Grazing Distribution: The Quest for the Silver Bullet

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Introduction

Since the beginning of the range management profession, distribution of livestock on rangelands has been one of many challenges. Much of the information on different livestock distribution practices has come from anecdotal evidence and case studies. Whereas the early focus was on distributing livestock evenly across a pasture, the more recent focus has been to keep livestock out of riparian areas. We have examined the effectiveness of several different distribution practices. It has become apparent that the effectiveness depends upon the ranching system to which it will be applied as to whether it is both ecologically and economically practical. For this reason, we have developed a model of an eastern Oregon ranching system to test the effect of each practice. We will discuss the model ranch and demonstrate how it is used to evaluate livestock distribution practices and show how the model can be applied to a region in terms of economic impacts and job creation.

The grazing distribution practices examined included off-stream water developments with trace mineralized salt, herding, early weaning, altering the season of use, fencing, and strategic supplementation. Northeast Oregon is characterized by mixed conifer forests in the mountains and valleys that are mostly cropped. The mountains have numerous riparian areas associated with a mixture of dry and wet meadows (Figs. 1 and 2). Seasonal grazing is traditionally practiced on a combination of deeded and federal land.

Livestock and Agriculture in Northeastern Oregon

Agriculture is an important part of the local economy in northeast Oregon (Wallowa, Union, Baker, and Grant counties). Agriculture ranked second to retail sales in terms of employment for the region and was first in 3 of the 4 counties. Due to its relative economic importance, what happens to agriculture in the region is important not only to agriculture but also to the rest of the local economy.

Livestock production (primarily cow–calf operations) is the largest component of agriculture in the region representing more than half of the total agricultural cash receipts. Livestock production is also the dominant agricultural land use in the region. About 2.8 million acres of land in livestock production represent nearly 85% of the total agricultural land in the 4-county region. Agricultural operations holding grazing permits, with forage leases primarily from the Bureau of Land Management (BLM) and US Forest Service (FS), account for more than 60% of the agricultural land in the region.

The Typical Northeastern Oregon Ranch

A typical ranch operation was defined for the 4-county area and a profit-maximizing model was developed for ranch-level analysis. This model was used to evaluate the likely economic response of each cattle distribution practice when the rancher's objective was to maximize profit. Western ranchers have been shown to be motivated by many

Figure 1. Typical summer rangeland for a northeastern Oregon ranch.

lifestyle-related factors that are not necessarily driven by or consistent with profit maximization. Nevertheless, we assume that ranchers prefer more money to less and the profit-maximizing model indicates how maximum economic returns would change the adoption for each alternative livestock distribution practice. Regardless of motivation, in the long run profitability can't be completely ignored without outside sources of income.

The seasonality of forage use is an important consideration in ranch planning because the number of forage alternatives is limited during certain months of the year, and some forage is considerably more expensive than others. As an example, feeding hay during the winter is relatively expensive, few alternatives exist, and it comprises a significant share of annual production expenses. With purchased and raised hay costing between \$65 and \$120 ton^{-1}, hay feeding alternatives cost 3 to 5 times more than grazing rangeland forage.

The typical northeast Oregon ranch is defined based on a balance between the class of livestock on the ranch in each season, their forage requirements during that season, and the amount of forage available by season. The ranch has the option of purchasing hay (\$85–\$120 ton^{-1} for meadow or alfalfa hay) or leasing private rangeland (\$13.75 AUM^{-1}) during different seasons of the year. As a baseline, the herd is on private rangeland and pasture (\$3.25 AUM^{-1}) for 4 months, on Forest Service permits (\$9.46 AUM^{-1} for fee and nonfee costs) for 3.5 months in the summer, and fed hay the other 4.5 months. Raised meadow hay costs \$65 ton^{-1} and raised alfalfa hay costs \$89 ton^{-1}. There are 1,650 acres of native private rangeland, 70 acres of alfalfa, and 350 acres of grass hay meadows along small streams used for both hay production and pasture. The available hay and rangeland grazing on the ranch will support a base herd of 300 cows with the accompanying calves, replacements, and bulls. Additional animals could be produced by reallocating forage between seasons and using additional leased forage and purchased hay when profitable.

This typical ranch sells calves, yearlings, cull cows, and cull bulls each year. The herd is maintained from within by retaining part of the heifer calves as replacements. Cows remain in the herd for about 9 years before death or sale as cull animals. Bulls are purchased and sold assuming a useful life of 4 years. In addition to raised replacements, additional brood cows can be purchased to build herd size if it is economically profitable.

The ranch characteristics are modeled in a multiyear linear programming framework using the initial characteristics of the ranch operation. The model solves for the profit maximizing herd size and forage use given a defined beef price situation. In the process, the profit-maximizing livestock sales and ranch income are also determined. The results from the first year are then used as input (starting conditions) for the second year. This process continues for

Figure 2. Cattle distribution research pastures on the Eastern Oregon Agricultural Research Center Hall Ranch. Note the mix of riparian area, open meadows, and upland timber sites. C indicates control; D, dispersion treatment; ND, no dispersion treatment.

40 years and optimal production levels are chosen for each year to maximize the net present value of ranch profits using a 7% discount rate. Within the model, livestock production is ultimately limited by available forage resources and money.

The economically optimal level of livestock production depends largely on livestock sale prices. Because the ranch faces price risk, we used 100 sets of random prices that ranchers would likely face over the 40-year planning horizon. The reported "optimal solution" is the average level of production and profit realized across the 100 alternative beef price scenarios.

The beef prices used in our models fluctuate randomly, but explicitly consider the linkage in prices between years and between livestock classes. The random prices were generated using Cattle-Fax™ data. Annual prices for steer and heifer calves, cull cows, and cull bulls were randomly generated for each of the 100 alternative beef price scenarios. The peaks and valleys of the price series were different for each 40-year price scenario with an approximate 12-year cycle from peak to peak. The proper relationship between different classes of cattle was maintained, recognizing that if high prices for steer calves are observed, high prices for heifer calves would be expected as well. Prices for steers weighing 500–600 pounds, as an example, varied from a high of about \$1.30 lb^{-1} to a low of \$0.70 lb^{-1}.

Typical livestock production rates, sale weights, and ranch returns for the northeast Oregon ranch are shown in Table 1. Sources of forage and allowed seasons of use are shown in Figure 3. Baseline economic returns are reported as averages for the profit-maximizing model with all prices and costs adjusted for inflation to a constant 1997 price basis.

Grazing Distribution Treatments

For each of the grazing distribution treatments, we assumed production and cost impacts based on changes in allowed season of grazing use for different forage sources (either deeded land or the FS permit) and improvements in animal distribution. These effects and assumed treatment costs are summarized in Table 2 for each of the management alternatives considered. The scenarios developed for the different grazing distribution practices are based on replicated research conducted primarily in Oregon and Montana. In some cases, additional information was gathered from other research studies and published papers.

For several of the grazing distribution treatments, one of the outcomes considered is to extend the summer grazing period on the FS allotment if livestock distribution is improved. The assumed current grazing practices result in variable and inappropriate forage use, too much in some areas and too little in other areas. If a 4- to 6-inch stubble height is used as a standard for management of grazing in riparian areas, then grazing in the pasture or allotment must end when that level of use is achieved, regardless of what occurs on the uplands. Without management, forage utilization within riparian areas currently reaches a minimum allowable stubble height of 4–6 inches before the full 3.5 months of summer grazing has been realized. Improved livestock distribution and less use in the riparian areas will eliminate the need for removing the cattle early.

Season of Use Adjustments

There is concern in northeast Oregon over summer grazing, especially in pastures with riparian areas. Three season-of-use alternatives to grazing summer-long were evaluated. The alternatives were 1) to delay turnout until July 15 (July 15–September 30 grazing season), as opposed to the typical June 15 turnout date; 2) to remove the herd a month early (June 15–August 31 grazing season); or 3) to not allow any summer grazing. The economic impact of altering the allowed season of use depends on the relative cost of alternative feeds and the seasonal availability of those feeds.

Off-Stream Water Development and Trace Mineralized Salt

Providing off-stream water and trace mineralized salt causes cows to distribute away from streams compared to cows that only had the stream for water. We found that cows that had both stream and off-stream water stayed further away from the stream and thereby used the uplands to a greater extent. Cows gained 0.62 $lb \cdot d^{-1}$ more with the off-stream water and calves gained 0.31 $lb \cdot d^{-1}$ more. There was no difference in calving rates. With better distribution, the cattle herd could also be allowed to stay in the pasture through September without exceeding riparian stubble height requirements. For this model, we assumed that 6 springs were developed at an annualized cost of \$1,624 (amortized over a 10-year life at 6% interest, with 10% salvage value). Water developments thus increased costs by \$1.35 AUM^{-1}.

Fencing

Fencing has often been used to change cattle distribution patterns. There is little doubt that with adequate annual upkeep this practice will succeed in changing where and when cattle graze an area. For our models, we assumed that 2.5 miles of new fence would be needed at \$5,000 $mile^{-1}$. The fence would have a 20-year life with a 10% salvage value, and annual maintenance would be 5% of the new cost. Annual fence costs amounted to a fixed cost of \$1,060, maintenance of \$625, and 2 days of additional labor (\$180). The total annual fencing cost (\$1,865) would increase operating costs by \$1.55 AUM^{-1}. The benefit to the ranch is that they would be able to graze in the late summer months with a grazing season of June 15–September 30 instead of the shortened season of June 15–August 31.

Table 1. Production, forage resources, and economic characteristics of typical northeastern Oregon cow–calf ranch		
Cow replacement rate		15%
Calf crop at birth		84%
Calving season		February–March
Weaning		November
Cow:bull ratio		20:1
Sale weights and death losses	**Weight (cwt)**	**Death loss (%)**
Cows	11	1
Bulls	20	1
Steer calves	5.75	4
Heifer calves	5.25	4
Yearling heifers	8	2
Base 1 (FS grazing June 15–September 30)		
Optimal number of cows	302 head	
Average annual ranch returns	**$ total**	**$/cow**
Gross returns from crop and livestock sales	160,792	532
Variable costs	105,825	350
Net return over variable costs	54,967	182
Fixed costs	17,446	58
Family living allowance	24,000	79
Off-ranch income	10,000	33
Net income after family living allowance	13,521	45

Table 1. Continued		
Base 2 (FS grazing June 15–August 31)		
Optimal number of cows	278 head	
Average annual ranch returns	**$ total**	**$/cow**
Gross returns from crop and livestock sales	150,378	541
Variable costs	97,352	350
Net return over variable costs	53,026	191
Fixed costs	17,446	63
Family living allowance	24,000	86
Off-ranch income	10,000	36
Net income after family living allowance	11,580	42

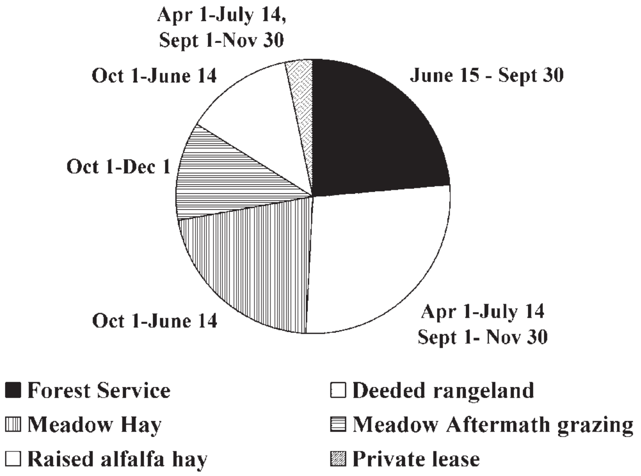

Figure 3. Feed sources and seasons used in the typical northeastern Oregon ranch.

Early Weaning

Early weaning of calves is a practice that would allow cows to distribute better during the late summer months and lower their nutritional requirements during this period of low forage quality. There is some evidence suggesting that with early weaning the cow is allowed more time to recuperate from raising the calf and she enters the winter with an increased body condition so that next year's calf crop might also be higher than it would have been otherwise. For our evaluation, we assumed that the calf crop would increase by 5% and that the cows would be able to graze until the end of September due to better distribution across the allotment. We did not study what happens to the calves after early weaning. We do know that it will take more management of the calves to ensure that they reach the market in comparable condition as if they had stayed with their mothers. Our assumption was that the increased costs of calf management would be roughly equal to the decreased costs of feeding the cows.

Herding

Herding cattle involves either moving them to an area where you want them or out of an area you do not want them. The effectiveness of herding depends on both the frequency and techniques used to move the cattle, and how well the herding activity is integrated with desired or natural cattle movements. Labor, horse use, and vehicle use increased costs by an estimated \$3.30 AUM^{-1} so that the total costs of grazing on the FS allotment went from \$9.46 AUM^{-1} to \$12.76 AUM^{-1}. Herding is conducted every other day for 2.5 months from mid-July through September. This activity allows the grazing permittee to remain on the FS allotment through the end of the season (until September 30).

Strategic Supplementation

Supplementation has been used to improve the growth and rate of gain of stocker cattle and replacement heifers, maintain or improve body condition of cows grazing low-quality forage, improve the intake and digestibility of low-quality forage, provide macro- and trace minerals that are deficient in the forage, and to provide additional nutrients within

Table 2. Impacts and costs of the grazing distribution treatments

Distribution practice	Season of use (dates)	Cattle age class	Weight gain	Calving rate	Cost
Off-stream water	July to August	Cow	0.62 $lb \cdot d^{-1}$	No difference	$6,000 initial cost
	No late summer	Calf	0.31 $lb \cdot d^{-1}$		$1,624 $year^{-1}$ maintenance
Early summer	June to July	Cow	0 to 1.1 $lb \cdot d^{-1}$	No difference	
		Calf	2.2 to 2.75 $lb \cdot d^{-1}$		
Late summer	August to September	Cow	−1.1 to 1.1 $lb \cdot d^{-1}$	No difference	
		Calf	0 to 2.2 $lb \cdot d^{-1}$		
Supplement	Add 1 month of fall grazing	Cow	No difference	No difference	$6.83 AUM^{-1} added grazing cost
	December 1 to December 31, add 300 AUMs	Calf	No difference		
Early weaning	Add 1 month of grazing		No difference	5% increase	
	No late summer		No difference		
Fencing		Cow	No difference	No difference	$1,865
	No late summer	Calf	No difference		
Herding	Add 1 month of grazing	Cow	No difference	No difference	$3.30 AUM^{-1} added to Forest Service cost
	No late summer	Calf	No difference		

periods of drought. Each reason for supplementation can enhance the potential profitability of livestock production. The economics of supplementation for these traditional reasons has been shown to be variable and dependent on livestock and rangeland conditions. In this case, an alternate reason for supplementation was evaluated: the use of low moisture block supplements for modification of grazing distribution patterns on rangelands.

Cattle have been shown to disperse more evenly across pastures and to increase forage utilization in upland areas during the late fall and early winter period when these low-moisture blocks are used. In the analysis, low moisture protein blocks were assumed to be placed in previously underutilized areas of the pasture from October 1 to December 31. During this time of year, cattle are grazed on deeded land for the Oregon ranch model. The grazing period of deeded pastures is extended by 1 month from the low moisture block placement.

Low moisture block supplement is assumed to be fed at the rate of 0.70 $lb \cdot head^{-1} \cdot d^{-1}$ for 91 days with a cost for the supplement of \$608 ton^{-1}. The supplement was projected to be sequentially placed in 6 locations using 4 hours of labor per placement, 36 miles on a 4-wheeler, and 240 miles in a pickup. The estimated supplement and placement increased grazing costs an estimated \$6.83 AUM^{-1} or \$0.23 $head^{-1} \cdot d^{-1}$. Deeded land grazing costs were assumed to increase from \$3.25AUM^{-1} to \$10.08 AUM^{-1}.

Ranch Returns and Optimal Production

The base ranch model was used to compare the distribution treatments. The ranch model balances herd size with forage and feed sources while seeking to maximize profits. Forage and management practices will only be used if they result in more profit than other available alternatives. The alternatives the model considers are to buy hay, lease additional forage, substitute the use of ranch forages between seasons, adjust herd size, and increase crop sales, while reducing livestock sales.

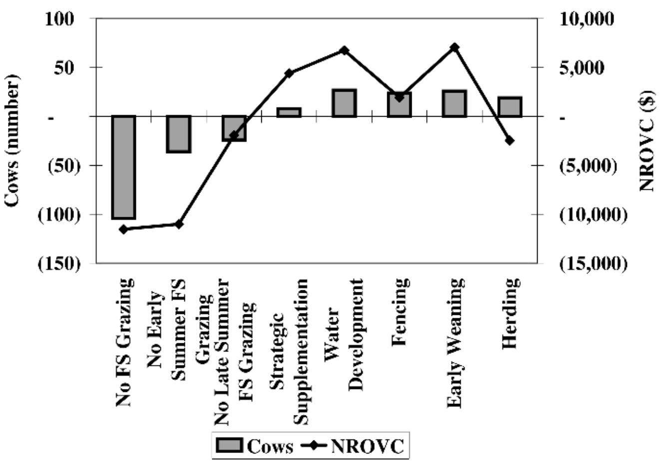

Figure 4. Cow numbers and net returns over variable cost (NROVC) changes for each cattle distribution practice.

Comparisons of the various distribution practices on ranch size and profit potential are shown in Figure 4 as changes in the cow numbers and net returns over variable costs (NROVC). NROVC is the amount that would be available to the ranch to pay fixed expenses and provide a return to the manager and the land investment.

Changing Season of Use on Forest Service

As shown in Figure 4 eliminating the use of the FS permit would cause a larger reduction in herd size (–104 cows) compared to limiting use to early (–36 cows) or late (–24 cows) summer grazing. It is interesting to note that in terms of profit, total elimination of the permit causes about the same level of lost profits (–\$11,526) as does losing the early summer grazing season (–\$11,005) even though the herd size impacts are markedly different. This occurs because forage is reallocated between seasons and fewer grazing options are available to the ranch for the early summer season. The loss of late season grazing resulted in the smallest reduction of the cow herd and the lowest impact on profits (–\$1,941). This was due largely to the availability of meadow aftermath grazing during this late fall period.

Mitigating FS Season of Use Adjustments

Without improved livestock distribution, the grazing season on FS permits is expected to be shortened because riparian areas are being overgrazed. For the Oregon ranch we considered the grazing season to be shortened by at least a month during the “hot season.” Thus, comparisons for the remaining distribution treatments are made to the ranch model that considered the loss of late summer grazing. As shown in Figure 4, with no late summer grazing there were fewer cows on the ranch and lower profits compared to the base model.

With the exception of herding, average net returns were estimated to be at or above those of the current seasonal forage use situation and the negative impacts of the season-of-use adjustment (1 month less FS grazing) could be offset following several alternative strategies. Optimal herd size was maintained near the current 300-head level. This assumes that our assumptions about production differences and costs, which are based on the best information available, accurately reflect the changes that would occur. With the assumptions made, the least-cost strategies would be to develop water or wean early with average annual returns estimated to be about \$7,000 more as compared to the scenario with a shortened FS grazing period but without mitigating actions taken. Although herding increased herd size, it resulted in lower profits than the loss of late summer FS grazing (\$50,572 vs \$53,026) due to the additional annual costs of the herding activities and would not be considered an economically viable strategy.

Strategic Supplementation

Increasing the time that cattle grazed native rangeland through strategic supplement placement increased average net returns. Most of the increase resulted from the reduction in the amount of hay purchased or increased amount of hay sold.

Northeastern Oregon Economic Impacts

The regional impacts of changes in grazing strategies were modeled using IMPLAN software to model the 4-county region using 2000 data. The cattle ranching sectors of the model were combined and the production coefficients were modified based on a 300-cow enterprise budget for northeastern Oregon. Regional economic impacts are generally divided into direct, indirect, and induced impacts. Direct impacts are those generated directly from the sale of the product in question, in this case cattle. Indirect impacts are those generated from the purchase of inputs by the ranching industry from other sectors of the economy. Induced impacts are those that arise from payments to households.

Ranching in northeastern Oregon was estimated to generate $65 million in gross sales per year. This included the production from 122,000 beef cows. These sales resulted in $115.1 million in economic activity in the region, which supported 2,092 direct and secondary jobs and generated $39.1 million in labor earnings. Grazing on FS-dependent ranches generated 70 percent of the economic impact associated with cattle production in the region. This represented the production from 85,400 beef cows. Because these ranching operations were not entirely dependent on FS grazing for all forage, all of the production from these ranches cannot be attributed solely to FS grazing. We estimated that FS grazing directly generated more than 34 percent of the annual cattle production in the region ($15.7 million). This production resulted in $27.7 million in economic activity, which supported 504 direct and secondary jobs and generated $9.4 million in labor earnings per year in the region.

The impacts of the different distribution practices are shown in Figure 5 with the indirect and induced impacts combined in the chart. As would be expected, the loss of summer grazing seasons results in economic losses to the regional economy. As herd size is decreased, there would be lower annual sales of cattle, which would result in lower purchases of inputs by ranches. For all of the other distribution practices, there would be gains to the economy relative to adjusting FS season of use without taking steps to mitigate the economic losses. Note that the regional economic impacts are different than the annual profit to the ranch. In the latter case, purchased inputs are considered a cost to the rancher, whereas in the regional economic analysis, they are expenditures by the rancher that increase economic activity.

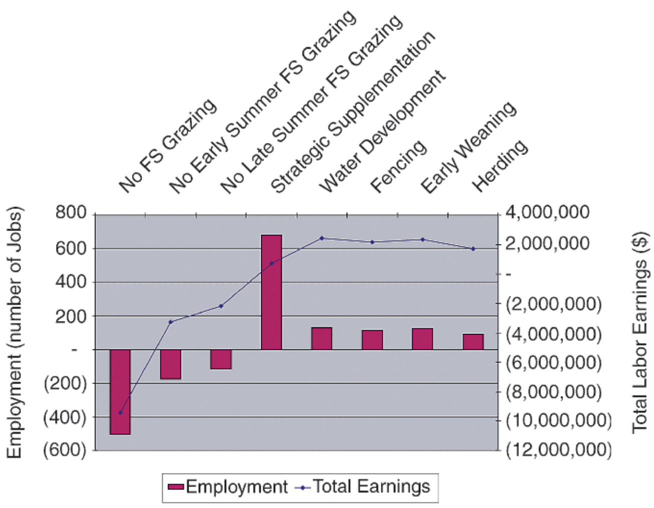

Figure 5. Regional economic impacts for each of the cattle distribution practices.

A major limitation of this analysis is that it is based solely on changes in the level of production. It is very likely that the changes in the ranch-level model not only change the level of production but also the revenue and cost relationships per unit of production. Further investigation into these changes is necessary in order to more accurately reflect economic impact on the region's economy.

Conclusions

Several different cattle grazing distribution practices were examined to document the effect they have on ranch economics. Although there are economically viable solutions to resolve grazing distribution problems, not every practice will increase rancher profits. Herding was the most expensive alternative examined to mitigate the need to shorten FS grazing seasons and was not economically viable. Water developments, fencing, and early weaning were less expensive and more profitable alternatives to ranchers. Strategic supplementation was a profitable practice to replace the amount of hay fed in the fall with a lengthened grazing season. Certainly, the results an individual rancher obtains will vary from what was estimated by the economic model. Whether a specific practice is economically practical depends on the makeup of the ranch, the resources available, and what the impacts of the specific practice will be on the ranch operation. Our ranch model is one way to evaluate these integrated effects.

For our typical northeast Oregon 300-cow ranch operating in a mix of public and private lands, the results were varied. Certainly, any activity that causes a loss of Forest Service AUMs or alters the season when those AUMs can be used will be detrimental to the ranch and the county economy. Loss of early-summer grazing was nearly as bad as the loss of the entire permit; however, the same loss of early grazing had a much lower negative impact on the county economy. This is the difference between the profit maximizing behavior of the ranch and the effect of the loss of cattle sales to the county economy. The ranch can adjust resources and costs to mitigate the impact of reduced cow numbers. For the economy as a whole, however, the impact is based on the aggregate change in gross sales of cattle products and the resulting inputs purchased by the ranch.

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