Economic Analysis of Management Alternatives in the Little Snake Field Office Resource Management Plan (RMP)

This document contains the analyses of the primary economic variables thought to be drivers of economic effects as the management alternatives vary. The first section below gives an overview of the methods used for analysis, which is followed by a discussion of the five economic sectors that create economic impacts from the management alternatives: non consumptive recreation use, represented by visitor days; oil and gas drilling and production; effects on agriculture, represented by changes in animal unit months (AUMs); consumptive recreation uses, which is seen in visitor days by hunters; and finally the impacts across alternatives of expenditures by the Bureau of Land Management (BLM), which is captured by variations in their budgets. The section after our methods discussion includes the presentation of the results in very abbreviated form. The subsequent sections give the logic of the economic scenarios used in the analysis, including the translation of those impacts into values and the details of the results. Several Appendices are attached as well.

Part I: Overview of Input-Output Analysis

In conducting an input-output analysis the key terms are direct, indirect and induced effects. These basic definitions and concepts will be presented here. For a full discussion of input-output multipliers see Miller and Blair (1985).

An output multiplier is the total value of production in all sectors that result from a one-unit (usually interpreted as one dollar) increase in final demand from a given sector. An example is how much of an increase in total output for the entire regional economy will result from a one-unit change in agricultural output. For example, the agricultural sector uses fertilizer to maintain its courses. If the agricultural industry grows (or contracts), it will correspondingly purchase more (or less) fertilizer. Depending on the RPC (Regional Purchase Coefficient) for fertilizer sales in the model, the industry will buy a certain percentage of their fertilizer locally. Likewise the fertilizer sales company will have to buy their inputs from somewhere and likewise down the processing chain to the quarries that mined the fertilizer minerals from the earth. A shock to the agricultural industry will therefore have a ripple effect throughout the entire regional economy, the extent to which will depend largely on how much of those backward linkages are produced and purchased locally.

To calculate an output multiplier, the change in total industry output in the economy is determined by the change in final demands from a given sector. For the sake of simplicity, we will use the example of calculating the total effect of a one-dollar change in final demand from a given industry in the larger economy. The output multiplier is simply sum of all of the changes in total industry output that result from the one-dollar increase in final demand for industry j. The difference between type one and type two multipliers used in IMPLAN are what is made endogenous (or is solved for by the model). For the type one multiplier, only inter-industry linkages are included. This means that only the direct effects of the actual change in the final demands from industry j and the indirect effects that occur from other sectors supplying industry j intermediate demands are included. The effects of the changes in employee income that come from an expansion (or contraction) of sector j are not included in the type one multiplier. Thus, the type one multiplier is defined as: Type I = (Direct effects + Indirect effects) / Direct effects.

Type two multipliers add household spending as an endogenous sector. The additional spending that occurs in the economy due to household income spurred by the expansion in any given industry is called an induced effect. The direct, indirect, and induced effects together yield a type two multiplier. It is calculated as was the type one multiplier, except that now the modified A matrix is larger and created more economic activity from that same one-dollar expansion of industry j's output. The type two multiplier is defined as: Type II = (Direct effects + Indirect effects + Induced effects). A more mathematical treatment of this model is given in Appendix I.

Part II: An Aggregated Summary of the Results of the Analysis

In this section, we summarize, in a highly aggregated form, each dimension of the economic effects for the major industries that generate economic impacts as a result of management alternatives in BLM's RMP. The oil and gas industry is presented in two categories, the drilling and extraction phases, but the details of these activities are given later. In addition, two recreation industries are analyzed, including non-consumptive watchable wildlife activities and large game hunting. At present, the latter is simply included as a placeholder and to provide rough comparisons with other sectors, as the variations across management alternatives have not been provided, and as a result, we have not processed the data from CDOW completely. Additionally, AUMs are evaluated for the cattle and sheep industries, which are the main agricultural activities found in the county. Also, as BLM administers the RMP with differing costs depending on the alternative undertaken, there is a need to review how those costs change.

The sales table on the following page provides a number of insights that follow through to the other variables present. First, the oil and gas industries are by far the largest players in the economy, accounting for up to 90% of total sales in the analysis in most alternatives. Hunting follows, with a significant effect, while the agricultural activities, BLM and other recreation are much smaller. Most of these values are relatively stable across the alternatives. As noted, hunting is not yet specified adequately, nor really is the oil and gas extraction activity, which will show more variation when we allow the number of wells drilled in the different scenarios to be affected more. The BLM expenditures are probably going to remain relatively fixed, as befits the realities of public sector budgeting.

The employment tables show a somewhat different set of outcomes. This variation comes from highly varying capital-labor ratios, where most of the expenditures by hikers and other recerators goes into food and retailing, and thus is given to firms with lots of labor and relatively little capital. The tables showing taxes and value added are more like the sales than the employment table, as oil and gas are far larger contributors, followed by hunting. The tax revenues are quite large across all alternatives, and they related sales levels to some extent. However, hunting appears to be relatively low compared to its sales values, reflecting the large part of expenditure by hunters on non-taxed services. Value added goes more to capital income in the oil and gas industries as opposed to the other industries, which have higher labor content in their activities.

Details of these results, unresolved issues and the approaches used to reflect the alternatives are all given in the next sections.

2) Impact Analysis Results on Total Sales

Categories	BLM Management Alternatives			
	A	**B**	**C**	**D**
Oil and Gas Drilling	52,735,637	73,193,863	54,255,148	43,598,692
Oil and Gas Extraction	148,643,270	148,643,270	148,643,270	148,643,270
Recreation Visitors' Days	1,114,646	1,114,646	1,210,892	1,015,047
Hunting Days	19,674,172	19,674,172	19,674,172	19,674,172
AUMs	(207,521)	917,832	(22,198)	399,454
BLM expenditures	4,005,891	4,041,228	4,060,257	4,065,872
Total Impact	226,381,137	247,585,011	227,865,937	217,396,507

1) Impact Analysis Results on Employment

Categories	BLM Management Alternatives			
	A	**B**	**C**	**D**
Oil and Gas Drilling	205	188	249	196
Oil and Gas Extraction	414	414	414	414
Recreation Visitors' Days	24	48	47	40
Hunting Days	316	316	316	316
AUMs	(4)	17	0	7
BLM expenditures	49	50	50	50.2
Total Impact	1,196	1,174	1,283	1,186

3) Impact Analysis Results on Taxes

Categories	BLM Management Alternatives			
	A	**B**	**C**	**D**
Oil and Gas Drilling	6,279,501	7,010,170	6,436,423	4,301,752
Oil and Gas Extraction	20,653,260	20,653,260	20,653,260	20,653,260
Recreation Visitors' Days	220,605	220,605	246,825	216,312
Hunting Days	519,067	519,067	519,067	519,067
AUMs	(21,485)	95,485	(2,299)	41,556
BLM expenditures	1,034,824	1,043,953	1,048,868	1,051,321
Total Impact	28,728,742	29,542,540	28,906,742	26,783,268

4) Impact Analysis Results on Total Value Added

Categories	BLM Management Alternatives			
	A	**B**	**C**	**D**
Oil and Gas Drilling	17,692,725	19,869,944	18,137,781	14,372,697
Oil and Gas Extraction	54,663,859	54,663,859	54,663,859	54,663,859
Recreation Visitors' Days	567,330	567,330	626,375	538,259
Hunting Days	8,482,615	8,482,615	8,482,615	8,482,615
AUMs	(70,115)	312,049	(7,500)	135,808
BLM expenditures	3,229,775	3,258,267	3,273,608	3,283,010
Total Impact	84,706,419	87,154,064	85,191,738	81,476,248

Part III: Scenario Development and Results for Major Economic Categories

This section contains analyses of the primary economic variables thought to be drivers of economic effects as the management alternatives vary. The five economic sectors that create economic impacts form the management alternatives are: non consumptive recreation use, represented by visitor days; oil and gas drilling and production; effects on agriculture, represented by changes in animal unit months (AUMs); consumptive recreation uses, which is seen in visitor days by hunters; and finally the impacts across alternatives of expenditures by the Bureau of Land Management (BLM), which is captured by variations in their budgets. These subsections below give the logic of the economic scenarios used in the analysis, including the translation of those impacts into values and the details of the results.

A. Economic Assessment of Recreation

Introduction to Economic Values of Recreation

Recreation is an important multiple use, and one that makes a perceptible contribution to the local economy via purchases of gasoline, lodging, supplies, etc. To quantify the county economic effects of BLM land recreation to Moffat County involves estimating visitor use and visitor expenditures. This information is then utilized in the IMPLAN input-output model to calculate the ripple or multiplier effects of this visitor expenditures on other indirect sectors of the Moffat County economy. Of course, recreation opportunities on BLM land also provide benefits to the visitors themselves. These non-market values are a monetary indicator of the contribution that BLM lands make to residents quality of life from living in this area. The non-market values also reflect the benefits received by non-residents who travel to the BLM lands in Moffat County for recreation. Due to BLM contracting delays there is insufficient data available at this time to statistically estimate the non-market values of recreation for the Draft EIS. Additional sampling is planned for the spring and should allow for statistical estimation of non market values of recreation for the Final EIS.

Below we present the recreation use estimates for the current condition and future without (Alternative A) developed using a combination of our own recreation use estimates below based on our limited sampling this summer and fall, as well as estimates for the recreation sites along the Yampa River administered by Colorado State Parks, and BLM's own recreation use estimates. The details ion the sampling approach and results are present in Appendix II. BLM staff provided the estimated change in recreation use by alternative.

Analysis of Recreation by Alternative

BLM recreation staff and BAH estimated how total recreation use and the type of recreation use (motorized versus non-motorized) would change across the four alternatives based on the management actions contained in each alternative. For example Alternative D would restrict the area available for motorized recreation use (particularly in the Sand Wash area) , and thus, overall motorized recreation use in the study area is expected to decrease by the amount indicated in Table x. BLM recreation staff also provided estimates of how much recreation use would increase by alternative. In Alternative A and B visitor use is expected to increase by 10% over each decade. In Alternative C, recreation use was expected to increase by 12%. In Alternative D, there would be a decrease in motorized use due to the seasonal restrictions on such use in the Sandwash Basin, but non-motorized recreation is expected to increase by 4%.

Table x Motorized, Non Motorized and Total Recreation Use (Visitor Days) by Alternative

	Decade One			
	Alt A	Alt B	Alt C	Alt D
Motorized	28,897	28,897	21,673	5,575
Non Motorized	7,224	7,224	14,448	22,300
Total	36,121	36,121	36,121	27,875

	Decade Two			
	Alt A	Alt B	Alt C	Alt D
Motorized	31,787	31,787	24,273	5,699
Non Motorized	7,947	7,947	16,182	22,794
Total	39,733	39,733	40,456	28,493

The direct change in regional economic effects of recreation use by alternative was calculated by taking the estimated visitor use times the expenditures of motorized and non-motorized visitors. This was the input into the IMPLAN regional economic model, to calculate the direct, indirect and induced effects on Moffat County. In the Final EIS we will also calculate and present the non market values associated with recreation by alternative.

Discussion of Recreation Impact Analysis Results. The results presented below are based on the results from "decade Two" in the above table, which was used to represent activity partly through the twenty years of the Plan. Motorized and non-motorized visitor spending creates direct sales to local businesses. This is shown in Table 1. These direct sales requires these businesses to purchase from other businesses both locally and outside the area (leakages). Current recreation use (Alternative A) by motorized users results in about $614,735 in direct sales. When the multiplier effects are included the total sales are $814,720. The multiplier is about 1.3 for recreation spending. Total sales resulting from non-motorized users is nearly $300,000, much less due to fewer non-motorized users currently and lower spending per visitor.

Table 2 shows the employment effects associated with visitor spending associated with each alternative. Currently (Alternative A) and with Alternative B, about 8 direct jobs and 11 total jobs are supported by spending from motorized recreationists. Non-motorized visitors support about 2 direct jobs and three total jobs currently. Thus there are a total of 14 jobs with these two alternatives. However, alternative D which reduces the season of use and area in Sandwash for motorized recreation to protect other multiple use resources, reduces employment related to motorized recreation but increases jobs associated with non motorized recreation. The total jobs in Alternative D are 10, a drop from 14 jobs currently supported.

Table 3 presents the taxes being generated from motorized and non-motorized recreation. Currently (Alternative A) and with Alternative B, about $155,500 in taxes are generated from motorized recreation and $65,000 from non motorized recreation, for a total of more than $220,000 in taxes from recreation. As with employment, the mix of taxes paid by motorized and non-motorized visitors changes by alternatives, but remains relatively stable above $200,000 for all alternatives including Alternative D.

Table 4 provides the estimates of local value added, which is the amount of money that takes the form of wages and business income in the county. This is currently over a half million dollars annually, and it increases with Alternative C to more than $600,000.

Table 1: Impact analysis results on Total Sales

Categories	BLM Management Alternatives			
	A	B	C	D
Visitors' Days Motorized				
Direct Impact	$614,735	$614,735	$461,051	$115,263
Total Impact	$814,720	$814,720	$611,040	$152,760
Visitors' Days Non Motorized				
Direct Impact	$217,500	$217,500	$435,000	$625,312
Total Impact	$299,926	$299,926	$599,852	$862,287
Total Sales to Recreation	$1,114,646	$1,114,646	$1,210,892	$1,015,047

Table 2: Impact analysis results on Employment

Categories	BLM Management Alternatives			
	A	B	C	D
Visitors' Days Motorized				
Direct Impact	8	8	6	2
Total Impact	11	11	8	2
Visitors' Days Non Motorized				
Direct Impact	2	2	4	5
Total Impact	3	3	5	8

Table 3: Impact analysis results on Taxes

Categories	BLM Management Alternatives			
	A	B	C	D
Visitors' Days Motorized				
Employee Taxes	$25,132	$25,132	$18,849	$4,712
Corporate Taxes	$7,348	$7,348	$5,511	$1,378
Household/sales	$77,795	$77,795	$58,346	$14,587
Indirect Business Taxes	$45,232	$45,232	$33,924	$8,481
Total Impact	$155,508	$155,508	$116,631	$29,158
Visitors' Days Non Motorized				
Employee Taxes	$8,251	$8,251	$16,503	$23,723
Corporate Taxes	$3,382	$3,382	$6,765	$9,725
Household/sales	$29,398	$29,398	$58,796	$84,519
Indirect Business Taxes	$24,065	$24,065	$48,131	$69,188
Total Impact	$65,097	$65,097	$130,194	$187,154
Total Taxes from Visitors	$220,605	$220,605	$246,825	$216,312

Table 4: Impact analysis results on Total Value Added

Categories	BLM Management Alternatives			
	A	B	C	D
Visitors' Days Motorized				
Direct Impact	$285,981	$285,981	$214,486	$53,621
Total Impact	$406,629	$406,629	$304,972	$76,243
Visitors' Days Non Motorized				
Direct Impact	$114,420	$114,420	$228,840	$328,958
Total Impact	$160,701	$160,701	$321,403	$462,016
Total Value Added	$567,330	$567,330	$626,375	$538,259

B Analysis of Oil and Natural Gas Activity in Moffat County

The oil and gas industries consist of two primary sectors, the first being drilling wells, which will produce natural gas, oil, or both. Then there is the extraction activity, which occurs after the well has been drilled and the economic value of the well has been determined. Oil wells are drilled in two phases, first the dry hole, or production phase, while the second is the completion stage, which is only undertaken if there is the possibility of adequate volumes of hydrocarbons. We constructed two sectors to comprise the industry, drilling and, secondly, extraction and distribution. The drilling sector sells their output, a drilled well, to the second sector, which then extracts oil and natural gas from the ground under the well. As our model is just for one year, the sale of a drilled well is represented by its "amortized" value to the extraction sector, assuming that the well lasts thirty years and the discount rate is 6 percent.

If a well appears to be economic, the second completion stage is added to make it conditioned for producing. In this case, the cost is about $1.233 million dollars for the production stage, while the total costs for adding the completion stage is $.818 million. The estimated prevalence of "dry" holes, which do not undergo the completion stage, is expected to be 20% of wells drilled over the life of the Plan. (Conrath, RFD, 2004).

The number of producing wells in LSFO during 2003 was 881, which includes some wells that reach back many years. In total there were 2,112 wells in stock, some of which were over sixty years old. The production of oil in 2003 was 419 barrels and 2116 MCF of natural gas. There were just 29 new wells drilled in 2002 and 59 in 2003. To get the average output value for each well, we used the prices from the RFD for 2002 at about $28 per barrel of oil and $3.80 per million cubic feet (MCF) natural gas. These led to the average sales per well of $92,160 per well during 2002, which was comprised of $80,422 sales of natural gas and $11,738 sales of oil, making the typical a gas well, with far greater income from sales of natural gas.

In the next section, we present the approach used to determine the economic value of the increased oil and gas activity during the RMP time frame and also some issues in the analysis to this point.

Determination of the Simulation Values. We need to forecast the increase in oil and gas activity throughout the life of the plan (20 years), and look at the impacts of various restrictions. These are summarized well in the EPCA Table on the following page, which shows the amount for acreage available (or not) under various designations, including those related to seasonal restrictions and others related to stipulations on surface occupancy. An inspection of the table shows that the acreage and estimated amounts of natural gas and oil are reported for each designation and management alternative. This provides a framework, when given assumptions, that can be used to determine the number of wells to be drilled and their associated costs. The general approach follows: We assume that there will be an average of 151 wells drilled per year to meet the target in

EPCA				
Designation	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
Open Subject to Standard Lease Term and Conditions	Area (Acres): 640,600 Total Liquids (Thousands of Barrels [MMBbl]): 88,340 Total Natural Gas (Millions of Cubic Feet [cf]): 3,137,054	Area: 1,601,190 Total Liquids [MMBbl]: 270,601 Total Natural Gas [Bcf]: 9,251,066	Area: 520,230 Total Liquids [MMBbl]: 85,657 Total Natural Gas [Bcf]: 3,072,976	Area: 413,210 Total Liquids [MMBbl]: 54,191 Total Natural Gas [Bcf]: 1,776,737
Open Subject to Controlled Surface Use	Area: 129,730 Total Liquids [MMBbl]: 15,471 Total Natural Gas [Bcf]: 541,104	Area: 154,150 Total Liquids [MMBbl]: 15,327 Total Natural Gas [Bcf]: 617,783	Area: 157,980 Total Liquids [MMBbl]: 20,700 Total Natural Gas [Bcf]: 731,075	Area: 110,300 Total Liquids [MMBbl]: 5,035 Total Natural Gas [Bcf]: 103,513
Cumulative Timing Stipulations <3 Months	Area: 12,730 Total Liquids [MMBbl]: 923 Total Natural Gas[Bcf]: 22,334	Area: 0 Total Liquids [MMBbl]: 0 Total Natural Gas [Bcf]: 0	Area: 13,390 Total Liquids [MMBbl]: 923 Total Natural Gas [Bcf]: 22,334	Area: 12,960 Total Liquids [MMBbl]: 923 Total Natural Gas [Bcf]: 22,334
Cumulative Timing Stipulations 3-6 Months	Area: 272,830 Total Liquids [MMBbl]: 76,825 Total Natural Gas [Bcf]: 3,003,491	Area: 146,240 Total Liquids [MMBbl]: 4,070 Total Natural Gas [Bcf]: 45,279	Area: 319,110 Total Liquids [MMBbl]: 72,861 Total Natural Gas [Bcf]: 2,830,024	Area: 319,950 Total Liquids [MMBbl]: 73,960 Total Natural Gas [Bcf]: 2,876,020

Designation	Alternative A	Alternative B	Alternative C	Alternative D
Cumulative Timing Stipulations 6-9 Months	Area: 843,490 Total Liquids [MMBbl]: 107,556 Total Natural Gas [Bcf]: 3,214,654	Area: 4,100 Total Liquids [MMBbl]: 1,327 Total Natural Gas [Bcf]: 50,395	Area: 862,850 Total Liquids [MMBbl]: 110,768 Total Natural Gas [Bcf]: 3,351,191	Area: 849,960 Total Liquids [MMBbl]: 107,438 Total Natural Gas [Bcf]: 3,209,966
Cumulative Timing Stipulations >9 Months	Area: 28,970 Total Liquids [MMBbl]: 9,391 Total Natural Gas [Bcf]: 389,736	Area: 0 Total Liquids [MMBbl]: 0 Total Natural Gas [Bcf]: 0	Area: 2,210 Total Liquids [MMBbl]: 455 Total Natural Gas [Bcf]: 14,696	Area: 29,300 Total Liquids [MMBbl]: 9,509 Total Natural Gas [Bcf]: 394,424
Open Subject to No Surface Occupancy	Area: 217,020 Total Liquids [MMBbl]: 17,744 Total Natural Gas [Bcf]: 420,792	Area: 22,440 Total Liquids [MMBbl]: 1,525 Total Natural Gas [Bcf]: 27,889	Area: 267,840 Total Liquids [MMBbl]: 23,985 Total Natural Gas [Bcf]: 591,023	Area: 500,510 Total Liquids [MMBbl]: 97,201 Total Natural Gas [Bcf]: 3,583,136
Closed to leasing	Area: 78,230 Total Liquids [MMBbl]: 68 Total Natural Gas [Bcf]: 273	Area: 78,230 Total Liquids [MMBbl]: 68 Total Natural Gas [Bcf]: 273	Area: 189,220 Total Liquids [MMBbl]: 2,495 Total Natural Gas [Bcf]: 80,792	Area: 272,850 Total Liquids [MMBbl]: 17,214 Total Natural Gas [Bcf]: 613,075

the RFD of 3031 wells put in place during the twenty-year period of the plan. We will further assume that all the 151 wells will be drilled in each of alternatives A, B, and C, but in alternative D, restrictions on acreage use lead to a decline in the number of wells by 25%, so that just 113 wells being drilled. The immediate question is how to determine where these wells will be drilled and how much they will cost. The general answer is to assume that the companies will target areas where they can get the greatest amount of natural gas (as gas is about three times more prevalent as oil in Moffat), so the wells would likely be placed in the designated areas following the relative proportions of total availability of gas in each area. Several of the designations require special attention or can be merged with others. First, the acreage facing cumulative timing stipulations of less than three months (Row 3 in the EPCA table) is merged with the open lease designation, as there is little acreage in that category and also only a small amount of gas to be found. Thus, we assume that these restrictions can be averted with no cost and this group can be added to the first category for determination of well distribution. Likewise, designations with stipulations greater than nine months are quite restrictive, so much so that it appears best to make that small amount of acreage and possible gas recovery added to the "closed to leasing" section.

This leaves five categories of stipulations that will likely lead to varying drilling costs. We review each of them as they occur in the table. The first is the open lease with standard terms, which are modeled as the "base", for which cost characteristics are reported below. The leases, which are open but with surface control will be modeled by increasing construction costs by 20% as most of these stipulations require some kind of adjustment in location, land preparation or reclamation. Because this cuts into the income to the proprietor or returns to capital, we reduce those categories in the budget to offset the increase in the cost of construction during drilling. BLM has argued that the horizontal and directional drilling required in the NSO areas would increase costs by 36%. We tried to follow the same line of argument as used above in the areas open but subject to controls, , but there were insufficient returns to capital and proprietor's income to be taken away, so we had to increase sales to make these budgets balance and have costs all covered by sales.

The seasonal restrictions have been more problematic. It is clear that if firms are restricted to drilling during a short period, in the aggregate there needs to be more drilling rigs and crews available to meet that demand. In general, it takes about 20 days to drill a well with a team of 7-10 workers, including professional and overhead staff. One crew can then drill about 16-17 wells per year at a maximum. This means that it takes ten crews to do the 151 wells assumed in this analysis. For the first seasonal designation, we assume that the restrictions are about 4.5 months, the mid point of the 3-6 month range. This implies that the increases in labor and rigs needed would be about 35%. There is the additional impact of being unable to drill and provide gas at the time at which the price is the highest, during the winter months (Cameron, 2005). This would add further penalties and will be included when we have adapted the methods to be more responsive in its qa response in the later steps. Additionally, this is really a shift of output from one year to the next, so the actual cost is the shifting back for one year of the revenues and the opportunity cost of that shift. It cannot be a "full" loss, but these are aspects that still need refinement in the next few weeks. We will use the same approach for the seasonal restriction of 6-9 months, which will lead to increased costs of 60% in selected areas of costs (construction, drilling expenses, finance, and labor).

This approach gives the somewhat perverse outcome that higher costs create more demand and higher economic activity. While this is often seen to be the case in natural disasters, as money flows into the economy to rebuild, we generally think of higher costs as inducing a reduction in the profitability and therefore amount to be produced. There will still be some drilling, as there is a speculative nature to the decision to put in a well that might last for over sixty years, but we would really expect that, other things being equal, that higher costs would reduce drilling by a factor that is often summarized in economics as an "elasticity" of input use to qa supplied. We will review the economics literature over the next few weeks to determine reasonable values, and perhaps cut drilling in response to the reactions seen in previous studies.

Table x: Hypothesized Distributions of Wells Drilled by Alternative and Designation

	Alternative			
Designation	Alt A	Alt B	Alt C	Alt D
Open Lease	44	140	44	16
Open subject Surface control	8	9	10	1
3-6 month seasonal limits	42	1	40	26
6-9 month seasonal limits	45	1	47	29
No Surface Occupancy	6	0	8	32
No Leasing	5	0	1	9
Total Wells Drilled per year	151	151	151	113

In table x above, we show how the wells might be distributed under each alternative and according to the designations reported in the earlier EPCA table. Because each alternative differs with regard to the acreage placed in the various designations, the amounts of natural gas in the mineral estate below the acreage varies as well. We assume that companies will drill where there is the greatest likelihood of obtaining natural gas, regardless of where the designation that the reserves would fall. (This will vary according to the various changes in costs imposed, as discussed in the paragraph above). Thus, in Alternative A, about 29% of the total natural gas is found in areas which are open to leasing under standard terms, which leads to 44 of 151 wells being drilled in a typical year in those areas. In Alt B, where far more land is open without restriction for almost all of the acreage and natural gas underneath, nearly all wells (140) can be drilled in these areas and few are drilled in areas with any other designation There is in fact little area contained in these other designations. In Alternative D, there are far more restrictions, so oil companies are faced with drilling in higher cost designations more often, and indeed, it is assumed they will not choose to drill as many wells, so the total drops to 113.

As noted, all three alternatives anticipate that all 151 wells will be drilled; however, the proportionality leads to putting some wells in areas where there is No Leasing, and this in effect has a slight variation already imposed in the number of wells drilled across alternatives. This is far from satisfactory, but as indicated above, we can do this more systematically based on values from the literature regarding elasticities. There will be increased economic activity from higher expenditures of firms as they drill but, at the same time, there will be fewer wells drilled as the costs are higher and profits lower. The balance between these two factors will be based on the size of the elasticities and the extent of the increases in costs.

Estimated Budgets for Drilling and Extraction. The budgets in the following table tables are taken from an AFE (Authority for Expenditures) provided from industry sources and converted into the IMPLAN sectoring scheme to some up with the costs of drilling each well. The extraction budget was taken form IMPLAN for the time being, as it appeared to be reasonable. Only the extraction levels were increased to match known values from the RFD and conversations with Fred Conrath of the BLM.

The key assumptions used in creating the drilling budget are presented below. First, we used a representative AFE (Authority for Expenditure) for 8500 feet, which came from the Peance Basin (?), not identical but similar to the Cretaceous Seas that formed deposits in Moffat County. The costs were converted from this AFE into our 28 sector grouping for IMPLAN for two categories, the Dry hole phase, which is required for all wells, and the completion phase, which is only undertaken when there is enough evidence that there will be sufficient resources found. After the completion drilling is finished, there is the ongoing servicing and extraction of hydrocarbons from the wells. The former stages are clearly marked out in the AFEs, and it is just a matter of making assumptions about where to put various categories. The structure of the budgets is such that the extraction phase "purchases" a competed well from the drilling phase, but it is just an amortized portion that is charged to a given year. We further assume that these costs reflect the "base" costs of drilling without any restrictions.

None of the costs to wildlife habitat are included here or any other possible decline in the visual resource or other environmental issues. These will be reflected later if there are agreeable ways to do so.

Moffat, Estimated Gas Drilling, Completion and Extraction Budgets

individual well, in Dollars

	Dry Hole	Completion	Extraction
Sales/Production Per well	1,233,431	817,921	92,146
Costs by Sector:			
crop			23
pasture			
cattle			
other animal			
other agriculture			
coal	82,500		
power			34
water	51,490		931
heavy construction	162,735	27,500	34
oil gas drilling	424,200	308,000	68
Oil gas extraction			32,770
manufacturing	220,426	363,546	9,194
wholesale trade		-	3,224
transport	3,500	38,120	2,497
retailing		-	4,461
food/bev retailing		-	57
communication		-	11
Finance Insurance Real Estate		-	454
professional services		-	1,146
health		-	8,070
recreation		-	-
outfitters		-	45
hotels		-	-
food services		-	68
other services	5,000	-	114
government		-	488
		-	57
			63,746
Employee Compensation	153,000	31,250	9,858
protyrt incomer	110,580	28,505	8,919
Proprietor Income	20,000	21,000	6,034
Business Taxes		-	3,589
Total Costs	1,233,431	817,921	92,146

Results of oil and gas simulations.

The following tables show the results of the oil and gas simulations as they stand at present. The presentation summarizes the costs of drilling across all designations and numbers of wells drilled in each designation to avoid excessive detail by designation, especially until we are sure of the methods we want to use. The second part of the presentation is the ongoing extraction phase. This analysis is placed after ten years in the plan, where there have been 1,510 wells drilled; however, with 20 percent dry holes, the number of new producing wells is 1208. This is a large contribution to the economy, but note that it does **not** vary across alternative. The stipulations affect costs of drilling, but much less so in extraction (we think, although there may be increased pumping and distribution charges). Once the wells are drilled, most impacts from BLM stipulations are finished, while the large extraction stream endures for many years. Thus, we have not altered the extraction impacts across the alternatives. At a later point, we will reflect the relative amount of drilling in that there may be fewer than 1208 wells in existence due to restrictions and lower drilling rates.

The results are contained in Tables x-y on the next page. It is clear that the sales values of drilling 151 or so wells each year are high, as the values range from $31 to $50 million. The reasons that these vary related to the number of wells not drilled (as in Alt D) or having more wells in designations with higher costs (and therefore sales). ("Sales" is this sense is really the value of the wells transferred into the extraction phase) The multipliers are about 1.43, which are reasonable given the type of industry and small geographical area considered. The extraction phase is based on 1,208 wells, but does not vary across alternative. The phase has much high sales values. The employment values are also quite high, and they come mainly from indirect and induced effects. These are derived from the purchases of inputs by drilling and extraction industries and the added expenditures of laborers and households. Nonetheless, these appear quite high, so we will have to review assumptions made in IMPLAN before inflaing these numbers. (The employment multiplier of the Extraction phase, at 4.93, is very high and questionable.)

The tax revenues drilling and extraction run over $26 million for many scenarios, although this is not all locally retained. In both the production and extraction phases, half of the tax revenues come from sales and household sources, which is consistent with the large induced effects in these simulations. Interestingly, the drilling phase yields more tax revenue, although it is probably more variable. Value added, which is the contributor to labor payments and capital income in the locality, is more stable than sales. Thus , this more important measure is similar across all alternatives except D, at this point.

As noted through the text, there are things to be improved over the next month. First, there should be responses in the number of wells drilled related to the profitability of drilling a well. Secondly, we need to review all data with industry sources to make sure of its accuracy and applicability. Thirdly, handing seasonal restrictions is probably the most complex part of the analysis, for which we need to review and present a more complete methodology. Finally, we need to see if there are ways to incorporate environmental costs and implications to this analysis.

Impact analysis results on Total Sales

Categories	BLM Management Alternatives			
	A	B	C	D
Oil and Gas Drilling				
Direct Impact	36,657,335	51,406,864	37,669,520	30,896,902
Indirect Impact	9,943,862	14,861,365	10,298,691	7,785,645
Induced Impact	6,134,439	6,925,634	6,286,937	4,916,146
Total Impact	52,735,637	73,193,863	54,255,148	43,598,692
Oil and Gas Extraction				
Direct Impact	111,327,936	111,327,936	111,327,936	111,327,936
Indirect Impact	21,772,839	21,772,839	21,772,839	21,772,839
Induced Impact	15,542,496	15,542,496	15,542,496	15,542,496
Total Impact	148,643,270	148,643,270	148,643,270	148,643,270

Impact analysis results on Employment

Categories	BLM Management Alternatives			
	A	B	C	D
Oil and Gas Drilling				
Direct Impact	76	21	98	64
Indirect Impact	60	78	69	68
Induced Impact	69	89	81	63
Total Impact	205	188	249	196
Oil and Gas Extraction				
Direct Impact	84	84	84	84
Indirect Impact	130	130	130	130
Induced Impact	200	200	200	200
Total Impact	414	414	414	414

Impact analysis results on Taxes

Categories	BLM Management Alternatives			
	A	B	C	D
Oil and Gas Drilling				
Employee Taxes	3,033,396	3,216,525	3,054,492	2,544,728
Corporate Taxes	1,944,961	2,021,222	1,954,163	2,202,976
Household/sales	14,165,273	14,930,077	14,253,061	11,907,249
Indirect Business Taxes	7,387,555	7,495,605	7,407,271	7,655,041
Total Impact	26,531,184	27,663,430	26,668,984	22,845,778
Oil and Gas Extraction				
Employee Taxes	2,176,221	2,176,221	2,176,221	2,176,221
Corporate Taxes	1,540,534	1,540,534	1,540,534	1,540,534
Household/sales	10,403,149	10,403,149	10,403,149	10,403,149
Indirect Business Taxes	6,533,356	6,533,356	6,533,356	6,533,356
Total Impact	20,653,260	20,653,260	20,653,260	20,653,260

Impact analysis results on Total Value Added

Categories	BLM Management Alternatives			
	A	B	C	D
Oil and Gas Drilling				
Direct Impact	9,399,734	9,495,440	9,605,412	7,401,451
Indirect Impact	4,413,928	5,995,585	4,556,835	3,860,891
Induced Impact	3,879,063	4,378,918	3,975,534	3,110,355
Total Impact	17,692,725	19,869,945	18,137,781	14,372,698
Oil and Gas Extraction				
Direct Impact	34,308,012	34,308,012	34,308,012	34,308,012
Indirect Impact	10,520,784	10,520,784	10,520,784	10,520,784
Induced Impact	9,835,061	9,835,061	9,835,061	9,835,061
Total Impact	54,663,859	54,663,859	54,663,859	54,663,859

C. Impacts on Agriculture

Approach

Cattle and sheep ranching are among the most traditional and most important economic activities in the Little Snake region. Based on the most recent agricultural census (2002) Moffat County had approximately 443 farms and ranches on more than 1 million acres of private land. Moffat County had approximately 32 thousand cattle and calves on 184 ranches (173 per operation) and 86 thousand sheep on 51 ranches (1,692 per operation) based on January 1, 2005 inventories, and about 45,000 acres of hay ground in 2004. Moffat County's sales of sheep, beef cattle and calves reached more than $19 million in 2002 (CASS, 2005).

A majority of the potentially affected private lands are held in ranching. In this region ranching and public land management are strongly linked through grazing rights. Rights to graze on public lands increase the capacity and profitability of ranch activities on private lands. Without grazing rights on public lands, ranchers would be forced to feed cattle and/or sheep on grown or purchased hay, presumably at a higher cost to the ranching operation. As a result, a loss of grazing rights on public lands will reduce the profitability of ranches in the Little Snake and may make them unprofitable, inducing a decision to sell the property. If the property is not profitable in extensively managed animal agriculture, it is likely that it will used to grow hay or leased as pasture to remaining ranchers, be sold into rural residential use or, potentially, rural recreational use (e.g., ATV) for a relative few parcels.

Alternatively, an increase in available AUMs is likely to increase profitability of farms and ranches through reduced need for the private (owned or leased) pasture and purchased hay. However, increases in AUMs available are not likely to lead to the conversion of private land out of pasture or hay acreage, as the likely impact will be to increase herd size in proportion to available AUMs. Nor is it likely that the economic incentives created by increases in available AUMs will be sufficient to induce the conversion of land from recreational or residential uses to extensive sheep or cattle operations.

Further, providing outfitter services for hunting tourism is an important source of supplementary income for ranchers in the Little Snake region. Outfitter services are considered part of the ranching operation and are included in the decision to operate the property as a ranch. However, off farm income is not considered part of the ranching operations, although it may be an important part of household income and may serve to defer the decision to sell unprofitable ranch operations. The logic of this distinction is that off farm income can continue regardless of the use of the rural property. However, rural residential development of ranch properties would probably, but not necessarily, prevent outfitter activities. Many nonconsumptive rural tourism services (guiding for wildlife watching and photography), currently of minor economic significance, would probably still be possible under rural residential development, depending on its density, but probably not under typical forms of rural recreational use.

Based upon discussions with ranchers in the Little Snake region, we planned to consider ranches in two acreage-based types: 'small' and relatively independent of grazing rights on public lands and 'large' and relatively dependent upon grazing rights. Both types of ranches can have supplementary income from hunter outfitter services. However, we were unable to collect adequate information from local stakeholders to confidently differentiate between the two likely private acreage-based ranch types. As a result, our analysis proceeds to trace the potential effects of Alternatives A-D on two species-based ranch types, sheep and beef cattle, but it is not further stratified into size categories.

If one or more of the land management alternatives were to result in a loss of available AUMs, we would need to consider three possible actions on the part of affected ranchers: 1) substitute AUMs for more or less locally purchased or grown hay; 2) reduce or increase ranching activity by the amount implied by the AUMs lost; and 3) go out of business entirely, in which case the land is considered to become economically idle. Under Scenario 3, we could, then, increase the number of acres in rural residential development or rural recreational use as the logical alternative uses for idled ranch acres.

Since the estimated changes in AUMs do not appear to be either huge windfall gains or catastrophic losses from a regional perspective, we chose to provide formal estimates only for scenario #2. This scenario is estimated for sheep and beef cattle ranches. Scenario 1 would have generated a more conservative estimate of the economic impact of the increase or decrease in available AUMs, while Scenario 2 will create an upper bound estimate on the likely impact of increased or decreased AUMs. These direct impacts are then considered in terms of their indirect and induced economic effects in order to derive a total impact of the reduction in public lands grazing rights on the Routt, Moffat and Little Snake regional economies by alternative. The budgets for cattle and sheep ranching found below provide the basis for the regional impact analysis (Tables 1 and 2). The results are provided in terms of jobs, income and local value-added.

Estimates of AUM impacts of Alternatives A-D

According to the NRCS Range and Pasture Handbook, 1 AUM is equivalent to 790 lbs of dried forage per month, 1 cow-calf pair, or 5 sheep. One dry cow is equivalent to 727 lbs of dried forage or 0.92 AUM. The current total permitted use is 149,503 AUMs, based on RAS Public Land Statistics for Billing Year 2005, and is the maximum allowable use regardless of scenario. Approximately, 78,963 AUMs constitute the baseline "actual use," derived from the mean of "Billed AUMs" from 1994 to 2003. The difference between the actual use and the permitted use is to be designated for wildlife forage and watershed protect and will vary by land management alternative.

The BLM has estimated that Alternative A will result in an estimated net loss of 4,172 AUM actual (and permitted) use from the 76,963 AUM baseline, or an estimated actual use of 72,791 AUM (Table 3). The estimated reduction is entirely due to new development associated with oil and gas. Alternative B will result in an estimated 22,043 increase in AUMs due to livestock decisions (e.g., vegetative conversion) and the same decrease in actual use due to development found in Alternative A. Alternative B results in an estimated net gain of 17,871 AUMs to 94,834 AUM actual use. Alternative C results in an estimated net loss of 446 AUM in actual use, comprised of an increase in 3,726 AUMs due to livestock decisions and a development driven decrease equivalent to Alternatives A and B. As a result, Alternative C should imply 76,517 AUM of actual use. Alternative D creates an estimated net gain of 10,906 AUM and an actual use of 84,740 AUM. This change is driven by a 10,906 AUM gain due to anticipated livestock management changes and a –3,129 AUM loss due to development. The loss due to development for Alternative D is 25% lower than in Alternatives A, B and C because of large areas NSO and closed to development.

For the four alternatives under examination there is an estimated difference of just over 22,000 AUM between the 'best' scenario from an AUM perspective (Alternative B) and the 'worst' scenario (Alternative A), representing an approximately 20% swing in actual AUM use in the region. This represents a variation of approximately 1,833 cattle and calves or 4,400 sheep in the region or about 5-6% of the current stock of livestock.

In 2005 there were 54,011 actual AUMs used for cattle in the region, leaving 22,952 in sheep. That is, 70% of the AUMs were used for beef cattle production and 30% for sheep production. If we assume that increases or decreases in AUMs will affect each part of the livestock industry proportionately to their traditional use, we can predict the number of AUMs and changes in livestock numbers resulting from the four alternatives. These estimates are found in Table 4. We estimate that Alternative A will result in a decrease of 244 cattle and 49 sheep due to the reduction in available AUMs. Similarly, we predict Alternative B will result in an increase of 1,045 cattle and 209 sheep, Alternative C a loss of 26 cattle and 5 sheep, and Alternative D an increase of 454 cattle and 91 sheep, approximately. Of course, this assumes that other economic factors that might vary between the two sub-industries remain relatively similar to current conditions.

Table 1: Moffat Cattle Budget, 2002

	Average for Herd Dollars	Per Cow Dollars	Industry	Percent of total sales
Industry Sales	307,800	513.0	12,908,619	100.00
Costs by Sector:				
Crop	4,654	7.8	195,199	1.51
Pasture	116,268	193.8	4,876,094	37.77
Cattle	32,151	53.6	1,348,361	10.45
Sheep and Lambs	0	0.0	-	-
other agriculture	0	0.0	-	-
Coal	15,068	25.1	631,923	4.90
Power	0	0.0	-	-
Water	0	0.0	-	-
heavy construction	0	0.0	-	-
oil gas	9,916	16.5	415,860	3.22
Manufacturing	16,392	27.3	687,441	5.33
wholesale trade	0	0.0	-	-
Transport	0	0.0	-	-
Retailing	0	0.0	-	-
food/bev retaling	0	0.0	-	-
communication	0	0.0	-	-
FIRE	8,651	14.4	362,816	2.81
professional services	10,000	16.7	419,396	3.25
health	0	0.0	-	-
recreation	0	0.0	-	-
outfitters	0	0.0	-	-
hotels	0	0.0	-	-
food services	0	0.0	-	-
auto	0	0.0	-	-
other services	20,195	33.7	846,925	6.56
miscellaneous	0	0.0	-	-
government	0	0.0	-	-
Subtotal	233,295	388.8	9,784,015	75.79
Value Added:				
Employee Compensation	26,687	44.5	1,119,214	8.67
Proprietary Income	17,395	29.0	729,522	5.65
Other Property Income	24,706	41.2	1,036,113	8.03
Indirect Business Tax	5,717	9.5	239,756	1.86
Value Added	74,505	124.2	3,124,604	24.21

Based on an average of 600 Head per herd

Table 2: Sheep Budget for 465 Head Operation, 2002

	Average for Herd Dollars	Per Sheep Dollars	Industry	Percent of total sales
Industry Sales	24,296	52.25	3,742,695.09	100.00
Costs by Sector:				
Crop	2,233	4.80	343,969.32	9.19
pasture	4,970	10.69	765,647.32	20.46
Cattle	-	-	-	-
Sheep and Lambs	360	0.77	55,439.06	1.48
other agriculture	-	-	-	-
coal	-	-	-	-
power	54	0.12	8,315.86	0.22
water	54	0.12	8,315.86	0.22
heavy construction	-	-	-	-
oil gas	54	0.12	8,315.86	0.22
manufacturing	2,168	4.66	333,942.50	8.92
wholesale trade	-	-	-	-
transport	1,264	2.72	194,716.15	5.20
retailing	-	-	-	-
food/bev retaling	-	-	-	-
communication	527	1.13	81,131.68	2.17
FIRE	205	0.44	31,600.27	0.84
professional services	-	-	-	-
health	1,161	2.50	178,768.80	4.78
recreation	-	-	-	-
outfitters	-	-	-	-
hotels	-	-	-	-
food services	-	-	-	-
auto	-	-	-	-
other services	1,780	3.83	274,223.47	7.33
miscellaneous	90	0.19	13,859.77	0.37
government	-	-	-	-
Subtotal	14,919	32.08	2,298,245.92	61.41
	-	-	-	-
	-	-	-	-
Value Added:	-	-	-	-
Employee Compensation	1,028	2.21	158,330.27	4.23
Proprietary Income	4,229	9.09	651,470.58	17.41
Other Property Income	3,608	7.76	555,745.80	14.85
Indirect Business Tax	512	1.10	78,902.53	2.11
Value Added	9,377	20.17	1,444,449.17	38.59

Table 3: Estimated actual AUM change due to land management alternatives

Alternative	Estimated actual AUM change due to: Livestock management (AUM)	Development (AUM)	Net gains/losses (AUM)	Predicted actual AUM
A	0	-4,172	-4172	72,791
B	22,043	-4,172	17,871	94,834
C	3,726	-4,172	-446	76,517
D	10,906	-3,129	7,777	84,740

Table 4: Predicted change in beef cattle and sheep AUM actual use, by alternative

Alt.	Predicted actual AUMs	Predicted actual beef AUMs	Predicted actual sheep AUMs	Predicted increase/decrease in beef cattle	Predicted increase/decrease in sheep
A	72,791	51,083.18	21,707.82	(243.99)	(48.80)
B	94,834	66,552.49	28,281.51	1,045.12	209.02
C	76,517	53,698.01	22,818.99	(26.08)	(5.22)
D	84,740	59,468.73	25,271.27	454.81	90.96

Estimates of economic impacts of Alternatives A-D

Tables 5-8 illustrate the estimated impacts of Alternatives A-D on employment (Table 5), total sales (Table 6), total value added (Table 7), and local taxes (Table 8) in the Little Snake management region.

Neither the beef cattle nor the sheep ranching industries are particularly labor intensive. As a result, there would need to be a relatively sizeable impact on the livestock industry to result in substantial job loss. On the other hand, the number of private land acres represented by each job in the livestock industry is large. The predicted employment impacts range from a gain of 16 in Alternative B to a loss of 4 in Alternative A. Alternative C does not generate sufficient losses in the beef industry to reduce jobs within the sector and Alternative D results in a 7 job increase in the economy. For every three direct jobs gained or lost, one indirect job (e.g., veterinarian or legal services), serving the cattle industry is gained or lost. The employment impacts across sheep operations are trivial with only scenario B resulting in one full direct job lost (Table 5).

The impact of the four alternatives on total sales is more easily grasped. Alternative A results in a total regional loss of beef industry sales of $210,914, while Alternative B results in a $903,300 increase in sales, illustrating the two bounding cases. Alternative D results in a predicted gain of $393,130 in beef industry related sales, while Alternative C results in a predicted loss of $22,561 in regional sales. Again, the impacts in the sheep industry are more modest with Alternative A resulting in a loss of 3,393 in total regional sheep industry sales and Alternative B resulting in a $14,532 increase. The sales multiplier in the beef cattle industry generates about $0.69 in additional indirect and induced economic activity for every $1 of sales, while each dollar of sheep sales generates about $0.33 in additional regional economic activity. Value added impacts show about 1/3 the impacts on total sales across both industry subsectors. Within the beef cattle industry, the impact is focused on indirect effects, where any animal processing or value-added products would be found.

Tax revenues change with changes in cattle and sheep industry economic activity. Employee income, business and personal sales tax collections will be affected locally. The effect on household sales taxes constituted about ½ of the total estimated tax revenue impact, while three categories of personal or business income taxes made up the other half. The predicted reduction of Alterative A on region tax collections due to changes in the beef cattle industry is $21,890 per year, while Alternative B is predicted to increase tax collections by almost $94 thousand per year. Alternative D increases taxes collected by about $41 thousand, while Alternative C should result in an increase of about $2,300 per year. Taxes impacts driven by changes in the sheep industry are again more modest, ranging from a $1,733 gain from Alternative B to a $405 loss from Alternative A.

Table 5: Impact analysis results on Employment

Categories	BLM Management Alternatives			
	A	B	C	D
Cattle AUMs				
Direct Impact	(3)	12	0	5
Indirect Impact	(1)	4	0	2
Induced Impact	(0)	1	-	0
Total Impact	(4)	16	0	7
Sheep AUMs				
Direct Impact	(0)	1	-	0
Indirect Impact	-	-	-	-
Induced Impact	-	-	-	-
Total Impact	(0)	1	-	0

Table 6: Impact analysis results on Total Sales

Categories	BLM Management Alternatives			
	A	B	C	D
Cattle AUMs				
Direct Impact	(125,163)	536,046	(13,388)	233,296
Indirect Impact	(69,130)	296,070	(7,395)	128,854
Induced Impact	(16,621)	71,183	(1,778)	30,980
Total Impact	(210,914)	903,300	(22,561)	393,130
Sheep AUMs				
Direct Impact	(2,549)	10,919	(273)	4,752
Indirect Impact	(518)	2,220	(55)	966
Induced Impact	(325)	1,392	(35)	606
Total Impact	(3,393)	14,532	(363)	6,324

Table 7: Impact analysis results on Total Value Added

Categories	BLM Management Alternatives			
	A	B	C	D
Cattle AUMs				
Direct Impact	(29,158)	124,875	(3,119)	54,348
Indirect Impact	(31,822)	136,287	(3,404)	59,314
Induced Impact	(10,509)	45,006	(1,124)	19,587
Total Impact	(71,488)	306,168	(7,647)	133,249
Sheep AUMs				
Direct Impact	(896)	3,838	(96)	1,670
Indirect Impact	(271)	1,162	(29)	506
Induced Impact	(206)	881	(22)	383
Total Impact	(1,373)	5,881	(147)	2,559

Table 8: Impact analysis results on Taxes

Categories	BLM Management Alternatives			
	A	B	C	D
Cattle AUMs				
Employee Taxes	(2,544)	10,893	(272)	4,741
Corporate Taxes	(2,525)	10,813	(270)	4,706
Household/sales	(10,851)	46,473	(1,161)	20,226
Indirect Business Taxes	(5,971)	25,572	(639)	11,130
Total Impact	(21,890)	93,752	(2,342)	40,802
Sheep AUMs				
Employee Taxes	(30)	128	(3)	55
Corporate Taxes	(58)	249	(6)	109
Household/sales	(221)	946	(24)	412
Indirect Business Taxes	(96)	410	(10)	178
Total Impact	(405)	1,733	(43)	754

D. Hunting Recreation

To this point, we have not received estimates of hunter days across alternatives, so it is not possible to assess the economic effects at this point. However, we have compiled data from BBC consulting who did the main study of the economic impacts of hunting and fishing in Colorado, and we present some aspects of this data set below. We also were able to develop budgets from the BBC database, which are presented in table x on the following page. These budgets, in combination with the estimated hunter days for large game in excess of 102,000 led to very high direct and indirect expenditures. Thus we present results that cut back the results from the budgets presented to 28% of their level. Clearly there is some work to do obtain variations in herd and potential success by management alternative. We also made a literature review on aspects of hunting, such as the impact of potential success (harvest) and scenery, which is presented in Appendix III.

Using the BBC Data.

The hunting demand for Moffat and Routt County is based on hunting direct expenditures and hunting recreation days. The expenditure and recreation data is calculated in terms of big game management units. Big game management units cross county lines, which need to be taken into consideration when aggregating county level data. In order to deal with this, the expenditure and recreation data was multiplied by the proportion of the game management unit that lied within the county lines. For example, if one-third of a game management unit lied within Moffat County and one-third of a game management unit lied within Routt County and one-third of a game management unit lied within Rio Blanco County, only two thirds of the total expenditure and recreation data for that game management unit would be taken into consideration for this analysis. The data would be multiplied by one-third for Moffat County and one-third for Routt County. The same technique was applied to differentiating between spending on BLM land versus non-BLM land. The proportion of the game management unit that was on BLM land was calculated in order to determine the proportion of spending on BLM versus non-BLM land.

The hunter recreation days by game management unit is given by the 2004 Harvest Survey Statistics from the Division of Wildlife. In order to aggregate to the county level, the correct proportion of game management unit and BLM versus non-BLM land was summed for both Moffat and Routt County by big game species.
The foundation for deriving the direct expenditures originated from a report prepared by BBC Research & Consulting titled "The Economic Impacts of Hunting, Fishing and Wildlife Watching in Colorado." From the report, economic impact analysis was conducted for residents and non-residents for each corresponding game management unit by expenditure categories derived from IMPLAN. Included in the economic impact analysis were direct expenditures, output, jobs and earnings affected by a change in hunter recreation days. A baseline analysis was performed and then individual IMPLAN runs were performed for each game management unit within Moffat and Routt County for residents and non-residents. The individual IMPLAN runs displayed the economic impact on each game management unit by resident and non-resident for a decrease in one

hundred hunter recreation days. In order to determine the impact of a change in one hundred hunter days, the results from the individual IMPLAN runs were subtracted from the baseline impact analysis. Further, in order to arrive at the economic impact of one hunter day, the difference between the baseline and individual run was divided by 100 to arrive at an average value of one hunter day. In addition, the IMPLAN analysis displayed secondary impacts to the other county based on hunting in one county. For example, if hunting was occurring in a game management unit based solely in Moffat County, secondary impacts to Routt County based on the hunting in Moffat was calculated. The proportions applied to Moffat County based hunting were carried through to the secondary impacts in Routt County in order to stay consistent.
The value of one hunter day is multiplied by the total hunter days by resident and non-resident for hunting on BLM and non-BLM land to arrive at the total economic impact of big game hunting in Moffat and Routt County.

Results.

Because there is only one version of the simulation available at present, the table is shorter, showing just one outcome for each category of sales, employment, value added and taxes. However, because the estimates of hunter activity are very large, the activity is quite sizable. It is noteworthy that our results suggest lower multipliers than do the BBC results which included $14.5 million in direct effects, which led to 24.5 million in total effects, while our results show only $19.7 million dollars, perhaps because of the more customized work done here for the region in question. It is also apparent that the industry has much importance in terms of employment, as it accounts for 319 employees directly and 379 when all impacts are included, yielding an employment multiplier of 1.19, which is somewhat lower than the multiplier of 1.37 found in the sales response. The tax revenue generated from this activity is significant also, as we estimate that it is nearly $3.3 million, which comes most predominately from sales and indirect business taxes (which are often sales taxes on business).

Moffat County	HUNTING ON BLM		
Expenditure Category	Res. Total	NR Total	TOTAL
Trucks Campers and RVs	$ 0.05	$ -	$ 0.02
Other Special Equipment	$ -	$ -	$ -
Muzzleloaders	$ -	$ 0.06	$ 0.04
Bows	$ 0.13	$ 0.01	$ 0.06
Hand Loaders	$ 0.06	$ -	$ 0.02
Food	$ 32.17	$ 131.39	$ 91.70
Membership Dues	$ 15.15	$ 1.83	$ 7.16
Shotguns	$ -	$ -	$ -
Guide Fees	$ -	$ 324	$ 194
Heating Fuel	$ 2	$ 3	$ 3
Camping Equipment	$ 1	$ 0	$ 1
Rifles	$ 0	$ 0	$ 0
Other Hunting Equipment	$ 0	$ 0	$ 0
Decoys	$ 0	$ 0	$ 0
Binoculars	$ 0	$ 0	$ 0
Pistols	$ 0	$ 0	$ 0
Finders	$ -	$ -	$ -
Other Fishing Equipment	$ -	$ -	$ -
Taxidermy	$ 11	$ 5	$ 7
Private Transportation	$ 19	$ 81	$ 56
Public Transportation	$ -	$ -	$ -
Magazines and Books	$ 0	$ 0	$ 0
Dogs	$ -	$ -	$ -
Creels	$ -	$ -	$ -
Private Land Fees	$ -	$ 77	$ 46
Equipment Rental	$ 0	$ 11	$ 6
Cabins	$ -	$ -	$ -
Lodging	$ 13	$ 168	$ 106
Scopes	$ 0	$ 0	$ 0
Public Land Fees	$ 0	$ 0	$ 0
Clothing	$ 1	$ 1	$ 1
Tackle Boxes	$ -	$ -	$ -
Boat Launch Fees	$ -	$ -	$ -
Ammunition	$ 4	$ 2	$ 3
Misc Equipment	$ -	$ -	$ -
			$ -
TOTAL (PER ELK DAYS)	$ 100	$ 806	$ 524

Hunting Impact analysis results
(No variation across Alternatives)

Categories	Sales	Employment	Value Added
Hunting Days			
Direct Impact	14,369,496	316	5,359,350
Indirect Impact	3,047,686	34	1,695,075
Induced Impact	2,256,990	29	1,428,190
Total Impact	19,674,172	379	8,482,615

Hunting Days	Taxes
Employee Taxes	519,067
Corporate Taxes	154,562
Household/sales	1,466,994
Indirect Business Taxes	1,117,259
Total Impact	3,257,882

E. Government

The Base Budget of the Little Snake Field Office was estimated by BLM staff to total $2.8 million per year throughout the life of the plan; of which 85% is labor, and 15% is operational costs. In terms of alternatives, Alternative A is the base budget of $2.8 million, Alternative B is increased over the base by $444,000 for vegetation treatments and TM costs for a total of $2,824,700. Alternative C costs climb above the base budget by $13,000 for weed treatments, vegetation treatments and recreation facilities, for a total increase of $2,838,250. Finally, Alternative D comes in over the base budget for a total of $2,860,950, based on increased weed treatments, vegetation treatments and recreation facilities. Specific numbers for each type of activity are available in earlier documents from the BLM.

The results of the BLM expenditure simulation are presented on the next page. We used the standard government sector in IMP LAN to approximate these expenditures, and that sector has 88% payments to labor versus 12% payments to for operating materials. While not identical, this is quite close to the 85/15 split suggested by the BLM staff. First, looking at sales, the considerable expenditures by BLM, due to the fact that there is not much variation, as all vary by less then $60,000 from the base, even though there is over $4 million in total impacts and a multiplier of 1.43, which is fairly high in comparison to some of the other effects. Nearly the same statement can be made about employment and value added. For instance, direct employment accounts for 35 employees in this expenditure and the indirect effect add about 15 persons to employment in the county, implying the same multiplier of 1.43. However, the total of 50 employees hardly changes throughout the alternatives. The total taxes generated are significant, at over $1.0 million in all alternatives, but there is once again little variation.

BLM Expenditure Impact analysis results on Total Sales

Categories	BLM Management Alternatives			
	A	B	C	D
BLM expenditures				
Direct Impact	2,801,611	2,826,325	2,839,633	2,862,646
Indirect Impact	160,337	161,751	162,513	162,241
Induced Impact	1,043,943	1,053,152	1,058,111	1,040,985
Total Impact	4,005,891	4,041,228	4,060,257	4,065,872

BLM Expenditure Impact analysis results on Employment

Categories	BLM Management Alternatives			
	A	B	C	D
BLM expenditures				
Direct Impact	35	35	35	35.3
Indirect Impact	2	2	2	1.5
Induced Impact	13	14	14	13.4
Total Impact	49	50	50	50.2

Impact analysis results on Total Value Added

Categories	BLM Management Alternatives			
	A	B	C	D
BLM expenditures				
Direct Impact	2,470,280	2,492,072	2,503,806	2,524,097
Indirect Impact	99,458	100,335	100,808	100,193
Induced Impact	660,037	665,860	668,995	658,720
Total Impact	3,229,775	3,258,267	3,273,608	3,283,010

Impact analysis results on Taxes

Categories	BLM Management Alternatives			
	A	B	C	D
BLM expenditures				
Employee Taxes	226,430	228,427	229,503	230,478
Corporate Taxes	60,740	61,765	62,057	62,147
Household/sales	667,212	673,097	676,267	678,539
Indirect Business Taxes	79,957	80,662	81,042	80,157
Total Impact	1,034,824	1,043,953	1,048,868	1,051,321

Appendix I: Details on Input-Output Analysis

In conducting an input-output analysis and describing direct, indirect and induced effects, it is appropriate to discuss formally the definitions and rational of these terms. Therefore, the basic definitions and concepts will be presented here. For a full discussion of input-output multipliers see Miller and Blair (1985). The fundamental equation of input-output analysis is key to understanding multipliers and is as follows:

$$X = (I-A)^{-1}Y$$

Where X is the vector of total industry output for the j sectors, $(I-A)^{-1}$ is collectively referred to as the "Leontief inverse" with I being an identity matrix that is i*j in dimension, and Y is the total final demand for sector j's production. A is the matrix of technical coefficients and is the ratio of flow of input from sector i to sector j, to the total industry output of sector j. What is included in the A matrix is key to the differences between types of multipliers. For a simple two-sector economy the A matrix of inter-industry linkages would look as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

With a_{11} is what industry sector one buys from other firms in the same sector, a_{21} is what industry sector one buys from industry sector two, a_{12} is what industry sector two buys from industry sector one, and a_{22} is what industry sector two buys from within its own sector. The Leontief inverse of the A matrix is then simply represented as:

$$(I-A)^{-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}$$

The values in the Leontief inverse matrix: α_{11}, α_{12}, α_{21} and α_{22} respectively, represent the total direct and indirect changes in output (measured in dollars) from other industries within the region that result from an additional dollar's worth of output from industry j due to the induced demand for industry j's inputs. In calculating multipliers, we are interested in the total changes required in the economy for a one-unit change in final demand of a given industry. For this discussion we will focus on the output multiplier, with the understanding that there are other similar multipliers for value-added and employment.

An output multiplier is the total value of production in all sectors that result from a one- unit (usually interpreted as one dollar) increase in final demand from a given sector. An example in the golf industry is how much of an increase in total output for the entire regional economy will result from a one-unit change in golf industry output. For example, the golf sector uses fertilizer to maintain its courses. If the golf industry grows (or contracts) it will correspondingly purchase more (or less) fertilizer. Depending on the RPC for fertilizer sales in the model, the golf industry will by a certain percentage of their fertilizer locally. Likewise the fertilizer sales company will have to buy their inputs from somewhere and likewise down the processing chain to the quarries that mined the fertilizer minerals from the earth. A shock to the golf industry will therefore have a ripple effect throughout the entire regional economy, the extent to which will depend largely on how much of those backward linkages are produced and purchased locally.

To calculate an output multiplier, the change in total industry output in the economy is determined by the change in final demands from a given sector. For the sake of simplicity, we will use the example of calculating the total effect of a one-dollar change in final demand from a given industry in the larger economy. This is calculated as follows:

$$\Delta X_1 = (I-A)^{-1}\Delta Y_{1j} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix}$$

Where ΔX_1 is a vector of changes in total industry outputs from a one-dollar change in final demand for sector j, $(I-A)^{-1}$ is the Leontief inverse, ΔY_{1j} is a column vector that contains a 1 in the row that represents the sector with the one-dollar change in final demand and 0s in all other positions. It can be seen that, for our simple example of a two-sector economy and for a one-dollar change in final demand in sector j, this is equal to the first column of the Leontief inverse. The output multiplier then is simply sum of all of the changes in total industry output that result from the one-dollar increase in final demand for industry j and is calculated as follows:

$$O_j = \sum_{i=1}^{n} \alpha_{ij}$$

Where O_j is the output multiplier for industry j, and α_{ij} is the sum of industry j's technical coefficients from its Leontief inverse.

The difference between type one and type two multipliers used in IMPLAN are what is made endogenous in the A matrix. For the type one multiplier, only inter-industry linkages are included in the A matrix. This means that only the direct effects of the actual change in the final demands from industry j and the indirect effects that occur from other sectors supplying industry j intermediate demands are included in the type one multiplier. The effects of the changes in employee income that come from an expansion (or contraction) of sector j are not included in the type one multiplier. Thus, the type one multiplier is defined as: Type I = (Direct effects + Indirect effects) / Direct effects.

Type two multipliers add household spending as an endogenous sector. In this case, the modified A matrix would look like this:

$$\overline{A} = \left[\begin{array}{cc:c} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ \hdashline a_{31} & a_{32} & a_{33} \end{array}\right]$$

With the additional column and row representing households as an endogenous sector that demands from other sectors and uses wages to purchase goods and services. The additional spending that occurs in the economy due to household income spurred by the expansion in any given industry is called an induced effect. The direct, indirect, and induced effects together yield a type two multiplier. It is calculated as was the type one multiplier, except that now the modified A matrix is larger and created more economic activity from that same one-dollar expansion of industry j's output. The type two multiplier is defined as: Type II = (Direct effects + Indirect effects + Induced effects) /

Direct effects.

Other multipliers, such as SAM multipliers, continue to endogenize additional sectors and institutions. For simplicity's sake we limit our discussion to direct, indirect and induced effects, with type two multipliers being used for this golf industry analysis.

Appendix II: Details on the Sampling Procedures Used in the recreation Analysis

Visitor Sites Sampled
In consultation with the Little Snake Field Office, 15 recreation sites were identified to query visitors about their use. We also sampled at many (but not all of these). These sites are shown on map #?? That was given to visitors in the survey packet
(Jeremy please put the file with the map in here).
These sites are:

1. Cedar Mountain Picnic Area/Trailhead
2. Duffy Mountain Trailhead
3. Duffy Mountain River Access
4. West Juniper Mountain Trailhead & River Access
5. East Juniper Mountain Trailhead
6. Thornburg Draw Trailhead
7. South Cross Mountain Trailhead
8. East Cross Mountain River Access
9. Twelve Mile Mesa Trailhead
10. Irish Canyon Interpretive Site
11. Irish Canyon Campground
12. Rocky Reservoir Campground
13. Sandwash Basin Entrance

Generally speaking many of those sites identified as trailheads are part of the Yampa Valley trail used for mountain biking. To avoid conflicting with visitors recreation experience, on river access we tended to focus on take out points rather than put-ins. Several of the river access sites are administered jointly by BLM and the Colorado State Parks (e.g., Duffy Mountain River Access). Some areas such as West Juniper Mountain trailhead emphasizes non motorized recreation with hiking, horseback riding and mountain biking. This area was heavily used on the day we did our training as there were five tents and several vehicles.

Irish Canyon Interpretive Site consists primarily of a large petroglyph panel. The Irish Canyon Campground consists of seven sites and is a no fee site. Sandwash Basin is a major OHV area used by motorcycles and ATV’s throughout the large basin.

Sampling Methods and Procedures
Each interviewer would drive to the site and count vehicles when they arrived. Depending on the schedule, the interviewer would remain on-site for 2-3 hours (the amount of time on-site was recorded). If visitors appeared during this time, the interviewer would, introduce themselves as part of the CSU study, obtain commitment to take a mail back survey package, and obtain the visitors name and address for our follow up mailings.

Sampling Schedule
Due to lack of a cooperative agreement in force during the summer and early fall, only the following days were sampled:

Two interviewers for July 2, 3, and 4: Total surveys handed out were 14 surveys
One interviewer for September 3, 4 and 5th: Total surveys handed out were 7 surveys
One interviewer for October 7, 8th: Total surveys handed out were 9 surveys (with 5 of them filled out on site).
CSU will update this sample with additional samples during spring and early summer 2006.
To date we have 20 surveys returned out of the 30 handed out. This represents a 66% response rate, a reasonably good one.

Table 1. Locations of Visitors

Sites	# of Interviews	Residence of Visitors
Cedar Mountain Picnic Area/Trailhead	5	Craig
Duffy Mountain Trailhead		
Duffy Mountain River Access	3	Craig
East Juniper Mountain Trail & River Access	2	Craig/Hayden
West Juniper Mountain Trail & River Access		
Thornburg Draw Trailhead		
South Cross Mountain Trailhead		
East Cross Mountain River Access	3	Craig
Twelve-Mile Mesa Trailhead		
Irish Canyon Interpretive Site	6	Craig, Rock Spgs, Green Riv
Irish Canyon Campground		
Rocky Reservoir Campground		
Sandwash Basin Area	11	Craig

Visitor Use Estimation

Up to three sources of visitor use information was used to estimate visitor use. The first estimate was developed from the visitor count data that utilized the number of vehicles observed at the site and the number of surveys handed out (one to each group). This number was then expanded to all weekends and holidays over a six month late spring-summer-early fall season using reciprocal of the number of days sampled to the number of weekend days and holidays in a six month season. This assumes visitor use on non-holiday weekdays is essentially zero (something our informal discussions with local users suggested was a conservative but reasonable assumption). We further expanded based on the hours sampled versus the hours the site was available for recreation. The resulting sample expansion factor was multiplied by the number of vehicles and surveys handed out. To convert vehicles to visitor days, we used the returned surveys that provided site-specific estimates of annual number of trips, group size and average length of stay. Theses estimates are based on small sample sizes thus provide an approximate estimate of use. We suspect that use is not zero at many sites estimated as zero, but it is low enough during the July through October time period that our coarse sampling time period did not observe any visitors. Sites with low use levels would have to be sampled more intensively to obtain an accurate estimate of use, but whether the sampling costs would be justified with such low use estimates is an open question.

The second estimate for three sites administered by Colorado Division of State Parks was based on their data from fee envelopes collected at these sites. Third estimate is drawn from BLM's REIS visitor use estimates for 11 sites. These three estimates were compared to one another. We developed calibration factors using the State Park sites and the BLM estimates. These calibration factors were then applied to the visitor use estimates based on visitor counts at the sites where we did not have State Parks or BLM data. Finally, we developed a low, medium and high estimate of visitor use based on the calibration factors, BLM visitor estimates and State Parks. These use estimates were reviewed by BLM and NWCOS including people familiar with recreation use of the area. It was agreed that the medium use estimate would be adopted as the best estimate of baseline recreation use in the study area. Table 2 provides the medium use estimates. The split between motorized and non motorized follows BLM staff estimates and is corroborated by our sampling data. In particular the visitor data collected indicated that nearly all motorized use (i.e., motorcycles and ATV's) occurred at Sand Wash. This area accounts for 20,700 visitor days, which is 72% of motorized visitor use in the LSR.

Table 2 Estimated Number of Vehicles and Estimated Visitor Days

	ALT A EXISTING
1. Cedar Mountain Picnic Area/Trailhead	8,797
2. Duffy Mountain Trailhead	225
3. Duffy Mountain River Access	1,118
4. West Juniper Mountain Trailhead & River Access	338
5. East Juniper Mountain Trailhead	130
6. Thornburg Draw Trailhead	33
7. South Cross Mountain Trailhead	30
8. East Cross Mountain River Access	1,832
9-12 Mile Mesa Trail	49
12. Irish Canyon Interpretive Site	813
13. Irish Canyon Campground	1,820
14. Rocky Reservoir Campground	236
15. Sandwash Basin Entrance	20,700
TOTAL NON HUNTING RECREATION USE	36,121
TOTAL MOTORIZED	**28,897**
TOTAL NON MOTORIZED	**7,224**

Table 3 Primary Recreation Activities at Each Site

Sites	Reported Recreation Activities
Cedar Mountain Picnic Area/Trailhead	Hiking, Picnicking
Duffy Mountain River Access	Rafting
East Juniper Mountain Trail & River Access	Rafting
West Juniper Mountain Trail & River Access	
West Cross Mountain River Access	Fishing, Hiking, Camping, Viewing
Twelve-Mile Mesa Trailhead	Hiking, Biking
Irish Canyon Interpretive Site	Rockart, picnic, wildlife viewing
Sandwash Basin Area	Motorcycles, ATV, Camping

Table 4 presents the group trip expenditures at each site and the percentage spent in Moffat and Routt counties. To facilitate the use of this data in IMPLAN, these expenditures are put on a per person basis using the size of the group sharing expenditures (from the survey) and then the expenditures are put on a per visitor day basis by adjusting for length of stay.

Table 4. Average Group Trip Expenditures of Visitors

			Spent in Moffat/ Routt Counties	Total Trip Cost	Group Size
Site	Cedar Mtn		$3.00	$3.00	1
% Moffat & Routt			100%		
Site	Duffy/E Juniper	Average	$170.00	$198.33	2
% Moffat & Routt			86%		
Site	East Cross	Average	$108.42	$150.00	1.3
% Moffat & Routt			72%		
Site	Irish Canyon	Average	$58.67	$76.33	1.7
% Moffat & Routt			77%		
Site	Sand Wash	Average	$114.47	$156.88	1.3
% Moffat & Routt			73%		

The Craig and Steamboat area appear to capture a sizeable portion of total visitor spending, with about three-fourths of total visitor spending having been made in Routt and Moffat counties.

This information may be used in the input output model to calculate income and employment related to recreation in the baseline or future without alternative in the chapter on estimated effects.

Appendix III: Hunting Demand Literature Review
Determinants of Demand:

A number of articles discuss the determinants of hunting demand. All studies include trip expenses, hunter preferences, distance traveled, and demographic variables such as age, income and education. Gum and Martin includes regional data by classifying the geographical area, and Nickerson considers area characteristics such as accessibility and terrain. Milon and Clemmons use urban/rural dummy variables to include residential location as a variable. Their study broadens the field by analyzing the importance of species variety to hunting demand.

Methodology:

The Clawson-Hotelling procedure is often cited as a method for estimating demand for hunting and other types of recreation. It is a two-step process. First, one estimates demand functions for the total outdoor recreation experience. Then, one derives the implied demand for and value of the resource itself (Gum and Martin, 1975). This model specifies days recreated as a function of average cost and average distance traveled per day and various combinations of other explanatory variables (Ziemer, Musser and Hill). Gum and Martin used this framework, deriving demand relationships for seven categories of hunting in Arizona, always including average cost variables. Twenty independent variables were regressed against the number of trips for a given activity to a given region in 1970. The authors then use the aggregate statistical demand curve to a second demand curve, which describes demand for the specific resource when used for the activity in question (Gum and Martin, 1975). They can estimate how the number of hunting trips will vary if entry fees change, for example.

Nickerson uses a lottery distribution model to analyze the demand for the regulation of elk and deer hunting in Washington State. Each permit has a series of attributes such as randomly selecting winners and being nontransferable. Participants are assumed to be risk-neutral wealth maximizers, and therefore enter the permit drawing with the highest expected value. Nickerson examines how changing permit characteristics, including price, affects people's likelihood of participating in a given drawing.

Milton and Clemmons add new contributions to the field by considering the demand for species variety as a component of recreation quality. Demand functions are estimated relating output choices to production cost and socioeconomic attributes that affect preferences (Milton and Clemmons). The authors first create an indirect utility function for hunting of different groups of species. They then find the implicit prices of variety with the hunter's expenditure function for variety, and then substitute these estimated implicit prices into implicit demand equations for variety. Finally, they are able to define the demand equations.

Gum and Martin (1977) use cluster analysis to analyze the structure of demand for outdoor recreation. They create clusters of groups of people with similar tastes and preferences, and then find recreation elasticities to predict the future structure of recreation demand.

Miller and Hay use a two-step estimating procedure in order to find the determinants of participation in duck hunting in the Mississippi Flyway. The first step is estimation of probability of participation equations, and the second step is estimation of the level or intensity of participation equations for those who participate (Miller and Hay). Because of statistical problems associated with using OLS for this type of estimation, the authors instead rely on probit and logit models. The underlying assumption is that an individual's decision to participate is a function of socioeconomic characteristics and the availability of waterfowl habitat and populations. If the value of the function exceeds a certain value, the person will participate.

Results:

Milton and Clemmons find that hunters' demand for species variety is positively related to expenditures. The urban/rural variable varied across species groups. Price per trip and price per capital expenditure were significant in the model. However, the signs on these variables varied with species group.

Gum and Martin (1975) were able to find a choke price for household trips. By varying the amount of additional cost per household trip, they eventually derive the additional cost at which households will no longer take trips as well as the total revenue and consumer surplus associated with different numbers of trips taken. In their later paper, Gum and Martin (1977) assigned a score to each person in each cluster on eight dimensions such as concern with money, no-kill attitude, and family not interested in outdoor recreation. They find that people with a no-kill attitude are also likely to be part of a family not interested in hunting, for example. In addition, people with a high quantity of total outdoor recreation are generally from families relatively interested in hunting and fishing, and would hunt more if they had more time. High recreation quantity is significant and associated with high income. This is often assumed in other articles on hunting demand, but the traditional Hotelling-Clawson approach often finds income to be insignificant.

Miller and Hay find men are more likely to hunt than women, and people in urban areas are less likely to hunt than people in nonmetropolitan areas, ceteris paribus. While other articles treat consumptive and nonconsumptive wildlife users as separate groups, Miller and Hay see there is overlap. Changes in upland habitat have less impact on duck-hunting participation rates than changes in wetlands availability. A habitat reduction reduces the number of duck hunters and hunter days.

Offenbach and Goodwin's Poisson regression showed that travel cost has a significant negative impact on visit rate, and the hunter's age and capital investment are also significant. The beauty of the site component of site "attractiveness" has a significant influence on visit rate, though the perceived success component does not.

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