Forest Service and livestock permittee behavior in relation to wilderness designation

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Abstract

Even though the Wilderness Act of 1964 provided for continuation of livestock grazing after wilderness designation, there has been continued debate about the Forest Service's implementation of this provision and the impact on livestock grazing permittees. The effect of wilderness designation, during the first 20 years after designation, on Forest Service and permittee behavior on Coronado and Tonto National Forests in Arizona was evaluated by (1) comparing changes in permitted AUMs, changes in permit ownership, and proportion of nonuse of permitted AUMs between paired wilderness and nonwilderness grazing allotments, and (2) assessing the importance of the proportion of an allotment in wilderness on these same behavioral parameters. In general, permitted AUMs increased on wilderness allotments but remained the same for nonwilderness allotments. However, there was no difference on Coronado National Forest when forests were analyzed separately. Compared to nonwilderness allotments, wilderness allotments had greater permittee turnover on Coronado National Forest, but there were no differences between wilderness and nonwilderness allotments when forests were combined. The higher the proportion of an allotment in wilderness, the faster the turnover of permit owners, but wilderness proportion did not affect nonuse or changes in permitted AUMs.

Key Words: rangeland policy, animal unit months, voluntary nonuse, grazing permit ownership, Arizona

Does wilderness designation impact livestock operations? This question gained prominence when early versions of the National Wilderness Preservation Act (Wilderness Act) first appeared in 1956, took focus in 1964 with passage of the Wilderness Act, and has recently been revitalized as lands administered by the Bureau of Land Management are being considered for wilderness designation (McClaran 1990). One area of concern is defined by Section 4(d)(4)(2) of the Wilderness Act that permits livestock grazing to continue in wilderness areas where it was present before designation, and prevents wilderness status from being used as a basis for reductions in livestock use. In addition, wilderness impact questions include the significance of such indirect effects as requirements to switch from mechanized to more primitive equipment, and reduced opportunities to apply vegetation and structural improvements. Perceived increased operating costs and decreased management flexibility associated with these indirect effects formed the basis for industry resistance to passage of the Wilderness Act and subsequent resistance to designation of new wilderness areas (McClaran 1990; Roth 1984a, 1984b). The Forest Service predicted that livestock use would decline due to increased costs of equipment restrictions and from missed opportunities for vegetation and structural improvements (United States Forest Service 1979). Despite more lenient restrictions on equipment and structures adopted by the Forest Service in 1980, the change has not been significant enough to quiet the debate and concern over the indirect impacts of wilderness designation (McClaran 1990). Contrary to these projections of negative impacts, in his seminal discussion of wilderness establishment, Aldo Leopold (1921) suggested that ranchers would benefit from wilderness designation because interference from road building and human traffic would be reduced.

Despite strongly held opinions concerning wilderness impacts on livestock operations, there has been a paucity of evidence evaluating agency and permittee behavior relative to wilderness designation. Popular accounts of stocking rate reductions and abandonment of wilderness allotments, and Trieman's (1976) analysis of permittee and stocking rate changes during the first 10 years after passage of the Wilderness Act, provide only half of the picture. Because permitted stocking rates, voluntary nonuse, and permittee turnover have fluctuated since the Forest Service began regulating grazing (Rowley 1985), and have continued since the passage of the Wilderness Act in 1964 (Joyce 1989), reduced stocking and abandonment of wilderness allotments is not surprising in and of itself. Therefore, a comparison of these fluctuations between wilderness and nonwilderness allotments would help isolate these background fluctuations.

If wilderness designation affects agency and permittee behavior, does designation of only part of an allotment have less of an effect? Again, for perspective, the proportion of the allotment in wilderness should be compared to an independent parameter of proven influence on permittee behavior such as allotment size (Workman 1986).

This study evaluates (1) the impact of wilderness designation on livestock operations by comparing Forest Service and permittee behavior expressed on nearby and physically similar wilderness and nonwilderness allotments, and (2) the influence on these behaviors of the proportion of the allotment designated as wilderness.

Certainly an unequivocal parameter of Forest Service behavior related to wilderness would be the change in an allotment's stocking rate since wilderness designation. By law, the Forest Service should not decrease the permitted stocking rate on an allotment simply because of wilderness designation. However, reducing stocking to protect resources is as legitimate on wilderness as nonwilderness allotments. Therefore, the first null hypothesis is that changes in permitted use since the date of wilderness designation will not be different between wilderness and nonwilderness allotments.

If wilderness designation limits efficient operation and opportunities to increase production because modern equipment and vegetation and structural improvements are restricted, then parameters that measure the impact of wilderness on permittee behavior should address expectations and willingness to invest in the operation. I used permit turnover and voluntary nonuse of permitted stocking (percentage of available permitted use not used and not paid for) as parameters to reflect permittee expectations and willingness to invest. These parameters were chosen because they are available as public records and, thus, are not susceptible to subjective biases that might occur from questionnaires sent to permittees (if living and locatable) concerning their business practices as much as 25 years ago. Therefore, the second and third null hypotheses are that permit turnover and nonuse since wilderness

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designation will not be different between wilderness and non-wilderness allotments.

To evaluate the relative influence of increasing the proportion of an allotment in wilderness to the size of an allotment, I chose to work with animal unit months (AUMs). The size of the allotment was expressed as total AUMs, and the proportion of AUMs in wilderness was calculated as the product of total AUMs and proportion of the allotment's grazeable land (land with forage rather than rock and cliffs) within wilderness. Therefore, the final null hypothesis is, that for wilderness allotments, accuracy of predicting agency and permittee behavior is not improved by including the proportion of an allotment's AUMs within wilderness.

Methods

Forest Service grazing permit records and annual billing receipts between 1965–84 for 40, year-round (predominantly cow-calf) grazing allotments in the Tonto and Coronado National Forests, Arizona, were used in this study. Half of the 16 Coronado allotments were at least partially within the Galiuro Wilderness (21,329 ha) boundary. Half of the 24 Tonto allotments were at least partially within 1 of 3 wilderness areas: the Mazatzal (82,943 ha), Sierra Ancha (8,436 ha), and Superstition (53,308 ha). These 4 wilderness areas were selected because they had experienced significant livestock use prior to, and since wilderness designation in 1964. Because all 4 areas were enlarged by the Arizona Wilderness Act of 1984, I focused my study on the effects of the original wilderness boundaries from 1965–84. With the assistance of the Range Staff Officers from each Forest, I chose nearby non-wilderness allotments that were similar to wilderness allotments in terms of size, terrain, and livestock stocking. This created pairs of comparable wilderness and nonwilderness allotments. Although it is unlikely all the ranching operations for each pair of allotments are similar, this does not invalidate the comparisons.

The focus of this study is an evaluation of federal land policy on federal agency and federal land grazing permittee behavior, not on entire ranching enterprises. For example, Gila and Maricopa County ranchers are generally more dependent on Tonto National Forest for their total AUMs than Graham County ranchers are on Coronado National Forest AUMs, 72 and 21% respectively (Mayes and Archer 1982). Therefore, because the nature of ranching operations, dependency on federal land, size and terrain of allotments, available seasons of use, and date of wilderness designation vary throughout the western United States, the conclusions drawn from this study should be qualified by their characteristics of space and time. However, the methods used to reach these specific conclusions should be applicable to analysis of wilderness designation effects elsewhere.

To evaluate the effect of wilderness designation on Forest Service behavior, I compared changes in permitted use from 1965–84 between paired wilderness and nonwilderness allotments. Changes in permitted use were calculated as the average proportion of 1965

Table 1. Comparison of wilderness and non-wilderness allotments.

	Allotments				
	Wilderness		Non-wilderness		
	$\bar{x}$	SE	$\bar{x}$	SE	p-value[1]
ALL ALLOTMENTS	(N = 20)		(N = 20)		
Area (ha)	10035	(1737)	9665	(1920)	.802
Grazeable area (ha)	7881	(1769)	7862	(1857)	.990
Average permitted AUMs (1965–84)	2399	(464)	2908	(588)	.175
Proportion of 1965 AUMs (1965–84)	1.05	(.04)	0.97	(.03)	.061
Number of owners (1965–84)	2.7	(.29)	2.2	(.29)	.227
Proportion non-use AUMs (1965–84)	0.10	(.03)	0.07	(.01)	.222
TONTO FOREST ALLOTMENTS	(N = 12)		(N = 12)		
Area (ha)	14168	(1977)	13920	(2410)	.921
Grazeable area (ha)	12149	(2159)	12016	(2423)	.957
Average permitted AUMs (1965–84)	3246	(632)	4128	(784)	.158
Proportion of 1965 AUMs (1965–84)	1.11	(.06)	1.0	(.04)	.077
Number of owners (1965–84)	2.42	(.34)	2.58	(.42)	.748
Proportion non-use AUMs 1965–84)	0.12	(.04)	0.07	(.02)	.206
CORONADO FOREST ALLOTMENTS	(N = 8)		(N = 8)		
Area (ha)	3835	(1454)	3284	(1274)	.300
Grazeable area (ha)	1479	(688)	1631	(554)	.466
Average permitted AUMs (1965–84)	1131	(367)	1079	(315)	.598
Proportion of 1965 AUMs (1965–84)	0.97	(.02)	0.94	(.05)	.557
Number of owners (1965–84)	3.0	(.54)	1.5	(.27)	.020
Proportion non-use AUMs (1965–84)	0.07	(.03)	0.07	(.02)	.932

[1]Two-tailed probability for 2 sample comparison made with paired t-test (Sokal and Rohlf 1981).

Table 2. Regression coefficients, coefficients of determination (R^2) and respective probabilities (p) for initial model (location and average AUMs), and the P-to-enter value for the addition of proportion wilderness to the initial model for allotments containing some wilderness.

	Independent variables						
Dependent variable	Constant	Location[1]	Average[2] permitted AUMs	Proportion wilderness	R^2	p	P-to-[3] enter
Proportion 1965 AUMs	1.11	–.14	$9.7X10^{-7}$		.17	.21	
	1.07	–.13	$2.9X10^{-6}$	0.11	.19	.32	.52
# owners	1.23	1.36*	$3.6X10^{-4}$*		.30	.05	
	1.54	1.54*	$3.0X10^{-4}$*	1.90*	.41	.03	.09
Proportion non-use	0.09	–.03	$1.1X10^{-5}$		.08	.47	
	0.57	–.02	$7.8X10^{-6}$	0.09	.12	.56	.48

[1]Tonto National Forest = 0, Coronado National Forest = 1.
[2]Average permitted AUMs for the years 1965–84.
[3]Probability that the change in R^2 is zero with the addition of percent wilderness to the model.
*Regression coefficients that are different from zero at $p \leq 0.1$ using a t-test.

AUMs that was permitted from 1965–1984;

$$y = \left\{ \sum_{i=1965}^{i=1965-84} \frac{X_i}{X_{1965}} \right\} \div 20$$

where: y is the average proportion of 1965 AUMs from 1965–84, and x_i is permitted AUMs. To evaluate the effect of wilderness designation on permittee behavior, I compared the number of permit owners and the amount of voluntary nonuse from 1965–84 between paired wilderness and nonwilderness allotments. A change in permit ownership required a formal exchange of deeds or the addition or deletion of deed partners. The average proportion of nonuse from 1965–84 was calculated as the difference between permitted and paid AUMs;

$$y = \left\{ \sum_{i=1965}^{i=1965-84} \frac{X_i - Z_i}{X_i} \right\} \div 20$$

where: y is the average proportion of nonuse from 1965–84, x_i is permitted AUMs, and z_i is paid AUMs. I used paired *t*-tests to evaluate these paired comparisons because this procedure focuses on the differences between allotment pairs (Sokal and Rohlf 1981).

For wilderness allotments only, I used multiple regression analysis to evaluate the influence of proportion of total AUMs in wilderness on agency and permittee behavior. I measured the predictive value of adding proportion of AUMs in wilderness to the initial model of total AUMs and location (Tonto or Coronado National Forests). Sokal and Rohlf (1981) refer to this approach as "forward selection" model building. If the proportion of AUMs in wilderness is important in explaining the variation in these behaviors, then its addition to the model should improve the coefficient of determination (R^2). I evaluated the significance of the R^2-change with the "P-to-enter" value that describes the probablility that the increase in R^2 with the addition of an independent variable is zero (Sokal and Rohlf 1981).

I used a $p \leq 0.1$ criterion to reject the null hypotheses for all inference analyses.

Results and Discussion

Selection of paired wilderness and nonwilderness allotments was successful; allotment size, grazeable area, and permitted AUMs were not significantly different between the wilderness and nonwilderness pairs (Table 1). Note that these allotment parameters only suggest that the Forest Service land leased for grazing use is similar, not that the remaining properties and leases used by the ranching operation are necessarily similar.

In general, allotment sizes and AUMs per allotment were greater in the Tonto than Coronado National Forest (Table 1), but proportion of grazeable allotment in wilderness was not different between forests (Tonto 0.47 (SE=0.07), Coronado 0.29 (SE=0.10), p=.148 using a *t*-test). These differences in allotment sizes and AUMs justify including location (Tonto or Corondo National Forests) as an independent variable in the regression analysis (Table 2).

The comparison of agency behavior between wilderness and nonwilderness allotments yielded different results for each forest. Although changes in permitted AUMs were different between wilderness and nonwilderness allotments for both forests combined, this difference was not apparent for Coronado N.F. allotments alone (Table 1). The increase in AUMs for wilderness allotments is contrary to the negative impact expected if designation is detrimental. The increase in permitted AUMs in Tonto N.F. may have resulted from structural and vegetation improvements performed on the portion of the allotment outside the wilderness boundary rather than increased carrying capacity within the wilderness portion of the allotments (Dave Stewart pers. comm., Range Staff Officer, Tonto N.F.).

Differences in permittee behavior between wilderness and nonwilderness allotments were also forest specific: about half as many ownership changes in nonwilderness allotments occurred in Coronado N.F., but there was no difference for Tonto N.F. (Table 1).

These forest-specific differences in wilderness and nonwilderness comparisons demonstrate a geographic variability in wilderness designation effects. It is possible that because Tonto N.F. ranchers have larger allotments and are more dependent on Tonto N.F. for their total AUMs than Coronado N.F. ranchers, they may have greater incentive to improve areas of the allotment outside of the wilderness rather than abandoning the allotment permit.

Analyzing only wilderness allotments, the proportion of the grazeable allotment within wilderness had no effect on agency behavior (proportion of 1965 AUMs) (Table 2). There was an effect on permittee behavior but only with respect to permit tenure (Table 2). Changes in permitted AUMs appear to be independent of the proportion of an allotment in wilderness, allotment size, and location (Tonto or Coronado National Forests). Similarly, permittee willingness to fully use permitted stocking opportunities, as measured by proportion nonuse, was not related to proportion of the allotment in wilderness, allotment size, or location. Changes in number of permit owners was positively related to proportion of the grazeable allotment in wilderness, and the inclusion of proportion of allotment in wilderness significantly improved the linear regression model consisting of location and allotment size (Table 2). Although the comprehensive model (location + size + proportion wilderness) accounts for only 41% of the variation in permit ownership between 1965–84, allotment size and proportion wilderness clearly increase the number of permit ownership changes over time.

If fulfillment of rancher expectations is reflected in persistence of permit ownership, then these results suggest that increasing amounts of wilderness interferes with the achievement of their expectations. Presumably, new permittees fully understood the constraints of managing livestock in wilderness, and it is possible that recent buyers have expectations about ranching that are more compatible with wilderness constraints, and akin to the Leopold (1921) view that wilderness designation is beneficial to their expectations of ranching. Smith and Martin (1972) and Bartlett et al. (1989) suggest that existing ranchers are motivated to remain in the business for quality-of-life reasons rather than purely wealth enrichment, but the motivations of new ranchers, as distinct from existing ranchers or ranchers in general have not been described. Nonetheless, because the average permit for allotments with some wilderness had at least 1 ownership change from 1965–84 (Table 1), and specifically 5 of 12 Tonto permits and 5 of 8 Coronado permits for wilderness allotments have had 2 or more ownership changes in this period, there is evidence that the expectations of newer owners may not always be met.

Because the number of owners of wilderness allotments was also positively related to allotment size (AUMs), the expectations of permittees with smaller allotments may be more likely to be satisfied than those with larger allotments. This pattern supports suggestions that ranchers remain ranching for reasons other than wealth enhancement (Smith and Martin 1972; Bartlett et al. 1989), because economies of scale would suggest that the larger allotments may be more profitable (Workman 1986).

In conclusion, on 2 Arizona national forests, wilderness designation was not followed by permitted use reductions by the Forest Service. Instead, there was a general increase in stocking in wilderness relative to nonwilderness allotments. The mere designation of

part of an allotment as wilderness did not consistently change permittee behavior of persistence on the allotment, but differences between wilderness and nonwilderness allotments was noted at the individual forest level. For wilderness allotments only, permittee turnover increased as proportion of the grazeable allotment in wilderness increased, suggesting that permittee expectations are less likely to be achieved with higher proportions of the allotment in wilderness. Because wilderness and nonwilderness comparisons varied between forests, the individual forest was an important influence on the effect that proportion of allotment in wilderness had on permit turnover.

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