

Contingent Valuation Method

As mentioned before, willingness to pay (WTP) is defined as the maximum sum of money an individual would be willing to pay for an improvement.[9] It is used in situations where the good, service, or amenity at hand cannot be freely traded in a market so there is no direct dollar value measurement. It is commonly used in environmental economics as it will give public goods, such as recreational sports, a monetary value. This method allows government agencies and economists to gain a concrete understanding of the value of previously priceless resources.

A way to calculate willingness to pay is the contingent valuation method (CVM). This method "uses survey questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specified improvements in them."[10] The survey sets up hypothetical markets in which the good is offered. The consumer's willingness to pay depends on which market is presented to them. Surveys consist of three parts: a description of the supposed market in which the good is being sold, questions deriving the consumer's willingness to pay, and questions about demographic characteristics of respondents and of the use of the goods.

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[8] Ibid., 58.

[9] Champ *et al*, 12.

[10] Robert C. Mitchell and Richard T. Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method* (Washington, DC: Resources for the Future, 1989), 2.

The description of the hypothetical market is important because it is the premise of the entire survey. The scenario needs to be plausible in its explanation of the method of provision, how the good is being offered, other substitutes available, and the payment vehicle.[11] This section is the informational component of the survey. An example from a previous study is as follows,

> The Colorado Division of Wildlife is faced with several problems in managing for big game hunting in Colorado. Important issues include complaints of crowding, declines in deer populations and decreased availability of mature bulls and bucks. In the next few questions, we'll be asking about possible solutions that involve license fee changes.[12]

In this example, it is clear that the license fees will increase in order to help solve problems involving those Colorado hunting issues listed.

The next section of the survey consists of questions seeking information about the willingness of the respondent to pay for the goods under analysis. The survey should not use biased or misleading questions it may skew or influence the response.[13]

Context of the responses is refined by examining the demographic characteristics of the respondent and the intended use of the goods. The demographic section asks questions regarding age, gender, income, education, and other possibilities. These are important determinants because they may explain the difference between peoples' willingness to pay for a specific good. The intended use of the good is also critical because it too plays a role in the individuals' view of the utility of the good or service.

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[11] Champ *et al*, *Nonmarket Valuation*, 116; Mitchell, *Using Surveys*, 3.

[12] John Loomis, Cynthia Pierce, and Mike Manfredo, "Using the Demand for Hunting Licenses to Evaluate Contingent Valuation Estimates of Willingness to Pay," *Applied Economics Letters* 7, no. 7 (2000), 437.

[13] Mitchell *et al*, *Using Surveys*, 3.

The hope is to find the importance of variables that theory identifies as predictors of WTP.

Depending on the information being elicited, the survey may use either open-ended or closed-ended questions.[14] Closed-ended questions have defined answers from which the respondent may choose. In open-ended questions the respondent is not limited in their response. An example is, "How far did you drive your car?" where the respondent would write down a mileage with no limitations. The advantage of using open-ended questions is that a direct data point is measured. If an open-ended question retrieves the data for the dependent variable in a regression equation, then ordinary least squares (OLS) regressions may be used.[15] Using OLS is beneficial because of its ease in empirical analysis. Open-ended questions are easier to write in the sense that only the question is written and not a set of intervals. This is beneficial in regressing equations because clustered data points will not be an issue as would happen if 90% of responses are in one of five intervals.

Closed-ended questions constrain the responses of the respondent. The questions can have answers that appear as yes or no, intervals, rankings, or some other type of determined options. An example of this is, "How far did you drive your car? Between 0-20 miles, 21-30 miles, or over 31 miles?" These types of questions are easier for the individual to answer because they do specify a number and they also take less time to complete the survey. The problem with closed-ended questions is that they are more

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[14] John C. Whitehead, "A Practitioner's Primer on Contingent Valuation," 18 October 1999, in *Google Scholar* [database on-line], PDF file; accessed 8 December 2008, 8.

[15] Ibid.

difficult to analyze empirically.[16] Closed-ended questions do not give unique points in the data. As mentioned before, the results can be in words (yes or no's), rankings, intervals, and other forms. In order to analyze the results empirically, different techniques can be used, such as qualitative variables. A qualitative variable assigns a value of zero or one to a point in the data. For example, if the response from a question is yes, the data point will be one and zero if the respondent answered no. The data obtained from a closed-ended question may not be as descriptive. An example of this can be seen in intervals. Instead of having the respondent answer with a specific number, he or she will selected an answer, say the answer is 21-30 miles. If a numerical data point is wanted for the regression, the author will have to determine if 21, 30, or even a number between 21 and 30 could be used to represent that interval. These situations complicate the empirical results.

There are several different ways in which the survey can be conducted: mail, in-person interviews, and telephone surveys.[17] These are the methods most commonly used by economists in order to obtain data. Mail surveys are the cheapest and visual aids can be used. Time consumption is the downfall because mail surveys are labor intensive, especially if the surveyor stuffs and sends the papers themselves. There is also a delay in data retrieval as the surveyor must wait for the survey to be returned. Also, the respondent may not return the survey or turn it in incomplete. Whitehead (1999) believes a sample of 500 surveys would cost around $1500, according to his 2007 paper. Telephone and in-person interviews will most likely require the hiring of professionals, whether it is an automated telephone service or trained worker. The high cost of

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[16] Ibid., 9.

[17] Champ *et al*, *Nonmarket Valuation*, 4, Whitehead 1999, 4.

telephone interviews is long distance calls or if the surveyor outsources the calling to an outside firm. The calling costs along with the hiring of a service will cost about $15-$40 per interview.[18] The last survey method is personal interviews, which is the most expensive. The costs are the downfall because if professionals are hired, which includes travel and time costs, it will be very expensive to conduct a survey. The estimated cost is $25-$50 per interview. A benefit of the in-person survey is that the respondent will answer all of the questions and visual aids can be used. A new method, very similar to the mail method, is online or email surveys. Websites, such as SurveyMonkey.com, offer free use of their services for small surveys and charge for various levels of memberships for larger surveys. Surveys are written online and can be distributed via e-mail or posted on other websites. This approach allows a zero or little monetary cost structure, but is limited to people with internet service.

Choosing an elicitation method can depend on which type of survey is conducted. This is the manner in which willingness to pay is asked and measured. As mentioned above, there is the open-ended question of WTP which gives no bounds to the participant. This is considered to be the preferred method as it will give the respondent's maximum WTP and provides more information about the respondent's choice.[19] The open-ended question also allows for the use of ordinary least squares regression models which are more straightforward than other statistical techniques.[20] One of the drawbacks of this

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[18] Champ *et al*, *Nonmarket Valuation*, 4.

[19] Mitchell *et al*, *Using Surveys*, 99.

[20] Ibid.; Whitehead 8.

method is that it can be hard for the respondent to make an accurate decision and many respondents do not answer the question.[21]

Until recently, one of the most widely used elicitation methods is the bidding game. This technique imitates a real auction, which is familiar to people, and will capture how much a person is willing to pay for a certain good.[22] The auction format captures a respondent's maximum WTP with the highest bid. Obtaining WTP through this procedure creates biases from various aspects, such as the starting bid giving a value to the item. Also, if the starting price of the item is above an individual's WTP, the revealed willingness to pay amount increases. This will obtain biased results which can be found to be unacceptable.

Another technique is the payment card developed by Mitchell and Carson. This technique yields a direct response from the participant by the use of a card displaying a large number of different dollar amounts. The question posed to the respondent is "what amount on this card or any amount in between is the most that you would be willing to pay for the level of good being proposed."[23] This method is more direct than an open-ended question by having various values listed as well as giving the respondent a blank to fill in his or her desired amount. Although this may seem to be a great method, its drawback is that there are biased results related to the numbers listed on the card.

Lastly, the take-it-or-leave-it approach determines a person's willingness to pay. This technique was developed by Bishop and Heberlein (1979, 1980).[24] As suggested by

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[21] Mitchell *et al*, *Using Surveys*, 97.

[22] Ibid., 99.

[23] Ibid., 100.

[24] Ibid., 101.

its name, this method offers the good at one price from a list of many prices and the respondent will either pay the price or not. Each price from the list is given to equal numbers of respondents who are assigned the value randomly. This type of question is suitable for telephone interviews and mail surveys as each price can be distributed equally. Take-it-or-leave-it is also useful in that it is an easier question for the respondent to answer as it is one binary question. Like all methods, take-it-or-leave-it has its drawbacks; it only obtains some WTP values and not a maximum willingness to pay. The main problem with this approach is obtaining the mean WTP through the valuation function or indirect utility function. Bishop and Heberlein argue that the area below a logistic or probit curve, fitted from the percentage of accepting respondents to each amount, equals the mean WTP.[25] This raises the question of the behavior outside the range of the curve, the prices not used in the study. A variation of the take-it-or-leave-it method includes a follow up. If the respondent selects yes to the given price then a second question is asked with a price higher than the original, and vice versa if he or she says no. Although this may gain efficiency in the model, the same drawbacks from the take-it-or-leave-it approach remain.[26]

Another characteristic of the contingent valuation method is the fact that it is based around a hypothetical situation. This gives it the characteristics to obtain judgments about the public good or service before any changes occur. It also captures willingness to pay amounts that include the existence values.[27] Gathering information on WTP for items that are not yet available on the market gives great foresight to the success

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[25] Ibid., 102.

[26] Ibid., 103.

[27] Ibid., 89.

of the good or service. Policy makers can have a good understanding of the value of a project and determine if it is a worthwhile venture or the cost of a project at hand. An example of the contingent valuation method being used for an environmental project is in the legal case involving the Exxon Valdez oil spill. CVM placed a value on the environmental damage due to the oil spill which Exxon had to pay in the settlement[28].

Many other methods rely on observed behavior which leads to difficulty obtaining existence values. An existence value is the "value that individuals may attach to the mere knowledge of the existence of something."[29] The existence value is important because it could greatly affect an individual's willingness to pay for a specific good. Say if one person, in the topic area of this paper, knows a specific area that contains large numbers of elk, he or she may be willing to pay more for a license than someone who has hunted without ever seeing an elk.

Besides the contingent valuation method, another popular approach to valuing environmental goods is with the travel cost method (TCM). Unlike the CVM where a direct question is asked about how much a person would be willing to pay in order to visit a specific site, TCM models use the cost of traveling and number of visits to a specific area as a substitute for price using a demand function.[30] There are single-site models as well as multiple-destination models in order to best capture an individual's trip. Although multiple-site models are used, single-site models are more common and

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[28] Champ *et al*, *Nonmarket Valuation*, 113.

[29] About.com: Economics, "Existence Value,"; available from economics.about.com/library/glossary/bldef-existence-value.htm; Internet; accessed 10 November 2008.

[30] John Loomis, "A Comparison of the Effect of Multiple Destination Trips on Recreation Benefits as Estimated by Travel Cost and Contingent Valuation Methods," *Journal of Leisure Research* 38, no. 1 (2006): 46.

will be the focus of this section.[31] Generally, the data collected is the cost of a day trip to the site. The site visited should be defined for type and use. For example, if the site is a lake it may have a variety of uses: boating, fishing, camping, or swimming. Because certain activities are seasonal, the season should be defined.[32] When gathering this information, there are some apparent drawbacks; the individual may have a multi-purpose trip. A single-purpose trip is one where the individual only participates in recreation at the site. The problem arises when he or she may take a side trip to go shopping, see friends, or run errands.[33] Single-purpose trips work well with the TCM but multiple purpose trips are harder to define as there is a "package of costs." Many studies use day trips only in order to make the assumption that are trips are single purpose.[34] This is a significant assumption as a trip will yield a higher cost when other activities are incorporated. The contingent valuation method has potential to yield better results. It allows a person to directly respond with how much they would be willing to pay to visit a recreational site.

The contingent valuation method was first used in a study in 1963 by Robert K. Davis in order to estimate the value of big game hunting in Maine.[35] Although the idea of using a "direct interview method" originated with resource economist Ciriacy-Wantrup in 1947 to place values on natural resources, Davis played a large role in CVM

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[31] Champ *et al*, *Nonmarket Valuation*, 271.

[32] Ibid., 276.

[33] Ibid., 279.

[34] Ibid., 280.

[35] Ibid., 111.

development.[36] This survey method did not catch on until the 1970's when other authors published studies varying from waterfowl hunting to visibility in the Four Corners region. The popularity of the method grew but so did the critics. A. Scott expressed his feeling that the contingent valuation method is a "short cut" due to his opinion, "ask a hypothetical question and you get a hypothetical answer."[37] Various economists compared the results from the CVM to established methods of valuing recreation.

According to Kevin Boyle, Bishop and Heberlein's study in 1979 demonstrated the validity of the contingent valuation method when comparing WTP for goose hunting between actual cash transaction, contingent valuation, and travel cost.[38] The results from this study concluded that all three methods yielded similar WTP results. Other economists tested their CVM results with other techniques. Robert Davis used a travel cost method; Arthur Darling used a property value model; and, Michael Hanemann used a generalized travel cost model.[39] All of these studies supported the idea that contingent valuation method yields similar results to the other techniques valuing goods such as recreation, hunting, and environmental issues.

The use of contingent valuation by government agencies has also promoted its acceptance as a method of valuing environmental goods. A few organizations to use CVM are the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency,[40] and the National Oceanic and Atmospheric Administration.[41] As more

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[36]Mitchell *et al*, *Using Surveys*, 58.

[37] Champ *et al*, *Nonmarket Valuation*, 111.

[38] Ibid.

[39] Mitchell *et al*, *Using Surveys*, 12.

[40] Ibid., 13.

research is being conducted with contingent valuation, the more credible it is becoming. This being said, the validity of the CVM relies on the survey itself. The survey must be very thorough in its design in order to yield acceptable value estimates.

Literature Review

The contingent valuation method is used for a wide variety of recreational activities ranging from the economic value of windbreaks in Kansas to hunting and viewing bears in Alaska. As mentioned previously, CVM has been becoming increasingly popular in this field and is recognized by various federal and state agencies as a legitimate method in estimating non-market activities.[42] Many economists and wildlife researchers also believe it is an acceptable method to use in these areas of research.[43]

The travel cost method is the main "competitor" of the contingent valuation method. TCM is also a process by which recreational sports can be valued and is frequently used by authors such as Sandrey *et al* (1983) and Loomis *et al* (2000) in conjunction with the contingent valuation method in order to act as a comparison.[44]

Sandrey *et al.* (1983) use both methods for pricing policies for cow and calf elk licenses in Oregon.[45] The authors attempt to discover the influencing factors affecting

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[41] Champ *et al*, *Nonmarket Valuation*, 113.

[42] Brett M. Fried, Richard M. Adams, Robert P. Berrens, and Olvar Bergland, "Willingness to Pay for a Change in Elk Hunting Quality," *Wildlife Society Bulletin* 33, no. 2 (1995): 680.

[43] Ibid.

[44] Loomis *et al* 2003, 435.

[45] Ronald Sandrey, Steven T. Buccola, and Daniel P. Metz, "Pricing Policies for Antlerless Elk Hunting Permits," *Land Economics* 59, no.4 (1983): 435.

the demand for antlerless elk in Oregon using the two methods for the nine hunting zones for Rocky Mountain elk. The travel cost method yielded high correlation between the costs to access each of the various zones. This is due to the similar travel costs to each individual hunting zone.[46] The CVM was also used in this study and the data was regressed using three functional forms. From this data using the exponential form, the study found its demand function for pricing policies.[47] Sandrey *et al* concluded that they obtained better results in their study using the contingent valuation method rather than the travel cost method.

This is similar to the focus of Loomis *et al* article, *Using the demand for hunting licenses to evaluate contingent valuation estimates of willingness to pay* (2000). Loomis, Pierce, and Manfredo compare the willingness to pay for deer and elk non-resident licenses from CVM estimates with the historic variation (their TCM) in order to have a true comparison for criterion validity.[48] The authors use dichotomous choice CVM and run a logistic regression to obtain mean WTP for an elk license of $164 with a 95% confidence interval of $149-179 and deer license mean of $72 with a 95% CI of $63-82. The actual license demand model which uses elk and deer license prices from 1965 to 1995 yields $284 mean and $188-$576 95% CI for elk and a $148 mean with a 95% CI of $92-371 for deer.[49] The confidence intervals in this study do not overlap suggesting that the results from the CVM are statistically less than the actual WTP. According to

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[46] Sandrey *et al.*, "Pricing Policies for Antlerless Elk Hunting Permits," 435.

[47] Ibit., 436.

[48] Loomis *et al* (2000), 435.

[49] Ibid., 437.

Loomis *et al*, the contingent valuation often obtains results lower than the revealed preference method.

Another study uses a very similar approach as Loomis *et al* (2000). Fix *et al* (2005) write a study about the validity of elk and deer license sales in Colorado using the contingent valuation method. As before, they use a historic data model based on elk and deer license price and quantity sold from 1975-1999. Instead of a dichotomous choice format, the willingness to pay question is multiple choice. There are 10 different prices available for resident and nonresidents for deer and elk licenses as options in the WTP question. The respondent was given one of ten prices for each an elk and deer license and asked if he or she would purchase "1) a deer license, 2) elk license, 3) both and elk and deer license, or 4) neither."[50] Using a logistic regression, the authors were able to obtain predicted numbers of sales of deer and elk licenses in Colorado and compare the results to the data obtained from the Division of Wildlife. The results in this study are mixed. Using convergent validity, it is found that the difference between CVM and the historic data model (HDM) using elk license fees is not statistically different, suggesting convergence. On the other hand, using deer license prices, the HDM estimates are lower than CVM and are significantly different. They conclude that CVM underestimates the economic value of deer and elk hunting.[51] Fix *et al* conclude that the contingent valuation method provides useful information, especially with elk as its historic trend is stable and there is a high association between the estimated and "true" results.

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[50] Peter J. Fix, Michael J. Manfredo, and John B. Loomis, "Assessing Validity of Elk and Deer License Sales Estimated by Contingent Valuation," *Wildlife Society Bulletin* 33, no. 2 (2005): 636.

[51] Ibid., 640.

Dichotomous choice is a popular method used in determining a person's willingness to pay. It is part of the take-it-or-leave-it elicitation method mentioned above. Fried *et al* and Nguyen *et al* use it in their studies about elk hunting quality and option prices for hunting permits respectively. The two studies differ in their method of asking the willingness to pay question. Fried *et al* use the WTP question, "If the number of animals were sufficient to make it virtually certain that you would have an opportunity to shoot at an elk, would you be willing to pay $t additional to hunt?"[52] Instead of asking about additional cost above the current price of a license, Nguyen *et al* present total amounts to the respondent as their question is the maximum amount a person is willing to pay to be guaranteed a moose license in Maine.[53] After running regression models, both studies found good results. Nguyen *et al* conclude that their model correctly predicted 84% of the responses. Fried *et al* found their logistic regression model to be statistically significant and that their mean WTP fell within the range of a similar study conducted in Montana. The contingent valuation method using the dichotomous choice elicitation method yields significant results in the two studies. This shows support for its use in valuing recreational activities.

Open-ended questions have also been used in studies to obtain a person's willingness to pay for a certain good. Two of these studies have been written by Cook and Cable (1990) and Miller *et al* (1995). Cook and Cable conducted a survey in order to determine the economic value of windbreaks for hunting in Kansas. The respondents were asked two questions in order to capture WTP: if hunting conditions remained the

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[52] Ibid., 681.

[53] To N. Nguyen, W. D. Shaw, Richard T. Woodward, Robert Paterson, and Kevin Boyle, "An Empirical Study of Option Prices for Hunting Permits," *Ecological Economics* 63, no. 2-3 (2007).

same, how much more would they be willing to pay in expenses in order to have similar hunting conditions and how much more they would pay if their game harvest doubled on the next trip.[54] Similarly, Miller *et al* asked how much more people would be willing to pay in expenses in order to for a wildlife-viewing or hunting trip for bears before they would no longer take the trip. Both studies used their results from the CVM data in regression models to find their results for net economic value and the significant contributing factors. Cook and Cable estimate the net economic value of windbreaks for hunting in Kansas to be at a minimum of $21.5 million.[55] Miller *et al* compare their WTP estimate to view or hunt bears of $485 to be acceptable because commercial bear-viewing charter companies in Homer, Alaska charge $425-480 per person.[56] In both studies, the contingent valuation method is used with acceptable results.

The contingent valuation method is commonly used in estimating the economic value of various recreational activities. Although some authors suggest that there some flaws in the contingent valuation method, it is an accepted method in determining the value of various recreational activities and quasi-private goods by various federal and private organizations. The literature suggests the extensive possibilities of using contingent valuation, but implies the results will be underestimates.

Determining the important variables in studies about hunting licenses is important in establishing ideas and comparisons for the results of this paper. The two studies which

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[54] Philip S. Cook and Ted T. Cable, "The Economic Value of Windbreaks for Hunting," *Wildlife Society Bulletin* 18, no.3 (1990), 339

[55] Ibid., 341

[56] Suzanne M. Miller, Sterling D. Miller, and Daniel W. McCollum, "Attitudes Toward and Relative Value of Alaskan Brown and Black Bears to Resident Voters, Resident Hunters, and Nonresident Hunters," *Ursus* 10 (1998): 373.

have similar and useful variables are Fried *et al.* (1995) and Nguyen *et al.* (2007). The variables that are important in Nguyen *et al.* are expected total cost of hunting in log term and two interaction terms involving this total cost term with male (gender variable) and education.[57] These three variables are significant to the 10% level. The expected total cost of hunting in log term and this variable interacting with education have positive coefficients. The total cost term interacting with male has a negative coefficient. Nguyen *et al.* find that cost, gender, and level of education play an important role in determining willingness to pay.

Fried *et al.* (1995) find annual income and natural log of days hunted to be the two variables that are significant at the 5% level. Annual income has a positive coefficient while days hunted has a negative coefficient. For this study, an income greater than $30,000 will increase the hunter's willingness to pay and hunting more days will decrease WTP. A hunter's earnings and length of hunter are also significant deciding WTP.

[57] Nguyen *et al* (2007), 481.

CHAPTER III

SURVEY METHODOLOGY AND DATA OVERVIEW

Survey Methodology

The contingent valuation method requires a survey or interview in order to gather the data for the study. In this particular study, the survey was conducted online using SurveyMonkey.com, a commonly used website for surveys. To select a group of respondents, the survey was posted on various online hunting forums, including ColoradoWaterFowl.com, MuleyMadness.com, and Elkcamp.com. The target group for this survey is elk hunters, which is why hunting forums were the only websites receiving the link to the survey. Each site has either a 'Big Game' or 'Elk Hunting' specific forum where the survey thread was posted. 214 people started the survey and 192 finished it for a completion percentage of 89.7%. This is a high response rate compared to other studies, although many of those were conducted via mail. The survey is relatively short as it contains 23 questions for both resident and non-resident hunters. Open-ended, multiple choice, and an interval question are the types of questions asked. A copy of the survey can be found in Appendix A.

Three sections form this survey: general, demographic, and willingness to pay. The general questions consist of elk hunting related categories such as reason for hunting elk, various costs, means of hunting (rifle, archery, and muzzleloader), and success in

harvesting an animal. These questions are included to capture the individual's elk hunt in both cost and experience. It is also crucial to determine an individual's willingness to pay because one would think that successfully harvesting an animal, accumulating preference points, and spending large amounts of money for various costs will have an effect on increasing the respondent's willingness to pay.

Demographic characteristics are a standard in conducting contingent valuation surveys or interviews. The demographic questions used include gender, age, personal annual income, and years of education.

The willingness to pay section presents a hypothetical situation. To determine reasons why the Colorado Division of Wildlife would impose an increase in elk license fees, inquiry was made to the DOW. Julie Stiver, a biologist, advised that land development is the primary concern of the wildlife.[1] It is critical to protect high value land areas for elk and other species from energy and land developers by acquiring conservation easements or outright purchase. These programs, as well as clear cutting patches of forest to promote aspen growth (a food source for elk) and winter feeding for areas having extremely harsh winter conditions, are included in the hypothetical situation as justifications for the increasing the price of elk licenses.

The WTP section is adjusted to account for the substantial differences between resident and nonresident licenses. The response to a question about Colorado residency directs the survey-taker to the appropriate "Residents" or "Non-Resident" portion of the survey. This is due to the large price difference between resident and non-resident

[1] Contacted Julie Stiver via e-mail on 11/24/2008

license fees. For the 2008 season, a resident of Colorado paid $59[2] for any elk license, whether it is a cow, bull, or either sex tag. On the other hand, non-resident hunters pay a much greater fee as a cow tag costs $254 and a bull or either sex permit has a $529 fee. In this study, the WTP inquiry is unique from other studies. It is a two part question; first the respondent is given a choice of nine $10 intervals for residents or nine $20 intervals for non-residents. This is followed by an open-ended question requesting the respondent to specify the maximum about he or she would be willing to pay. Although some studies express concern that the respondent is not as likely to provide an "accurate" response from an open-ended question as a closed-ended question. However, it was believed that in this survey, the dual question approach would narrow a respondent's willingness to pay. This method is used to combine the accuracy of a closed-ended question with the ease of analysis of an open-ended question.

Data Overview

This section will provide an overview of the data collected from the survey. Means, medians, maximum, and minimums will be used to analyze the data to show trends and interesting behavior which may help explain the results obtained from the regression models. It may also help in determining whether there are outliers in the data that could negatively affect the regressions.

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[2] The real price of an elk license for residents is $46. In order to present a more accurate cost of an elk license in the survey, $59 is used as the price includes the application fee ($3) and two habitat stamps ($10) which are required for the first two licenses purchased

TABLE 3.1

Reason for Hunting

Reason for Hunting	Response Count (%)
Subsistence (food)	44 (22.2%)
Sport (enjoyment)	147 (74.2%)
Trophy (antlers/mount)	7 (3.5%)

Looking at the results from the first question of the survey, the respondents are asked what their primary reason for elk hunting is. According to their responses, elk hunting is overwhelmingly done for sport, which the survey defines as enjoyment. Sport hunting yields 147 responses, or 74.2% of the total responses. Subsistence hunting, defined as hunting for food, has second most with 44 responses. Receiving only seven responses, trophy hunting, hunting for the antlers/mount, is the least popular reason for hunting elk. These results are on par to what would be expected as sport hunting is the primary reason for elk hunting. With modern grocery stores, fewer people require hunting as a means for food so subsistence hunting receives fewer responses. The one surprising result is that trophy hunting received only seven responses, all from non-residents. With today's hunting shows and hunting companies' marketing schemes, which generally only involve trophy animals, one would think the number of trophy hunters would be higher. Also, the preference points required to hunt some game management units suggests the demand for trophy hunting at levels higher than reflected in this study. Some GMU's require ten or more preference points in order to obtain a bull license, which strongly implies that the unit possesses trophy elk.

TABLE 3.2

Equipment and Travel Costs

Expense	Average	Minimum	Maximum
Equipment	$829.02	$0	$8,000
Trip/Travel	$724.72	$0	$7,000

The expenses incurred by hunters in order to travel and be fully equipped can be indicative of how much a person is willing invest to go elk hunting in Colorado. The results for expenses, equipment and trip/travel costs combined, have means of $829.02 and $724.72, respectively. Adding these expenditures shows a total expense of $1,553.74 for hunting during the 2008 season. This value is not much different from the Colorado 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation data which has a trip expenditure of $1,416.[3] The difference will be even less if the 2006 average were adjusted for inflation. The 2006 National Survey data gives foundation for my results as the two means are similar. The equipment costs, which are specified as ammunition, firearms, clothing, and other items such as tents, have a median of $500, minimum of $0, and maximum of $8,000. This maximum is possibly an outlier because the next highest equipment cost is $5,000 and the mean is only $829.02. With a difference of mean and median of $329.02, this suggests that the data may not be distributed equally. The money spent on trip and travel related costs, lodging, food, gas or diesel, and other related fees, has a median of $500, minimum of $0, and a maximum of $7000. Again, the mean and median have a large difference, in this case $224.72.

[3] 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 31

These values are not much different from the equipment costs, suggesting that people spend similar amounts on the equipment being used for elk hunting and the trip to their hunting camp. The median expenditure per person is $1,000, which is significantly lower than the mean of $1553.74.

TABLE 3.3

Harvest Results

Successful harvest 2008 elk season	Response count
Yes	61 (31.0%)
No	126 (64.0%)
Did not hunt	10 (5.1%)

Of the respondents who hunted during the 2008 elk season, 61 (of 187) successfully harvested an animal. This is a 32.6% success rate which is significantly higher than the average which is about 23%, calculated from all manners of take harvest success rate from the 1999 to 2007 elk seasons[4]. The 2008 harvest summary is currently unavailable so there is no basis for comparison between the sample's success rate of 32.6% and the overall harvest rate. Even so, a 9.6% higher successful harvest rate, compared to the '99-'07 seasons, is dramatic and without explanation. One possibility is that some respondents were not candid in their responses. This deviation from the data from the Colorado Division of Wildlife could also be explained if the respondents over represented the population that successfully harvested an animal. Of the successful

[4] Colorado Division of Wildlife, "Archived Big Game Statistics"; available from http://wildlife.state.co.us/Hunting/BigGame/Statistics/ArchivedStatistics.htm; Internet; accessed 11 Februrary 2009.

hunters, 28 harvested a bull, 25 harvested a cow, and seven successfully harvested both a bull and a cow.

TABLE 3.4

Manner of Take

Manner of Take	Response Count	Response Percent
Rifle	143	71.9%
Archery	99	49.7%
Muzzleloader	53	26.6%

The "manner of take" is measured in a question asking the respondents to check which type(s) of hunting they participate in. A hunter is allowed to hunt all three manners of take if he or she desires and successfully draws the licenses. In the responses, rifle hunting is the most popular with 143 responses. This is not surprising because rifle season draws in the most hunters. According to the 2007 Harvest Summary from the Colorado Division of Wildlife, 176,397 of 227,262 hunters purchased a license for rifle season. This is an overwhelming 77.6% of the total number of hunters.[5] The survey has rifle accounting for 71.9% of the three types of hunting. These values differ by about 6%, suggesting the survey yields similar results as the true proportion of hunters in Colorado. Archery is the second most used manner of take from the survey as 99 of 199 respondents selected it. This translates to 49.7% of the respondents archery hunt compared to only 16.4% of the total from the same 2007 Harvest Summary. Although archery is over represented, in both the survey and the DOW's information it is the

[5] Colorado Division of Wildlife, "2007 Harvest Summary"; available from http://wildlife.state.co.us/NR/rdonlyres/EF5A0F6C-FB96-4B25-AC47-8643ED887FFF/0/2007StatewideElkHarvest.pdf; Internet; accessed 11 January 2009, 3, 6.

second most popular manner of take. This leaves muzzleloader hunting to be the least popular, whether from demand of the sport or number of licenses. 53 people in the survey hunt using a muzzleloader, which is 26.6% of total responses. Again, this is an over representation of the true proportion of 6.0% of all Colorado hunters. Although all the proportions do not match up, the three manners of take are ordered in the same sequence as the 2007 Harvest Summary. These percentages do not add up to 100 because each respondent can select multiple manners of take.

The average days hunted is 7.37. This is reasonable as archery season lasts 30 days, muzzleloader season is 9 days, and normal rifle season ranged from 4-9 days during the 2008 season. The days hunted has a median of 6, minimum of 0, and maximum of 100. One may think 100 days is not possible, but there are some game management units that allow private land to be hunted from Sept. 1 to Jan. 31.[6] This could possibly be an outlier as the next highest days hunted is 30 or even a mistake, as the respondent could have meant 10 days. Both the mean and median are realistic value and fall within almost every season no matter which manner of hunting it is.

Although not many, 29 hunters paid to hunt private land or hire a guide. Of these, 21 paid to hunt on private land. This indicates that 168 people hunted public lands, which includes National Forests, Bureau of Land Management lands, State Wildlife Areas, and more. The 12 hunters who paid to hunt private land on average paid $1,185.71. This means that nine hunters hunted their own property or a friend's land. Eight people hired a guide; these hunters are all non-residents. The average amount paid for a guiding service is $2,293.88.

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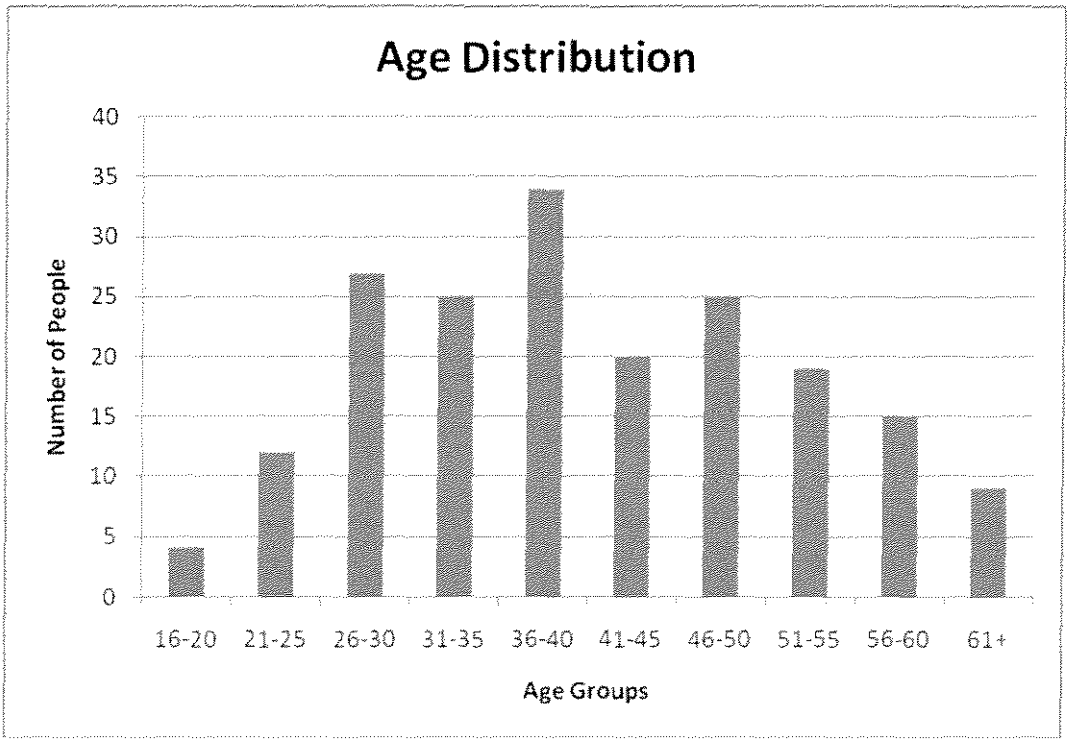
[6] Colorado Division of Wildlife, "Big Game Brochure," 26.
Note: the 2008 Big Game brochure has been removed from the Colorado Division of Wildlife's website. It is replaced with the 2009 Big Game brochure.

Now looking at the years of experience hunting elk could possibly lead to an explanation for the higher-than-normal success rate of harvesting an elk. The average number of years hunting elk is 11.71 with a median of eight. Zero in the minimum numbers of years hunting while 42 is the maximum. In looking at these values as well as the actual data, it appears the respondents as a whole are experienced elk hunters, which could help explain the above average harvest rate. As people say, experience comes with age. The mean age of the respondents is 40.51 years with a median of 40. The youngest hunter is 16 while the oldest is 68. Figure 3.1 shows the age distribution in five year intervals:

Figure 3.1

Age Distribution



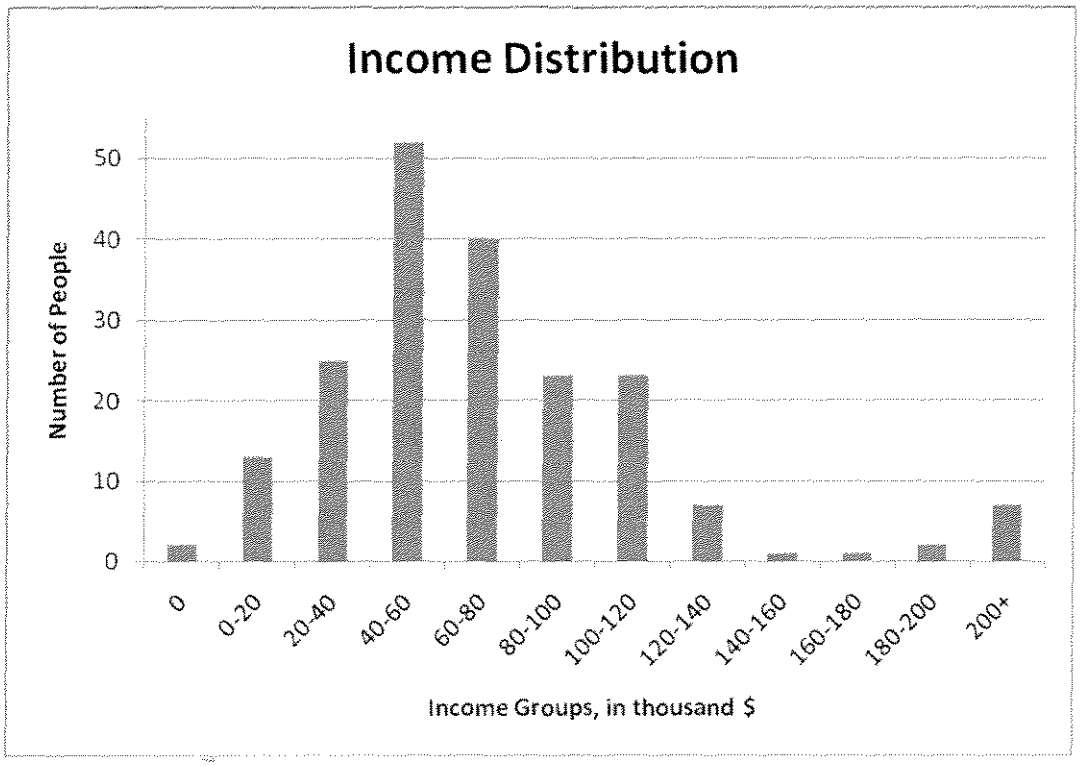
When grouping ages together in these intervals, 36-40 is the largest group with 34 people and 26-30 is the next biggest with 27. The distribution of ages is almost shows

natural variation[7], bell shaped, except for the two interval adjoining 36-40. Although it is not perfectly symmetric, it shows a desirable distribution among the respondents as it shows a general pattern for natural variation.

Similarly to the age distribution, income is almost naturally distributed. The flaw occurs towards the end there is an increase in the number of people making over $180,000, with nine people in those two intervals. Even with the slight increase, the data shows sought-after distribution among the various income intervals.

Figure 3.2

Income Distribution



For statistics of income distribution, the largest group is $40,001-60,000 with 52 people in that category. In order to obtain usable numbers for the regression analysis,

[7] A graph with a high center and tapered sides is bell shaped. A bell shaped graph shows natural variation.

each income interval is assigned a specific number; in this case the whole number in the middle is chosen to the nearest ten thousand. For example, for $60,001-80,000 the number used is $70,000. Using these constant numbers, the mean individual income is $71,224.49 and median of $70,000. These values are much larger than the average per capita income of $38,388 in the United States, 2007 measurement.[8] According to these numbers, a hunter has earnings well above the average American. The higher income could be due to the "tail" found on the income distribution having seven respondents earning over $200,001. The minimum income is zero which was given by the youngest, 16, and one of the oldest, 61, respondents.

There could possibly be a correlation between education and income. For the years of education, the mean is 15.06 and the median is 15. The two values are essentially the same, which shows good results as there is not a likelihood of outliers. 15 years of schooling is equivalent to having three years of college education, equivalent to at least an associate's degree at most universities. This could explain the higher mean income because a male with an associate's degree has a mean income of $47,575.[9] This being said, the minimum years of education in the survey is four, which is equivalent to completing fourth grade. Even with the fewest years of education, this respondent has an annual income of $60,001-80,000. The maximum schooling is 21 years which is comparable to five years of graduate school. According to the survey, elk hunters, on

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[8] The World Bank, "World Development Indicators United States GDP per capita 2007"; available from http://0-ddp-ext.worldbank.org.tiger.coloradocollege.edu/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=6; Internet; accessed 14 January 2009.

[9] U.S. Census Bureau, "Current Population Survey: Annual Social and Economic Supplement"; available from http://pubdb3.census.gov/macro/032007/perinc/new04_010.htm; Internet; accessed 26 March 2009

average, are more educated than the typical person as the average American has an average 12 years of schooling.[10]

The last section of the survey includes the willingness to pay questions. WTP is very important in this study, as it is the dependent variable for the regression models. In looking at the combined data, residents and non-residents, of the open-ended question asking how much more a person is willing to pay, there is a mean of $32.05, median of $16, minimum of $0, and maximum of $279. Although it is interesting to look at the data as a whole, it is more beneficial to look at the results in terms of residents and non-residents because of the price difference in licenses: $59 for residents vs. $254 (cow) or $529 (either sex/bull) for non-residents. In order to determine which set of willingness to pay questions the respondent would answer, there is a question of whether the person is a resident of Colorado. The results showed that 101 respondents are residents (48.6%) and 107 are non-residents (51.4%). It is beneficial that there is almost an equal number Coloradans as out-of-towners when running regressions because there will basically be equal sample sizes for the two regression models.

Beginning with residents, 94 people responded to this question. The two intervals receiving the most responses are $0 and $1-10, each having 24. Table 3.4 includes all the intervals with their respective number of responses.

[10] NationMaster.com, "Education Statistics: Average Years of Schooling of Adults by Country"; available from http://www.nationmaster.com/graph/edu_ave_yea_of_sch_of_adu-education-average-years-schooling-adults; Internet; accessed 27 March 2009.

TABLE 3.5

Willingness to Pay (Residents)

WTP Interval	Response Count (%)
$0	24 (25.5%)
$1-10	24 (25.5%)
$11-20	12 (12.8%)
$21-30	3 (3.2%)
$31-40	2 (2.1%)
$41-50	7 (7.4%)
$51-60	3 (3.2%)
$61-70	7 (7.4%)
$71+	12 (12.8%)

As mentioned above, this question is used in order to narrow a person's specific willingness to pay. $10 intervals are used since a resident license is only $59. The next question is "Based on your answer above, specify the exact amount you will be willing to pay more than the current price, 2008-$59," which is the value that will be used as the dependent variable.

TABLE 3.6

Basic Statistics of Willingness to Pay (Residents)

Variable	Observations	Mean	Standard Error	95% Conf. Interval
WTP	94	27.49	3.91	19.73-35.25

The results showed a mean of $27.49 and median of $10.50. This suggests a wide range of data as the mean and median differ by $16.99, which is large considering the two values. As can be seen in Table 3.4, the minimum value is $0 while the maximum is $200. The values show a wide range of data that can explain the differences between the mean and median.

The non-resident data shows similar distributions as the resident results. The two categories receiving the most results are $0 and $1-20. 42 non-residents are not willing to pay any more money for an elk license than they already are. This is a higher number than the residents who chose this category, but it is understandable as a non-resident is paying a much higher price for a license, either $254 or $529.

TABLE 3.7

Willingness to Pay (Non-Residents)

WTP Interval	Response Count (%)
$0	42 (40.4%)
$1-20	18 (17.3%)
$21-40	13 (12.5%)
$41-60	10 (9.6%)
$61-80	4 (3.8%)
$81-100	8 (7.7%)
$101-120	2 (1.9%)
$121-140	2 (1.9%)
$141+	5 (4.8%)

The mean willingness to pay more for an elk license is $36.16 and median of $20. Again, there is a sizable difference between the two values which could explained by having nine people willing to pay over $100, five of whom would pay over $141. The minimum WTP is $0 and the maximum is $279. This is a large range in the data that can account for the difference in the mean and median. Three individuals responded that their WTP is over $200.

TABLE 3.8

Basic Statistics of Willingness to Pay (Non-Residents)

Variable	Observations	Mean	Standard Error	95% Conf. Interval
WTP	104	36.16346	5.329896	25.59287-46.73405

The price of a non-resident elk license is considered to be expensive by many respondents, as 40.4% chose $0 for their WTP more. As a substitute for a Colorado elk license, the respondents are asked if the price of the license increases to an amount more expensive than other states' fees, such as New Mexico, Wyoming, Montana, and other states, if they would hunt in the other state. 77 (74.8%) people responded that they would hunt in another state and 26 (25.2%) would still hunt in Colorado. This reflects the willingness of consumers to switch one good to a substitute when the original good becomes more expensive. A quarter of the respondents chose to continue hunting in Colorado if its license becomes more expensive than another state's fee. There are a couple of possible explanations for this. Of the 26 who would continue hunting in Colorado, 7 harvested animals and three hunted private land. A person could feel than

additional costs are worth hunting familiar areas, whether it is private or public land, or if they feel they have a greater chance of harvesting an animal in Colorado.

Overall, the typical Colorado elk hunter defined by this survey is a middle aged male who has a higher income than the average American and has three years of college or university education. He is also a skilled elk hunter with almost 12 years of hunting experience and a 32.6% success rate.

CHAPTER IV

MODELS AND RESULTS

Expected Results

Before creating the survey, it is important to consider variables that could possibly be significant in determining a hunter's willingness to pay for an elk license in Colorado. Once questions have been posed, predicting the descriptive variables is helpful in determining possible regression models.

For both residents and non-residents, the coefficient of an individual's annual income should be an important determinant of willingness to pay. In the case of this study, an elk license is considered to be a normal good. An overwhelming majority of hunters pursue elk for sport/enjoyment, so it is not seen as a necessary food source. In economic theory, the demand for normal goods increases when income increases.[1] Thus, for Colorado elk licenses, a person should be willing to pay more when his or her income increases, or when their income is higher compared to other hunters'. In this study, there is a broad range of data for income ranging from $0 to over $200,001.

Although there could possibly be correlation between income and all costs involved with the trip, it seems that cost variables, including equipment, trip/travel, guide fees, and private land, would be important in determining WTP. Thus, if an individual incurs $1000 in expenses annually when hunting elk then he or she would likely be

[1] The partial derivative of quantity with respect to income is positive($\partial Q/\partial Y > 0$)

willing to pay $30 more for a license rather than not hunt that year. The marginal cost of the trip increases by 3% from the previous year with the higher priced license. Thus, it is expected that $\partial Q/\partial C > 0$.

We expect that preference points, harvesting an elk, and trophy hunting will be statistically significant in determining WTP. Preference points are predicted to be a significant factor because of their use in obtaining an elk license in Colorado. As described in the introduction, an individual can accumulate preference points in order to hunt more desirable areas that will either allow for a greater chance of harvesting an animal or hunt for a trophy bull. Each year when a person does not draw a license, he or she receives a preference point and a partial refund of their money. Preference points are basically an investment because they require time and money to accumulate. A person with accumulated preference points has a greater probability of hunting a desired game management unit and thus is expected to have a greater willingness to pay; $\partial Q/\partial PP > 0$. The coefficient of preference points will be positive.

Knowing that people are willing to wait ten or more years in order to have the opportunity of harvesting a trophy bull is why trophy hunting seems like it would be significant in determining a hunter's willingness to pay. Trophy bulls are found all over the state, even areas where an over-the-counter tag allows people to hunt. Even so, they are more prevalent on the trophy game management units and Ranching for Wildlife ranches. If a person is truly hunting for the trophy, there is a chance that he or she would hunt private land, hire a guide, and possibly have saved preference points. These factors all seem to point towards a higher willingness to pay for an elk license, so trophy hunting will have a positive coefficient in the regression equation.

Lastly, harvesting an elk seems suitable to be one of the descriptive variables included in the model. Harvesting an animal will naturally increase the enjoyment. This enthusiasm will support the expenditure of more money, increasing a hunter's willingness to pay. Conversely, the lack of success could reasonably be expected to dampen the eagerness and end enjoyment. Therefore reduce the WTP for the license.

Correlation

The correlation between two variables, put simply, is how much one of the variables affects the other. It is measured by a correlation coefficient, which is defined as "a measure of linear dependence between two random variables that does not depend on units of measurement and is bounded between -1 and 1."[2] Assume that u and x are the two variables being examined. When the coefficient is zero, it means that u has no effect on x and they can easily be included together in the regression model. If u and x have a correlation coefficient of 1, they positively affect each other in a perfectly linear manner, meaning that u and x will travel in the same direction as each other. If the coefficient is -1, then they will move in opposite directions as their linear relation with have a negative slope. If u and x are highly correlated, they may present the problem of multi-collinearity. Multi-collinearity is an issue that needs to be avoided since it affects the coefficient estimates of the explanatory variables. If u and x are multi-collinear variables, the predictive quantity u has on the dependent variable will not be accurate because u will be affected by variable x. A complete chart of the correlation coefficients from the full data set is available in Appendix B.

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[2] Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*," (Cincinnati, OH: South-Western College, 2000), 860

In looking at the correlation coefficient chart, there are no two variables that have high correlation coefficient. The two variables with the highest correlation are Guide and Guide $ with a correlation coefficient of 0.778. Guide is the qualitative variable determining if the respondent hired a guide: 1 if the respondent hired a guide and 0 otherwise. Guide $ is the cost of hiring the guiding service. It is understandable that these two variables show some correlation because when someone hires a guide they will have to pay for the services.

Other pairings of variables that show the next highest correlation are Harvest with Cow and Bull. Harvest is a qualitative variable that takes a value of 1 when the respondent harvested an elk during the 2008 season. Cow and Bull are also qualitative variables that determine what sex the harvested animal is: a value of 1 when the elk was a cow or bull and 0 if otherwise. Harvest with Bull has a correlation coefficient of 0.685 while Harvest and Cow has a coefficient of 0.604. The correlation between these variables is logical because when a respondent harvests an elk, it will either be a cow or a bull.

TABLE 4.1

Five Highest Correlated Variables

Variable 1	Variable 2	Correlation Coefficient
Guide	Guide $	0.778
Harvest	Bull	0.684
Harvest	Cow	0.604
Guide	Trip $	0.551
Guide	Land $	0.543

When looking at the subsets of data, resident and nonresident results separately, the only perfectly correlated variables are Sport and Subsistence for residents. They have a correlation coefficient of -1, so they are perfectly inversely correlated. This occurs because no residents hunted elk for a trophy. Trophy, Subsistence, and Sport are all qualitative variables from the same question, so Trophy+ Sport+ Subsistence= 1. When trophy is excluded from the results, Sport+ Subsistence= 1. This means that Sport and Subsistence cannot appear in the regression model together.

Regression Models

Determining which factors affect a hunter's willingness to pay for an elk license in Colorado is the focus of this study. In order to do so, regression models will be found that show the explanatory variables which significantly affect the WTP. When asking the respondents their willingness to pay, $0 is an option. In the results, 24 residents and 42 non-residents are not willing to pay more than the current price of a license. This suggests that zero is a weighted response in the dependent variable. In order to account for this, a Tobit model is used. The Tobit model is defined as

$$y_i^* = x_i\beta + \varepsilon_i$$

$$y_i = y_i^* \text{ if } y_i^* > 0$$

$$y_i = 0 \text{ if } y_i^* \leq 0$$

"where y_i^* is the latent dependent variable, y_i is the observed dependent variable, x_i is the vector of the independent variables, β is the vector of coefficients, and the ε_i's are assumed to be independently normally distributed."[3] Ordinary Least Squares cannot be

[3] Lee Sigelman and Langche Zeng, "Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models," *Political Analysis* 8, no. 2 (1999), 168.

used in this situation because it will have downward biased results with the inclusion of the zero values. Stata, a commonly used data analysis program, is used to run the necessary Tobit models.

In order to find appropriate models, the data is split into the resident and non-resident sections. The reason for this is the difference in the costs between resident and non-resident licenses. A $1 increase in willingness to pay for a resident's $59 license is proportionally greater than a $1 increase in a non-resident's WTP of either $254 or $529 license fee. This disproportion is best solved by using the two different models.

The price difference in license costs for non-residents also poses a problem. In the survey, a respondent was not asked to specify whether he or she purchased a cow, bull, or either-sex tag so it is impossible to know which type of license their willingness to pay corresponds to. For this study, it will be assumed that a non-resident's WTP is for a bull/either-sex license based on the fact that the survey results show only non-residents trophy hunt and they harvested more bulls than cows.

TABLE 4.2

Definition of Variables

Variable	Definition	Variable	Definition
WTP	Willingness to pay in addition to current license fee, in dollars	Age	Age in years
Equip	Equipment costs, in dollars (ammunition, firearms, clothes, etc.)	Education	Years of schooling
Trip	Trip/travel costs, in dollars (gasoline, lodging, food, etc.)	Yrs Hunted	Years hunting elk
Distance	Miles traveled to reach hunting location	Subsistence	Qualitative variable, 1-hunts for food, 0- otherwise
Days	Days hunted in 2008 elk season	Sport	Qualitative variable, 1-hunts for enjoyment, 0 otherwise
Land	Cost to hunt private land, in dollars	Trophy	Qualitative variable, 1-hunts for antlers/mount, 0- otherwise

TABLE 4.2 Continued

Variable	Definition	Variable	Definition
Guide	Qualitative variable: 1-hired guide, 0- otherwise	Harvest	Qualitative variable, 1- harvested elk in 2008 season 0- otherwise
GuideFee	Cost of hiring guide, in dollars	Cow	Qualitative variable, 1- harvested cow, 0- otherwise
Bull	Qualitative variable, 1-harvested bull, 0 otherwise	PP	Qualitative variable, 1-has preference points for 2009 season, 0- otherwise
Private	Qualitative variable, 1-hunted private land, 0-otherwise	Nonfisher	Qualitative variable, 1- does not fish, 0- fishes
Rifle	Qualitative variable, 1-Rifle hunted, 0 otherwise	Female	Qualitative variable, 1- female, 0- male
Archery	Qualitative variable, 1- Archery hunted, 0 otherwise	Income	Annual personal income, in dollars
Muzzleloader	Qualitative variable, 1- Muzzleloader hunted, 0- otherwise	Substitute	Qualitative variable, 1- if would hunt other state if CO became more expensive, 0- otherwise

In order to obtain the final regressions for the models, a multi-step process is used. First, a regression with all variables is run. The most significant variables stay in the equation and the others are removed. From this point, one variable is added at a time. Variables are included and removed for each regression until the best model is obtained. To narrow the model to the most informative explanatory variables, the overall significance and descriptive value of the model is inspected. The significance of the equation can be determined when examining the p-values of each variable individually as well as chi-squared statistic value and "Prob > chi-squared" statistic. The chi-squared statistic value should be as large as possible and the Prob > chi-squared statistic should be as small as possible to show overall significance. When the chi-squared statistic is large the Prob > chi-squared should be small, implying that the equation as a whole is significant, i.e. a test of the joint hypothesis:

H_0: $\beta_{1=0}$ and/or $\beta_{2=0}$, …, and/or $\beta_n=0$

H_1: $\beta_1 \neq 0$ and/or $\beta_2 \neq 0$, …, and/or $\beta_n \neq 0$

The null hypothesis is rejected at the 5% level when Prob > chi-squared is .05 or less. Rejecting the null hypothesis indicates at least one of the explanatory variables is significantly different from 0. The explanatory variables need to make sense in describing their effect on the willingness to pay based on its theoretical sign and magnitude of the coefficient.

TABLE 4.3

Resident Tobit Regression Model

Tobit regression

Log likelihood = -326.41196

Number of obs	= 81
LR chi2(7)	= 22.51
Prob > chi2	= 0.0021
Pseudo R2	= 0.0333

wtp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rifle	26.57238	15.30528	1.74	0.087	-3.924067	57.06882
archery	16.37227	11.71074	1.40	0.166	-6.961886	39.70642
female	66.57215	45.13514	1.47	0.144	-23.36158	156.5059
equip	-.0145691	.0069271	-2.10	0.039	-.0283716	-.0007667
land	.0814783	.0240207	3.39	0.001	.0336159	.1293407
subsistence	-27.34766	10.59414	-2.58	0.012	-48.45695	-6.238366
income	-.0001019	.0001364	-0.75	0.457	-.0003737	.0001699
_cons	17.4604	20.76849	0.84	0.403	-23.92172	58.84251
/sigma	42.59184	4.043212			34.53556	50.64811

Obs. summary: 21 left-censored observations at wtp<=0
60 uncensored observations
0 right-censored observations

. mfx compute, predict(e(0,200))

Marginal effects after tobit
y = E(wtp|0<wtp<200) (predict, e(0,200))
= 43.301866

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
rifle*	11.64551	5.97098	1.95	0.051	-.057389	23.3484	.82716
archery*	8.084789	5.8312	1.39	0.166	-3.34416	19.5137	.469136
female*	46.3573	38.855	1.19	0.233	-29.7978	122.512	.012346
equip	-.0071402	.00335	-2.13	0.033	-.013699	-.000581	685.531
land	.0399318	.01208	3.31	0.001	.016257	.063607	26.5432
subsis~e*	-13.06471	4.98779	-2.62	0.009	-22.8406	-3.28883	.419753
income	-.0000499	.00007	-0.75	0.454	-.000181	.000081	65555.6

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table 4.3 displays the final model for the residents. The top table shows the results from the Tobit model and the lower table shows the Tobit results into values comparable to OLS estimates. The "marginal effects after Tobit" computes the marginal effects based on the fitted value calculated at the means of the regressors. While the first table is important, the second table will be used for a majority of the data analysis because we are interested in marginal effects of each variable on WTP.

The equation as a whole is statistically significant because the chi-squared value is 22.51 and the Prob > chi-squared stat is 0.0021. When looking at the "marginal effects after Tobit" table, it can be seen that there are a few variables that are not statistically significant at the 10% level, a p-value larger than 0.10.

Beginning with the most statistically significant variable, land has a t-stat of 3.31 with a p-value of 0.001. It is significant at the 1% level. Land is the amount of money spent to hunt private land. With a coefficient of 0.04, it means that for each additional dollar spent on private land access a hunter's willingness to pay increases by approximately $0.04, ceteris paribus. The average amount spent to hunt private land is $1075. This means that the average person who pays to hunt private land is willing to pay about $43 more than the current license fee. This is both statistically significant and economically large.

Another cost variable in this model is equipment. This variable measures the amount of money a hunter spends on various hunting equipment items such as ammunition, firearms, and clothing. It has a t-stat of -2.13 and p-value of 0.033 so it is significant at the 5% level. Holding all other variables constant, a one dollar increase in equipment expenditures decreases willingness to pay about $0.007. With the average

resident equipment costs being $679.77, this could be a decrease in willingness to pay of $4.76. Equipment costs have the opposite sign of what was expected. The original prediction stated that the costs would have a positive affect towards willingness to pay. Equip is a variable that was always significant so it holds a place in the final model even though the sign is not as predicted.

Subsistence and rifle are qualitative variables that are statistically significant in the resident model. Subsistence has a t-stat of -2.62 and p-value of 0.009 so it is significant at the 1% level. It is a qualitative variable that has a value of 1 when the hunter primarily hunts for subsistence and zero for sport hunters. A resident subsistence hunter is willing to pay $13.06 less for a license than a sport hunter, ceteris paribus. No residents of Colorado trophy hunt, so they have the option of being sport or subsistence hunters. These two variables cannot be included in the equation together due to multi-collinearity.

Archery and rifle are both variables showing types of hunting possible. Rifle has a t-stat of 1.95 with a p-value of 0.051, so it is significant at the 10% level. Holding all other variables constant, a rifleman is willing to pay $11.65 more for an elk license than someone who may hunt using a muzzleloader or bow. The archery variable has a t-stat of 1.39 with a p-value of 0.17. . It is not statistically significant at the 10% level so no direct analysis can come from its coefficient.

It should be noted that income is not statistically significant at the 10% level. It has a t-statistic of -0.75 with a p-value of 0.46. This suggests that income has no effect on a hunter's decision of willingness to pay for an elk license. It is surprising that it is

not an important factor in the decision making. This may suggest that hunters place a high value on elk licenses no matter the size of their income.

Overall, various costs and a means of take are significant in determining a resident hunter's willingness to pay. The expenses of hunting private land and equipment have opposite effects on WTP. The way and reason people hunt also prove to be significant in their decision making.

TABLE 4.4

Non-Resident Regression Model

```
Tobit regression                                  Number of obs   =         90
                                                  LR chi2(7)      =      26.99
                                                  Prob > chi2     =     0.0003
Log likelihood = -333.09991                       Pseudo R2       =     0.0389
```

wtp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
harvest	35.40027	18.67786	1.90	0.062	-1.749236	72.54978
distance	.0284038	.011445	2.48	0.015	.0056401	.0511674
trophy	50.76812	28.97237	1.75	0.083	-6.856766	108.393
trip	.0225916	.0075572	2.99	0.004	.0075606	.0376225
rifle	-51.66106	17.37364	-2.97	0.004	-86.21653	-17.10559
income	-.0001891	.0002035	-0.93	0.355	-.0005938	.0002156
substitute	-32.70093	17.82209	-1.83	0.070	-68.14836	2.746498
_cons	7.984766	24.78416	0.32	0.748	-41.30993	57.27946
/sigma	67.64065	6.86441			53.98761	81.29368

```
  Obs. summary:         35  left-censored observations at wtp<=0
                        55     uncensored observations
                         0 right-censored observations

. mfx compute, predict(e(0,279))

Marginal effects after tobit
      y  = E(wtp|0<wtp<279) (predict, e(0,279))
         =  59.975341
```

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
harvest*	15.80208	8.93887	1.77	0.077	-1.71778	33.3219		.266667
distance	.0117953	.00472	2.50	0.012	.002554	.021037		1349.09
trophy*	25.25171	16.856	1.50	0.134	-7.78614	58.2896		.077778
trip	.0093817	.00318	2.95	0.003	.00315	.015613		1197.39
rifle*	-22.85669	8.03644	-2.84	0.004	-38.6078	-7.10556		.633333
income	-.0000785	.00008	-0.93	0.352	-.000244	.000087		75111.1
substi~e*	-14.56007	8.41549	-1.73	0.084	-31.0541	1.93399		.744444

```
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

Table 4.4 displays the final non-resident Tobit regression. Again, the Tobit model itself is the top table. Below it is a table that transforms the Tobit results into values that are comparable to OLS data analysis. There are 35 left-censored observations, the number of zeros for willingness to pay associated with this model. Overall, the equation is statistically significant because there is a chi-squared value of 26.99 and Prob> chi-squared statistic of 0.0003. Also, all the variables are statistically significant at α=0.10 while the constant is insignificant. Data analysis will be base on the second table as it shows the marginal effects on willingness to pay.

Looking at the variables individually, trip is the most statistically significant. It has a t-stat of 2.95 and p-value of 0.003, so it is statistically significant at the 1% level. Its coefficient is 0.0094 which means that for every one dollar increase in trip/travel costs the individual's willingness to pay increases by approximately $0.01, ceteris paribus. The average trip cost for a non-resident is $1,108.48 which means that their willingness to pay for an elk license increases by $11.08. As mentioned before, the more a person is willing to spend on an elk hunting trip the more he or she should be willing to pay for the license.

Rifle is the second most significant variable with a t-stat of -2.84 and p-value of 0.004. It is significant at the 1% level. Rifle is a qualitative variable taking on a value of 1 if the respondent hunts elk in Colorado using a rifle and 0 otherwise. Its coefficient suggests that when a non-resident rifle hunts in Colorado he or she is willing to pay $22.86 less than an archery or muzzleloader hunter, all other variables held constant. 65 of 108 non-resident hunters pursue elk with a rifle in Colorado.

The distance traveled to reach one's hunting location is another significant variable. Distance has a t-stat of 2.50 and p-value of 0.012 so it is significant at the 5% level. This variable has the potential to greatly affect the magnitude of willingness to pay as non-resident hunters are not limited to the United States. For every extra mile traveled a hunter is willing to pay $0.01, ceteris paribus. For the non-residents, the distance traveled has a maximum of 3,200 miles and average of 1,250.67 miles. This translated to an increase in WTP of $32 and $12.51, respectively.

Harvest and substitute are the two variables that are only significant at the 10% level. Substitute has a t-stat of -1.73 with a p-value of 0.084. It is a qualitative variable that indicates whether or not the respondent would hunt a different state is a Colorado elk license became more expensive than another's fees. It has a coefficient of -14.56. This means that a hunter who is willing to hunt another state is willing to pay $14.56 less for a Colorado elk license. They main point to take from this variable is that the coefficient is negative showing that hunters greatly consider the cost of an elk license. The last explanatory variable is harvest, which is a qualitative variable that shows whether or not the person harvested an elk during the 2008 season. It has a t-stat of 1.77 and p-value of 0.077. If a hunter harvested an elk this past season, he or she is willing to pay $15.80 more than someone who was unsuccessful for the 2009 season, ceteris paribus.

The non-resident model has more diversity in its explanatory variables. It includes variables that describe a hunter's 2008 elk trip, success and distance traveled, as well as type of and reason for hunting, and trip cost.

Discussion

The variables that are not found in the regression models have been taken out due their level of significant greater than 10%, a p-value greater than 0.10. A couple variables have been included in order to see their respective sign.

One variable that is surprisingly not in either model is income. In defining an elk license as a normal good, one would assume that it would be significant in a hunter's decision on willingness to pay. In almost every model, income had a p-value of 0.40 or higher suggesting that it did not play an import role in deciding willingness to pay. For both residents and non-residents, income has a p-value of .35 or greater with its largest coefficient being -0.00001. Using this coefficient, for every $100,000 in income, a hunter is only willing to pay $1 less than the current license. This is such a small amount that it makes sense that income is not statistically significant and it is economically small.

The results from the two regression models are varied. Some of the variables were predicted while others are unexpected. The most surprising variable is equipment in the resident model. It has the opposite sign of what was expected. Before, it was assumed that the more a person spends on their hunting trip, all costs, that they would have a higher willingness to pay. There is no clear explanation of this in looking at the data.

It can also be observed that the resident and non-resident models vary in their explanatory variables. The only significant variable that is common to both models is rifle. In the resident model rifle has a coefficient of 11.65 while for non-residents it is -22.86. The main difference between the two is the opposite signs. A possible explanation for this could be due to non-residents being the only trophy hunters. Hunters

seemingly have better chances of harvesting a large, mature bull during the rut, which generally begins in mid-September. Archery and muzzleloader seasons fall during this time so a non-resident may be willing to pay more as an archer or muzzleloader hunter in order to hunt this prime time of the year.

Various types of costs and reason for hunting are included in both equations. The fees for hunting private land and equipment affect a resident's decision in willingness to pay more for the 2009 elk license. A non-resident considers trip costs when deciding on WTP. Non-residents also find trophy hunting to be of some significance in their decision making, as its p-value in the original Tobit model is 0.083. They are willing to pay $50.77 more to hunt for trophy elk rather than hunting a cow for food or enjoyment. Residents on the other hand do not place much value on trophy hunting, according to the survey. No residents selected trophy hunting, but they do place a $13.06 value to hunt for sport over food. Although the variables are different in the decision making of residents and non-residents, everyone seems to place value on similar ideas in determining their willingness to pay.

CHAPTER V

CONCLUSION

Contingent valuation method was used in this study to examine which factors affect a hunter's willingness to pay and by how much for an elk license in Colorado. This method also determines the value elk hunting has to the hunter. The results from this study are hard to compare to other studies because of the differences in surveys and methodology. Many of the other CVM studies conducted in relation to elk have different hypothetical situations and elicitation methods. Although most articles used dichotomous choice for their WTP questions, the main difference in results lies in that other studies asked much different reasons for an increase in the price of an elk license. The WTP question in this survey asks hunters how much they are willing to pay in order to improve elk habitat where others ask about increasing one's opportunity to shoot at an elk.

Fried *et al* (1995) ask the respondent, "If the number of animals were sufficient to make it virtually certain that you would have an opportunity to shoot at an elk/deer, would you be willing to pay $t additional to hunt."[1] This study is conducted in relation to hunting the Starkey Experimental Forest and Range in Oregon. It yielded a response that the maximum willingness to pay is $287 while the median is $90. This study also mentions another study conducted in Montana, which estimated the mean

[1] Fried *et al* 1995, 681.

value of doubling a hunter's chance to harvest a trophy elk between $179 and $317.[2] Compared to these values, the results from my survey are quite different. In my study, the results show residents have a mean willingness to pay of $27.49 with a 95% confidence interval of $19.73-35.25 and non-residents have a $36.16 mean WTP with a 95% CI of $25.59-46.73. My results are significantly lower than the other studies mentioned. The main reason for this is the difference in the willingness to pay question. It would be much more desirable for a hunter to pay for a situation that greatly increases their chance at harvesting an elk than to improve habitat. Paying for bettering elk habitat could possibly increase a hunter's chance of shooting an elk, but it is a process that takes time to affect the elk. If the WTP amounts are compared, the contingent valuation will underestimate its results, as previously mentioned in Chapter II.

The other study that shows results that comparable is written by Loomis *et al* (2000). In this study, an actual license demand model and a logistic model are examined in order to find willingness to pay for a non-resident Colorado elk license. The license demand model shows a mean increase in WTP of $284. At the time of the survey, a non-resident elk license was $250. This shows a large increase in willingness to pay for a license. Non-residents are willing to pay more than double the current price at the time of that survey. The other model in Loomis *et al* is a logistic model found using data from a contingent valuation survey. Its results show an increase in WTP of $164. These two increases of willingness to pay are much larger than the results obtained from my survey. One reason for this discrepancy is the price difference of a non-resident license at the time of the surveys. $250 for a non-resident license in their survey is much different from the 2008 license of $529. According to Loomis *et al*, a person is willing to pay

[2] Ibid., 682

either $534 or $414, depending on the model. My model shows a total willingness to pay of about $565. These results show that as the price of an elk license increases, non-residents are willing to pay less. My results are fairly consistent with the total WTP from the other survey's historic data model. It also suggests that the mid-$500 range could be the maximum total willingness to pay as both results fall into this area. Nyugen *et al.* define their cost variable as the expected total cost of a hunting trip. The statistically significant cost variables in my regression equations are equipment and land costs for resident and trip fees for non-residents. This information suggests that hunters take costs variables into consideration when considering a hunting trip.

The variables that are statistically significant in this study compared to other studies do not overlap except for costs. As mentioned in Chapter II, Fried *et al.* (1995) find income and days hunted while Nyugen *et al.* (2007) find total cost, gender, and education to be the significant variables in determining willingness to pay. In my regression equations, income, days hunted, gender, and education do not significantly affects a hunter's WTP. The only variables that are similar are the costs.

During the processes of this study, there are multiple aspects that could be changed for future studies. One of the problems encountered during the process is accounting for the price difference in non-resident licenses. If another question were added to the survey that ass non-residents which type of license they purchased: cow, bull, or either-sex. This question could then redirect them to different willingness to pay sections which would result in the ability to separate the data based on responses.

Another comment about the survey is its detail. The willingness to pay section of the survey may not have been clear to the respondents. In looking at the WTP data, some

respondents specified a willingness to pay more outside of their WTP interval. For example, say a respondent chose $11-20 for his or her WTP interval. One situation that happened is the respondent then specified they would be willing to pay $25 more. There is no true error in this mistake as the specified WTP is the data used for the dependent variable in the models. A different situation that occurred is when respondents seemed to specify their total willingness to pay. For the same example, a respondent input a WTP of $79 over the current price after selecting the $11-20 interval in the resident question. A resident license was said to be $59, so $79 is $20 higher than the resident price. In the data, I changed their specified WTP from $79 to $20 due to what I thought was an honest mistake. My reason for this is that I believe the respondent misread my question and listed their total WTP in the second question.

Lastly, if time and money allowed, conducting a mail or e-mail survey could help as it would allow the use of a dichotomous choice elicitation method. Conducting the survey on internet hunting forums limited the options in elicitation method for the willingness to pay question. Using either a mail or e-mail survey, I could distribute equal numbers of surveys with varying WTP amounts attached to use the popular dichotomous choice method.

APPENDIX A

Sample Survey with Results

Willigness to Pay for a Colorado Elk License

1. What is the primary reason you hunt elk?

	Response Percent	Response Count
Subsistence (food)	22.2%	44
Sport (enjoyment)	74.2%	147
Trophy (antlers/mount)	3.5%	7
answered question		198
skipped question		16

2. How much money did you spend on equipment for the 2008 elk season? (Ammo, guns, tents, clothes, etc.)

	Response Average	Response Total	Response Count
$	829.02	164,145	198
answered question			198
skipped question			16

3. What was your approximate trip/travel cost (lodging, food, gas or diesel, etc) spent in connection with your elk hunting during the 2008 season?

	Response Average	Response Total	Response Count
$	724.72	143,495	198
answered question			198
skipped question			16

4. Approximately how many miles did you travel by motor vehicle or plane to reach your hunting locations during the 2008 elk season?

	Response Average	Response Total	Response Count
Miles:	801.33	158,663	198
answered question			198
skipped question			16

5. Did you harvest an elk in the 2008 season?

	Response Percent	Response Count
Yes	31.0%	61
No	64.0%	126
Did not hunt	5.1%	10
answered question		197
skipped question		17

6. Did you harvest a bull, cow, or both?

	Response Percent	Response Count
Did not harvest	68.3%	129
Bull	14.8%	28
Cow	13.2%	25
A bull and a cow	3.7%	7
answered question		189
skipped question		25

7. How many days did you hunt during the 2008 elk season?

	Response Average	Response Total	Response Count
Days:	7.37	1,460	198
answered question			198
skipped question			16

8. What type of land did you hunt during the 2008 elk season?

	Response Percent	Response Count
Public (National Forest, BLM, etc)	88.9%	168
Private (your own land, friend's land, leased land, etc)	11.1%	21
answered question		189
skipped question		25

9. How much did you pay to hunt private land during the 2008 elk season? (Enter 0 if you hunted public land or private land for free)

	Response Average	Response Total	Response Count
$	136.81	24,900	182
answered question			182
skipped question			32

10. Did you hire a guide service for the 2008 elk season?

	Response Percent	Response Count
Yes	4.1%	8
No	95.9%	186
answered question		194
skipped question		20

11. How much did you pay for the guide service during the 2008 elk season? (Enter 0 if you did not hire a guide service)

	Response Average	Response Total	Response Count
$	100.28	18,351	183
answered question			183
skipped question			31

12. What type of hunting do you do? Check all that apply

	Response Percent	Response Count
Rifle	71.9%	143
Archery	49.7%	99
Muzzleloader	26.6%	53
answered question		199
skipped question		15

13. Do you have any preference points for an elk license for the 2009 season?

	Response Percent	Response Count
Yes	53.3%	105
No	46.7%	92
answered question		197
skipped question		17

14. How many years have you hunted elk?

	Response Average	Response Total	Response Count
Years:	11.71	2,318	198
answered question			198
skipped question			16

15. Do you fish?

	Response Percent	Response Count
Yes	89.9%	178
No	10.1%	20
answered question		198
skipped question		16

16. What is your gender?

	Response Percent	Response Count
Male	99.5%	197
Female	0.5%	1
answered question		198
skipped question		16

17. What is your age?

	Response Average	Response Total	Response Count
Years:	40.51	8,021	198
answered question			198
skipped question			16

18. What is your personal annual income?

	Response Percent	Response Count
0-Do not have an income	1.0%	2
$1-20,000	6.6%	13
$20,001-40,000	12.8%	25
$40,001-60,000	**26.5%**	**52**
$60,001-80,000	20.4%	40
$80,001-100,000	11.7%	23
$100,001-120,000	11.7%	23
$120,001-140,000	3.6%	7
$140,001-160,000	0.5%	1
$160,001-180,000	0.5%	1
$180,001-200,000	1.0%	2
$200,001+	3.6%	7
answered question		196
skipped question		18

19. How many years of education do you have? (For example, through 9th grade=9, through high school=12, 2 years of college=14, etc)

	Response Average	Response Total	Response Count
Years:	15.07	2,968	197
answered question			197
skipped question			17

20. Are you a resident of Colorado?

	Response Percent	Response Count
Yes	48.6%	101
No	51.4%	107
answered question		208
skipped question		6

21. Again, Currently the Division of Wildlife is faced with several problems in managing elk herds. In a hypothetical situation, suppose the Colorado Division of Wildlife is going to take action in order to help promote the elk population through programs such as feeding struggling elk during the winter months, clear-cutting areas of forests to promote aspen growth (a food source for elk), and protecting lands from land developers and energy companies. In order to resolve these issues, the Division of Wildlife will need increased funds, which will include increasing the price of an elk license. The 2008 license fee was $59 for a resident hunter and $529 for a non-resident bull or either-sex license, and $254 for a non-resident cow license. Should the Department of Wildlife decide to increase the price of an elk license in order to implement the listed programs in order to promote elk population and habitat, how much more are you willing to pay for a license for the 2009 season?

	Response Percent	Response Count
$0	25.5%	24
$1-10	25.5%	24
$11-20	12.8%	12
$21-30	3.2%	3
$31-40	2.1%	2
$41-50	7.4%	7
$51-60	3.2%	3
$61-70	7.4%	7
$71+	12.8%	12
answered question		94
skipped question		120

22. Based on your answer above, specify the exact amount you will be willing to pay more than the current price. 2008- $59

	Response Average	Response Total	Response Count
$	42.55	4,000	94
answered question			94
skipped question			120

23. If the price of a Colorado elk license increases to an amount higher than an elk license in Wyoming, Montana, Idaho, New Mexico, Utah, etc, would you choose to hunt in the other state over Colorado?

	Response Percent	Response Count
Yes	38.3%	36
No	61.7%	58
answered question		94
skipped question		120

24. Again, Currently the Division of Wildlife is faced with several problems in managing elk herds. In a hypothetical situation, suppose the Colorado Division of Wildlife is going to take action in order to help promote the elk population through programs such as feeding struggling elk during the winter months, clear-cutting areas of forests to promote aspen growth (a food source for elk), and protecting lands from land developers and energy companies. In order to resolve these issues, the Division of Wildlife will need increased funds, which will include increasing the price of an elk license. The 2008 license fee was $59 for a resident hunter and $529 for a non-resident bull or either-sex license, and $254 for a non-resident cow license. Should the Department of Wildlife decide to increase the price of an elk license in order to implement the listed programs in order to promote elk population and habitat, how much more are you willing to pay for a license for the 2009 season?

	Response Percent	Response Count
$0	40.4%	42
$1-20	17.3%	18
$21-40	12.5%	13
$41-60	9.6%	10
$61-80	3.8%	4
$81-100	7.7%	8
$101-120	1.9%	2
$121-140	1.9%	2

$141+	4.8%	5
answered question		104
skipped question		110

25. Based on your answer above, specify the exact amount you will be willing to pay more than the current price. 2008- Cow $254, bull/either-sex $529

	Response Average	Response Total	Response Count
$	172.82	17,973	104
answered question			104
skipped question			110

26. If the price of a Colorado elk license increases to an amount higher than an elk license in Wyoming, Montana, Idaho, New Mexico, Utah, etc, would you choose to hunt in the other state over Colorado?

	Response Percent	Response Count
Yes	74.8%	77
No	25.2%	26
answered question		103
skipped question		111

27. Email address

	Response Count
	169
answered question	169
skipped question	45

APPENDIX B

Correlation Coefficients

	Equip $	Trip $	Distance	Days	Land $	Guide $	Yrs Hunted
Equip $	1.00						
Trip $	0.29	1.00					
Distance	0.12	0.51	1.00				
Days	0.05	0.02	0.00	1.00			
Land $	0.04	0.52	0.25	-0.06	1.00		
Guide $	0.01	0.43	0.33	0.00	0.04	1.00	
Yrs Hunted	-0.02	-0.01	-0.09	0.04	-0.03	-0.13	1.00
Age	-0.10	0.15	0.24	-0.01	0.10	0.08	0.43
Education	0.00	0.14	0.03	0.00	0.15	0.11	-0.11
Substitute	0.21	0.17	0.25	-0.02	0.09	0.14	-0.06
Subsistence	-0.20	-0.24	-0.29	0.05	-0.01	-0.08	0.00
Trophy	0.17	0.14	0.02	-0.03	0.02	0.01	0.05
Harvest	0.07	0.03	-0.05	-0.12	0.14	-0.04	0.16
Cow	-0.06	-0.14	-0.07	-0.12	0.02	-0.06	0.23
Bull	0.21	0.12	0.03	-0.05	0.14	0.00	0.05
Private	-0.09	0.29	0.06	0.06	0.51	0.07	0.03
Guide	0.02	0.55	0.38	-0.02	0.54	0.78	-0.07
Rifle	0.02	0.06	-0.03	-0.12	0.08	0.10	0.04
Archery	0.08	-0.03	-0.05	0.26	-0.15	-0.17	-0.13
Muzzleloader	0.06	0.02	0.04	-0.08	-0.01	-0.10	-0.03
PP	0.07	-0.17	-0.15	0.14	-0.09	-0.12	0.21
NonFisher	0.09	0.06	0.09	-0.01	-0.01	0.07	-0.02
Female	-0.06	-0.06	-0.07	0.00	-0.02	-0.01	-0.07
Income	0.15	0.28	0.06	-0.10	0.21	0.01	0.15

	Age	Education	Substitute	Subsistence	Trophy	Harvest	Cow	Bull
Equip $								
Trip $								
Distance								
Days								
Land $								
Guide $								
Yrs Hunted								
Age	1.00							
Education	0.05	1.00						
Substitute	0.07	0.00	1.00					
Subsistence	-0.08	-0.06	-0.15	1.00				
Trophy	0.02	-0.06	0.05	-0.10	1.00			
Harvest	-0.05	0.08	-0.05	-0.07	-0.08	1.00		
Cow	0.00	0.10	-0.09	-0.01	-0.08	0.60	1.00	
Bull	-0.04	0.01	0.10	-0.09	-0.01	0.69	0.04	1.00
Private	0.05	0.19	-0.04	0.11	0.11	0.15	0.06	0.08
Guide	0.12	0.07	0.18	-0.05	0.11	0.02	-0.03	0.04
Rifle	-0.02	0.03	-0.19	0.12	0.00	0.13	0.16	0.09
Archery	-0.21	-0.09	0.06	-0.07	0.03	-0.08	-0.20	-0.02
Muzzleloader	-0.01	0.05	0.03	-0.02	0.01	0.03	-0.01	0.02
PP	0.01	-0.04	-0.15	0.11	0.07	0.07	0.02	0.11
NonFisher	0.05	0.10	0.01	-0.14	0.03	0.07	-0.01	0.07
Female	-0.04	0.03	-0.08	0.14	-0.01	-0.05	-0.03	-0.03
Income	0.24	0.22	0.00	-0.12	0.01	0.18	0.11	0.15

	Private	Guide	Rifle	Archery	Muzzleloader	PP	NonFisher	Female	Income
Equip $									
Trip $									
Distance									
Days									
Land $									
Guide $									
Yrs Hunted									
Age									
Education									
Substitute									
Subsistence									
Trophy									
Harvest									
Cow									
Bull									
Private	1.00								
Guide	0.18	1.00							
Rifle	0.15	0.13	1.00						
Archery	-0.17	-0.21	-0.35	1.00					
Muzzleloader	0.02	-0.12	0.13	0.11	1.00				
PP	-0.05	-0.17	0.01	0.04	0.04	1.00			
NonFisher	-0.01	0.01	-0.05	-0.07	-0.09	-0.02	1.00		
Female	-0.03	-0.02	-0.11	0.07	-0.04	-0.08	0.21	1.00	
Income	0.23	0.10	0.05	-0.12	-0.05	-0.02	-0.03	-0.07	1.00

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