Discovering Grazing Values[1]

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Highlight

Are market forces at work in determining range forage values? This study tests the hypothesis that market forces are at work in spite of the facts of administered grazing fees, rationing, and grazing control. The evidence in the research supports the hypothesis, and it should assist ranchers and public land agencies in their deliberations on adjusting public land grazing policies.

Discovering range forage values is a crucial step in the process of establishing a "fair" public land grazing fee. Two obvious questions confront anyone interested in discovering the value and establishing the "fair" fee. The first question is: What is "fair"? The second question is: How can the value be discovered?

What is a "Fair" Fee

Everyone "knows" what a "fair" grazing fee is according to his own individual value system. No man's value judgments, however, are universally accepted as "fair". For this research fairness is considered the value of range forage as it has been established by the ranching community over a long period of time. It is the value of range forage that fits with all other elements of ranching to provide the observable economic organization of ranches. It is not the forage value that will guarantee ranchers the best alternative rate of return on investment. Legitimate ranchers often accept a lower rate of return on ranch investment than they could get on their money if invested elsewhere. Their "love for ranching" or their "fear of not ranching" is worth something to them. If ranchers will stay in business for a 2% rate of return on investment and their alternative outside of ranching is 6%, then they are willing to pay 4% for their "love of ranching".

The ranching community can provide information about what range forage is worth to ranchers. Economically speaking, that value will be "fair" by rancher definition because it has been established through the interaction of many buyers and sellers within a "range market" area.

A general hypothesis has guided the research reported here. It is that the economic principles of supply and demand operate to establish range forage prices just as they do for products in other market places. Of course, variations exist and lags in price changes occur as a result of shifts in supply and demand pressures. These characteristics are evident in any market place in the real world because knowledge is not perfect and expectations of the future are varied and uncertain. The market will clear itself, however, unless there are arbitrary and capricious restrictions imposed on either demand, supply, or both. If administrative restrictions become institutionalized over time in the minds of suppliers and consumers, then a new market structure will be created that will clear the market. This has happened to range forage markets as will be demonstrated later.

If society decides that the value for range forage as determined by the market, or that the share of the value it captures is not "fair", then it should consider the social costs of changing either the value or the share captured. Windfall gains and windfall losses are often sustained by different groups of people when society manipulates established economic institutions.

Ranching in the West has an economic order that has operated under a relatively stable institutional environment since the creation of national forests and since the Taylor Grazing Act was implemented over 30 years ago.

How to Discover Range Values

The Models

If the laws of economics operate freely in a range market area as hypothesized, rancher total-use-costs for comparable public and private ranges will be equal. If cost differentials exist, ranch-

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ers will attempt to gain control of the low-cost forage source. In the process of shifting demand, the price of the low-cost forage will increase and the price of the high-cost forage will decrease until the differential is erased. If the fee for one forage source is fixed by administrative edict, other use costs free to adjust in the market will do so even if it means creating a new asset such as a "permit value". In the end, market-sensitive use costs will be revised until differentials are eliminated.

The disposition of grazing permits on public ranges among potential users is not completely free. Some rationing exists; base property is required in order to obtain permits to graze; uncertainty of tenure on public ranges is experienced by ranchers; and, fear of permit reductions is growing among ranchers. These negative forces may cause the value of public ranges set by ranchers to be less than the value for the more secure but productively comparable private ranges.

The above economic model has been developed in more sophisticated terms several times before.[3] The present research was designed to test the model with analysis of data obtained from range markets in Utah. Three questions were asked at the outset.

1. What are total rancher costs for using comparable public and private ranges?
2. What is forage on comparable public and private ranges worth to ranchers at the site?
3. What factors are needed to predict with confidence total range use costs?

Each question attacks the problem of discovering range values differently. Number 1 postulates that total rancher use costs for comparable public and private ranges will be equal or nearly so. Any differences will be in favor of the private range as a result of the restrictions on the model noted earlier. If the postulate is correct, then the value to ranchers of a range of a certain quality can be established by looking at the situation for either public or private ranges of the same quality in each range market area. The operational questions are reduced to formulas. For public ranges:

$$Y_1 = F_1 + P_1C + E_1 \ldots\ldots (1)$$

Where:

Y_1 = total annual use costs per AUM for a U.S. Forest Service range.
F_1 = the annual Forest Service range grazing fee per AUM.
P_1 = the market value per AUM for Forest Service grazing permits.
C = the capitalization rate.
E_1 = the total annual non-fee use costs per AUM ($E_1 \ldots i$) for a Forest Service range.

$$Y_2 = F_2 + P_2C + E_2 \ldots\ldots (2)$$

Where:

Y_2 = total annual use costs per AUM for a Bureau of Land Management (BLM) range.
F_2, P_2, C, and E_2 are defined as in formula (1) except for the BLM rather than the Forest Service.

For private ranges:

$$Y_3 = F_3 + E_3 \ldots\ldots\ldots (3)$$

Where:

Y_3 = total annual use costs per AUM for grazing private range.
F_3 = annual grazing fee per AUM for private range.
E_3 = total annual non-fee use costs per AUM ($E_1 \ldots i$) for grazing leased private range.

If the economic proposition posed earlier is correct, $Y_1 = Y_2 = Y_3$ for ranges of comparable quality. The P's, E's, and F_3 are free to fluctuate as market conditions change or as F_1 and F_2 (the administered fees) misprice public ranges.

Formulas 1, 2, and 3 partition total rancher use costs among resource owners. E_1, E_2, and E_3 pay for rancher-owned non-fee services or for services hired by ranchers. F_1 and F_2 are captured by society through public land management agencies. F_3 is paid to private land owners. The P's are assets owned by ranchers and are part of the capital investment in ranching just like land, buildings, and equipment. Whether or not owners capture the full value of the contribution of their resources to livestock production is another question.

Question Number 2 attempts to discover the value of range forage at the site. The formulations are:

$$V_1 = F_1 + P_1C \ldots\ldots\ldots (4)$$

Where:

V_1 = the annual value per AUM to ranchers of the forage on a U.S. Forest Service range.
F_1 = the annual Forest Service grazing fee per AUM.
P_1 = the market value per AUM for Forest Service permits.
C = the capitalization rate.

$$V_2 = F_2 + P_2C \ldots\ldots\ldots (5)$$

Where:

V_2 = the annual value per AUM to ranchers of the forage on a BLM range.
F_2, P_2, and C are defined as in formula (4) except for the BLM rather than the Forest Service.

$$V_3 = F_3 \ldots\ldots\ldots\ldots (6)$$

Where:

V_3 = the annual value to ranchers of the forage on a private range per AUM.
F_3 = the annual private range grazing fee per AUM.

The only difference between the Y's and V's is the dropping of the E's in the latter formulas. If $Y_1 = Y_2 = Y_3$, then V_1, V_2, and V_3 indicate the value of forage and related on-site services which landlords could charge ranchers without upsetting the balance between public

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[3] *See: B. Delworth Gardner, Transfer restrictions and misallocation in grazing public range, Journal of Farm Economics, February 1962. Gardner, A proposal to reduce misallocation of livestock grazing permits, Journal of Farm Economics, February 1963. Michael F. Brewer, Public pricing of natural resources, Journal of Farm Economics, February 1962. N. K. Roberts, Economic foundations for grazing use fees on public lands, Journal of Farm Economics, November 1963. Marion Clawson, Determination of sales and lease values of public and private lands, Journal of Farm Economics, 1938.*

and private range values. For comparable ranges V_1 and V_2 will generally be smaller than V_3, ($V_1 < V_3 > V_2$), because E_1 and E_2 are larger than E_3, ($E_1 > E_3 < E_2$). Private ranges are generally closer to a lessee's base of operations and include more nonforage on-site services than public ranges; thus, transportation, herding, and death loss costs are lower for lessees of private ranges. Range owners (public and private) do charge for the nonforage on-site services provided, but they cannot upset the $Y_1 = Y_2 = Y_3$ proposition for long or lessees will increase their effort to control the lower cost ranges.

The answer to question 3 will help predict what the market price of any range is to ranchers if appropriate data are available. To be useful it must explain enough of the variation in the Y's of formulas 1, 2, and 3 to make prediction possible. The general formula is:

$$Y = f(X_1) \ldots\ldots\ldots\ldots (7)$$

Where:

Y = the annual total rancher use cost per AUM for any range.

f = "function of".

X_1 = the factors ($X_1 \ldots X_n$) influencing Y.

The concern with formula 7 is not with cause and effect but with association and prediction. If prediction is possible, then a logical basis for variable fees based on range quality measures can be established.

The Design

Cattle and sheep ranchers, public land agencies, and credit agencies in Utah were contacted for information to satisfy the needs of the formulas introduced above. About 635 public and private range situations were studied in detail. Information covering all aspects determining range use levels and costs were obtained for each range situation studied. Observations were obtained from every county in the State in order to represent all the possible range market areas.

Record data on actual leasing situations were obtained wherever possible. In some cases, however, contacts reported what they thought lease fees were for various range classes in their area. A mean difference test was made for actual and estimated lease fees to see if there was a difference. The statistical test indicated that there was no significant difference at the 1% level of probability between estimated and actual lease fees in the State. Thus, ranchers, public land managers, and credit agencies in Utah know what the range lease market is in their areas.

Control over important variables was introduced by stratifying the ranges on the basis of three variables possessing definite class indicators. The first was to determine if the range was grazed by sheep or cattle. Because of the vegetation some ranges are classed as cattle ranges and some as sheep ranges. Even if the vegetation does not determine the class of livestock grazing the land, sheep and cattle ranges have become institutionalized to the point that a sheep range does not easily enter the cattle range market and the opposite is also true. A mean difference test indicated that a significant difference did exist between total sheep and cattle range use costs per AUM.

The second stratifying variable was season of use. Natural phenomena determine to a large extent the season a range will be grazed. The clearest distinction is between summer and winter ranges. Spring and fall grazing is usually transitional. Actual season of use, like class of livestock, has become institutionalized. Even where season of use is ecologically improper, a summer range does not easily enter the winter range market.

Third, data were gathered for public and private ranges which, of course, constitutes the comparison of primary interest in the research.

The Analysis

Comparisons are made between public and private ranges whereever data were available. First, total range use costs (Y's) are analyzed; second, forage site values (V's) are presented; and third, methods of predicting range values are developed.

Total Rancher Use Costs (Y's)

In this section total range use costs are presented and analyzed for the state of Utah. Also, the differences among the means for comparable ranges but differing ownership situations were statistically tested to determine if they are real.

Obviously, not all possible "quality" combinations of public and private ranges in Utah are important enough to include in the analysis. Most of the high summer ranges are controlled by the U.S. Forest Service. Much of the winter, desert ranges are controlled by the BLM. Not much privately owned winter range is leased. Only those combinations where private range and one or the other public range situations could be compared are included.

Public land use costs per AUM (Y_1 or Y_2) were composed of the following (Table 1):

F = the grazing fee.

PC = the permit value discounted at 6 percent.

E_1 = death losses.

E_2 = herding.

E_3 = hauling and traveling.

E_4 = other costs such as watering, fencing, and grazing association fees.

Two major types of leasing are recognized for privately owned range. The first system requires the landlord to assume the costs of supporting the lessee's livestock. In the second system the lessee takes over the range and assumes the costs of maintaining the range and the livestock. The components of total rancher utilization costs are different in each case. Since the first leasing system was by far the most often used in Utah in 1964 and since no significant difference at the 1% level was found between total use costs for the two over the state, only the first is included here (Table 2). The component costs per AUM were:

F = the grazing fee.

E_1 = death losses.

E_2 = travel and livestock transportation.

E_3 = lessee herding costs.

Except in one case, the differ-

Table 1. Total rancher use costs per AUM for publicly owned range lands, Utah, 1964.

Range class	No. of obs.	Grazing fee (F)	Permit value disc. @ 6% (PC)	Death losses (E_1)	Herding (E_2)	Distance hauling and travel (E_3)	Other costs (o) (E_4)	Total utilization costs (Y_1 or Y_2)	Permit values per AUM (P)
		cents	cents	cents	cents	cents	cents	dollars	dollars
Cattle:									
BLM— winter desert	37	30	72	52	44	46	79	3.25	12.08
BLM— spring-fall desert	19	30	52	47	29	70	52	2.80	8.52
BLM— summer foothill	14	30	81	102	10	45	38	3.06	13.51
BLM— summer desert	21	30	64	105	28	53	48	3.28	10.61
BLM— year long desert	12	30	139	59	72	63	101	4.64	23.32
FS— summer mountain	193	57	123	107	28	65	48	4.28	20.15
Sheep:									
BLM— winter desert	42	30	70	60	145	55	70	4.30	11.75
FS— summer mountain	48	55	155	145	185	60	55	6.55	26.15

(o) Includes watering, fencing, and grazing association fees.

Table 2. Total rancher use costs per AUM when leasing privately owned range, Utah, 1964.

Range class	Number of obs.	Grazing fee ($)(F)	Death losses (¢)(E_1)	Travel to and from site (¢)(E_2)	Herding (¢) (E_3)	Total util. costs ($) ($Y_3$)
Cattle:						
Winter desert	8	2.07	42	47	41	3.37
Spring-fall desert	13	2.30	34	40	36	3.40
Summer mountain	68	3.51	52	54	22	4.79
Summer desert	7	3.12	37	32	22	4.03
Sheep:						
Summer mountain	25	3.40	70	60	155	6.25

ences in total utilization costs per AUM between comparable public and private ranges were not statistically significant at the 5% level (Table 3). Thus, Y_1 could equal Y_3, and Y_2 could equal Y_3 statistically speaking. No comparison between Y_1 and Y_2 was made because of the limited seasonal overlapping of the two public agency ranges. Also, in some cases the number of observations involving private range is small because of the lack of private leases in those classes. Still, the evidence strongly supports the conclusion that a range market is operative which has adjusted to the institutional framework superimposed upon the public resource over 30 years ago for BLM and even longer for U.S. Forest Service ranges.

In the case of the Forest Service range used by cattle in the summer, the difference between public and private use costs is not great, but it is significant at the 5% level and it might be real. Possibly the difference is the result of the uncertainty of forest grazing permit control that has built up over a number of years in some parts of Utah. The pressure of extensive recreation is certainly greater on the mountain areas than on the relatively larger areas of desert controlled by the BLM. Also, permit cuts that have taken place on forests generally have been cuts in actual use, where as ranchers have tended to use BLM ranges below their permitted number for years and recent adjustments have mainly eliminated the historical non-use. Thus, the fear of permit cuts probably depresses the

market for Forest Service permits in the study area.

Value of Range Forage at the Site (V's)

Since it has been established that statistically speaking $Y_1 = Y_3 = Y_2$ in the Utah range market, then the annual value of the forage (V) can be estimated by subtracting out of Y the non-forage costs. For Forest Service ranges (Y_1) and BLM ranges (Y_2) this annual value per AUM (V_1 and V_2) is composed of the fee (F) plus the discounted permit value (PC). In other words, F + PC is what ranchers are willing to pay for public range forage consistent with the cost of competing sources and other utilization costs. For private ranges, the fee (F) reflects what ranchers are willing to pay for forage consistent with other comparable sources and non-forage utilization costs (V_3). Of course, the fees cover the forage plus forage-related on-site services provided by the landlords of both public and private ranges. The lessee of a private range does not own an asset comparable to the permit value associated with use of public range. Because non-forage use costs differ between public and private ranges, $V_1 < V_3 > V_2$ (Table 4).

The fact that $E_1 > E_3 < E_2$ verifies the hypothesis that public range forage under present management is worth less to ranchers than comparable private range forage. Because of this situation, public grazing fees high enough to reduce permit values to zero should still be less than private grazing fees for comparable ranges.

Who, after all these years of federal range administration, should capture the value of the public grazing resources (V_1 or V_2) is not the same question as, what is the value of public range forage. The second question has been answered; the first question has not. To answer it policy makers must decide whether or not the consequences of capturing the full value of the range (F + PC) are worth it.

The consequence on the one hand is that society would capture the full value of its resource. The consequences on the other hand are first, that rancher fixed costs would be reduced and annual cash operating costs would increase; thus, increasing the economic risk in ranching. Second, the loss of the permit asset would result in a transfer of income from ranchers to society, aggravating poverty problems already found in ranching communities.

Predicting Use Costs ($Y = f(X_i)$)

A number of variables contribute to the variation in rancher total range use costs (Y). The purpose of this analysis is to identify the minimum number of variables required to predict Y with confidence. Since the previous analyses have indicated that economic laws are operative in pricing range land with similar characteristics regardless of ownership, then the Y predicted for one ownership class should also predict the Y's for all other ownership classes. Land administrators could then look at the range source where data are most conveniently located.

Not all possible livestock-season classes for public ranges are

Table 3. Private vs. public range comparisons of total use costs ($/AUM), Utah, 1964.

Range class	Number of observations		Average use costs			Satistically significant differences at the 5% level of probability
	Public	Private	BLM	FS	Private	
Cattle:						
Winter desert	37	8	3.25		3.37	no
Spring-fall desert	19	13	2.80		3.40	no
Summer mountain	193	68		4.28	4.79	yes
Summer desert	21	7	3.28		4.03	no
Sheep:						
Summer mountain	48	25		6.55	6.25	no

Table 4. Annual value to ranchers of range forage and related services ($/AUM) for comparable public and private sources, Utah, 1964.

Range class	Number of observations		Average annual values (V's)			Differences significant at the 5% level of probability
	Private	Public	FS[0]	BLM[0]	Private[00]	
Cattle:						
Winter desert	8	37		1.02	2.07	yes
Spring-fall desert	13	19		.82	2.30	yes
Summer mountain	68	193	1.80		3.51	yes
Summer desert	7	21		.94	3.12	yes
Sheep:						
Summer mountain	25	48	2.10		3.40	yes

[0] V_1 or $V_2 = F + PC$ and $C = 6\%$.

[00] $V_3 = F$. Remember that the Y's, total use costs, are not significantly different (Table 3).

common enough to warrant study. Those important in Utah are:

1. Cattle grazing U.S. Forest Service mountain range in the summer.
2. Sheep grazing U.S. Forest Service mountain range in the summer.
3. Cattle grazing BLM desert range in the winter.
4. Cattle grazing BLM desert range in the summer.
5. Sheep grazing BLM desert range in the winter.

Some factors that influence annual use costs are evident in all range classes. These are the ones that can help predict Y. The variables (X's) considered for public ranges were:

1. Carrying capacity in acres per AUM.
2. Length of grazing period.
3. Percent of the range improved or reseeded.
4. Death losses per AUM.
5. Distance traveled to utilize the range per AUM.
6. Range improvement per AUM.
7. Herding per AUM during the season.
8. Miscellaneous costs per AUM including water, fence, and association fees.
9. Grazing fees charged per AUM.
10. Discounted permit values per AUM.

Not all 10 of the variables were significantly (added more than 8% to the explaining ability of the multiple coefficient of determination, R^2) associated with variations in the Y's for public ranges. Only 4, 5, 6, 8, and 10 proved to be important in this linear analysis, and not all of them in each case (Table 5). Death losses (X_4) were important in all public land cases. Miscellaneous costs (X_8) were important in all but the cattle-summer class.

Privately-owned ranges were leased two ways. The first placed much of the responsibility for the lessee's livestock on the landlord. The second placed much of the responsibility for the range upon the lessee. Total use costs were not significantly different at the 1 percent level for the two types of lease arrangements for comparable ranges.

Lease type 1 was found most often during the survey. Two range classes had enough observation for study:

1. Cattle grazing summer valley ranges.
2. Cattle grazing summer mountain ranges.

In the case of lease type 2, two range classes had enough observations to warrant study.

4. Sheep grazing spring or fall mountain ranges.
5. Sheep grazing summer mountain ranges.

Ten variables (X's) were identified as influencing lessee use costs (Y_3) for lease type 1, whereas, 17 were suggested for lease type 2. Not all the X's proved to be necessary to predict Y_3. Only three were needed to provide a strong predictive formula for either lease type (Table 6).

Of course, there is no cause

Table 5. Multiple regression summary for total user costs on public range lands, Utah, 1964.

Range class	Obs.	Regression coefficients (b's)[00] Death loss X_4	Dist. costs X_5	Impr. costs X_6	Misc. costs[0] X_8	Permit values[a] X_{10}		Coef. of determination[00] R^2
Cattle:								
Mountain summer	192	.87	1.15	−2.03	.94	1.04	.71	.8925
Desert winter	37	1.00	.98	.....	.90	.....	.20	.9075
Desert summer	21	1.07	.....	.....	1.12	.91	.67	.9572
Sheep:								
Mountain summer	48	1.06	.....	.....	1.08	.99	.20	.9075
Desert winter	42	1.04	.91	.....	.98	.....	.24	.9206

[0] Includes drinking water, fence maintenance, association fees, salt, supplemental feed, and incidental expenses.
[00] All significant at the 1% level of probability.

Table 6. Multiple regression summary for total user costs on leased private range lands, Utah, 1964.

Range class	Number of obs.	Regression coefficient (b's)° Death loss costs X_1	Distance costs X_2	Grazing fee X_3	Herding costs X_4	a	Coef. of det.° R^2
Lease Type 1:							
Cattle summer valley	58	1.17	.15	.77		.88	.8248
Cattle summer mt.	55	1.35		1.03		.02	.9375
Lease Type 2:							
Sheep spring fall mt.	16	1.25		1.03	1.45	—.02	.9397
Sheep summer mt.	16			.93	1.14	.36	.9057

° All significant at the 1 percent level of probability.

and effect relationship intended from the analysis. It is enough for this study that three to five "bits" of information make it possible to predict total rancher utilization costs for grazing land with similar livestock-season characteristics.

Conclusions

This research has verified several hypotheses concerning range markets in Utah:

1. Range markets do exist.
2. Ranchers and others know prices in their range market areas.
3. Total use costs for comparable ranges are statistically equal for public and private sources or favor private sources when uncertainty increases.
4. The value of forage and related on-site services to ranchers at the site is lower for public than for privately owned ranges of comparable productivity because non-forage use costs are higher on public ranges.
5. The fee plus the discounted value of the permit is a good estimate of the value of public forage at the site.
6. It is possible to predict total use costs for both public and private ranges with a relatively few pieces of data that are available.
7. Increasing fees will affect ranches two ways. First, it will increase cash costs, decrease net ranch income, and increase risk in ranching. Second, increasing fees to the point where society captures the full value of the forage will effect an income transfer from ranching to society by eliminating the rancher-owned investment in his permit assets.