

An Economic Analysis of Time-Controlled Grazing in Three Creeks, Rich County, Utah

Ruby A. Ward

Man-Keun Kim

Paul M. Jakus

Dillon Feuz

**Department of Applied Economics
Utah State University
Logan, UT 84322-3530**

**Economic Research Institute Report #2012-02
February 20, 2012**

Acknowledgments

We would like to thank Randy Wood, Scott Walker and Darren Dubois of the Utah Division of Wildlife Resources and Jeff Ostermiller of the Utah Division of Water Quality for discussions regarding the proposed time-controlled grazing program for the Three Creeks of Rich County, Utah. We would also like to thank Bill Hopkin of the Utah Department of Agriculture and Food. The authors remain responsible for all errors.

An Economic Analysis of Time-Controlled Grazing in Three Creeks, Rich County, Utah

EXECUTIVE SUMMARY

- Grazing on the public lands portion of the 143,000 acre Three Creeks region of Rich county may be eliminated if federal agencies withdraw grazing allotments. A time-controlled grazing plan (TCGP) is likely to improve habitat for livestock, game and non-game species, and improve riparian health and water quality.
- In 2009 the Gross Regional Product of the Rich county economy was estimated to be just under \$52 million (IMPLAN, 2010). Employment in the county was estimated to be 1600 full and part-time jobs.
- In 2009 cash receipts for production agriculture in the county were \$16.1 million (Utah Agricultural Statistics, 2010). Including direct and induced multiplier effects, production agriculture contributes \$24.3 million to the county economy, or almost 50% of gross regional product. Federal, state, and local tax revenues associated with production agriculture total just over \$1.4 million.
- The majority of the land on which 3200 head of cattle and 2500 sheep currently graze in the Three Creeks region is publicly owned. All cattle and 500 sheep are associated with Rich county producers. Production of these animals directly contributes just under \$2.0 million to the Rich county economy. Multiplier effects increase this contribution to \$3.2 million, or just over 6% of the county total economic output.
- Under the assumption that federal allotments would be eliminated, the economic impacts of a variety of production scenarios were evaluated. Alternatives included (1) maintaining the status quo, (2) shipping all livestock currently grazed at Three Creeks out-of-county to other private land, (3) feeding hay all year long, and (4) reducing the number of animals by one-third such that the reduced herd can graze exclusively on private land located within Rich county. Four final alternatives consider the economic impact of improved range quality (under the TCGP) such that a greater number of livestock AUMs could be supported. Using the range for a longer period of time means that less hay need be grown or purchased.
- Under scenarios (2), (3), and (4), labor income in the county fall, with differing effects on total value of output and employment depending on the scenario. Scenarios (5)

through (8) result in mixed effects on the total value of output, income, and employment depending on the degree to which public range substitutes for grown or purchased feed.

- Non-market benefits associated with improved quality of habitat for game and non-game species were estimated using an economic value meta-regression. The meta-regression revealed values for four key recreation activities expected to benefit from the TCGP. Adjusted to 2009 dollars, the economic value per person per activity day for big game hunting was estimated to be \$94.89. Economics values for small game hunting (\$62.38), freshwater fishing (\$68.70) and wildlife viewing (\$92.06) were also estimated.
- Discussions with Utah Division of Wildlife Resources (UDWR) personnel indicate that winter range for big game species (elk, moose, and pronghorn) in the Three Creeks region and surrounding areas is already being used at its capacity. While animals would enter the winter in better condition, UDWR management objectives regarding the number of big game animals on the range are far more likely to decrease than increase. Thus, there are minimal economic benefits associated with improved big game hunting.
- UDWR officials believe that a TCGP is likely to significantly improve range for sage grouse, a small game species. Economics benefits are likely to be very modest, as the number of sage grouse hunters is relatively small. Even if current hunting levels could be doubled on the management unit, annual benefits are estimated at less than \$25,000.
- Wildlife viewing is a high-valued activity, estimated at over \$90 per person per activity day. UDWR does not keep county level specific information on wildlife viewing away from home, but Utahns spent 2.4 million days viewing wildlife away from home in Utah during 2006 (US Fish and Wildlife Service, 2008). If the TCGP can generate an additional 543 wildlife viewing days away from home in the Three Creeks region (a 0.02% increase over the state total for 2006), an economic value of \$50,000 will have been created.
- Freshwater fishing is valued at just under \$69 per person per day. Utahns spent 3.4 million days fishing in-state during 2006 (US Fish and Wildlife Service, 2008). If the TCGP can improve water quality in the region such that residents enjoy an additional 728 days of in-state fishing (a 0.02% increase over the state total for 2006), an economic value of \$50,000 will have been created.
- A literature search of EPA-approved Total Maximum Daily Loads analyses in nearby watersheds provides a benchmark to gauge restoration costs for Big Creek, whereas another literature search provides cost estimates for restoring and monitoring sage

grouse habitat. Both efforts provide alternative criteria against which to compare the non-market benefits of the time-controlled grazing plan.

Table of Contents

Acknowledgments.....	2
Executive Summary.....	3
1. Introduction.....	8
2. Economic Impact of Agriculture on Rich County.....	10
3. Economic Impact Analysis of Ranching in Three Creeks.....	12
A. Modeling Reductions in Grazing Allotments.....	14
B. Modeling Increases in Grazing Allotments.....	17
C. Fiscal Impacts of Alternative Scenarios.....	21
4. Non-Market Benefits of Time-Controlled Grazing in Three Creeks.....	22
A. Estimating the Value of Recreation in Rich County.....	23
B. Valuing Ecosystem Restoration: an “Avoided Cost Approach To Water quality and Species Management.....	30
5. Summary.....	32
6. References.....	34
Appendix A: A Brief Description of Economic Impact Analysis.....	35
Appendix B: Budgets Used in Economic Impact Analysis Scenarios.....	36
Appendix C: Meta-Regression Results.....	43

List of Tables and Figures

Tables

Table 2.1: Economic Contribution Of Production Agriculture To Rich County’s Economy.....	12
Table 2.2: The Fiscal Impacts Of Production Agriculture In Rich County.....	12
Table 3.1: Economic Contribution Of Status Quo Grazing In The Three Creeks Area.....	13
Table 3.2: Economic Impact Of Using Additional Out-Of-County Private Grazing for Animals Currently In The Three Creeks Grazing Area.....	15
Table 3.3: Economic Impact Of Reducing Cattle From 3,200 To 2,144 And Keeping Sheep On Private Grazing In The Three Creeks Grazing Area.....	17
Table 3.4: Economic Impact Of Maintaining Status Quo Stocking Rates, And Extending the Grazing Period By X Months In The Three Creeks Grazing Area.....	18
Table 3.5: Economic Impact Of Increasing Cattle By 10% And Extending The Grazing Period By 1 Month In The Three Creeks Grazing Area.....	19
Table 3.6: Economic Impact Of Increasing Sheep By 40% And Extending The Grazing Period By 1 Month In The Three Creeks Grazing Area.....	20
Table 3.7: Economic Impact Of Increasing Sheep By 40% And Extending The Grazing Period By 1 Month In The Three Creeks Grazing Area.....	21
Table 3.9. The Fiscal Impacts Of Grazing Alternative In The Three Creeks Region.....	22
Table 4.1: Predicted Economic Value Of Outdoor Recreation In Rich County.....	25
Table 4.2: Sage Grouse In Rich County, 2001-2009.....	27
Table 4.3: Nearby TMDLs And Remediation Costs For Livestock.....	31
Table B.1a: Budget for Scenarios #1, #5, and #8	37
Table B.1b: Budget for Scenarios #1, #5, and #8	38
Table B.2: Budget for Scenario #2.....	39
Table B.3: Budget for Scenario #3.....	40

Table B.4: Budget for Scenario #4..... 41

Table B.5 Budget for Scenarios #5, 6, 7, 8..... 42

Table C.1. Meta Regression Estimation Results.....43

Figure

Figure 2.1: Cash Receipts By Primary Agricultural Product, 2009 11

An Economic Analysis of Time-Controlled Grazing in Three Creeks, Rich County, Utah

1. Introduction

A watershed scale time-controlled grazing plan (TCGP) for grazing allotments on public land in Rich county, Utah would coordinate range management amongst the US Bureau of Land Management (BLM), the US Forest Service (USFS) and the local grazing association to improve the quality of rangeland in the Three Creeks region. Time-controlled grazing would occur on adjacent lands totaling 143,000 acres—activities would include changing grazing patterns, providing infrastructure for better distribution of water, additional fencing, possible prescribed burns and other planned disturbances to balance landscape succession. The proposed TCGP would mirror many of the management actions of the nearby Deseret Land and Livestock (DLL) parcel located six miles to the south of the Three Creeks region. Potential benefits from the project are numerous. In addition to maintaining commercial ranching in Three Creeks at its current level, the TCGP is likely to improve recreation opportunities such as hunting, fishing, and wildlife viewing, as well as provide changes in water quality that may allow removal of Big Creek from Utah’s 303d list of impaired waterbodies.

This study is divided into multiple sections. Section 2 presents an overview of the Rich county economy, highlighting the role of production agriculture. The third section focuses on the economic impact of changes in grazing allotments and management in the Three Creeks region of Rich county. The *economic impact analysis* presupposes that if current grazing management practices continue then no public grazing allotments will be available in the Three Creeks region at some time in the future. We outline the changes in economic output, income and employment under various scenarios. Subsequently we analyze the economic impacts if the TCGP allows increased grazing. The fourth section of this report uses the *benefit transfer* technique to estimate the non-market value of water quality and habitat improvements under a TCGP. A meta-regression is used to estimate the value of hunting, fishing and wildlife viewing, activities which may be enhanced with the proposed TCGP. The Utah Division of

Wildlife Resources collects reliable use and visitation statistics for hunting units across the state, but does not collect visitation statistics for anglers or wildlife-viewing. We estimate what we believe to be an upper bound estimate on the increased value of hunting associated with the TCGP, but cannot do so for fishing or wildlife viewing. Instead, we use our knowledge of the economic value of these activities to ask how much each activity must increase to generate an additional \$50,000 in economic value. We then compare the result to state-wide visitation measures. Finally, we use an “avoided cost” approach to better understand the benefits of the TCGP in helping remove Big Creek from the 303d list and in providing better habitat for sage grouse.

2. Economic Impact of Agriculture on Rich County

Agricultural production is a very significant part of the Rich county economy. In 2009, Rich county's Gross Regional Product was estimated to be about \$51.5 million, with employment of just under 1600 jobs (IMPLAN, 2010).¹ While cattle ranching and farming provide only a small fraction of direct employment in the county (about 100 of the county's 1600 jobs), production agriculture (ranching and farming) is Rich county's top industry as measured by value of output. Using IMPLAN statistics, cattle ranching and farming directly contributes \$14.1 million in output to Rich county's economy, or about 27.5% of the total economy. Due to differences how IMPLAN allocates value of output to different sectors of the economy, the IMPLAN model's \$14.1 million is less than the \$16.1 million in agricultural output for Rich county as reported for 2009 in the annual Utah Agricultural Statistics report. Using the "Ag Stats" figure, agricultural production directly accounts for 31.4% of the total county output.

The vast majority of agricultural sales in Rich county are from cattle ranching, as measured by cash receipts (Figure 2.1). Cash receipts do not capture the full value of agricultural production because they do not include the value of agricultural products produced and used on the farm, such as hay grown and fed to cattle within a single operation—a common practice in Rich

¹ IMPLAN (IMpact PLANning for Analysis) is a commercial software product that allows one to estimate economic impacts for a county, group of counties, state or region. The 2010 version of IMPLAN captures the economic structure of Rich county in 2009.

county. In this sense cash receipts "undervalue" agricultural production. Regardless, the remainder of this report will use only cash receipts as a measure of agricultural value.

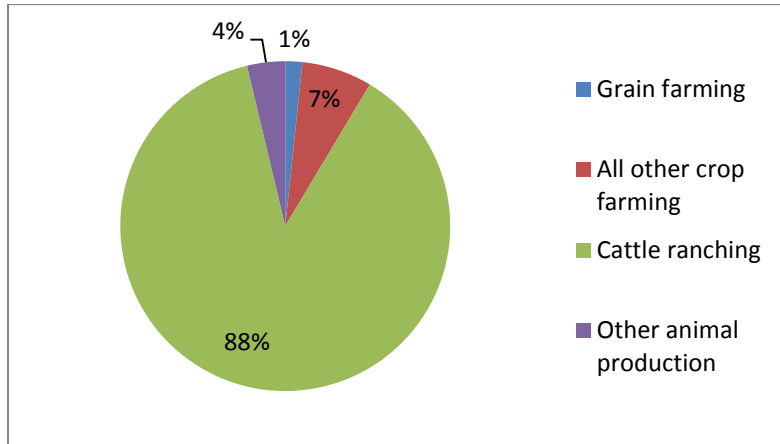


Figure 2.1: Cash Receipts by Primary Agricultural Product, 2009 (\$16.1 million total)

Source: 2009 Utah Agricultural Statistics

Economic impact analysis takes the direct effect of agricultural production, and then uses inter-industry linkages to calculate the indirect, or upstream effects (business to business) and induced, or downstream effects (how labor income is spent in an economy). These are the so-called, "multiplier effects".² Using the \$16.1 million in cash receipts reported for Rich county in 2009, the multiplying effects increase this impact to \$24.3 million, for a multiplier of 1.5. That is, every dollar of agricultural output created another \$0.50 in economic output within the county (Table 2.1). By this measure, production agriculture—and its indirect and induced multiplier effects—accounts for almost half of the county's gross economic output. It also contributes approximately 180 full and part-time jobs.

² A short summary of economic impact analysis is provided in Appendix A.

Table 2.1: Economic Contribution of Production Agriculture to Rich County’s Economy

	Direct Effects	Indirect Effects	Induced Effects	Total
Total Output	\$16,134	\$7,155	\$1,013	\$24,303
Labor Income	\$1,823	\$1,134	\$244	\$3,201
Jobs	97.3	71.3	11.9	180.5

Source: IMPLAN analysis using 2009 agricultural receipts (2010 Utah Agricultural Statistics)

Note: All output and income reported in \$1000 units.

Agricultural production in Rich county contributes tax revenues to federal, state and local entities (Table 2.2). IMPLAN analysis indicates that state and local governments collect about \$0.78 million in various taxes as a result of agricultural production in Rich county, whereas the Federal government collects \$0.64 million.

Table 2.2: The Fiscal Impacts of Production Agriculture in Rich County

	State and Local Revenues	Federal Revenues
Indirect Business Taxes	\$647,308	\$88,658
Corporate Profits Taxes	\$49,260	\$83,671
Proprietor Income	-	\$47,967
Employee Compensation	\$943	\$297,270
Households	\$78,674	\$122,358
Total	\$776,185	\$639,924

3. Economic Impact Analysis of Ranching in Three Creeks

Under current conditions, public grazing in the Three Creeks Area supports 3,200 head of cattle and 2500 head of sheep. Federal grazing allotments are under pressure; without

improvements in grazing practices, the loss of some or all of the allotments is possible. A number of potential future grazing scenarios were considered and the economic impact on Rich County under each scenario was analyzed. Scenarios included: (1) status quo—maintaining the current situation, (2) using additional private (out-of-county) grazing to replace loss of federal allotments, (3) purchasing additional hay to replace public grazing, and (4) reducing the number of cattle, a scenario in which some ranchers quit raising cattle and instead lease their private pasture to others. Finally, if the TCGP is successfully adopted by Rich county ranchers, they may be able to add animals to the range, as was done over a thirty-year period in a similar program on the privately held Deseret Land and Livestock parcel located just six miles to the south. Scenarios (5) through (8) examine the economic impact of increasing AUMs on public allotments in Three Creeks. All scenarios use the 2009 IMPLAN model of the Rich county economy, suitably adjusted to reflect knowledge of Rich county production practices and 2009 prices. Production practices were taken from USU Extension production budgets, which can be found in in Appendix B.

Scenario #1: Status Quo

Some 3,200 head of cattle and 500 head of sheep³ are grazed on allotments and private land in the Three Creeks region, with a value of just under \$2.0 million (Table 2.1). Relative to the \$16.1 million in cash receipts for agricultural output in the county, the livestock currently raised in the Three Creeks region represent just over 12% of total direct agricultural output. Table 3.1 shows the economic impact in Rich County, Utah of the 3,200 head of cattle and 500 head of sheep currently using public grazing in the Three Creeks Area. The analysis is based on a cattle budget and sheep budget for Rich county report in Appendix B, Tables B.1a and B.1b.

³ Currently 2,500 head of sheep are being grazed in the Three Creeks region, but only 500 head are sold in Rich County. The remaining 2,000 head—with a direct output value of \$340,000—do not have an economic impact in Rich County and are not included in the analysis.

Table 3.1: Economic Contribution of Status Quo Grazing in the Three Creeks Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output	\$1,953	\$1,059	\$166	\$3,178
Labor Income	\$296	\$194	\$40	\$530
Jobs	12.0	10.5	1.9	24.5

Note: Output and income reported in \$1000 units.

The livestock raised in the Three Creeks directly generate \$296,000 in labor income and 12 full and part-time jobs. Indirect and induced effects (the “downstream” and “upstream” multiplier effects) result in an additional \$1.2 million in value of output, \$234,000 in labor income, and just over 12 more jobs. The \$3.18 million in total output represents 6.2% of the county's total gross output for all sectors of the county's economy.

A. Modeling Reductions in Grazing Allotments

Scenario #2: Using Additional Private Grazing to Offset Public Grazing

An alternative to using public grazing allotments is for Rich county ranchers to use additional private range for cattle and sheep. The county does not have enough private land to support current livestock numbers for the summer grazing season, so this scenario examines the economic impact of producing 3,200 head of cattle and 500 head of sheep if all were shipped out-of-county to summer on private land elsewhere. This scenario would entail additional transportation and lease costs for producers; on the other hand, fees collected by public land management agencies from ranchers are reduced, as are other non-permit costs of using public range. For the purposes of this scenario, it was assumed that current levels of production would be held constant. However, ranchers’ profit from cattle operations is reduced to \$0 under this scenario (See Table B.2 in Appendix B). The profit for sheep is greatly reduced, but remains slightly profitable.

Table 3.2 shows that reduced rancher income and direct employment has a negative effect on Rich County’s economy, but this is offset by expenditures for transport of livestock to out-of-county pastures. While the decrease in income accruing to ranchers and employees is quite large, falling by 55% relative to the Status Quo scenario of Table 3.1, the value of output in Rich county actually increases modestly (by 2.6% to \$3.3 million). This somewhat counterintuitive result is due to model limitations: all transport expenditures were assumed to occur in county, thus benefiting this sector of the county economy. To the degree that this modeling assumption is violated and that some expenditures would be made outside of the county, the overall effect on the local economy would be smaller, or even negative.

Table 3.2: Economic Impact of using additional out-of-county private grazing for animals currently in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output	\$1,953	\$1,196	\$112	\$3,261
Labor Income	\$134	\$192	\$27	\$353
Jobs	11.6	12.0	1.3	25.0

Note: Output and Income measure in \$1000 units.

Scenario #3: Feeding Additional Hay to Offset Public Grazing

An additional scenario considered would maintain the same number of cattle and sheep in the Three Creeks region, but additional hay would be purchased and fed to offset lost public grazing. Our analysis shows this scenario to be unrealistic for both cattle and sheep. An outcome relying fully on purchased hay to offset lost public grazing would result in a loss of over \$34,000 per 400 cattle (a typical herd size in Rich county), with an aggregate estimated loss of over \$277,000 for the full 3,200 animals (Table B.3 in Appendix B). As such, if additional private grazing were not available some producers would quit raising livestock. Those knowledgeable about the quantity and quality of private rangeland in Rich county believe the

county does not have sufficient private land available to support the current number of livestock on the range. If federal allotments were revoked, it is anticipated that some producers would cease active operations and instead would lease private pasture to other producers. Thus, a smaller number of producers would operate in the county. This is the basis of Scenario #4.

Scenario #4: Reducing the Number of Cattle Raised in Rich County and Keep 500 Head of Sheep on Private Pasture

Under Scenario #3, in which neither public land nor sufficient private land is available for grazing current stocking rates of cattle and sheep, it is not feasible for all ranchers to remain in operation. Ranchers use some private grazing land under current Status Quo conditions (Scenario #1), so it would be reasonable to assume that some operators would quit ranching and lease their privately held pasture to those ranchers choosing to remain in operation. Discussions with those familiar with the quantity and quality of private grazing land in the Three Creeks region indicate that it is feasible for some ranchers to remain in business, but that the cow herd would be reduced by about one-third. Our economic impact analysis therefore reduces the number of cattle by 33%, falling from 3,200 head to 2,144 head, with these animals grazing exclusively on private land, including some land owned by those who have chosen to cease their own ranching operations. The budget that forms the basis of this scenario can be found in Table B.4, Appendix B. In scenario #2, sheep operations remained profitable using additional private pasture so it was assumed that 500 head of sheep would continue to be raised under scenario #4.

The direct value of output falls by 32%; when one includes indirect and induced effects the total value of output for the Three Creeks region falls by about 26%, to \$2.3 million (Table 3.3). Labor incomes falls by 43%, to \$301,000 as five jobs directly and indirectly associated with cattle and sheep production in Three Creeks are lost (from 25 to 20 jobs). Relative to the status quo for the entire county, scenario #4 results in a 1.6% decline in the county's economic output.

Table 3.3: Economic Impact of reducing cattle from 3,200 to 2,144 and keeping sheep on private grazing in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output (\$ Thousands)	\$1,336	\$916	\$94	\$2,347
Labor Income (\$ Thousands)	\$140	\$139	\$23	\$301
Jobs	8.5	10.1	1.1	19.6

Note: Output and Income measure in \$1000 units.

B. Modeling Increases in Grazing Allotments

Current grazing allotments in the Three Creeks grazing unit are for 3,200 cattle and 2,500 head of sheep for a period of 4 months (though only 500 sheep are sold in Rich County). If the TCGP successfully improves conditions and increases the carrying capacity of the region, it is possible that allotments could be increased. For over thirty years the privately held Deseret Land & Livestock, located just south of Three Creeks, has used a grazing plan similar to that proposed for the Three Creeks region and has managed to almost double the grazing capacity of the range. We model this possibility using a four conservative scenarios: keep stocking rates constant but extend the grazing season by 1 month (Scenario #5); increase the number of cattle by 10% and extend the time on grazing by 1 month for all sheep and cattle (Scenario #6); increase the number of sheep and extend the time on grazing by 1 month for all sheep and cattle (Scenario #7); and double the number of sheep and extend the grazing period for 1 month (Scenario #8).

Scenario #5: Keep Stocking Rates constant, add one month of grazing for Cattle and Sheep

Scenario #5 holds cattle and sheep numbers constant, but extends the grazing time for all animals by 1 month. This represents a 24% increase in AUMS on federal allotments. The direct economic effect of animal sales remains constant (\$1.95 million), but savings are accrued in feed costs and the cost of hired labor. Income accruing to ranchers increases, but the total

economic impact in Rich County falls by 7.3% relative to the status quo (Table 3.4 compared to Table 3.1).

Table 3.4: Economic Impact of maintaining status quo stocking rates, and extending the grazing period by X months in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output (\$ Thousands)	\$1,953	\$814	\$197	\$2,963
Labor Income (\$ Thousands)	\$426	\$167	\$47	\$640
Jobs	11.6	8.1	2.3	22.0

Note: Output and Income measure in \$1000 units.

Scenario #6: Increase Cattle by 10%, Add one month of grazing for Cattle and Sheep

Scenario #6 increases cattle numbers by 10% (from 3,200 to 3,520) and extends grazing time by one month for both sheep and cattle. This represents a 36% increase in AUMs on federal allotments, which is well below the increase in grazing on Deseret Land & Livestock’s private range. The direct economic effect of 10% more cattle is \$186,000 (Table 3.4); when one includes the upstream and downstream economic effects of the increased number of cattle and the additional grazing on federal lands, total value of output associated with the Three Creeks region rises to \$3.5 million, an increase of 10.1% relative to the status quo. The income accruing directly to ranchers and employees increases by 60% to \$475,000. This large increase is due to increased profitability for operators associated with the additional month of grazing.

Table 3.5: Economic Impact of increasing cattle by 10% and extending the grazing period by 1 month in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output (\$ Thousands)	\$2,139	\$1,122	\$238	\$3,500
Labor Income (\$ Thousands)	475	247	57	778
Jobs	13.0	10.9	2.8	26.7

Note: Output and Income measure in \$1000 units.

Scenario #7: Increase Sheep by 40%; Add one month of grazing for Cattle and Sheep

This scenario assumes that the number of sheep grazing in the Three Creeks region from Rich County increases from 500 to 700 and that all sheep and cattle utilize public allotments for an additional month of grazing. The scenario increases total AUMs by 27%, with AUMs for cattle increasing by 25% and AUMs for sheep increasing by 63%. The economic effect of the 200 additional head of sheep is a 2% increase in the direct value of output for both sheep and cattle combined over the status quo (scenario #1) to just under \$2 million (Table 3.6). Overall, the indirect and induced effects result in a 5% *decrease* in the total effect, falling from \$3.18 million to \$3.02 million. The decrease in total value of output is because the additional grazing offsets purchases of locally produced hay. (In scenario #5 the loss in local hay sales due to the additional month of grazing was counteracted by additional demand for hay from increased cow numbers after these animals have left the public range.) Overall, direct income from ranching and raising sheep and employees increased by 47% to \$436,000.

Table 3.6: Economic Impact of Increasing Sheep by 40% and Extending the Grazing Period by 1 month in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output (\$ Thousands)	\$1,987	\$833	\$202	\$3,022
Labor Income (\$ Thousands)	436	172	48	657
Jobs	12.5	8.6	2.4	23.4

Note: Output and Income measure in \$1000 units.

Scenario #8: Increase Sheep by 100%; Add one month of grazing for Cattle and Sheep

This scenario assumes that the number of sheep grazing in the Three Creeks region from Rich County increases from 500 to 1000 and that all sheep and cattle utilize public allotments for an additional 1 month of grazing. The scenario increases total AUMs by 32%, with AUMs for cattle increasing by 25% and AUMs for sheep increasing by 133%. The economic effect of the 500 additional head of sheep is a 2% increase in the direct value of output for both sheep and cattle combined over the status quo (scenario #1) to just under \$2 million (Table 3.7). Overall, the indirect and induced effects result in a 1.3% *decrease* in the total effect, falling from \$3.18 million to \$3.13 million. Again, the decrease in total value of output is because the additional grazing offsets purchases of locally produced hay. Overall, direct income from ranching and raising sheep and employees increased by about 35% to \$453,000.

Table 3.7: Economic Impact of Increasing Sheep by 40% and Extending the Grazing Period by 1 month in the Three Creeks Grazing Area

	Direct Effects	Indirect Effects	Induced Effects	Total
Cash Receipts from Utah Agricultural Statistics				
Total Output (\$ Thousands)	\$2,038	\$885	\$212	\$3,135
Labor Income (\$ Thousands)	\$453	\$186	\$51	\$690
Jobs	14.1	9.6	2.4	26.2

Note: Output and Income measure in \$1000 units.

C. The Fiscal Impacts of Alternative Scenarios

Table 3.9 summarizes both the state and local revenue and federal tax impacts related to the current situation and alternatives to the status quo. Total state, local and federal tax revenues fall when cattle are sent out-of-county to graze elsewhere (Scenario #2) and if the number of ranchers and cattle are reduced in the county (Scenario #4). Fiscal revenues grow if the time-controlled grazing plan is implemented and allotments to ranchers allow for an extra month on the range for cattle, sheep, or both, as well as increases in the number of animals stocked (Scenarios #5 through #8).

Table 3.9. The Fiscal Impacts of Grazing Alternative in the Three Creeks Region

	Scenario #1 (Status Quo)	Scenario #2 (Graze out-of-county)	Scenario #4 (Reduce Herd Size)	Scenario #5 (Status quo stocking, extend season)	Scenario #6 (Increase Cattle 10%)	Scenario #7 (Increase Sheep 40%)	Scenario #8 (Increase sheep 100%)
<i>State and Local Revenues</i>							
Indirect Business Taxes	\$81,236	\$56,718	\$54,471	\$77,118	\$93,401	\$78,386	\$81,485
Corporate Profits Taxes	\$5,135	\$5,178	\$5,598	\$4,690	\$5,475	\$4,750	\$4,885
Proprietor Income							
Employee Compensation	\$127	\$101	\$70	\$121	\$142	\$124	\$128
Households	\$13,019	\$8,688	\$7,413	\$15,663	\$19,005	\$16,077	\$16,898
Total	\$99,517	\$70,685	\$67,534	\$97,592	\$118,023	\$99,337	\$103,396
<i>Federal Revenues</i>							
Indirect Business Taxes	\$11,126	\$7,768	\$7,460	\$10,562	\$12,792	\$10,736	\$11,160
Corporate Profits Taxes	\$8,721	\$8,796	\$9,479	\$7,968	\$9,300	\$8,068	\$8,298
Proprietor Income	\$13,267	\$6,267	\$8,364	\$22,439	\$28,231	\$23,185	\$24,662
Employee Compensation	\$40,276	\$31,682	\$21,976	\$38,322	\$44,929	\$39,030	\$40,459
Households	\$20,248	\$13,513	\$11,531	\$24,361	\$29,559	\$25,004	\$26,282
Total	\$93,638	\$68,026	\$58,810	\$103,652	\$124,791	\$106,023	\$110,861

Note: Scenario #3, feeding hay all year, caused all ranches to be unprofitable and close. Impact analysis was not conducted for this scenario—one can simply refer to Scenario #1 (Status Quo) for an estimate of the fiscal losses that would occur.

4. Non-Market Benefits of Time-Controlled Grazing Program in Three Creeks

The nonmarket benefits of the TCGP are numerous. Time-controlled grazing on the nearby Deseret Land and Livestock pastures has improved the number and diversity of wildlife, made riparian areas healthier, and improved the quality of surface water. Improved habitat has the potential to increase the number of hunters and wildlife viewers, whereas improved water quality could increase the number of anglers in the region. We provide estimates for the economic value of recreation by supplement the available recreation data for Rich county using a method called *benefits transfer*. We also examine the literature and report the cost estimates for restoring water quality to beneficial uses and costs to restore and manage sage grouse habitat.

A. Estimating the Value of Recreation in Rich county

Various methods can be used to estimate the economic value of recreation opportunities, such as the travel cost method (TCM) or contingent valuation method (CVM). Both approaches require comprehensive information about action being evaluated, the number of users (visitors), the available resources at the policy site (site under action), and other socio-economic information. Analyses of the value of recreation activities under habitat changes such as those proposed for Three Creeks generally require a large budget and a period of time sufficient to conduct population surveys. Unfortunately it is often the case that either funding or time (or both) are insufficient for the task. Economists have developed a number of techniques for use in such cases, all of which fall under the umbrella term, *benefit transfer* (BT).⁴ BT is the use of recreational benefit estimates and other information from a *study site*, *i.e.*, similar valuation studies in other regions in other time, as *transferred* to a *policy site* for which little or no data exist (Rosenberger and Loomis, 2001). (In our case, Rich county is the policy site.) While benefits transfer is considered a second-best strategy, it can be very useful in informing decisions at the site of interest.

Dr. Randy Rosenberger at Oregon State University has provided our research team with his database of several hundred studies of outdoor recreation conducted between 1958 and 2006, reporting over 2700 economic value estimates. The database provides a comprehensive summary of the non-market valuation literature for this time period, including refereed journal articles, theses, dissertations, working papers, government agency reports, consulting reports, and proceedings papers. A subset of papers was selected from this database: those studies conducted for activities relevant to recreation in the Three Creeks region. The final dataset used to estimate the value of recreation in Rich county was based on 2256 individual benefit estimates for recreation sites located in the United States. Our “target” recreation activities were big game hunting, small game hunting, freshwater fishing in lakes and rivers, and wildlife

⁴ Benefits transfer is increasingly applied to a wide variety of environmental goods and services, and a special issue of *Ecological Economics* published in 2006 provides more information BT techniques (Wilson and Hoehn, 2006).

viewing. The studies from which these benefit estimates were selected sometimes focused on a single, narrowly defined site, while others reported economic values at a state or regional (multi-state) level. Some studies reported a value for only one of our target activities, while other studies reported on a wider range of recreational activities that may occur at a site or in a region (swimming, various types of boating, etc.)

The 2256 measures of recreation benefits were used to estimate a “meta-regression” model to predict the value of outdoor recreation in Rich county. A meta-regression is a statistical summary of the relationship between economic value measures and the quantifiable characteristics of the economic study and the study site (Rosenberger and Loomis, 2001; Appendix C). The explanatory variables used in the meta-regression were characteristics of the site (its location and facilities), the activities available at the site (hunting, fishing, boating, swimming, etc.), and characteristics of the study itself (year of the study, which benefit measure was used, value elicitation method, etc.).

The meta-regression model can be found in Appendix C (Table C.1). Using the coefficients of the model, we substitute the site characteristics that are most germane to estimating the value of outdoor recreation in Rich county: namely, those associated with location (the *Mountain* census division), the type of activity available (*Freshwater Fishing*, *Big Game Hunting*, *Small Game Hunting*, and *Wildlife Viewing*), the level of site aggregation (*Single Site*), *Dispersed* recreation, and the population expected to use the site (residents and non-residents, or *Both*). Again, details may be found in Appendix C.

Using the meta-regression model, economic values for the four recreation activities can be estimated by substituting the appropriate values into the equation. The top portion of Table 4.1 reports activity values in 2006 dollars. The benefit of the big game hunting is given by \$89.17 per person per activity day. In a similar way, the value of the small game hunting is computed as \$58.62 per person per /activity day. A benefit of \$64.56/person/activity day is estimated for fresh water fishing; finally, the model estimates a value of \$86.51/person/activity day for wildlife viewing. The bottom line of Table 4.1 presents the economic value of outdoor activities in adjusted 2009 dollars.

Table 4.1: Predicted Economic Value of Outdoor Recreation in Rich county

	Big Game Hunting	Small Game Hunting	Freshwater Fishing	Wildlife Viewing
Predicted Value (\$2006/person/day)	\$89.17	\$58.62	\$64.56	\$86.51
Standard Error	\$1.39	\$1.45	\$1.39	\$1.42
95% lower bound	\$86.44	\$55.79	\$61.84	\$83.73
95% upper bound	\$91.90	\$61.46	\$67.28	\$89.30
\$2009/person/day	\$94.89	\$62.38	\$68.70	\$92.06

Estimating the Value of Additional Hunting Activity in the Three Creeks Region

As noted above, ranchers in the Three Creeks region plan to adopt time-controlled grazing policies similar to those currently used by Deseret Land and Livestock. DLL keeps thorough landscape-scale records on vegetation, wildlife, and commercial activities in a region that is ecologically quite similar to the Three Creeks region. According to DLL, the TCGP has allowed habitat on the range to support a greater number of livestock and game animals. While the increase in wildlife numbers cannot be attributed solely to grazing improvements, the DLL experience can be illustrative of the potential for the Three Creeks region. The number of elk supported on DLL range increased by 60% between 1983 and 2010. Similarly, moose numbers increased by 300% (to 200 moose) and sage grouse numbers increased by 125% (from 800 to 1800).⁵ Antelope have gone from non-existent in 1983 to 850 animals in 2010. While the 1983 count for bird species is unknown, by 2010 some 276 species were found on DLL land. The Audubon Society named the DLL Cooperative Wildlife Management Unit (CWMU) as a Globally

⁵ A large die off of mule deer in 1983 prevents an accurate estimate of the change in deer numbers. Some 3500 mule deer were present in 2001.

Significant Important Bird Area.⁶

Improving wildlife habitat in the Three Creeks region, particularly for highly valued hunting opportunities, is a “side benefit” of time-controlled grazing improvements. If the habitat improvements which occurred on DLL land are replicated in the 143,000 acre Three Creeks region, game hunters will benefit if the Utah Division of Wildlife Resources (UDWR) is able to issue more hunting permits.

Discussions with UDWR personnel indicate that growth in populations of elk, moose, and pronghorn are unlikely to occur in the Three Creeks region because:

1. While grazing improvements will improve summer range and thus improve animal condition as they enter the winter (increasing winter survival rates), the winter range for elk and moose is not available in Three Creeks. Elk and moose must winter outside the Three Creeks area in regions that already sustain the target numbers of animals.
2. Elk, moose and pronghorn are already managed at the current objective levels; indeed, wildlife damage to private land and the need for winter habitat recovery has UDWR wildlife specialists planning to reduce the number of moose and pronghorn in the Cache Management Unit in the near future.
3. Increased animal numbers on Three Creeks will cause increased damage to local ranchers’ fields, requiring an increased “tolerance” for damage on the part of ranchers.

In sum, UDWR biologists do not believe the grazing improvements on the Three Creeks allotments will allow many more elk, moose, and pronghorn hunting opportunities.⁷

⁶ According to the Audubon Society website, the DLL parcel qualifies as a Globally Significant Important Bird Area because of the Greater Sage Grouse and the Long-billed Curlew. Criteria for the “global status” include having over 1% of the global population or documented breeding success for a given species. The Greater Sage Grouse at DLL satisfy both criteria, whereas the Long-billed Curlew satisfies the breeding criterion.

In contrast, UDWR personnel believe that increased opportunities for other species may occur over time, particularly for sage grouse and, perhaps, deer.⁸ The Three Creeks region provides ideal sagebrush habitat needed by sage grouse and, to a lesser extent, deer. In Utah, only western Box Elder county provides more habitat for sage grouse leks (a gathering of males for mating displays) than Rich county. For the period 2001-2009, Rich county averaged 33 strutting grounds per year and just under 39 males per lek. In 2009, some 234 hunters entered the Rich unit, which contained 23 leks. Table 4.2 provides historical data for the Rich unit, gathered from UDWR Upland Game Annual Reports.

Table 4.2: Sage Grouse in Rich county, 2001-2009

	Leks	Hunters	Permits	Hunters / Lek	Permits / Lek
2001	32	175	-	5.47	-
2002	38	61	66	1.61	1.74
2003	41	99	112	2.41	2.73
2004	40	165	198	4.13	4.95
2005	36	240	300	6.67	8.33
2006	35	345	416	9.86	11.89
2007	19	245	282	12.89	14.84
2008	27	208	237	7.70	8.78
2009	23	234	271	10.17	11.78

Over the last five years for which data are available (2005-2009), the Rich unit averaged about 28 leks and 300 permits per year, with just over 250 hunters afield.

The number of sage grouse hunting permits for any given hunt unit is based on a formula in which lek counts serve as the key variable. UDWR biologists are hesitant to predict the effect of habitat changes in the Three Creeks region because such changes occur slowly over time. It is clear, however, that the number of hunters that would be affected by the TCGP will be relatively limited. Even if the number of permits were doubled such that an additional 250

⁷ Telephone and email communication with Randy Wood, Scott Walker and Darrin DeBois in August 2011. UDWR is not responsible for any errors introduced by the authors of this report.

⁸ UDWR personnel believe that the amount of snow in the Three Creeks region may limit the degree to which deer herds can expand.

hunters could hunt sage grouse, the increase in economic value is relatively modest. Our best estimate for the economic value of small game hunting is about \$62 per day (2009 dollars).⁹ At an average of 1.53 days afield per hunter, the additional economic value associated with sage grouse hunting would be about \$24,000. If UDWR cannot double the number of sage grouse hunters in the region, benefits to hunters would be smaller.

Estimating the Value of Additional Wildlife Viewing Activity in the Three Creeks Region

Wildlife viewing is among the most popular outdoor activities in the U.S., with over 500,000 residents and non-residents engaged in wildlife watching *away from home* in Utah in 2006, while another 350,000 Utahns viewed wildlife from the comfort of their home and did not take a trip (US Fish and Wildlife Service, 2008). Those traveling to view wildlife away from home spent a total of 3.9 million days observing, feeding and photographing wildlife. Total expenditures for wildlife viewing in Utah in 2006 were \$564 million, almost 60% of which was spent on trip-related items. Utah residents engaged in 2.4 million days viewing wildlife in the state away from home, spending almost \$120 million in trip-related and equipment expenditures.

Wildlife viewing is a highly valued activity. The meta-regression model predicts an economic value of \$92.06 per day for wildlife viewing after adjusting to 2009 dollars (Table 4.1). It has also been observed that time-controlled grazing has helped Deseret Land and Livestock improve its habitat and, thus, its wildlife numbers. The Audubon Society named the DLL parcel a Globally Significant Important Bird Area, and birding is an extremely popular form of wildlife viewing. We would like to estimate the change in away from home wildlife viewing that would occur in the Three Creeks region, but such data simply nonexistent: there is no wildlife-viewing information available for Rich county. Thus, we cannot estimate the expected increase in economic value associated with wildlife viewing in the Three Creeks region. However, we can estimate the number of visitors needed to attain a certain economic value. That is, how many visitor-days of wildlife viewing in Three Creeks are required each year to provide, say, \$50,000 in economic value? From Table 4.1, we predict that wildlife viewers enjoy an economic value of

⁹ See meta-regression in Appendix C, Table C.1. Economics values reported in Table 4.1.

\$92 per person per day. At \$92 per person per day, an increase of only 543 wildlife viewing days in the Three Creeks region would be needed to provide \$50,000 in net economic benefit. The additional activity days would represent an increase of just 0.02% of Utah residents' in-state activity in 2006.

Estimating the Value of Additional Fishing Activity in the Three Creeks Region

The proposed TCGP for the Three Creeks region has the potential to improve riparian health and water quality in Big Creek, which is included on the State of Utah's 303d list of waterbodies failing to attain their beneficial uses. If a waterbody appears on the 303d list, the State is compelled to develop a remediation plan, called a "TMDL", designed to allow the waterbody to achieve its beneficial uses.¹⁰ TMDLs have been implemented for both Bear River-4 and Saleratus Creek, waterbodies in the same watershed as Big Creek..

It has been speculated that the TCGP could improve Big Creek water quality and habitat such that it achieves status as a "Blue Ribbon" fishery, one whose waters "...provide highly-satisfying fishing and outdoor experiences for diverse groups of anglers and enthusiasts." Criteria for inclusion on the Blue Ribbon list—and thus being featured on the Utah Division of Wildlife Resources webpage—include high quality fish habitat and fishing quality that provides economic benefit to local communities. UDWR officials are reluctant to state that the proposed TCGP will improve Big Creek to the status of a Blue Ribbon fishery, but a representative of the Utah Division of Water Quality (UDWQ) stated that grazing improvements such as those utilized in a TCGP have the *potential* to allow Big Creek to be removed from the state's 303d list.¹¹

If time-controlled grazing could allow Big Creek to be listed as a Blue Ribbon fishery, then the communities of Woodruff and Randolph would benefit from increased activity by anglers. Further, a higher quality fishing experience increases the number of anglers and fishing trips, thus increasing the economic value accruing to anglers. One could use the economic value for fishing shown in Table 4.1 (\$68.70) and apply that to the increase in the number of angler-days

¹⁰ TMDL is an acronym for Total Maximum Daily Load, a reference to the daily limits placed on pollutants that cause impairment in meeting beneficial uses for a waterbody.

¹¹ Email exchange with Jeff Ostermiller of UDWQ.

to calculate an aggregate change in economic value. Unlike use statistics for hunting units, UDWR does not collect water-body specific visitation for anglers. Indeed, even after contacting other researchers known to have surveyed Utah anglers in the past, the only use statistics available are at the state-level.

In 2006 some 288,000 Utah residents fished in the state, spending almost 3.4 million days fishing with almost \$300 million in trip-related and equipment expenditures (US Fish and Wildlife Service, 2008). Using our estimate of about \$69 per person per activity day (Table 4.1, adjusted to 2009 dollars), the TCGP would need to increase fishing by 728 days to generate \$50,000 in economic benefit. The 728 days represents an increase in in-state fishing by residents of just 0.02%.

B. Valuing Ecosystem Restoration: an “Avoided Cost” Approach to Water Quality and Species Management

Water Quality in Big Creek

As noted above, the TCGP has the potential to improve water quality in Big Creek. The state of Utah has yet to perform a Total Maximum Daily Load (TMDL) water quality study for Big Creek, a waterbody which does not meet its designated beneficial uses. However, Utah’s Division of Water Quality has conducted a number of TMDL studies elsewhere in the state and which have been approved by EPA. We can use an approach akin to benefits transfer by examining the cost of TMDL remediation projects for similar water quality problems in nearby regions, using an “avoided cost” approach. UDWQ maintains a website at which all approved TMDL studies are available.¹² We found approved TMDLs for four nearby watersheds and waterbodies in which the source of water quality degradation was similar to that of Big Creek and for which cost data were provided. These studies are reported in Table 4.3.

Costs associated with livestock operations include only those for Best Management Practices and feedlot “cleanup” according to a comprehensive nutrient management plan. Table 4.3

¹² <http://www.waterquality.utah.gov/TMDL/index.htm#pending>

includes costs for fencing off streams and canals, allowing riparian vegetation to grow along a stream, watering livestock away from stream channels, and preventing overgrazing of pastures, many of which are components of the proposed TCGP for Three Creeks. The costs reported in Table 4.3 do not include remediation efforts such as stream bank restoration, installation of filter strips, etc. Costs will obviously vary by region, type and source of impairment, the extent of the area, and other factors, but Table 4.3 makes clear that the livestock management component of an approved TMDL can be expensive. The TCGP for Three Creeks would essentially accomplish many of the goals of a TMDL and avoid many of the cost reported in Table 4.3.

Table 4.3: Nearby TMDLs and Remediation Costs for Livestock

Name	County	Year	Pollutant	Remediation Cost Associated with Livestock Operations
Spring Creek	Cache	2002	Phosphorous, Dissolved Oxygen Ammonia Temperature Fecal coliforms	\$1,430,800
Deer Creek Reservoir Drainage	Summit, Morgan	2002	Phosphorous Dissolved Oxygen	\$715,400
Pineview Reservoir	Weber	2002	Phosphorous Dissolved Oxygen Temperature	\$360,100
Clarkston Creek, Newton Reservoir, Newton Creek	Cache	2004	Phosphorous	\$494,000

Costs adjusted to constant 2009 dollars.

Species Management

As mentioned in a previous section, the sage grouse has been considered for listing as an endangered species, and the literature concerning the technical aspects of restoring sage grouse habitat is extensive. In contrast, very little information is available regarding the cost of

restoration efforts. One large scale cost study was conducted by Stiver et al. (2006) on behalf of the Western Association of Fish and Wildlife Agencies. This study attempted to cost out all aspects of sage grouse habitat restoration and monitoring. The cost study includes all costs associated with a communications network, habitat monitoring, conservation planning, conservation evaluation, and adaptive management (Section 6 of Stiver et al.) The total five-year implementation cost for 11 states and two Canadian provinces was in excess of \$450 million in 2009 dollars.

Two other cost studies were identified. In the Klamath National Wildlife Refuge Complex, the Sage Grouse Initiative of the Natural Resources Conservation Service provided \$2 million to restore over 15,000 acres of habitat in 2010. Stinson, Hays and Schroeder (2003) report annual costs for implementing the sage grouse recovery plan developed for the state of Washington. The plan would triple the number of birds in the state (from about 1000 to just over 3000) and triple the number of active lek complexes from two to six. The annual implementation cost was estimated to be a little more than \$1.1 million (2009 dollars), but did not include several costs which could not be quantified. Although the literature is relatively sparse, it is clear that habitat restoration and monitoring for sage grouse is somewhat costly.

5. Summary

This report has outlined the economic contribution of ranching in the Three Creeks region to the Rich county economy and the potential impacts to the economy of changes in public grazing allotments in Three Creeks. Current ranching activity in Three Creeks contributes over 6% of the total economic value of output in Rich county. The economic impact of possible adjustments by ranchers was modeled; adjustments could lead to losses smaller than 6% of the county's economic output, but the exact impact will depend upon the adjustment mechanism selected by ranchers.

A benefits transfer approach was used to estimate the value of nonmarket benefits associated with a time-controlled grazing plan. Benefits are likely to accrue to hunters, anglers, and those who view wildlife away from home. Only small increases in aggregate recreation activity are

needed to generate relatively large benefits. We have also conducted a literature search to help gauge the cost of efforts needed from livestock operations to aid in water quality restoration. Finally, we have reported on the cost of sage grouse habitat and monitoring efforts elsewhere in the western United States. Restoration for both water quality and sage grouse habitat can be quite costly.

The Three Creeks region also operates as an important wildlife corridor, allowing wildlife to migrate between the northern and southern Rockies. Revocation of grazing permits on the 143,000 acres of public land in the Three Creeks region is likely to place private grazing land in danger of conversion to residential lots. The market and non-market analysis needed to address this issue is beyond the scope of this study.

References

- Audubon Society. 2012. "Important Bird Areas Program." Retrieved February 11.
<http://web4.audubon.org/bird/iba/index.html>
- Rosenberger, R S., and Loomis, J.B. 2001. *Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan (2000 revision)*. Gen. Tech. Rep. RMRS-GTR-72. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 59 p.
- Stinson, D.W., D.W. Hays, and M.A. Schroeder. 2003. Draft Washington State Recovery Plan for the Sage-Grouse. (November)
http://wdfw.wa.gov/publications/00395/draft_sage_grouse_recovery.pdf
- Stiver, S.J., A.D. Apa, J.R. Bohne, S.D. Bunnell, P.A. Deibert, S.C. Gardner, M.A. Hilliard, C.W. McCarthy, and M.A. Schroeder. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming. <http://wdfw.wa.gov/publications/01317/wdfw01317.pdf>
- U.S. Fish and Wildlife Service. 2008. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. <http://www.census.gov/prod/2008pubs/fhw06-ut.pdf>
- U.S. Fish and Wildlife Service Journal. 2011. "Klamath NWRC: Restoring Greater Sage Grouse at the Devil's Garden." <http://www.fws.gov/FWSJournal/regmap.cfm?arskey=30528>
- Wilson, M.A., and Hoehn, J.P. 2006. "Valuing Environmental Goods and Services Using Benefit Transfer: The State-of-the Art and Science." *Ecological Economics* 60:335-342.

Appendix A

A Brief Description of Economic Impact Analysis

Economic impact analysis combines the value of the total direct sales (output) of the production agriculture and agricultural processing sectors with spending multipliers derived from an input-output model of the Utah economy. We use the state model developed by the Minnesota IMPLAN Group, which is an outgrowth of an input-output model developed by the US Forest Service.¹³ An input-output (I-O) model traces the flow of goods and services through the regional economy, where the model is structured to capture the inter-industry relationships within the region.

I-O models are constructed to yield estimates of the indirect (backward) and induced (forward) linkages in an economy. Indirect effects, or backward linkages, account for business-to-business purchases where businesses purchase inputs from other businesses, which in turn purchase additional inputs. For production agriculture, backward linkages include effects of agricultural production on the businesses that support these activities: the output of firms that supply agricultural inputs such as seed, machinery and financial services. Induced effects or forward linkages account for the effects of the increased demands for goods and services because of increased household income from employee compensation and proprietor's income. The induced effects would include the effects of spending by households as household income increases or decreases due to economic activity in the agricultural production sector and its backward linked supply firms. The total impact is the sum of the direct effect, indirect effect, and the induced effect.

¹³ The IMPLAN software and data sets are used by many federal and state agencies in conducting impact analysis. More information about IMPLAN can be found at <http://implan.com/v3/>.

Appendix B

Budgets Used in Economic Impact Analysis Scenarios

Table B.1a for Scenario #1, #7, and #8

Table B.1b for Scenario #5, #6, #7, and #8

Table B.2 for Scenario #2

Table B.3 for Scenario #3

Table B.4 for Scenario #4

Table B.5 for Scenario #6

Table B.1a: Cattle Status Quo.

Rich County Utah

Cow/Calf operation, 2010

3200 head

Assumptions

Percentage of cows to wean a calf	85%	Change the values highlighted in the yellow cells to reflect your production levels and your costs.
Percent death loss of cows	1%	
Cost of replacement stock (heifers and bulls) @market value		
Cull Cow rate	10%	
Bull replacement rate	25%	
Feed costs at market value		
All calves sold. Some may be sold to another enterprise.		
Cows per Bull	25	
Number of months grazed		
Federal land	4	
Private	3	
Number of months feed hay	6	Not all months are at full feed or strictly grazing
Animals sold in the fall		

	No. of Animals	Average Weight	Units	Sale Price per Unit	Value/cow	Total Value
Receipts						
Steers	1360	525 lbs		\$1.25	\$278.91	\$892,500.00
Heifers	1360	485 lbs		\$1.17	\$241.17	\$771,732.00
Cull Cows	320	1100 lbs		\$0.48	\$52.80	\$168,960.00
Cull Bulls	32	1850 lbs		\$0.58	\$10.73	\$34,336.00
Total					\$583.60	\$1,867,528.00

Expenses	Units/cow	Total Units	Units	Cost per Unit	Cost/Cow	Total Costs
Variable Costs						
Feed Expense						
Grass Hay	2.08	6669.76 tons		\$70.00	\$145.90	\$466,883.20
Alfalfa Hay	0	0 tons		\$100.00	\$0.00	\$0.00
Salt and Mineral	0.05	160 tons		\$125.00	\$6.25	\$20,000.00
Federal permit						
Grazing Fees	1.06	13568 AUMs		\$1.35	\$5.72	\$18,316.80
Non fee costs	1.06	13568 AUMs		\$16.00	\$67.84	\$217,088.00
Private Pasture Lease*	1.06	10176 AUMs		\$17.00	\$54.06	\$172,992.00
Reproduction Costs						
AI project	0.11	352 heifer		\$25.00	\$2.75	\$8,800.00
Breeding Bulls	0.01	32 bull		\$2,500.00	\$25.00	\$80,000.00
Replacement heifers/cows*	0.11	352 heifer		\$900.00	\$99.00	\$316,800.00
Animal Health						
Veterinarian service	1	3200 cow		\$3.00	\$3.00	\$9,600.00
Medication & supplies	1	3200 cow		\$1.50	\$1.50	\$4,800.00
Vaccinations-cow	1	3200 cow		\$7.00	\$7.00	\$22,400.00
Vaccinations-calf	0.85	2720 calf		\$8.00	\$6.80	\$21,760.00
Bull testing & vaccine	0.04	128 bull		\$50.00	\$2.00	\$6,400.00
Hired Labor						
Calving season	2.4	7680 hrs		\$10.00	\$24.00	\$76,800.00
General Feeding	0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Cattle handling & care	0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Marketing and Transportation						
Transportation			1 yr.	\$32,000.00	\$10.00	\$32,000.00
Sale Commission	0.96	3072 head		\$9.00	\$8.64	\$27,648.00
Other Variable Costs	1	3200 head		\$29.10	\$29.10	\$93,116.80
Interest Expense (1/5 variable costs @7%)					\$17.87	\$57,183.17
			Total Variable Costs		\$528.43	\$1,690,987.97
General Overhead Cost						
Facility Maintenance			1 yr.	\$4,800.00	\$1.50	\$4,800.00
Fuel & lube			1 yr.	\$1,920.00	\$0.60	\$1,920.00
Machinery			1 yr.	\$3,200.00	\$1.00	\$3,200.00
Vehicles & trailers			1 yr.	\$3,200.00	\$1.00	\$3,200.00
Animal death insurance		3200 head		\$1.00	\$1.00	\$3,200.00
Depreciation-machinery & vehicles			1 yr.	\$24,000.00	\$7.50	\$24,000.00
Property taxes			1 yr.	\$16,000.00	\$5.00	\$16,000.00
Miscellaneous			1 yr.	\$44,800.00	\$14.00	\$44,800.00
			General Overhead Costs		\$31.60	\$101,120.00
			Total Costs		\$560.03	\$1,792,107.97
				NET INCOME	\$23.57	\$75,420.03

Table B1b. Sheep Status Quo.

Rich County Utah

Range Sheep Operation 2010

500 head

Assumptions

Lamb Weaning Percent	100%
Percent death loss of ewes	12%
Ewe replacement rate	20%
Ram replacement rate	33%

Change the values highlighted in the yellow cells to reflect your production levels and your costs.

Feed costs at market value

All lambs sold. Some may be sold to another enterprise.

Ewes per Ram 33

Number of months grazed

BLM land 4

Forest Service 2

Private 3

Number of months feed hay 4 Not all months are at full feed or strictly grazing

Animals sold in the fall

	No. of Animals	verage Weig	Units	sale Price per Un	Value/ewe	Total Value
Reciepts						
Lambs	500	90 lbs		\$1.50	\$135.00	\$67,500.00
Cull Ewes	100	150 lbs		\$0.38	\$11.40	\$5,700.00
Cull Rams	5	200 lbs		\$0.42	\$0.84	\$420.00
Wool	515	10 lbs		\$2.30	\$23.69	\$11,845.00
Total					<u>\$170.93</u>	<u>\$85,465.00</u>

	Units/ewe	Total Units	Units	Cost per Unit	Cost/Ewe	Total Costs
Expenses						
Variable Costs						
Feed Expense						
Grass Hay	0	0 tons		\$70.00	\$0.00	\$0.00
Alfalfa Hay	0.2	100 tons		\$150.00	\$30.00	\$15,000.00
Salt and Mineral	0.0015	0.75 tons		\$125.00	\$0.19	\$93.75
Federal permit*						
Grazing Fees	0.3	900 AUMs		\$1.35	\$2.43	\$1,215.00
Non fee costs	0.3	900 AUMs		\$1.00	\$1.80	\$900.00
Private Pasture Lease*	0.3	450 AUMs		\$10.00	\$9.00	\$4,500.00
Reproduction Costs						
AI project					\$0.00	\$0.00
Breeding Rams	0.01	5 ram		\$500.00	\$5.00	\$2,500.00
Replacement ewes/breeding e	0.32	160 ewe		\$180.00	\$57.60	\$28,800.00
Vet & Medicine	1	500 ewe		\$4.00	\$4.00	\$2,000.00
Trucking	1	500 ewe		\$2.00	\$2.00	\$1,000.00
Shearing	1	515 ewe		\$3.00	\$3.09	\$1,545.00
Predator Control					\$2.40	\$1,200.00
Hired Labor		0.5 man		\$15,000.00	\$15.00	\$7,500.00
Other Variable Costs	1	500 ewe		\$4.00	\$4.00	\$2,000.00
Interest (1/2 variable costs @ 7%)					\$4.78	\$2,388.88
Total Variable Costs					\$141.29	\$70,642.63
Facility Maintenance		1 yr.		\$1,600.00	\$3.20	\$1,600.00
Fuel & lube		1 yr.		\$600.00	\$1.20	\$600.00
Equipment		1 yr.		\$1,000.00	\$2.00	\$1,000.00
Insurance		1 yr.		\$300.00	\$0.60	\$300.00
Depreciation		1 yr.		\$1,700.00	\$3.40	\$1,700.00
Property taxes		1 yr.		\$300.00	\$0.60	\$300.00
Miscellaneous		1 yr.		\$400.00	\$0.80	\$400.00
General Overhead Costs					\$11.80	\$5,900.00
Total Costs					\$153.09	\$76,542.63
				NET INCOME	\$17.84	\$8,922.37

Table B.2: Out-of-State Grazing							
Rich County Utah							
Cow/Calf operation, 2007							
3200 head							
Assumptions							
Percentage of cows to wean a calf	85%	Change the values highlighted in the yellow cells					
Percent death loss of cows	1%	to reflect your production levels and your costs.					
Cost of replacement stock (heifers and bulls) @market value							
Cull Cow rate	10%						
Bull replacement rate	25%						
Feed costs at market value							
All calves sold. Some may be sold to another enterprise.							
Cows per Bull	25						
Number of months grazed							
BLM land	0						
Forest Service	0						
Private	7						
Number of months feed hay	6	Not all months are at full feed or strictly grazing					
Animals sold in the fall							
		No. of Animals	Average Weight	Units	Sale Price per Unit	Value/cow	Total Value
Receipts							
Steers		1360	525 lbs		\$1.25	\$278.91	\$892,500.00
Heifers		1360	485 lbs		\$1.17	\$241.17	\$771,732.00
Cull Cows		320	1100 lbs		\$0.48	\$52.80	\$168,960.00
Cull Bulls		32	1850 lbs		\$0.58	\$10.73	\$34,336.00
Total						\$583.60	\$1,867,528.00
Expenses							
		Units/cow	Total Units	Units	Cost per Unit	Cost/Cow	Total Costs
Variable Costs							
Feed Expense							
Grass Hay		2.08	6669.76 tons		\$70.00	\$145.90	\$466,883.20
Alfalfa Hay		0	0 tons		\$100.00	\$0.00	\$0.00
Salt and Mineral		0.05	160 tons		\$125.00	\$6.25	\$20,000.00
BLM permit*							
Grazing Fees		1.06	0 AUMs		\$1.35	\$0.00	\$0.00
Non fee costs		1.06	0 AUMs		\$16.00	\$0.00	\$0.00
Private Pasture Lease*		1.06	23744 AUMs		\$17.00	\$126.14	\$403,648.00
Reproduction Costs							
AI project		0.11	352 heifer		\$25.00	\$2.75	\$8,800.00
Breeding Bulls		0.01	32 bull		\$2,500.00	\$25.00	\$80,000.00
Replacement heifers/cows*		0.11	352 heifer		\$900.00	\$99.00	\$316,800.00
Animal Health							
Veterinarian service		1	3200 cow		\$3.00	\$3.00	\$9,600.00
Medication & supplies		1	3200 cow		\$1.50	\$1.50	\$4,800.00
Vaccinations-cow		1	3200 cow		\$7.00	\$7.00	\$22,400.00
Vaccinations-calf		0.85	2720 calf		\$8.00	\$6.80	\$21,760.00
Bull testing & vaccine		0.04	128 bull		\$50.00	\$2.00	\$6,400.00
Hired Labor							
Calving season		2.4	7680 hrs		\$10.00	\$24.00	\$76,800.00
General Feeding		0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Cattle handling & care		0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Marketing and Transportation							
Transportation			1 yr.		\$112,000.00	\$35.00	\$112,000.00
Sale Commission		0.96	3072 head		\$9.00	\$8.64	\$27,648.00
Other Variable Costs		1	3200 head		\$29.10	\$29.10	\$93,116.80
Interest (1/2 variable costs @7%)						\$18.69	\$59,816.96
Total Variable Costs						\$552.77	\$1,768,872.96
General Overhead Cost							
Facility Maintenance			1 yr.		\$4,800.00	\$1.50	\$4,800.00
Fuel & lube			1 yr.		\$1,920.00	\$0.60	\$1,920.00
Machinery			1 yr.		\$3,200.00	\$1.00	\$3,200.00
Vehicles & trailers			1 yr.		\$3,200.00	\$1.00	\$3,200.00
Animal death insurance			3200 head		\$1.00	\$1.00	\$3,200.00
Depreciation-machinery & vehicles			1 yr.		\$24,000.00	\$7.50	\$24,000.00
Property taxes			1 yr.		\$16,000.00	\$5.00	\$16,000.00
Miscellaneous			1 yr.		\$42,335.04	\$13.23	\$42,335.04
General Overhead Costs						\$30.83	\$98,655.04
Total Costs						\$583.60	\$1,867,528.00
NET INCOME						\$0.00	\$0.00

Table B.3: Purchase Additional Hay

Rich County Utah		Assumes that surplus Alfalfa hay can be purchased in the county to meet the needs of the cows.					
Cow/Calf operation, 2007		3200 head					
Assumptions		Change the values highlighted in the yellow cells to reflect your production levels and your costs.					
Percentage of cows to wean a calf	85%						
Percent death loss of cows	1%						
Cost of replacement stock (heifers and bulls) @market value							
Cull Cow rate	10%						
Bull replacement rate	25%						
Feed costs at market value							
All calves sold. Some may be sold to another enterprise.							
Cows per Bull	25						
Number of months grazed							
BLM land	0						
Forest Service	0						
Private	3						
Number of months feed hay	6	Not all months are at full feed or strictly grazing					
Animals sold in the fall							
		No. of Animals	Average Weight	Units	Sale Price per Unit	Value/cow	Total Value
Receipts							
Steers		1360	525 lbs		\$1.25	\$278.91	\$892,500.00
Heifers		1360	485 lbs		\$1.17	\$241.17	\$771,732.00
Cull Cows		320	1100 lbs		\$0.48	\$52.80	\$168,960.00
Cull Bulls		32	1850 lbs		\$0.58	\$10.73	\$34,336.00
Total						\$583.60	\$1,867,528.00
Expenses		Units/cow	Total Units	Units	Cost per Unit	Cost/Cow	Total Costs
Variable Costs							
Feed Expense							
Grass Hay		2.08	6669.76 tons		\$70.00	\$145.90	\$466,883.20
Alfalfa Hay		1.8	5760 tons		\$100.00	\$180.00	\$576,000.00
Salt and Mineral		0.05	160 tons		\$125.00	\$6.25	\$20,000.00
BLM permit*							
Grazing Fees		1.06	0 AUMs		\$1.35	\$0.00	\$0.00
Non fee costs		1.06	0 AUMs		\$16.00	\$0.00	\$0.00
Private Pasture Lease*		1.06	10176 AUMs		\$17.00	\$54.06	\$172,992.00
Reproduction Costs							
AI project		0.11	352 heifer		\$25.00	\$2.75	\$8,800.00
Breeding Bulls		0.01	32 bull		\$2,500.00	\$25.00	\$80,000.00
Replacement heifers/cows*		0.11	352 heifer		\$900.00	\$99.00	\$316,800.00
Animal Health							
Veterinarian service		1	3200 cow		\$3.00	\$3.00	\$9,600.00
Medication & supplies		1	3200 cow		\$1.50	\$1.50	\$4,800.00
Vaccinations-cow		1	3200 cow		\$7.00	\$7.00	\$22,400.00
Vaccinations-calf		0.85	2720 calf		\$8.00	\$6.80	\$21,760.00
Bull testing & vaccine		0.04	128 bull		\$50.00	\$2.00	\$6,400.00
Hired Labor							
Calving season		2.4	7680 hrs		\$10.00	\$24.00	\$76,800.00
General Feeding		0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Cattle handling & care		0.6	1920 hrs		\$10.00	\$6.00	\$19,200.00
Marketing and Transportation							
Transportation				1 yr.	\$32,000.00	\$10.00	\$32,000.00
Sale Commission		0.96	3072 head		\$9.00	\$8.64	\$27,648.00
Other Variable Costs		1	3200 head		\$29.10	\$29.10	\$93,116.80
Interest (1/2 variable costs @7%)						\$21.60	\$69,104.00
			Total Variable Costs			\$638.60	\$2,043,504.00
General Overhead Cost							
Facility Maintenance				1 yr.	\$4,800.00	\$1.50	\$4,800.00
Fuel & lube				1 yr.	\$1,920.00	\$0.60	\$1,920.00
Machinery				1 yr.	\$3,200.00	\$1.00	\$3,200.00
Vehicles & trailers				1 yr.	\$3,200.00	\$1.00	\$3,200.00
Animal death insurance				3200 head	\$1.00	\$1.00	\$3,200.00
Depreciation-machinery & vehicles				1 yr.	\$24,000.00	\$7.50	\$24,000.00
Property taxes				1 yr.	\$16,000.00	\$5.00	\$16,000.00
Miscellaneous				1 yr.	\$44,800.00	\$14.00	\$44,800.00
			General Overhead Costs			\$31.60	\$101,120.00
			Total Costs			\$670.20	\$2,144,624.00
					NET INCOME	-\$86.59	-\$277,096.00

Table B.4: Reduce Herd Size

Rich County		This scenario assumes some go out of business others stay in.					
Cow/Calf operation, 2007							
2144 head							
Assumptions							
Percentage of cows to wean a calf	85%	Change the values highlighted in the yellow cells					
Percent death loss of cows	1%	to reflect your production levels and your costs.					
Cost of replacement stock (heifers and bulls) @market value							
Cull Cow rate	10%						
Bull replacement rate	25%						
Feed costs at market value							
All calves sold. Some may be sold to another enterprise.							
Cows per Bull	25						
Number of months grazed							
BLM land	0						
Private	7						
Number of months feed hay	6	Not all months are at full feed or strictly grazing					
Animals sold in the fall							
		No. of Animals	Weight	Units	Sale Price/ Unit	Value/cow	Total Value
Receipts							
Steers	911.2	525 lbs	\$1.25	\$278.91	\$597,975.00		
Heifers	911.2	485 lbs	\$1.17	\$241.17	\$517,060.44		
Cull Cows	214.4	1100 lbs	\$0.48	\$52.80	\$113,203.20		
Cull Bulls	22	1850 lbs	\$0.58	\$10.73	\$23,005.12		
Total				\$583.60	\$1,251,243.76		
Expenses							
		Units/cow	Total Units	Units	Cost per Unit	Cost/Cow	Total Costs
Variable Costs							
Feed Expense							
Grass Hay	2.08	4469 tons	\$70.00	\$145.90	\$312,811.74		
Alfalfa Hay	0	0 tons	\$100.00	\$0.00	\$0.00		
Salt and Mineral	0.05	107.2 tons	\$125.00	\$6.25	\$13,400.00		
BLM permit*							
Grazing Fees	1.06	0 AUMs	\$1.35	\$0.00	\$0.00		
Non fee costs	1.06	0 AUMs	\$16.00	\$0.00	\$0.00		
Private Pasture Lease*	1.06	15908.48 AUMs	\$17.00	\$126.14	\$270,444.16		
Reproduction Costs							
AI project	0.11	235.84 heifer	\$25.00	\$2.75	\$5,896.00		
Breeding Bulls	0.01	22 bull	\$2,500.00	\$25.00	\$53,600.00		
Replacement heifers/cows*	0.11	235.84 heifer	\$900.00	\$99.00	\$212,256.00		
Animal Health							
Veterinarian service	1	2144 cow	\$3.00	\$3.00	\$6,432.00		
Medication & supplies	1	2144 cow	\$1.50	\$1.50	\$3,216.00		
Vaccinations-cow	1	2144 cow	\$7.00	\$7.00	\$15,008.00		
Vaccinations-calf	0.85	1822.4 calf	\$8.00	\$6.80	\$14,579.20		
Bull testing & vaccine	0.04	86 bull	\$50.00	\$2.01	\$4,300.00		
Hired Labor							
Calving season	2.4	5145.6 hrs	\$10.00	\$24.00	\$51,456.00		
General Feeding	0.6	1286.4 hrs	\$10.00	\$6.00	\$12,864.00		
Cattle handling & care	0.6	1286.4 hrs	\$10.00	\$6.00	\$12,864.00		
Marketing and Transportation							
Transportation		1 yr.	\$32,160.00	\$15.00	\$32,160.00		
Sale Commission	0.96	2058.8 head	\$9.00	\$8.64	\$18,529.20		
Other Variable Costs	1	2144 head	\$29.10	\$29.10	\$62,388.26		
Interest expense (1/2 variable costs @ 7%)					\$38,577.16		
		Total Variable Expenses			\$1,140,781.72		
General Overhead Cost							
Facility Maintenance		1 yr.	\$3,216.00	\$1.50	\$3,216.00		
Fuel & lube		1 yr.	\$1,286.40	\$0.60	\$1,286.40		
Machinery		1 yr.	\$2,144.00	\$1.00	\$2,144.00		
Vehicles & trailers		1 yr.	\$2,144.00	\$1.00	\$2,144.00		
Animal death insurance		2144 head	\$0.99	\$0.99	\$2,127.11		
Depreciation-machinery & vehicles		1 yr.	\$16,080.00	\$7.50	\$16,080.00		
Property taxes		1 yr.	\$10,720.00	\$5.00	\$10,720.00		
Miscellaneous		1 yr.	\$30,032.88	\$14.01	\$30,032.88		
		Total Overhead Costs			\$67,750.40		
		Total Costs			\$1,208,532.11		
			NET INCOME		\$583.60		\$42,711.65

Table B.5: Increase Herd Size, Additional Month of Public Grazing							
Rich County Utah							
Cow/Calf operation, 2007							
3520 head							
Assumptions							
Percentage of cows to wean a calf	85%	Change the values highlighted in the yellow cells to reflect your production levels and your costs.					
Percent death loss of cows	1%						
Cost of replacement stock (heifers and bulls) @market value							
Cull Cow rate	10%						
Bull replacement rate	25%						
Feed costs at market value							
All calves sold. Some may be sold to another enterprise.							
Cows per Bull	25						
Number of months grazed							
BLM land	5						
Forest Service	0						
Private	2.5						
Number of months feed hay	5.5	Not all months are at full feed or strictly grazing					
Animals sold in the fall							
		No. of Animals	Average Weight	Units	Sale Price per Unit	Value/cow	Total Value
Receipts							
Steers		1496	525 lbs		\$1.25	\$278.91	\$981,750.00
Heifers		1496	485 lbs		\$1.17	\$241.17	\$848,905.20
Cull Cows		352	1100 lbs		\$0.48	\$52.80	\$185,856.00
Cull Bulls		40	1850 lbs		\$0.58	\$10.73	\$37,769.60
Total						\$583.60	\$2,054,280.80
Expenses							
		Units/cow	Total Units	Units	Cost per Unit	Cost/Cow	Total Costs
Variable Costs							
Feed Expense							
Grass Hay		1.8343	6456.736 tons		\$70.00	\$128.40	\$451,971.52
Alfalfa Hay		0	0 tons		\$100.00	\$0.00	\$0.00
Salt and Mineral		0.05	176 tons		\$125.00	\$6.25	\$22,000.00
BLM permit*							
Grazing Fees		1.06	18656 AUMs		\$1.35	\$7.16	\$25,185.60
Non fee costs		1.06	18656 AUMs		\$16.00	\$84.80	\$298,496.00
Private Pasture Lease*		1.06	9328 AUMs		\$17.00	\$45.05	\$158,576.00
Reproduction Costs							
AI project		0.11	387.2 heifer		\$25.00	\$2.75	\$9,680.00
Breeding Bulls		0.01	40 bull		\$2,500.00	\$25.00	\$88,000.00
Replacement heifers/cows*		0.11	387.2 heifer		\$900.00	\$99.00	\$348,480.00
Animal Health							
Veterinarian service		1	3520 cow		\$3.00	\$3.00	\$10,560.00
Medication & supplies		1	3520 cow		\$1.50	\$1.50	\$5,280.00
Vaccinations-cow		1	3520 cow		\$7.00	\$7.00	\$24,640.00
Vaccinations-calf		0.85	2992 calf		\$8.00	\$6.80	\$23,936.00
Bull testing &vaccine		0.040909091	144 bull		\$50.00	\$2.05	\$7,200.00
Hired Labor							
Calving season		2.4	8448 hrs		\$10.00	\$24.00	\$84,480.00
General Feeding		0.6	2112 hrs		\$10.00	\$6.00	\$21,120.00
Cattle handling & care		0.6	2112 hrs		\$10.00	\$6.00	\$21,120.00
Marketing and Transportation							
Transportation				1 yr.	\$35,200.00	\$10.00	\$35,200.00
Sale Commission		0.961363636	3384 head		\$9.00	\$8.65	\$30,456.00
Other variable costs		1	3520 head		\$29.10	\$29.10	\$102,428.48
Interest (1/2 variable costs @ 7%)						\$17.59	\$61,908.34
			Total Variable Costs			\$520.09	\$1,830,717.94
General Overhead Cost							
Facility Maintenance				1 yr.	\$4,800.00	\$1.36	\$4,800.00
Fuel & lube				1 yr.	\$1,920.00	\$0.55	\$1,920.00
Machinery				1 yr.	\$3,200.00	\$0.91	\$3,200.00
Vehicles & trailers				1 yr.	\$3,200.00	\$0.91	\$3,200.00
Animal death insurance			3520 head		\$1.00	\$1.00	\$3,520.00
Depreciation-machinery & vehicles				1 yr.	\$24,000.00	\$6.82	\$24,000.00
Property taxes				1 yr.	\$16,000.00	\$4.55	\$16,000.00
Miscellaneous				1 yr.	\$47,680.00	\$13.55	\$47,680.00
			General Overhead Costs			\$29.64	\$104,320.00
			Total Costs			\$549.73	\$1,935,037.94
					NET INCOME	\$33.88	\$119,242.86

Appendix C

Meta-Regression Results

A meta-regression (MR) is a statistical summary of the relationship between economic value measures and the quantifiable characteristics of the economic study and the study site (Rosenberger and Loomis, 2001). For the illustrative purposes, we introduce the simple MR:

$$(1) \quad CS_{ij} = b_0 + b_1SITE_{ij} + b_2METHOD_{ij} + b_3ACTIVITY_{ij} + e_{ij},$$

where CS_{ij} stands for estimate (user value or consumer surplus) i from study j . We need the subscript i because a study j may have multiple benefit estimates. b_0 , b_1 , and b_3 are coefficients to be estimated and e_{ij} is residual. *SITE* is a vector of site-specific variables, e.g., geographic location of the study area and identification of environment. *METHOD* represents a vector of method used in study sites to derive CS, e.g., TCM or CVM. And also, *METHOD* includes visitor type and value units. *ACTIVITY* is a vector of recreation activities in the study, e.g., camping, fishing, hiking, and hunting. We may add value year, document type, and other variables to describe the study sites.

Data and Estimation Results

The final dataset used to estimate the value of recreation in Rich county was based on 489 research papers that jointly provided 2256 separate benefit estimates. Each estimate becomes an observation to be used in estimating equation (1). Table C.1 shows the coefficients of the estimated regression. A negative coefficient means that the reported estimate of economic value associated with that particular characteristic is less than reported values of those studies which do not share that characteristic. Similarly, a positive sign means that value estimates are greater for studies with that characteristic than those that do not. For example, the negative

sign on *Journal Article* means that refereed journal articles report lower estimates of economic value than do other types of reports, all else equal. The positive sign on *Consulting Report* means that this type of study has a higher value than do other types of reports, again, all else equal.

Table C.1. Meta Regression Estimation Results

		Coef.	t	P > t	
Document type	Journal article	-0.104	-1.420	0.16	
	Consulting report	0.584	4.260	0.00	
	MS thesis	-0.589	-3.520	0.00	
	PhD dissertation	-0.160	-1.460	0.14	
	Working paper	0.205	2.990	0.00	
Census region	New England	-0.886	-8.430	0.00	
	S. Atlantic	-0.447	-4.310	0.00	
	NE Central	-0.848	-7.650	0.00	
	NW Central	-0.823	-8.150	0.00	
	SE Central	-0.512	-4.520	0.00	
	SW Central	-0.492	-4.190	0.00	
	<i>Mountain</i>	-0.500	-5.250	0.00	
	Pacific	-0.485	-4.670	0.00	
	Activities	Backpacking	-0.510	-3.300	0.00
		Biking	0.391	1.720	0.09
Camping		-0.164	-0.940	0.35	
XC Skiing		0.449	1.110	0.27	
DH Skiing		-0.666	-1.290	0.20	
<i>Freshwater Fishing</i>		0.401	3.520	0.00	
Saltwater Fishing		0.503	2.300	0.02	
Floating		0.628	3.540	0.00	
Hiking		0.276	1.630	0.10	
<i>Big Game Hunting</i>		0.724	6.000	0.00	
<i>Small Game Hunting</i>		0.304	1.550	0.12	
Waterfowl Hunting		0.531	3.860	0.00	
Mountain Biking		1.262	5.350	0.00	
OHV		0.221	0.730	0.47	
Snorkeling		-0.418	-0.850	0.40	
Snowmobiling		-0.698	-1.670	0.10	
Swimming		-0.351	-1.080	0.28	
Water Skiing		0.429	1.670	0.10	
<i>Wildlife Viewing</i>		0.293	2.350	0.02	
General Recreation		0.331	2.580	0.01	
Beach	0.169	0.820	0.42		
Sightseeing	0.341	1.460	0.15		
Developed site	Developed	-0.312	-3.460	0.00	
Dispersed site	<i>Dispersed</i>	-0.142	-1.540	0.13	
Site change	Site Quality Change	0.320	3.690	0.00	

Site quality	High quality	-0.137	-1.600	0.11
	Mod quality	-0.468	-1.820	0.07
	Low quality	0.310	1.000	0.32
Site aggregation	National	1.635	4.320	0.00
	Multi-state	1.065	3.090	0.00
	State	1.753	5.100	0.00
	County	0.662	1.840	0.07
	Multi-county	1.091	1.890	0.06
	Multi-site	1.279	3.750	0.00
	<i>Single site</i>	1.341	4.010	0.00
Data source	Data source	-0.377	-4.000	0.00
Visitor type	Resident	-0.977	-2.160	0.03
	Non-resident	-0.490	-1.080	0.28
	Both	-0.800	-1.780	0.08
	Specialty Group	-1.335	-1.850	0.07
	Summary Stats Reported	-0.336	-4.420	0.00
Value method	Value method	-0.251	-2.630	0.01
	Regression Model			
Regression model	Reported	-0.302	-5.100	0.00
Estimate type	Compensating Variation	-0.467	-6.440	0.00
	Compensating Surplus	0.237	0.670	0.50
Favored estimate	By author	-0.132	-1.680	0.09
Value year	Value year	0.012	3.870	0.00
		-		
	Constant	19.542	-2.980	0.00
N		2256		
R-squared		0.3403		
F(60, 2195)		24.88		
Root MSE		0.8469		

The characteristics that are most germane to estimating the value of outdoor recreation in Rich county are being in the *Mountain* census division, the type of activity pursued (*Freshwater Fishing, Big Game Hunting, Small Game Hunting, and Wildlife Viewing*), the level of site aggregation (*Single Site*), *Dispersed* recreation, visited by both residents and non-residents (*Both*). All else equal, recreation in the Mountain census division has a lower value than the reference census division (Middle Atlantic region). Freshwater fishing, big and small game hunting, and wildlife viewing all have positive coefficients, indicating these activities are more highly valued than “other recreation”, the reference category (which includes all forms of motorized boating, picnicking, climbing, diving, and a host of other activities). The negative sign for dispersed recreation activities, such as those anticipated for Rich county, indicates that such sites have a lower economic value, all else equal, than recreation at sites with developed

recreational facilities. *Single-site* studies show a greater economic value than do studies which include more than one site.

The meta-regression can be used to forecast the average recreation user values for the U.S. by simply substituting the mean values for every explanatory variable in the model. Alternatively, one may estimate a value for activities specific to the Three Creeks region of Rich county by inserting independent variables values that are appropriate for that particular site. For example, the Three Creeks region is in the Mountain census division, so we set the value of Mountain equal to one, with all other census divisions equal to zero. Similarly, we assume that the Three Creeks region of Rich county will provide visitors with small game hunting opportunities, so the value for this activity can be set equal to “1” while all other recreation activity values are set equal to zero. We proceed in this fashion to substitute the appropriate explanatory value and calculate economic values for big game hunting, small game hunting, wildlife viewing, and freshwater fishing. The values appear in Table 4.1.