APPENDIX C

LIVESTOCK GRAZING, FIRE REGIMES, AND TREE DENSITIES

Grazing occurs on 91% of all federal lands in the 11 contiguous western states (Armour et al, 1991). The negative effects of livestock grazing in a variety of native ecosystems have been documented in several excellent reviews (Fleishner 1994; Kauffman and Krueger 1984; Skovlin 1984; Thurow 1991) and in a recent report to the Interior Columbia Basin Ecosystem Management Project by Belsky and Blumenthal (1995). These papers, plus others that cover the effects of grazing on forests in western states, illustrate the transformations that have occurred throughout the west, including in the previously open, park-like ponderosa pine and mixed-conifer forests, which once stretched from British Columbia to Mexico.

A great deal of evidence exists suggesting that livestock grazing has contributed to increases in the distribution and density of many woody species across the western United States (see reviews by Arnold 1950; Ellison 1960; Bahre 1991; Archer and Smeins 1991). Scientists have found that livestock grazing causes increased tree densities in two ways:

- livestock consume and lower the density of grasses that would otherwise compete with tree seedlings for space, water and nutrients, and

- livestock remove the herbaceous understory which provides fuel for 'cool' surface fires that kill regenerating trees.

In addition, cattle and sheep directly facilitate conifer invasions into western grasslands by:

- exposing mineral soils and/or destroying cryptogamic (biotic) soil crusts and thereby creating mineral seedbeds, and

- inducing arroyo formation, which dries out meadows and promotes pine invasion.

Aldo Leopold (1924) was among the first to recognize that livestock grazing can result in reduced fire frequency. Indeed, some foresters of the day encouraged grazing (and in many cases still do) so that herbaceous fuel loads would be reduced and denuded areas could act as firebreaks (Leopold, 1924). Leopold's suspicions were borne out later as tree densities across the west began to increase concomitant with widespread livestock grazing (Cooper 1960; Madany and West 1983; Peet 1988; Belsky and Blumenthal 1995).

Shade increased with increasing forest density, fostering the growth of more shade-tolerant and fire-sensitive species such as Douglas-fir, noble fir and white fir. Forest stands previously dominated by fire-tolerant species such as ponderosa pine and western larch shifted to dominance by Douglas-fir and true fir, a process that was exacerbated by selective logging (Zimmerman and Neuenschwander 1984;

Habeck 1990; Morgan 1994). In all cases, the new stands of poles and saplings were forced into intense competition with each other, and the ability of young trees to withstand attacks by forest pests and diseases was compromised (Weaver 1950; Hessburg 1994; Morgan 1994). These pests and diseases became proportionately more prevalent in the denser stands appearing across the west.

In a series of papers published in the 1940s and '50s, Harold Weaver, mentioned earlier, also recognized the connection between livestock grazing and ponderosa thickets. He wrote that overgrazing was "of great significance in development of such stands, through breaking up of original sod cover and preparation of mineral seedbeds." Weaver warned that the future of these forests was in jeopardy, asking "Shall we attempt to reduce the hazard in the dense stands, or shall we ask for larger and ever larger [fire suppression] budgets?" Today's "crisis" is a result of the Forest Service choosing the latter course.

Cooper (1960) echoed Weaver's concerns, stating that "The overuse and mismanagement which followed introduction of livestock into the West produced profound changes, some of them permanent, in the plant cover. In particular, overgrazing has often been assigned as the primary cause of the overabundance of young pines." Similarly, Ellison (1960) and Archer and Smeins (1991) described the process whereby grazing allows the introduction of woody plants, shrubs, and trees into rangelands and forests. Ellison surmised that the transition from prairie to forest in the Middle West may have been caused by a factor seldom suggested or studied: overgrazing by domestic livestock.

The Critical Studies

In 1923 Aldo Leopold wrote "Whether grass competitors or fire was the principle deterrent to timber reproduction is hard to answer because the two factors were always paired, never isolated." The question of which variable, grazing or active fire suppression, is the primary cause of overstocking long vexed scientists because it was (and still is) difficult to find an ungrazed forest for a control site. We know of three field studies that were ultimately able to isolate the "paired" variables: these studies (Rummell 1951; Madany and West 1983; Zimmerman and Neuenschwander 1984) identified grazing as the principle factor in causing forest overstocking. A further study described the complex interactions needed to produce increased tree densities once grazing had been introduced (Savage and Swetnam 1990).

Rummell (1951) studied two neighboring and ecologically similar ponderosa pine forests in central Washington. One had been grazed by livestock for 40 years while the other had never been grazed by livestock. Neither had experienced a fire for at least 125 years. Rummell characterized the ungrazed forest as "one of the few [remaining] relicts of virgin ponderosa pine forest and range" with "an almost unbelievably lush mat" of pine grass. Significantly, very little pine reproduction was found: only 85 trees less than 4 inch dbh per acre.[1] In sharp contrast, the grazed forest had little grass, and a density of

[1]1 N.B. - Total number of Ponderosa/acre (all diameter classes) in Rummell's"open and parklike" area = 115; Doug fir = 18; western larch = 0.4 and grand fir= 1. Total number of trees per acre is then 134.4. This number is much

3,291 trees less than 4 inch dbh per acre (2,033 ponderosa pines, 1,016 Douglas firs, and 242 western larch).

Rummell concluded that the high density of herbaceous understory vegetation on the ungrazed forest contributed substantially to the low tree reproduction rate. Overall, "heavy grazing of the herbaceous understory vegetation, rather than exclusion of fire, appeared to be the prime factor in explaining the dense tree reproduction" on the grazed forest (emphasis added).

A similar study was conducted in 1983 on three areas in Zion National Park "almost identical biotically and environmentally." They had similar fire histories but markedly different grazing histories. The Horse Pasture Plateau was heavily grazed until about 1960, while Greatheart and Church Mesas - isolated by cliffs and slickrock - were never grazed and approximated pre-settlement conditions. Both areas were dominated by ponderosa pine and Gambel oak, and both had a similar history of browsing by large ungulates.

The authors characterized the study area as "uniquely suited to allow independent assessment of the relative importance of fire cessation and livestock grazing in the conversion of savannas to forests." They stated that the visual contrast between the areas was obvious, with dense thickets of ponderosa, Gambel oak, and Rocky Mountain juniper saplings prevalent on the grazed plateau and largely absent on the ungrazed mesas. They noted that fire was excluded from all the study areas but stated that decreased fire frequency alone is not the essential factor needed to cause these physiognomic changes. The

"presence of savanna conditions on Church and Greatheart Mesas despite long fire-free intervals is the strongest evidence yet for our contention...The fact that there were no thickets of "dog-hair" ponderosa pine on either mesa despite a comparable absence of fire, implicates livestock grazing as the critical factor (emphasis added)."

Fire, they say, "may have been the most important secondary factor for the maintenance of savanna conditions (emphasis added)." They went further, concluding that:

"Our findings challenge the widely accepted notion that the high frequency of fires in ponderosa pine savanna was the prime cause for the prevention of succession to denser stands of ponderosa pine or to shade-tolerant but fire-sensitive conifers... However important fire may be for management and maintenance of ponderosa pine communities, the key factor in the widespread conversion of savanna to forest seems to have been livestock grazing (emphasis added)."

The study showed that after the removal of livestock from Horse Pasture Plateau in 1960, the establishment rate for ponderosa pine dropped significantly. Importantly, this indicates that with the removal of cattle, the potential for forest restoration, via an increase in grass cover and a decrease in

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greaterthan the accepted Forest Service portrayal of 15-50 trees/acre for presettlementconditions in the SW Region.

tree density, is possible.

The third study, by Zimmerman and Neuenschwander (1984), looked at grazed and ungrazed ponderosa pine and Douglas-fir stands in the foothills of the Bitteroot Mountains of Idaho. The authors found the grazed stands of both species to have more young trees than ungrazed stands. As did the previous authors, Zimmerman and Neuenschwander concluded that "livestock grazing was probably the principal factor in creating and maintaining conditions that favored increased tree regeneration." They also predicted that if the grazed stands did not burn, they would "stagnate, causing reductions in growth rates and increased susceptibility to damage from insects and disease." This study, like the one in Zion National Park, is significant because the results suggest that if grazing is excluded and cool fires allowed to burn, the forests can once again approach their original healthy state.

Conclusion

While information linking livestock grazing to high stand density has been available for nearly a century, it appears to have been forgotten. Or, at least, the implications have not been expressed in Forest Service policy for any of the varied western forest types. Indeed, a review of recent Forest Service publications could find little mention of grazing as a factor in decreased forest health (Belsky and Blumenthal, 1995); instead the blame seems to fall almost exclusively on past fire suppression policies. The Forest Service's current move toward an active prescribed burning program is welcome (providing it is an appropriate program, i.e. no spring burning, etc), but such a program cannot be successful if the current level of grazing is maintained. The two are mutually exclusive.

It is imperative that whatever the next stages of the forest health debate include, the role of livestock grazing as a causal and perpetuating factor in forest health problems be recognized and addressed. This is not only a historical problem: as long as livestock are present, the problem will remain. Furthermore, it is clear that grazing is not just a range issue. It is a silvicultural problem and, given that the Forest Service must legally consider all relevant scientific information, it must be analyzed in timber sales, salvage sales, juniper control and other silvicultural activities.

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