*The following document is an Appendix to the Southern Utah Land Restoration Project's "Grazing Management Under a Multiple Use Mandate," submitted to the Grand Staircase Escalante National Monument (GSENM) for consideration in its preparation of a programmatic grazing Environmental Impact Statement (EIS).*

# APPENDIX A: A SCIENCE-BASED TOOL FOR DETERMINING WHETHER GRAZING IS THE CAUSE OF FAILURE TO MEET RANGELAND HEALTH STANDARDS

**A tool provided to the Monument range staff by the Southern Utah Land Restoration Project**

**September, 2003**

## SECTION 1: INTRODUCTION

This document presents a process, based on the best available science, that will help the Grand Staircase-Escalante National Monument (Monument) determine whether grazing is the cause of degradation when rangeland fails to meet Bureau of Land Management (BLM) rangeland health standards. The method presented here offers a systematic, repeatable, and legally defensible tool to assist BLM in meeting its obligations under the Fundamentals of Rangeland Health (Fundamentals) and Standards and Guidelines for Grazing Administration (Standards and Guidelines), 43 CFR § 4180. To this end, we draw upon expert experience and peer-reviewed science to outline a procedure for determining whether current grazing use and management is a significant factor that causes specific allotments or pastures to be classified as non-functioning or functioning at risk with a downward trend, and therefore not meeting BLM's rangeland health standards.

The determination method described here relies, to the greatest extent possible, on existing data, requires few agency resources, can be consistently replicated, is based on simple, observable evidence, and requires technical expertise common to land managers and experienced members of the public.

In keeping with the structure and approach common to other BLM ecological assessment processes, the determination method presented here uses the same indicators used in BLM's upland and riparian rangeland health assessment methods that describe livestock-related indicators of habitat health. Based on how many of these livestock-related indicators are indicating non-functioning conditions, the determination that grazing is the cause of an area not meeting rangeland health standards is based on a preponderance of evidence.

The need for a repeatable and quantitative method to make determinations on whether livestock grazing is causing impairment is relevant to the BLM beyond the borders of the Monument. The BLM promulgated the Fundamentals and Standards and Guidelines in response to the deteriorated state of the public lands subject to livestock grazing. The environmental impact statement (EIS) that analyzed the regulations revealed that 68.5 million acres, or 43% of BLM uplands assessed, were in non-functioning condition or were functioning at risk. According to BLM's most recently published data, 54% of riparian areas are functioning at risk or non-functional[1] – notwithstanding the Bureau's goal, established in 1989, of having 75% of riparian areas in "proper functioning condition" (BLM 1991).

This analysis echoes the findings of previous studies. In 1989, published land use plan information revealed that 94.7 million acres or 68.9% of BLM lands were in poor or fair condition, while only 43.8 million acres or 31.6% were in good or excellent condition (Wald and Alberswerth 1989). In 1988, the U.S. General Accounting Office concluded that many publicly owned riparian areas "are in degraded condition, largely as a result of

[1] Public Land Statistics (2001), Table 2-2 ("Lower 48 Totals").

poorly managed livestock grazing." (GAO 1988, pg.2). In 1990, the U.S. Environmental Protection Agency (EPA) similarly concluded that "extensive field observations in the late 1980's suggest riparian areas throughout much of the West were in the worst condition in history" (EPA 1990, pg. 2).

The above studies and agency data present a compelling need to identify the cause behind these rangeland conditions. That is where this guidance document will come in handy.

This document is organized as follows. First, we set the stage for our analysis, describing the statutory framework that guides BLM in making determinations that livestock is a significant factor in causing an area to fail to meet rangeland health standards (Section 2.0). We explain the statutory and regulatory foundations for the implementation of the Fundamentals of Rangeland Health and Standards and Guidelines, focusing on the critical determination of whether grazing management practices need to be changed to achieve healthy and sustainable ecosystems. We cite the BLM Handbook for preliminary guidance on this inquiry.

Second (Section 3.0), we present (1) indicators that present evidence of grazing use and overuse and its known impact to resources, as well as (2) specific habitat attributes tiered directly to BLM's rangeland health assessments that can be used to reach a determination. The above indicators include utilization monitoring, grazing stocking levels and distribution, season of use, BLM upland and riparian rangeland health assessments, and other observations. In terms of this last suite of indicators (those based on actual on-the-ground conditions revealed in rangeland health assessments), we feature those where the literature supports that failure to meet these key indicators can be attributed to livestock grazing. At the close of Section 3.0, we explain how to use the preponderance of evidence in determining that livestock grazing is a significant factor explaining why an allotment fails to meet the rangeland health standards

Third (Section 4.0), we explain how the relevant scientific literature generally rules out other possible factors that might be responsible for impairment in semi-arid and arid lands grazed by livestock in the intermountain West.

## SECTION 2: LEGAL FRAMEWORK FOR DETERMINATION OF WHETHER LIVESTOCK GRAZING IS A SIGNIFICANT FACTOR FOR AN AREA FAILING TO MEET RANGELAND HEALTH STANDARDS

The ailing condition of public lands outlined above confirms that, in failing to achieve healthy and sustainable ecosystems on the public lands, the BLM is violating the dictates of the Federal Land Management Policy Act (FLPMA). FLPMA, the core authority for BLM's management duties, requires the agency to manage the public lands to "protect the quality of" various values including ecological, environmental, and water resources. 43 U.S.C. § 1701 (a)(8). The statute also mandates that BLM manage the lands to provide food and habitat for fish and wildlife. Id. The BLM must also balance resources uses on the public lands to reflect the long-term interests of the American people, 43 U.S.C. § 1702(c), manage the lands to achieve high annual out put, 43 U.S.C. § 1702(h), and avoid "permanent impairment of the productivity of the land." 43 U.S.C. § 1702(c).

By allowing the condition of much of the public land to become impaired, the BLM is failing to fulfill FLPMA's promise of fruitful lands characterized by well functioning ecological processes and ecosystem values. Thus, FLPMA requires a prompt response to the ailing state of the public lands and mandates that the conditions envisioned by the Fundamentals and Standards and Guidelines are realized on the public lands.

The Fundamentals of Rangeland Health and Standards and Guidelines, 43 CFR § 4180, are binding regulations which require the BLM to "promote healthy sustainable rangeland ecosystems," and ensure these ecosystem components are "properly functioning." 43 CFR § 4100.0-2. By adhering to the regulations, the BLM will both protect and restore ecosystem values on the public lands and provide for the "sustainability of the western livestock industry and communities that are dependent upon productive, healthy public rangelands." Id.

The Fundamentals of Rangeland Health, which apply nationally, describe the ecological conditions that must exist on BLM public lands. 43 CFR § 4180.1. The Standards and Guidelines, which were developed specifically for BLM lands in Utah and explain, with more specificity, these conditions. These rangeland health standards dictate that on public lands, 1) upland soils allow water infiltration that sustain or improve productivity; 2) riparian and wetlands areas are in properly functioning condition; 3) Wildlife including, special status species, are maintained an appropriate level.; and 4) water quality standards be met (Department of the Interior 1977).

To implement its regulatory duties, BLM must first determine whether a particular area is characterized by healthy and sustainable ecosystems – and specifically the conditions outlined by the Fundamentals and Standards and Guidelines[2]. 40 C.F.R. § 4180. If one or more of these conditions does not exist, BLM must ask itself if current livestock grazing practices need to be changed to achieve the desired conditions. From another angle, BLM must determine whether current grazing management is a significant factor in the failure to realize the various ecosystem values outlined by the regulations.

The BLM Handbook H-4180-1 – Rangeland Health Standards ("Handbook") – confirms that BLM must undertake this inquiry and provides basic guidance as how the agency should proceed. Initially, the Handbook notes that "[w]hen one or more Standards is not achieved nor making significant progress toward achievement,[3] or there is a lack of conformance with guidelines, the causes for the deviation need to be identified." BLM Handbook 4180-1, III-12. To do this, the BLM must list the standard(s) not achieved, review ancillary data, list suspected significant causes, and review both site-specific and landscape-level causes. *Id*.

As part of the determination process, the BLM must determine if existing grazing management practices or levels are significant factors in failing to achieve the Standards or failing to conform to the Guidelines;[4] the agency also must determine whether existing grazing management needs to be modified to ensure that the Fundamentals of Rangeland Health are met, or make significant progress toward being met. *Id*. at III-14. To determine which activity or activities are "significant factors resulting in failure to meet the Standards," the BLM is commanded to "use the best data and resource information available," including "watershed assessments, quantitative data from monitoring and inventories, qualitative information, professional knowledge, and information provided by State agencies, public land users and others." *Id*. at III-13.

The Handbook appropriately recognizes that current grazing practices need not be the **sole** factor creating undesirable condition – only that it be a significant factor – before triggering the need for remedial action. BLM Handbook 4180-1, I-7 ("To be a significant factor, a use may be one of several factors contributing to less-than-healthy conditions; it need not be the sole causal factor inhibiting progress towards the standards").

To implement the federal regulations found in the Fundamentals of Rangeland Health, each state published standards and guidelines for healthy rangelands (Utah BLM 1997). The standards establish ecological standards. The guidelines describe grazing management practices based on meeting these standard. In the case where BLM

[2] This involves performing an assessment to see if the standards are met. BLM relies on assessment tools described in a number of technical references: *Interpreting Indicators of Rangeland Health* (TR 1734-6) for upland areas (Pellant et al 2000), the Lentic PFC assessment method (TR 1737-9) for riparian areas and the Lotic PFC assessment method for ponds, marshes, and lakes).
[3] The Standards define "significant progress towards achievement" as either Functioning Properly (PFC), or Functioning at Risk with an upward trend. Non-functioning conditions, or Functioning at Risk with a downward trend convey failure to meet the Standards.
[4] The Handbook defines "Significant Factor" as a "[p]rincipal causal factor in the failure to achieve the land health standard(s) and conform with the guidelines. A significant factor would typically be a use that, if modified, would enable an area to achieve or make significant progress toward achieving the health standard(s)." (BLM Handbook 4180-1, I-7).

determines that a standard is not met and ecological conditions are moving toward the rangeland health standards, “grazing may be allowed to continue.” The Utah rangeland health guidelines continue, “[o]n lands where a standard is not met, conditions are not improving toward meeting the standard or other management objectives, and livestock is deemed responsible, administrative action with regard to livestock will be taken by the Authorizing Officer pursuant to CFR 4180.2(c)”

Helping Monument staff determine whether current grazing practices are significantly responsible for the deteriorated condition of various ecosystem values is the focus of this document. We build upon the foundation laid by the regulations and BLM Handbook 4180-1 to produce a science-based checklist for objectively determining whether current grazing practices are the cause of assessment areas failing to meet rangeland health standards.

## SECTION 3: FACTORS USED TO DETERMINE THAT LIVESTOCK GRAZING IS A SIGNIFICANT FACTOR FOR LANDS THAT FAIL TO MEET RANGELAND HEALTH STANDARDS

This section describes 16 indicators that we suggest be used to determine whether livestock grazing is a significant factor leading to an area not meeting rangeland health standards. This assessment method draws both from general information on livestock impacts related to utilization and stocking rates, season of use, livestock distribution and grazing in riparian areas; as well as individual habitat attributes used in the BLM’s upland (TR 1734-6) and riparian (TR 1737-9) health assessment procedures.

Using these two suites of indicators provides for a qualitative determination procedure that is based on current observable conditions, ecological health assessments, monitoring, and other quantitative measures. This determination process has been designed for use by trained rangeland health assessors, and is designed to be repeatable regardless

Indicators in determining livestock grazing as the significant cause:

****Livestock use indicators****

1. Livestock Utilization
2. Livestock Stocking Rates
3. Grazing in Growing Season
4. Livestock Distribution
5. Livestock Grazing in Riparian Areas
6. Field Observations that Livestock Use is Dominant Herbivory
7. Livestock Grazing During Drought

****Habitat Indicators****

8. Bare Ground [Upland Rangeland Health (URH) Attribute 4]
9. Soil Compaction [URH Attribute 11]
10. Upland Erosion [URH 1, 3 and 8; Riparian PFC Item (RI) 5]
11. Stream Morphology Alteration and Erosion [RI Item 11 ]
12. Plant Community Vigor, growth and Productivity [URH Attributes 13, 15, 17; RI Items 4, 14]
13. Litter [URH Attribute 14]
14. Plant Community Structure, Function, Composition [URH Attributes 12, RI Items 6 and 7]
15. Invasive Plants [URH Attribute 16]
16. Cryptobiotic Soils [URH Attribute8]

**Figure 1. Indicators used in proposed method**

of who performs the original upland and riparian health assessments on which this determination method is based.

This determination method should be used on an allotment by allotment basis. We recommend that 16 indicators be used in making the determination that livestock is a significant reason that an area fails to meet the rangeland health standards. These indicators are grouped in two sets: livestock use indicators and habitat condition indicators (Table 1). The first set of indicators presents evidence of the degree or intensity of livestock grazing use for a specific allotment, and establishes whether livestock is a significant factor influencing habitat degradation. The second set of indicators assesses habitat conditions measured against the ecological potential of a specific allotment. As you can see, the habitat indicators are taken directly from BLM's upland and riparian rangeland health assessment checklists (TR 1734-6 and TR 1737-9), and are those indicators that have been shown in the ecological literature to be most affected by grazing.

As described at the end of this section, this determination method calls for a rating of one to five points to be assigned to each of our proposed indicators in Figure 1. These scores indicate the degree that livestock grazing is evident at or impacting the site (for livestock use indicators), or the degree that conditions depart from the potential conditions found in an ecological reference site (for the habitat indicators). Table 1 illustrates a conceptual framework of how livestock use indicators and habitat indicators are scored in our proposed determination procedure. The final determination is based on a preponderance of evidence, where the final determination is based on the scores received by the majority of the 16 indicators.

## 3.1. Indicators that Grazing Use is a Significant Factor in Impairment

Several indicators, gleaned from the management of any allotment or pasture, are highly relevant to determining whether livestock grazing practices are the cause of areas being out of compliance with the standards and guidelines. These indicators are: (1) utilization rates – Section 3.1.1; (2) stocking rates – Section 3.1.2; (3) seasons of use – Section 3.1.3; (4) livestock distribution – Section 3.1.4; (5) whether riparian areas are being grazed – Section 3.1.5, (6) whether areas are grazed during drought – Section 3.1.6, and (7) whether there is sign that cattle are the primary herbivore in an area – Section 3.1.7. In other words, the inquiry into to the cause of resource degradation should be undertaken in the context of current grazing practices on the allotment or pasture in question. Where utilization levels are too high – either because they were set too high or because there is a history of over utilization – it is almost certain that livestock grazing is the cause of damage to plant communities, wildlife habitat and soils. Similarly, where stocking rates are too high or seasons of use are inappropriate, all indications are that livestock use is a significant factor in the failure to achieve compliance with the Fundamentals and Standards and Guidelines.

**Table 1. Conceptual framework of how livestock use indicators and habitat indicators are scored in our proposed determination procedure.**

| Degree of livestock grazing | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Livestock use over a longer period of time has lead to 80% or more reduction in annual productivity of the area. Strong primary evidence of heavy livestock use. | Short term intense grazing use or sustained long term moderate use exceeds carrying capacity of forage production. | Continuing grazing use occurs as a level that sustains dominant perennial grasses. Little direct evidence of livestock trailing and scat. | Grazing use occurs at a level where the forage that remains after the end of the grazing season is 60-80% of potential forage biomass. | Grazing use occurs where the forage that remains at the end of the grazing season is 80% or better of potential plant biomass |
| Degree that habitat condition departs from potential (ecological site description) | | | | |
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Ecological indicators 20% or less of potential. | Ecological indicators between 20 to 40% of potential | Ecological indicators are between 40 to 60% of their potential. | Ecological indicators are between 60 and 80% of their potential. | Ecological indicators are 80% or more of their potential. |
| Score 1 | 2 | 3 | 4 | 5 |
| Grazing is a significant factor | | | Grazing is not a significant factor | |

We address each of these factors in two ways. First, we speak generally about these factors and their relationship to resource damage, citing the relevant ecological literature. Second, we consider current grazing practices specifically in the Monument and discuss the connection between these specific practices and livestock-caused impairment.

**3.1.1 Indicator 1: Livestock Utilization** According to widely accepted range studies, typical utilization levels – of 50% to 60% – are responsible for significant resource damage in the Colorado Plateau. Specifically, in the Monument, BLM has typically set utilization levels at 50% to 60%. Actual utilization data recorded by BLM shows that actual utilization levels routinely reach and often significantly exceed these permitted levels. The conclusion must be, therefore, that in the Monument, where there is resource damage and utilization rates are or have been 50% to 60% or more, the resource damage is caused by livestock grazing practices.

As an initial matter, the standard 50% utilization standard, developed from research on root-growth stoppage as a result of grazing (Crider 1955) and sometimes known as the "take half and leave half" policy, is inappropriate for the Colorado Plateau. Crider grew several Midwestern perennial grasses under ideal precipitation conditions and monitored root growth changes due to clipping over a period of two months. Crider concluded that root growth at the end of the growing season was not impaired when a single clipping removed 50% or less of the above ground biomass. The concept of "take half and leave half" is further elaborated in a report by Harland Dietz, a Soil Conservation Service scientist (Dietz 1989). He emphasized the link between Crider's root growth research and the concept of "take half and leave half."

The results of Crider's research do not reflect a number of factors that come into play on BLM lands in the arid West, including the applicability to the broad diversity of rangeland plants, grazing practices commonly found on BLM lands, semiarid or arid conditions, plant regeneration, soil nutrient recycling, litter generation, plant community composition, and wildlife habitat structure, and others. As a result, range scientists have concluded that there is no scientific basis behind BLM's policy for utilization (Caldwell 1984). Still, allowable utilization rates of 50% seem to dominate AMPs in the intermountain West.

Moreover, even within Crider's narrow area of research, current grazing utilization policy does not actually follow his recommendations. Crider was only looking at root growth of perennial grasses under ideal growing conditions. Under those conditions, he concluded that up to 50% of the aboveground biomass could be clipped **once** without root growth being significantly impaired. He further concluded that repeated clipping (which more accurately represents multi-month grazing periods common on BLM allotments) would significantly inhibit plant growth when a total of 50% of the biomass is removed. BLM was incorrect to apply the take half and leave half conclusions where grazing leads to numerous clippings and does not take into consideration arid conditions with its varying precipitation patterns.

That utilization levels of 50% to 60% will cause significant damage to ecosystem values is bourn out by the scientific literature. For example, in their well-respected range management text, Holechek et al. (1998), summarize multiple long-term studies analyzing utilization, or grazing intensity, and its impact on forage production. Holechek and his colleagues determine, that while acceptable use ranged from 40% to 60% on productive rangelands, acceptable rates ranged from just **30% to 40%** on more arid rangelands, such as those found on the Colorado Plateau. Moreover, the authors caution that only "[r]anges in good condition and/or grazed during the dormant season can withstand the higher utilization level [of 40%]" while those "in poor condition or grazed during active growth should received the lower utilization level [of 30%]. Holechek et al. (1998, p. 206). In yet another meta-analysis of grazing studies, Holechek concludes that "moderate" utilization levels of 50% "results in rangeland deterioration in semi-arid grasslands, desert and coniferous forest rangelands" and heavy utilization rates of 57% "consistently cause a downward trend in ecological condition" in all areas. Holechek et al. (1999, p. 13).

Galt et al. (2000) recommend a lower or utilization rate of 35% for arid areas. Importantly, they also point out that actual measured use is generally higher than the intended use. For example, on New Mexico rangelands, actual measured use was 10-15% higher than intended due to livestock trampling, wildlife use and weathering. Ultimately, the authors recommend assigning 25% of forage to livestock, 25% to wildlife and natural disappearance and 50% to site protection, concluding that the 25% utilization rate is the "surest way to avoid chronic forage deficits and land degradation" for aris areas.

Holechek et al. (1999) define moderate stocking rates in terms of use, or the "degree of herbage utilization that allows the palatable species to maintain themselves[,] but usually does not permit improvement in herbage producing ability." Holechek, et al. (1999, p. 12). When **all** grazing studies were averaged, the authors found that moderate stocking was defined as 43% utilization. However, as stated above, Holechek and his colleagues ultimately defined moderate stocking levels for arid and semiarid climes as between 30% and 40%, with the proviso that the higher level is only appropriate where the range is in good condition and grazing is occurring during the dormant season.

In arid and semi-arid areas such as the Colorado Plateau, higher utilization rates cannot be justified by reliance on deferred-rotation or rest rotation grazing schemes. Again in his range management text, Holechek and his colleagues explain that neither system has been found to have an appreciable benefit to resource conditions when compared to continuous grazing. In analyzing the former grazing scheme, the authors note that on flat sage brush and shortgrass rangelands, the scheme results in no vegetation benefits when compared to continuous or season-long grazing. Along the same vein, the authors also conclude that "[o]n flat arid and semiarid rangelands, deferred-rotation grazing has shown no advantages over continuous grazing." Holechek et al. (1998, p. 238).[5]

The authors take a similarly cautious view of rest-rotation grazing schemes pointing out that "[t]he problem with rest-rotation grazing is that the benefits from rest may be nullified by the extra use that occurs on the grazed pastures." Holechek et al. (1998, p. 244). In any case, Holechek et al. explain that in semiarid and arid climes, successful rest-rotation scheme cannot include heavy stocking rates or heavy use. This is because "[i]t is well established that for most plants in arid areas, 1 [one] or more years of rest will not compensate for 1 [one] year of severe defoliation during the growing season." Holechek et al. (1998); *see also* p. 246 ("A 10-year Nevada study showed that rest-rotation did not overcome the effects of heavy use (65%) during the growing season"). This conclusion was echoed in subsequent work, where the authors noted: "In the semi-arid and desert range types, rotation grazing systems generally showed no advantage over continuous or season-long grazing." Holechek et al. (1999, p. 13).

[5] Deferred-rotation may have a benefit where various areas are more convenient to livestock than others and therefore are more regularly used.

Moreover, while rest periods arguably may allow the marginal recovery of individual plants, rotation schemes cannot mitigate the loss of soil protection, thermal regulation, or water absorption and retention, or the alteration of plant competition that results from removal of biomass by grazing. These conclusions are echoed in a 1989 Forest Service paper which concludes that short duration livestock grazing has no different effect on hydrologic performance and soil characteristics than any other grazing system. "[H]eavy stocking would result in downward trend in hydrologic characteristics and [ ]vegetation growth response in a short-duration grazing system is similar to that expected from any other grazing system." Clary and Webster (1989, pg 6). In sum, they noted, "no grazing system can counteract the negative impacts of overstocking on a long-term basis."

As evidenced above, in the Monument, utilization rates – typically at 50%-60% – are set well above appropriate levels. Moreover, these rates **do not** take into consideration critical factors such as grazing during the growing season, the condition of the range, or that actual use is higher than intended use. Therefore, as Holechek concludes, current grazing management practices are causing a deterioration of the resources and a downward trend in ecological conditions.

Examples bear this out. The 1983 AMP for the Upper Cattle Allotment, which implements a deferred rotation grazing scheme, allows utilization levels to reach 60% from November 1 to January 21, 50% during the growing season from April 16 to June 15, and 60% from January 22 to April 15. The AMP allows these high utilization levels despite BLM determination that 72% of the allotment was in poor to fair condition, and findings of soil erosion, overstocking, and poor cattle distribution. Recent BLM records show that high utilization of the Upper Cattle Allotment has continued – often exceeding 50% to 60% levels. Thus, utilization levels on this allotment not only exceed the 30% levels Holechek recommends for poor condition range or range grazed in the growing season, but also surpass the 40% utilization levels he considers appropriate for only lands in good condition, grazed in the dormant season.

Management of the Lake Allotment similarly allows an untenable utilization level of 60%. This level was set in 1989 despite findings that 58% of the allotment was in poor condition, 17% in fair condition, 24% unsuitable for livestock and only 1% in good condition. The BLM also found riparian areas being utilized on average 85-90%, active erosion throughout the allotment, poor livestock distribution, and poor condition of wildlife habitat. Again, record data shows excessive utilization levels on this allotment. BLM's 1997 allotment evaluation notes indicate that riparian vegetation had disappeared from some areas, and from1989 to 1996, utilization of riparian areas was 95%. More recent data establishes that significant overuse of uplands and riparian areas on this allotment have continued. Thus, both the permitted utilization and the actual utilization on Lake Allotment greatly exceeds Holechek's recommendations and fails to take into consideration growing season and the condition of the range.

Across the Monument, the story is the same. As a rule, the BLM does not condition permitted utilization levels based on Holechek's findings and does not accommodate growing season or the condition of the particular allotment. Moreover, actual utilization data confirms that the Monument is routinely overgrazed. Out of 1,943 records showing recent utilization levels on key plants, 946 (or 48.6%) of these show utilization levels of 50% or greater, with many cases of utilization rates of 85% and above.

In sum, because much of the Monument has been significantly overgrazed, because permitted utilization levels are too high, and fail to reflect the condition of the allotment and whether grazing is occurring during the growing season, and because actual utilization levels often even higher than permitted levels, range science and study confirms with almost certainty, that grazing is the cause of resource degradation. On a site-specific level, BLM should examine permitted and actual use data and compare it to Holechek's recommendations. Where ecosystem values are impaired and where Holechek's recommendations are exceeded, and where use does not reflect factors such as allotment condition and the growing season, the conclusion must be that grazing is the cause, or significant factor in the failure of the site to exhibit the desired conditions. As a result, grazing management must be changed in a meaningful way to guarantee that in the near future, these conditions are achieved.

Table 2 illustrates how, when using the proposed determination method, one should score the utilization indicator (Indicator 1). Choose the score that best fits the circumstances found in the allotment undergoing a determination assessment. Enter this score for Indicator 1 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 2. Recommended method for scoring the utilization indicator (Indicator 1) when using our proposed method for making determinations.**

| Livestock utilization scoring | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Utilization is or has been between 60-100% on the allotment | Utilization is or has been between 40-60% on the allotment | Utilization is or has been between 20-40%. | 5-20% grazing utilization | Utilization 5% or less. |
| Score 1 | 2 | 3 | 4 | 5 |

**<u>3.1.2 Indicator 2: Livestock density</u>.** Inappropriate stocking levels, much like high utilization levels (which are of course the most common outcome of overly high stocking rates), are almost certainly the cause of a failure to achieve desired ecosystem conditions on the public lands. As Holechek concluded "[h]eavy stocking consistently caused a downward trend in ecological condition, light stocking caused an upward trend, and slight improvement occurred under moderate stocking." Holechek, et al. (1999, pg. 13). Grazing management in the Monument consistently allows heavy stocking rates. Moreover, where the ailing condition of the land requires light stocking rates to allow for recovery, the Monument fails to reduce stocking rates and therefore forestalls any improvement in resource conditions.

As mentioned in the previous section, according to Holechek et al. (1999) stocking rates in the semiarid and arid climate of the Colorado Plateau that result in utilization rates or grazing intensity of more than 40% are considered heavy and therefore will "consistently" degrade ecological conditions. According to Holechek, if these conditions are to be improved, light stocking – or use of less than 30% – is most appropriate.

Yet, the Monument sets stocking rates to allow for grazing intensities that are much too high for: 1) the semiarid and arid conditions of the Colorado Plateau; 2) the many allotments where conditions are less than good; and 3) the many allotments that are grazed during the growing season. Therefore, where ecosystem values are not properly met and utilization is inappropriate and fails to account for resource conditions and whether grazing occurs during the growing season, the likely cause of this degradation is over-stocking, which in turn, is characterized by high to moderate use.

Table 3 illustrates how, when using our new proposed determination method, one should score the livestock density Indicator (Indicator 2). Select the score that best fits the circumstances found in the allotment undergoing a determination assessment. Enter this score for Indicator 2 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 3. Recommended method for scoring the livestock density indicator (Indicator 2) when using our proposed method for making determinations.**

| Livestock densities and scoring | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Stocking density is above yy* | Stocking density is between xx and yy. | Stocking density is between ww and xx | Stocking density is between vv and ww. | Stocking density is less than vv* |
| Score 1 | 2 | 3 | 4 | 5 |

****note to readers – this section is still under development. A revised version will appear in final Guidance Document SULRP submits to the Monument later this summer. Feedback from readers on this item is welcomed and appreciated. In the meantime, we recommend using utilization levels, explained above, as a place holder for stocking levels.***

**<u>3.1.3 Indicator 3: Livestock grazing during the growing season</u>.** As with high use, the scientific literature generally concludes that allowing livestock to graze during the growing season is detrimental to the vegetation and soil communities of arid and semiarid climes, such as that of the Colorado Plateau. Moreover, as explained above, where grazing is allowed during the growing season, use levels or stocking levels must be reduced appropriately. However, in the Monument, BLM more often than not allows spring grazing to occur, and does so without reducing use or stocking levels. Thus, where resource values are damaged and spring grazing is allowed, particularly at high levels, the conclusion must be that the relevant ecological damage is caused by livestock grazing practices.

The scientific literature establishes that livestock grazing during the growing season is deleterious to the range ecosystems of the arid West (Holechek et al. 2001). Grazing up to the period of flowering may prevent plant recovery and seed generation (Heady 1984). While there is evidence that grazing during the growing season can lead to some compensatory growth in plants that co-evolved with large, hooved ungulates, grazing is damaging to low-elevation vegetation of the intermountain west, especially during the growing season (Painter and Belsky 1993, and references therein). For example, spring grazing has been shown to increase mortality of certain species of sagebrush (i.e. *Artemisia spinescens*) (Chambers and Norton 1993).

The dominant grasses in the sagebrush-grassland, being cool-season types, complete their growth during spring when soil moisture is highest from the over-winter accumulation of snow. These plants are susceptible to grazing damage during their active spring growing period due to depletion of carbohydrate reserves, loss of seed pools and ultimately loss of the plant entirely. In lower elevation salt-desert shrub communities with little vegetation growth during dry years, spring grazing can deplete the herbaceous plants and without summer precipitation, no regrowth can occur. In pinyon-juniper communities, with a mixture of warm and cool-season grasses, spring grazing has been detrimental to the cool-season grasses. This results in increased juniper canopy with loss of the perennial grasses and forbs (Holechek et al, 2001).

A study carried out 1963 by Cook and Stoddart studies the effects of intensity and season of use on the vigor of desert range plants. The authors studied the effects of different times and intensities of simulated grazing on desert forage species, concluding that desert ranges are best adapted for winter grazing, with springtime being the worst time to graze (Cook and Stoddart, 1963).

These determinations are echoed by BLM in the Management Framework Plan for the Escalante Resource Area. The agency found that "[t]he most damage [from grazing] occurs when plants are grazed during the growing season[,] which reduces the amount of food made and stored by the plant." (MFP, Recommendation RM-1.1). Indeed, the agency confirmed that "[c]ontinued grazing each year during the growing season can severely weaken or kill the plants." Id. As a result, BLM recommended that, with some exceptions, that the period of use on the Escalante allotments be changed so that grazing is not permitted during the growing season. *See also* Recommendation RM-2.6.

By far the most compelling reason to foreclose grazing in the spring is the damage that livestock cause to moist and wet soils. The pressure from livestock hooves, especially cattle, easily compacts soil in the spring when the soil is wet and most vulnerable to compaction (Brady 1984, Warren 1987). Fine textured soils or those with inorganic crusts are particularly susceptible when wet (Webb and Wilshire 1983).

Of even more concern is the effect of livestock trampling on the rare and ecologically important cryptobiotic soil crusts in the arid West. Crusts are only metabolically active when wet (Belnap et al. 2001). Winter use by livestock has been shown to have less of an impact on crust cover and species composition than spring use (Belnap et al. 2001). In a study of livestock grazing impacts on cryptogamic crust communities, Marble and Harper (1989) found that grazing in late winter and into spring reduced cryptogamic cover and species richness.

Spring grazing can also be deleterious for various soil-related variables such as streambank morphology and erosion potential. Grazing stream banks during spring when soils are wet or saturated can lead to hoof shear and compaction, resulting in greater stream bank erosion and sedimentation (Trimble and Mendel, 1995; Clary and Leininger 2000). Lusby (1979) demonstrated that in western Colorado, early winter grazing results in less runoff and erosion than continuing grazing into spring.

Despite consistent findings that grazing during the growing season degrades various ecosystem values, grazing practices in the Monument do not sufficiently curtail spring grazing. Currently, 46 out of 76 allotments (over 60%) are grazed during some part, or all, of the growing season. Moreover, as stressed above, the Monument does not predicate spring use on light utilization level, contrary to the recommendations of Holechek and others. Thus, where spring use occurs, particularly where utilization levels are moderate or heavy, and plant communities, soil stability, and soil nutrition are compromised, the conclusion must be that livestock grazing is almost certainly the cause of a failure to achieve desired ecosystem health and sustainability.

Table 4 illustrates how, when using our proposed determination method, one should score the spring grazing Indicator (Indicator 3). Select the score that best fits the circumstances found in the allotment undergoing a determination assessment. Enter this score for Indicator 3 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 4. Recommended method for scoring the spring grazing indicator (Indicator 3) when using our proposed method for making determinations.**

| Livestock grazing during the growing season | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Grazing use occurs during more than one month of the growing season | Livestock grazing occurs during the first month of the growing season | Grazing use occurs only during the last month of the growing season | Grazing occurs for no more than one week at end of growing season | No grazing use during the growing season |
| Score 1 | 2 | 3 | 4 | 5 |

**<u>3.1.4 Indicator 4: Livestock distribution</u>.** The relevant literature makes plain that where livestock are poorly distributed, resource damage in the places they do use is most likely attributable to grazing management practices. At the same time, livestock grazing in the Monument is plagued with poor livestock distribution, most often because water sources are scarce and cattle will not travel far from water. In addition, in the heat, cattle are also reluctant to leave the shade and relative coolness of riparian areas. The Monument is characterized by rugged terrain, steep slopes and other features which force and encourage cattle to use only limited areas of an allotment.

As Holechek and his colleagues establish, "cattle make little use of areas farther away than 3.2 km (2 miles) from water." Holechek (1998, pg. 209). Particularly in a climate such as that of the Colorado Plateau, ignoring this critical fact, the authors conclude, has been highly detrimental to resource conditions: "Failure to adjust stocking rates for travel distance to water has resulted in considerable range degradation, particularly in the hot, arid rangelands of the southwestern United States . . . ." Holechek (1998, pg. 209). Only in the winter, when there is snow on the ground or water in pot holes, will water availability cease to be a limiting factor in livestock distribution.

Similar adjustments must be made on the basis of terrain because cattle prefer "convenient" flat areas, such as valley bottoms, riparian zones and ridge tops, over rough, steep or rugged areas. Holechek et al. (1998).

In a recent study, Holechek et al. (2001) quantified their analysis, providing recommendations for adjusting the stocking rate for cattle in order to account for distance from water and steepness of slope. These recommendations are found in Table 5. Galt et al. (2000) indicate that the Natural Resources Conservation Service has adopted these guidelines for slope adjustments.

**Table 5. Adjustments for distance to water and slope for cattle (Holechek et al 2001).**

| Distance from Water miles | Percent Reduction in Grazing Capacity |
|---|---|
| 0 – 1 | 0 |
| 1 – 2 | 50 |
| >2 | 100 |
| **Slope %** | |
| 0 – 10 | 0 |
| 11 – 30 | 30 |
| 31 – 60 | 60 |
| >60 | 100 |

In sum, proper livestock distribution is a function of terrain, and in semiarid and arid climes, water availability. Particularly in the Monument, cattle cannot be expected to travel far from water, except for immediately after snowfall or rain. In addition, they will use convenient areas heavily and forego steep slopes and otherwise rough terrain. If stocking rates do not reflect these realities, as Holechek asserts, the result will be "considerable range degradation." Thus, where ecosystem values are damaged in convenient areas and stocking levels do not accurately reflect water availability and terrain, more than likely, grazing management is the cause of the resource damage and grazing practices must be changed so that the desired conditions are restored.

Table 6 illustrates how, when using our proposed determination method, one should score the livestock distribution Indicator (Indicator 4). Two factors are presented in this scoring system. The first is the amount of the suitable grazing lands that are within 2 miles of a water source (the more range near water, the better grazing distribution). The second factor considers the average slope of the allotment, based on Holechek's work. Select the score that best fits the circumstances found in the allotment undergoing a determination assessment. Enter this score for Indicator 4 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 6. Recommended method for scoring the livestock distribution indicator (Indicator 4) when using our proposed method for making determinations.**

| Livestock distribution scoring | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Most of the allotment's suitable range is more than 2 miles from water, and/or average slopes are above 45% | Half of the suitable range is more than 2 miles from water, and/or average slopes are between 35% and 45% | Most of suitable range lands are within 2 miles of water, and/or average slopes are between 20% and 35% | Almost all suitable range is within 2 miles of water, and/or average slopes are between 10% and 20% | All suitable range is within 2 miles of water, and/or average slopes are between 0% and 10% |
| Score 1 | 2 | 3 | 4 | 5 |

**<u>3.1.5 Indicator 5: Livestock grazing in riparian areas</u>.** Various riparian/wetland indicators required to meet the Standards and Guidelines include adequate "vegetative cover to protect stream banks, [dissipate floods], protect against accelerated erosion, capture sediment, and provide for groundwater recharge," and "vegetation reflecting…soil moisture,…diverse age structure and composition, ….and providing food, cover and other habitat needs for dependent animal species."

Because livestock spend a disproportionate amount of their time in riparian communities, which are the most productive habitats in arid lands generally, and in the Colorado Plateau specifically, the ecological stakes are highest here, and many of the adverse impacts of grazing are magnified. Life forms relying on western aquatic habitats include invertebrates, reptiles, amphibians, fish, birds, and mammals. Birds are often referenced as one of the significant suites of species relying on healthy riparian zones. The stability of populations of various avian species has been used to determine the effects of grazing on riparian vegetation (Knopf et al. 1988, Fitch and Adams 1998). Participants in studies at the High Desert Ecological Research Institute state that "the loss of riparian habitats has been suggested as the most important cause of population decline among landbird species in western North America" (Dobkin et al. 1998).

The negative impacts of cattle grazing on wildlife in riparian zones is manifested through impacts to the animals' habitats (i.e. riparian vegetation). Grazing can reduce or totally eliminate vegetation bordering a stream (Szaro and Pase 1983**,** Platts 1991). Numerous studies have found greater riparian species richness in ungrazed areas compared to grazed riparian zones (USGAO 1988a, Armour et al. 1994, Popolizio et al. 1994, Green and Kaufman 1995). Other studies have found that grazed riparian areas suffer increases in exotics, upland species, and sub-dominant species that are released from competition when dominant wetland plants are grazed down (Great Basin-Schulz and Leininger 1990, eastern Oregon-Green and Kauffman 1995). The spread of wetland exotics, namely tamarisk, has been aided by grazing throughout the west (Ohmart and Anderson 1982, Hobbs and Huenneke 1992). Furthermore, prevention of seedling establishment due to grazing and trampling has transformed a variety of southwest riparian systems into even-aged, non-reproducing vegetative communities (Fleischner 1994). The combination of these influences on vegetation structure and composition is detrimental to wildlife. A review by Skovlin (1984) concluded that grazing results in adverse impacts to both small mammals and birds within riparian areas.

The most well documented effects of grazing on riparian zones are reviewed by Platts (1982), Fleischner 1994, Ohmart (1996), and a most extensive analysis by Belsky et al. (1999) who reviewed over 150 separate studies on grazing effects on western riparian areas. In a survey of 15 experiments, Platts and Wagstaff (1984) concluded "when the riparian and stream habitats are fenced to exclude grazing, riparian habitats improve quickly and stream morphology improves slowly." Platts and Wagstaff, 1984 at 269. Belsky et al. report that they found no systematic investigations showing positive impacts or ecological benefits that could be attributed to livestock activities when grazed reaches were compared to protected areas. In a different forum, Administrative Law Judge Rampton concluded that no factor other than livestock grazing as currently practiced could explain the drastic difference in condition between degraded riparian areas in grazed canyons draining into Comb Wash and superior riparian areas in Grand Gulch, from which cattle had been removed twenty years earlier. National Wildlife Federation v. BLM, No. UT-06-91-1 (U.S. Dep't of Interior, OHA, Hearings Div.) (Dec. 20, 1993).

The National Park Service has also concluded that livestock grazing as currently practiced adversely impacts and impairs water quality and riparian areas (GCNRA, 1999). The agency states that livestock overgrazing reduces plant cover, which results in erosion. Erosion, in turn, leads to an increased sediment load in streams, blocking light penetration and otherwise adversely impacting aquatic life and habitat. Livestock use also deteriorates water quality because cattle trample springs, streams and streambanks. Indeed, as the Park Service notes, "[s]ome springs in the Glen Canyon NRA, such as those on the Kaiparowits Plateau, have been severely damaged by livestock trampling, with in some cases almost total elimination of riparian vegetation" (GCNRA 1999, pg.

19). At the same time, the agency points out that cattle feces in water can cause unnecessary beach closures in Glen Canyon (GCNRA 1999, pg 20).

While the BLM touts overall rangeland health improvements over the last century, the U.S. Department of the Interior (in its DEIS: "Rangeland Reform '94") clarifies that these asserted rangeland improvements have for the most part occurred only in upland areas, not in riparian areas. The DEIS further concedes that western riparian areas "have continued to decline and are considered to be in their worst condition in history." Livestock grazing as currently practiced is identified in the DEIS as the chief cause of this deteriorated condition. The reason that riparian zones continue to degrade while upland areas improve is simple; cattle spend anywhere from 5 to 30 times longer in riparian habitats than upland habitats (Skovlin 1984). Moreover, most BLM allotments operate under management plans that were designed to meet the phenological growth requirements of uplands (Ohmart 1996). In fact, one of the more recent manuals on inventorying and monitoring rangelands (NRC 1994) only devoted five sentences to riparian areas. Simply reducing overall livestock numbers on an allotment has proven in multiple cases not to be a solution to riparian degradation (Dahlem 1979, Olson and Armour 1979). Unless fencing, cattle removal or other profound management changes are made, riparian habitats will continue to be degraded under most of the current BLM RMPs.

In sum, livestock grazing has a disproportionately adverse impact on riparian areas – given the chance, cattle will spend most of their time in these cooler, more lush areas, particularly in the spring and summer, and particularly in the hot, dry conditions found on the Colorado Plateau. Much of the Monument is highly susceptible to livestock abuse of riparian areas. Water and shade is scarce, temperatures are hot and snowfall and rain infrequent. These factors combine to encourage cattle to concentrate their use on riparian areas to a significant degree. Therefore, in the Monument, where cattle are allowed access to riparian zones and these areas are damaged, it is more than likely that the damage is attributable to grazing practices which: 1) allow access to riparian areas, and 2) fail to account for severely limited water availability in setting stocking rates. In summary, range science and study confirms with almost certainty, that grazing is the cause of resource degradation in riparian zones.

Table 7 illustrates how, when using our new proposed determination method, one should score the livestock distribution Indicator (Indicator 5). Select the score that best fits the circumstances found in the allotment undergoing a determination assessment. Enter this score for Indicator 5 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 7. Recommended method for scoring the livestock in riparian areas indicator (Indicator 5) when using our proposed method for making determinations.**

| Livestock grazing in riparian areas | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Grazing occurs in all riparian areas during growing season | Grazing occurs in most riparian areas outside the growing season | Grazing occurs for less than one month in riparian areas. | Grazing excluded from most riparian areas or grazing occurs for less than a week | Grazing does not occur in riparian areas |
| Score 1 | 2 | 3 | 4 | 5 |

**<u>3.1.6 Indicator 6: Livestock grazing during drought conditions</u>.** Decisions on the AUMs that a permittee can run are normally made a few months in advance of the start of the season of use described in the grazing permit. For many of the allotments in the Monument, this decision occurs before the growing season starts. For this reason, stocking rate is usually set too high for the first year of a drought. Normal stocking rates, which are set with the expectation of a normal precipitation year, lead to grazing in excess of the forage capacity of the range during the first year of a drought.

BLM does not have current records in the allotment files for multi-year records of stocking levels compared to or tiered to precipitation totals over the years. Wild Utah Project has compiled such a record for the Upper Hackberry Allotment that could serve as an example. The precipitation measurement nearest to the Upper Hackberry Allotment is located three miles north of the allotment in Kodachrome State Park. Using BLM records of grazing use found in BLM's allotment file, we assembled a history of the amount of grazing that occurred in the grazing season, along with the annual precipitation for a period of twenty years. The grazing season for this allotment begins in the first of November and ends in the middle of June. The precipitation year is from the first of January to the end of December. The average annual precipitation for this area is 12 inches a year. Drought conditions are defined for this allotment as 8 inches of annual precipitation or less.

The precipitation history and grazing chronology for the Upper Hackberry Allotment indicate that three droughts have occurred in the past twenty years. In 1989, 1996, and 1999 precipitation levels indicated drought conditions. As figure 2 shows, grazing levels at the start of two of these drought periods remained near average stocking levels despite low precipitation and the resulting low forage production. Stocking levels did respond in advance to low precipitation in the 1999 drought.

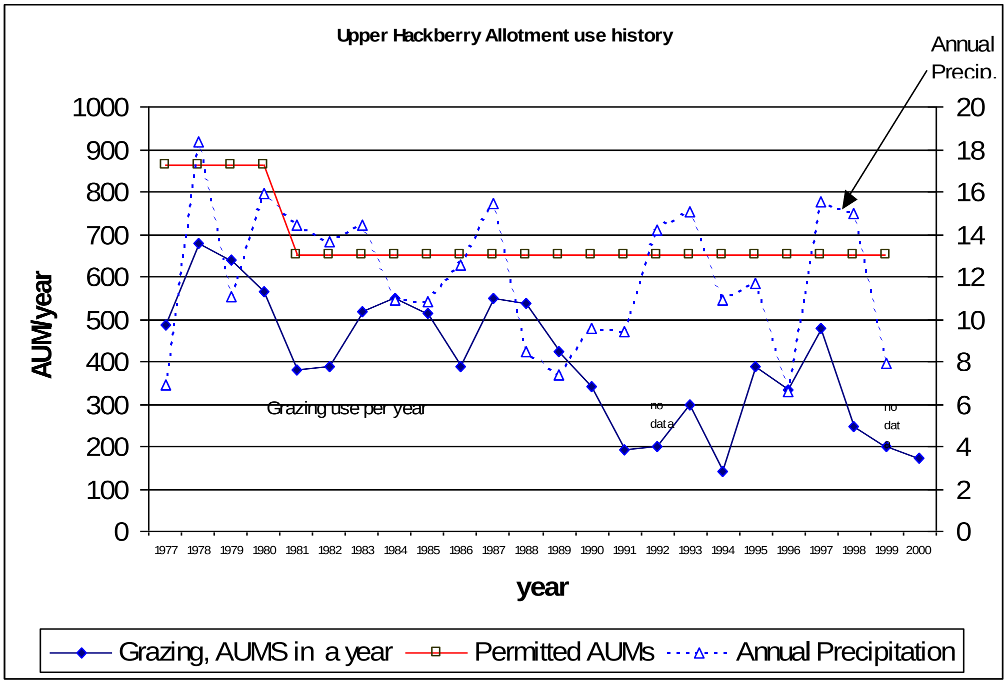



**Figure 2 History of precipitation and Grazing, Upper Hackberry Allotment**

Drought tolerance among plants varies. Those most tolerant to drought tend to have slow growth rates and low productivity (Low et al. 1984). Plants less drought tolerant with low reserves may only recover over long periods of time, if at all. The length of time for recovery for upland plants can be seven years or more (Caldwell 1984). In addition, long-term competitive interactions of plant species may in some circumstances be determined during relatively short periods of drought or limited moisture (Caldwell, 1984). Caldwell concluded "[o]ne must question whether management recommendations can be based only on the years of normal precipitation."

Precipitation does not fall uniformly during the year. Again using the Upper Hackberry Allotment example, the late summer and early fall period sees the heaviest precipitation on average (Figure 3). Another lesser period occurs in the late winter at the start of the growing season. Unfortunately, BLM does not factor in seasonal precipitation variation as part of recommending a stocking level for the upcoming grazing. If we had a record such as this, we could more accurately correlate grazing levels with plant productivity in the Monument.

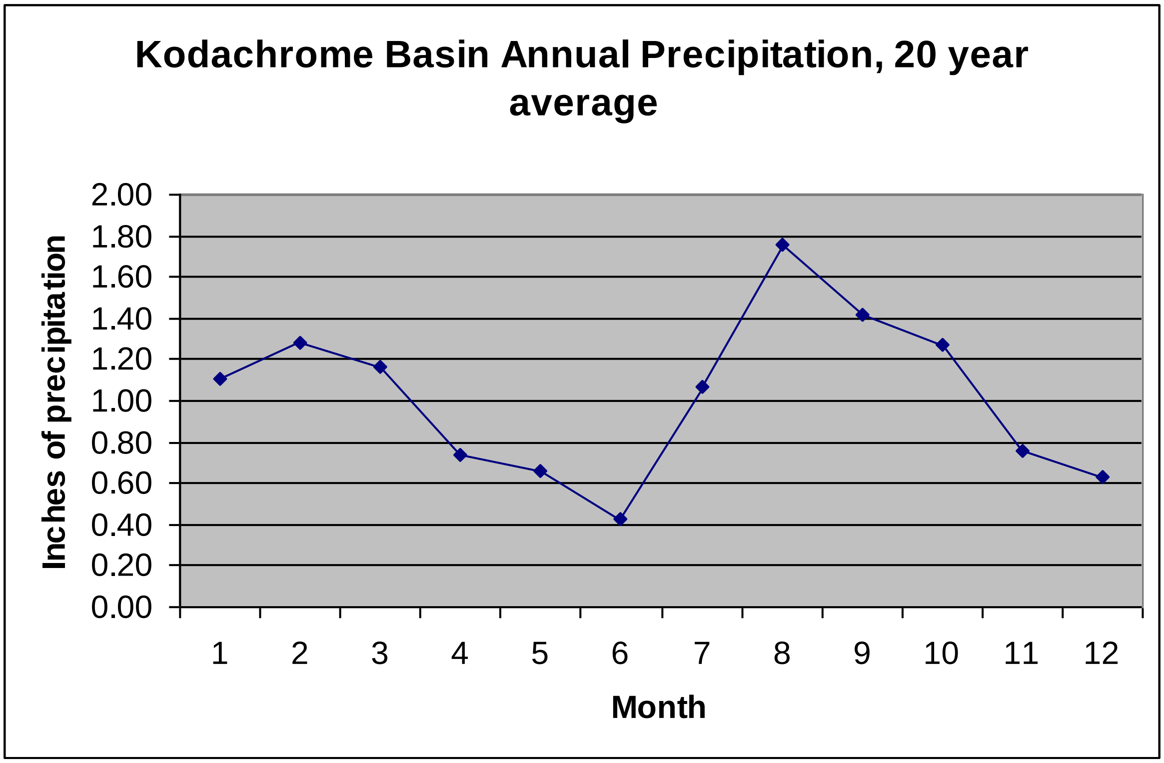



**Figure 3. Seasonal Average Precipitation, Kodachrome Basin, UT**

The score given for this indicator (Table 8) is based on the studies of growth and recovery of range plants during times of reduced precipitation. To ensure recovery, appropriate levels of grazing during drought periods must leave a greater fraction of standing biomass at the end of the grazing period than can be accommodated during a normal precipitation period. Enter the score for Indicator 6 on the *Determination that Grazing is the Cause* checklist (Appendix A).

**Table 8. Recommended method for scoring the grazing during drought indicator (Indicator 6) when using our proposed method for making determinations.**

| Livestock grazing During drought periods. | | | | |
|---|---|---|---|---|
| Extreme | Moderate to Extreme | Moderate | Slight to Moderate | Slight to None |
| Grazing occurs at the normal stocking rate during the drought. | Grazing occurs at half or more of the normal stocking rate during the drought. | Grazing occurs during the start of a drought but is then discontinued. | Stocking levels are reduced during the drought to leave 75% of forage growth in tact. | No grazing occurs during any drought period. |
| Score 1 | 2 | 3 | 4 | 5 |

**<u>3.1.7 Indicator 7: field observations that livestock are the dominate herbivore</u>.** A combination of on the ground observation, BLM records on grazing use, and habitat monitoring are used in making the observation of whether livestock are the dominate herbivore in the allotment where the determination of impairment is being made. The BLM data records should be supplemented with field observations, especially when records for an allotment lack key information. BLM's monitoring practices, for example, do not capture herbivore feces density or cowpie densities.

The field observations for this indicator need to answer a number of questions relating to the manner and degree of livestock use in an allotment:

1. Based on livestock trails and hoof prints, how much of the ground shows evidence of livestock use?
2. Based on transects that assess the mass of scat, are livestock the dominate herbivore in this allotment?
3. Based on the topography and condition of fences, does livestock use appear to match the management prescription?
4. Based on field counts, does livestock use numbers and season of use match data in the allotment file?

Scoring for Indicator 7 is a simple binary method. This indicator uses field observations supplemented with agency data on use to verify that livestock use is (1 point) or is not (5 points) the dominate ungulate use in the area.

## 3.2. Specific Habitat Indicators that Livestock Use is a Significant Factor in Impairment

The previous section describes indicators that generally identify the level and intensity of grazing use in an impaired area. In this section, we present indicators that specifically relate to habitat variables that have already been assessed for upland (using *Interpreting Indicators of Rangeland Health*, Tech. Ref. TR 1734-6) and riparian (using Tech Ref. 1737-9) PFC assessments carried out by the BLM.

In order to give this guidance on how to carry out determinations to the Monument, our team of scientists,[6] in collaboration with other scientists[7] with expertise in livestock grazing impacts and riparian and/or upland health assessments, has reviewed all of the indicators on the BLM field checklists for assessing PFC of riparian zones and uplands. For each indicator, we asked ourselves, "**If** this indicator receives a failing score, AND IF other causes of failure for this indicator can be ruled out (i.e. drought, fire suppression,[8] ORV abuse, etc.), **and if** livestock are known to graze this area and signs of livestock are present (i.e. feces, trailing, hoofprints, etc.), **does it follow that**, based on our field experience and knowledge of the grazing literature, the **failure to meet the Standards and Guidelines for this indicator can be attributed to livestock grazing**?

[6] Jim Catlin, Allison Jones, and John Carter.
[7] Elizabeth Painter, Peter Stacey
[8] Fire suppression is sometimes itself a cause of livestock grazing

The answers that our team, with assistance from outside scientists, gave to these questions are based on our collective expert opinion, field experience and knowledge of the literature. Below, we cluster the key indicators into groupings based on similarities of indicators (soil-related variables, etc.). For each set, we provide examples from the literature to bolster our argument that if a riparian or upland site fails the overall PFC assessment conducted by the BLM, and if the assessor finds that many of the indicators below are not meeting standards and other rule out other causes, then the assessor can conclude that the degradation present at the assessment site CAN BE ATTRIBUTED TO LIVESTOCK GRAZING.[9]

**3.2.1 Indicator 8: PFC indicators relating to bare soils: Upland Rangeland Health Attribute (URHA) 4 (Bare ground).** Based on our field experience and the literature cited below, we argue that if the above indicator relating to bare soils is failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy uplands.

Numerous studies have shown livestock grazing results in reduced ground cover and increased instances of bare ground in arid systems. In fact, measurements and comparisons of bare ground, or (inversely) total vegetative cover between grazed and ungrazed areas are some of the most common variables measured in grazing effect studies. A large number of researchers working in the arid West have found increased amounts of bare ground on grazed sites compared to ungrazed sites or lightly grazed sites (Rauzi 1963, Rich and Reynolds 1963, Meeuwig 1965, Pearson 1965, Rauzi and Hanson 1966, Brown and Schuster 1969, Robertson 1971, Byrant et al. 1972, Rauzi and Smith 1973, grant et al. 1982, Brotherson et al. 1983, Kauffman et al. 1983, Johansen and St. Clair 1986, Rasmussen and Brotherson 1986, Brady et al. 1989, Naeth et al. 1991).

Use the same score from the original field checklist for Upland Rangeland Health Attribute 4 for the scoring for Indicator 8. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.2 Indicator 9: PFC indicators relating to soil compaction : Upland Rangeland Health Attribute (URHA) 11 (Soil compaction).** Based on our field experience and the literature cited below, we argue that if the above indicator relating to soil compaction is failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of the site failing to meet the standards for healthy uplands.

The role of domestic livestock grazing in increasing soil bulk density is not disputed. We know of no scientific study that compared grazed areas to ungrazed areas and found greater soil bulk density in the ungrazed area. Similarly, we know of no

[9] Of course – its important for Monument staff working to review the actual PFC dataforms used in the assessment process for clues to whether grazing is the cause of areas failing to be in compliance with the standards. Out of the combined 119 wetland (lotic and lentic) PFC assessments that resulted in NF or FAR with downward trend, 70 of them (59%) include assessor comments that implicate cattle grazing as the primary cause (or one of a few primary causes) resulting in the degradation of these wetland areas.

studies that have compared lightly grazed areas to heavily grazed areas and found greater soil bulk density in the lightly grazed sites. Rather, a large number of researchers working in the arid West have found increased soil bulk densities on grazed sites compared to ungrazed sites or lightly grazed sites (Knoll and Hopkins 1959, Orr 1960, Rhoades et al. 1964, Meeuwig 1965, Laycock and Conrad 1967, Thompson 1968, Brown and Schuster 1969, Byrant et al. 1972, Van Harren 1983, Warren et al. 1985, Orodho et al. 1990).

Another measurement of soil compaction is infiltration rates – more compacted soils with higher bulk densities uniformly display lower infiltration rates. A number of studies in the western United States have found greater soil compaction and thus decreased soil infiltration caused by trampling in grazed areas (Knoll and Hopkins 1959, Branson et al. 1962, Rauzi 1963, Rhoades et al. 1964, Meeuwig 1965, Brown and Schuster 1969, Rauzi and Smith 1973, Buckhouse and Gifford 1976, Gifford et al. 1976, Wood 1982, Achouri and Gifford 1984, Gamougoun et al. 1984, Orodho et al. 1990).

Use the same score from the original field checklist for Upland Rangeland Health Attribute 11 for the scoring for Indicator 9. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.3 Indicator 10: PFC indicators relating to upland erosion: Riparian Item (RI) 5 (Upland watershed not contributing to degradation), Upland Rangeland Health Attribute (URHA) 1 (Presence of rills), URHA 3 (Pedestals/terraces), URHA 8 (Soil surface stability and resistance to erosion)**. Various conditions indicating that the physical structure of an ecosystem is in compliance with the Standards and Guidelines, include "sufficient cover and litter to protect the soil surface from…erosion," and "the absence of indicators of excessive erosion such as rills, soil pedestals, and actively eroding gullies." Based on our field experience and the literature cited below, we argue that if the above indicators relating to soil erosion are failing to meet the Standards and Guidelines, and if other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy riparian zones/uplands.

Livestock grazing as typically practiced contributes to the deterioration of soil stability in deserts (Warren et al. 1985), thus leading to increased soil erosion. Soil erosion is exacerbated by increased surface runoff triggered by the loss of vegetative cover and litter (Ellison 1960), both of which have been shown to be reduced by cattle grazing. As soils take 5,000 to 10,000 years to naturally re-form in arid regions such the Colorado Plateau (Webb 1983), accelerated soil loss caused by grazing is an irreversible loss. Steep slopes with little to no vegetal cover underlain by highly erodible rock – common in the rugged landscape of southern Utah – are particularly susceptible to cattle-induced erosion.

One of the chief hydrological impacts attributed to grazing in the arid west is increased storm runoff caused by an interaction of two chief factors: (1) greater soil compaction and thus decreased soil infiltration caused by trampling (Colorado-Rauzi and Smith 1973, southeastern Utah-Gifford et al. 1976**,** central Utah-Achouri and Gifford

1984, Four Corners region-Orodho et al. 1990), and (2) less vegetation, litter, and cyptobiotic soils on the surface to absorb rain (Ellison 1960). Evidence of increased storm-runoff on grazed versus ungrazed watersheds is considerable (Lusby 1979, Meehan and Platts 1978, Stevens et al. 1992). Increased storm runoff indirectly triggered by grazing can, in turn, cause further soil erosion, and flooding (Ohmart and Anderson 1982). These same conclusions are reached in a number of good reviews that describe, indisputably, that livestock grazing leads to significant soil compaction, infiltration and runoff (*see* Gifford and Hawkins 1978, Kauffman and Krueger 1984, Fleischner 1994, Trimble and Mendel 1995, Jones 2000, and Carter 2000).

Numerous studies have also observed severe erosion when comparing heavily grazed to ungrazed sites in the arid west (Cooperrider and Hendricks 1937**,** Croft et al. 1943, Gardner 1950, Kauffman et al. 1983). In a particularly well-designed study (Lusby 1979), a federal inter-agency committee chose Badger Wash, just over the border from Utah in western Colorado, as a representative Colorado Plateau site to assess grazing effects on erosion. BLM was one of the five agencies cooperating in this 20-year study, initiated in 1953, which compared four entire ungrazed watersheds to four others left open to grazing. The findings indicated that runoff was reduced by 40%, and sediment yield by 63%, on ungrazed watersheds compared to grazed watersheds. These conclusions are echoed by a number of good reviews that describe the conclusive, adverse impact of livestock grazing on soil stability (*see* Gifford and Hawkins 1978, Fleischner 1994, Trimble and Mendel 1995, and Jones 2000).

BLM has repeatedly emphasized that grazing has tremendous adverse impacts on soil stability. For example, the agency determined that "[i]mpacts to soils are often secondary to surface disturbing activities or grazing." San Juan Draft EIS at 4-11. In laying out its underlying assumptions and alternative management scenarios in the San Juan Resource Area, the agency concluded that "[t]he major cause of soil loss and sediment yield would be grazing though licensing livestock at the past 5 years average use." Draft EIS at 4-11 (assumptions); Final EIS at 1-105 (no changes). Moreover, the BLM determined that in implementing "Alternative E", soil loss would decrease, but still continue – totaling 8,729,625 tons from 1985 to 2000. Final EIS at 1-127. Importantly, "the major reductions in soil loss" achieved by implementing Alternative E, "would result from the exclusion of livestock from 138,120 acres of land" and from reductions in range treatments. *Id*. Indeed, excluding livestock from a tiny fraction of the resource area would result in a reduction of 34,000 tons per year of soil loss – or 510,000 tons by 2000. *Id*. In turn, with decreases in sedimentation, water quality would improve. Id.[10]

For the scoring of Indicator 10, use the original scores from the completed field checklist for Upland Rangeland Health Attributes 1, 3 and 8, and the original PFC checklist score for Riparian Item 5. The original attribute scores for all four of these

[10] Again in assessing Glen Canyon National Recreation Area, the Park Service agreed that livestock grazing as currently practiced adversely impacts soil stability. The Park Service stated: "[r]esearchers have recognized that higher grazing levels contribute to deterioration of soil stability and porosity, cause an increase in erosion and soil compaction, and can remove beneficial soil litter which can improve the physical and biological aspects of the soil ecosystem." Glen Canyon EA at 15 (citations omitted).

attributes will need to be averaged. Use the original (1-5 pt) scores for the upland attributes, and translate "yes" or "no" ratings from the PFC checklist into either a score of "5" or "1" for the riparian checklist item. Then average these four scores together. Enter this average score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.4 Indicator 11: PFC indicators relating to stream morphology alternation and erosion: Riparian Item (RI) 11 (Adequate cover present to protect banks/dissipate energy).** Based on our field experience and the literature cited below, we argue that if the above indicator relating to stream erosion is failing to meet the Standards and Guidelines, and other causes can be ruled out, grazing is the cause of these assessment sites failing to meet the standards for healthy riparian zones/uplands.

One of the fundamental sources of augmentation of streambanks is trampling by livestock and removal by livestock of supporting vegetation that anchors the banks. Once streambanks are trampled and devoid of vegetation, they quickly lose their shape and are unable to support the vegetation that is critical to protect banks from high flows and dissipate the energy form these flows.

Cattle grazing eliminates over-hanging banks (Behnke and Zarn 1976, Duff 1979, Hubert et al. 1985), which can be important to maintain streambank integrity and function. Grazing also leads to loss of shrub cover on streambanks (Kovalchic and Elmore 1992, Chaney et al. 1993), which further serves to anchor banks and stave off erosion triggered by high flows. Overgrazing by livestock can eventually lead to profound changes in stream morphology through the addition of sediment through bank degradation and off-site soil erosion (Armour et al. 1991).

Because of cattle grazing, bank stability along stream channels is reduced due to fewer plants and roots to anchor the soil, less plant cover to protect the soil from wind and rain erosion, and direct trampling of banks (Carter 2000). Studies that have shown that grazing reduces streambank stability include Behnke and Zarn (various locations - 1976), Winget and Reichert (UT – 1976), Duff (UT – 1983), Kauffman et al. (OR – 1983), and Stuber (CO - 1985).

Because of the effects of cattle grazing on bank stability, banks essentially "retreat" back, (Platts 1991), thus leading to channel widening (Duff 1979**,** Kauffman et al. 1983, Stuber 1985). Grazing can also lead to "gullying" (Winegar 1977) and channel incision (Kovalchik and Elmore 1992), due to a combination of bank instability and downcutting from higher flood energy. The water table is effectively lowered in an incised channel, with associated negative impacts such as a distinct narrowing of the riparian zone. Most reviewers conclude that livestock have been a contributing factor to the entrenching of stream channels in the southwest (Leopold 1951, Hereford and Webb 1992, Betancourt 1992).

Use the score from the original field checklist for Riparian PFC Checklist Item 11 for the scoring of Indicator 11. A "yes" on the PFC checklist equals five points under our determination system; a "no" on the PFC checklist translates into a score of 1. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.5 Indicator 12: PFC indicators relating to plant community vigor, growth, and productivity: Riparian Iteam (RI) 4 (Riparian zone widening), RI 14 (Point bars are revegetating), Upland Rangeland Health Attribute (URHA) 13 (plant mortality/recruitment), URHA 15 (Annual production), URHA 17 (Reproductive capability of perennial plants).** Based on our field experience and the literature cited below, we argue that if the above indicators relating to vegetative growth and productivity are failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy riparian zones/uplands.

Assuming that estimates of total vegetative cover is a measure of productivity, numerous studies have found increased total vegetative cover, or annual production, on ungrazed or lightly grazed sites compared to grazed sites (Rauzi 1963, Rich and Reynolds 1963, meeuwig 1965, Pearson 1965, Rauzi and Hanson 1966, Brown and Schuster 1969, Robertson 1971, Byrant et al. 1972, Rauzi and Smith 1973, grant et al. 1982, Brotherson et al. 1983, Kauffman et al. 1983, Johansen and St. Clair 1986, Rasmussen and Brotherson 1986, Brady et al. 1989, Naeth et al. 1991). The impact of livestock grazing on overall growth and productivity of riparian areas has also been documented. Grazing can reduce or totally eliminate vegetation bordering a stream (Szaro and Pase 1983**,** Platts 1991). A study by Schultz and Linnegar in Colorado found that 29 years after an exclosure was built in a riparian zone, canopy cover of willows was 8.5 times higher inside the exclosure than outside, and total herbaceous standing crop was 50% greater than that outside of the exclosure.

If a riparian zone is narrowing (as in Riparian Health indicator 4), this too is usually attributable to overgrazing. Because of the effects of cattle grazing on bank stability, banks essentially "retreat" back, (Platts 1991), thus leading to channel widening (Duff 1979**,** Kauffman et al. 1983, Stuber 1985). Grazing can also lead to "gullying" (Winegar 1977) and channel incision (Kovalchik and Elmore 1992), due to a combination of bank instability and downcutting from higher flood energy. The water table is effectively lowered in an incised channel, with associated negative impacts such as a distinct narrowing of the riparian zone. Most reviewers conclude that livestock have been a contributing factor to the entrenching of stream channels in the southwest (Leopold 1951, Hereford and Webb 1992, Betancourt 1992).

For the scoring of Indicator 12, use the original scores from the completed field checklist for Upland Rangeland Health Attributes 13, 15 and 17, and the original PFC checklist score for Riparian Checklist Items 4 and 14. The original attribute scores for all five of these attributes will need to be averaged. Use the original (1-5 pt) scores for the upland attributes, and translate "yes" or "no" ratings from the PFC checklist into either a score of "5" or "1" for the riparian items. Then average these four scores. Enter this average score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**<u>3.2.6 Indicator 13: PFC indicators relating to amount of litter: Upland Rangeland Health Attribute (URHA) 14 (Amount of litter)</u>.** Based on our field experience and the literature cited below, we argue that if the above indicator relating to litter presence is failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy uplands.

Cattle grazing removes soil litter from arid systems, with negative repercussions for nesting wildlife, and protection of desert soils from erosion. A large number of researchers working in the arid West have found decreased litter abundance on grazed sites compared to ungrazed sites or lightly grazed sites (Knoll and Hopkins 1959, Branson et al. 1962, Rauzi 1963, Rhoades et al. 1964, Reardon and Merril 1976, Rasmussen and Brotherson 1986, Orodho et al. 1990, Willey 1994, Rosenstock 1996).

Use the same score from the original field checklist for Upland Rangeland Health Attribute 14 for the scoring for Indicator 13. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**<u>3.2.7 Indicator 14: PFC indicators relating to plant community structure, function, composition: Riparian Item (RI) 6 (Diverse age structure), RI 7 (Diverse composition), Upland Rangeland Health Attribute (URHA) 12 (Functional/ structural groups)</u>.** Various conditions indicating that the vegetative component of an ecosystem is in compliance with the Standards and Guidines, include "sufficient cover and litter [to prevent erosion and promote soil moisture], an appropriately diverse plant community that "sustains…properly functioning ecological conditions," and "diverse age structure and composition." As outlined below, each of these indicators can be severely affected by cattle grazing. Based on our field experience and the literature cited below, we argue that if the above indicators relating to plant community structure, function, and composition are failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy riparian zones/uplands.

Scientific studies show that livestock grazing as currently practiced has adverse impacts on both the composition and structure of the vegetative community. Decreases in native plant species diversity, cover, and density as a result of traditional and existing livestock grazing practices have been observed in a wide variety of arid ecosystems in the western United States. Moreover, these alterations to the vegetative community can, in turn, lead to significant repercussions for successional trajectories, the abiotic environment, and wildlife.

*<u>Community composition</u>***:** Grazing affects species composition of plant communities in two ways: first, active selection by herbivores for or against a specific plant taxon, and second, differential vulnerability of plant taxa to grazing. Grazing can also delay plant phenology, which, in turn, can have dramatic effects on communities of pollinators and seed dispersers (Fleischner 1994), thereby further disrupting the composition of a vegetative community. Studies that have documented significantly greater native plant species richness in ungrazed areas compared to those that are grazed include Brady et al. (Arizona - 1989), and Floyd-Hanna et al. (New Mexico - 2000).

While cattle grazing has been shown to decrease species richness in arid communities, it similarly affects species evenness, with considerable secondary effects. Long-term cattle grazing has been shown to decrease the abundance of perennial grasses and forbs and increase the amount of annual grasses and weeds in western deserts (in northern Arizona-Schmutz et al. 1967; the Great Basin-Rice and Westoby 1978; central Utah-Brotherson and Brotherson 1981; California-Hanley and Page 1981; and Nevada-Medin and Clary,1990). Studies that have focused chiefly on impacts to perennial grasses have found densities of these grasses to be significantly decreased by grazing (in central Utah-Cottam and Evans 1945; New Mexico-Gardner 1950**;** Arizona-Blydenstein et al. 1957; Capitol Reef N.P.-Rosenstock 1996). Studies that have shown shrub cover to significantly decrease due to cattle grazing include Bock et al. (Arizona - 1984) and Jones (Nevada -1999). Any significant grazing-induced changes in cover, densities or relative abundances of certain plant species or guilds can have profound implications at the community level, as these changes can translate into major conversions of community organization, for example, transforming grassland to desert (Schlesinger et al.1990).

What is true for uplands is true for riparian areas. Numerous studies have found greater riparian species richness in ungrazed areas compared to grazed riparian zones (USGAO 1988a, Armour et al. 1994, Popolizio et al. 1994, Green and Kaufman 1995).

While it is useful to document various studies that demonstrate the deleterious effects of cattle grazing on arid plant communities, previously completed literature reviews comprise the strongest evidence of the impacts cattle have on vegetation in xeric environments. For example, in a quantitative literature review involving 50 independent grazed/ungrazed comparisons from 41 different studies performed in arid environments of the western United States, Jones (2000) found significant negative impacts of cattle grazing on shrub cover, grass cover, vegetation biomass, and seedling survival. Another extensive literature review by Fleischner (1994) cites numerous cases where grazing was shown to have deleterious effects on vegetative communities.

*Vegetation structure***:** Intact physical structure of arid ecosystems is very important to native wildlife on large and small scales. Because of grazing, shrub components have appeared where none were before (Archer 1989, Schlesinger et al. 1990), and extensive willow stands have been removed from streams (Oregon - Kovalchik and Elmore 1992), with profound effects on native wildlife. Grazing structurally changes habitat for ground-dwelling vertebrates, such as snakes and lizards, through the loss of low-height vegetation (Jones 1981, Szaro et al. 1985). Grazing similarly affects shrub and woodland riparian forest structure, with impacts on birds that require diverse habitat structure (Taylor1986, Knopf et al 1988).

Prevention of seedling establishment due to grazing and trampling has transformed a variety of southwest riparian systems into even-aged, non-reproducing vegetative communities (Fleischner 1994). The combination of these influences on vegetation structure and composition is detrimental to riparian wildlife. A review by

Skovlin (1984) concluded that grazing results in adverse impacts to both small mammals and birds within riparian areas.

*Special consideration of URHI 12 – Functional/Structural Groups*: Indicator 12 deserves extra scrutiny, especially if the assessment site is failing to meet standards for this indicator. This special scrutiny draws from Part c of Standard 1 and Part b of Standard 2 and Part d of Standard 3 in the Standards and Guidelines which state that the presence of the "desired plant community" identified in the land use plan is a pertinent indicator for evaluating these Standards. It follows logically from the Monument plan decision VEG-00 (plan, at page 22) that the desired plant community is the "potential natural community" reflected in the appropriate NRCS Ecological Site Description for that area. The Clark Bench EA and other permit-buyout EAs provide precedent for this interpretation of VEG-00. Moreover, the Functional-Group indicator is useful as a stand-alone measure because it is one of the few RLH indicators that is quantitative, and so it can be tied to the Management Plan objectives for vegetation (i.e. the Potential Natural Community as specified in NRCS Ecological Site Descriptions).

*Scoring Indicator 14 (indicators relating to plant community structure, function, composition)*: For the scoring of Indicator 14, use the original scores from the completed field checklist for Upland Rangeland Health Attribute 12, and the original PFC checklist score for Riparian Checklist Items 6 and 17. The original attribute scores for all three of these attributes will need to be averaged. Use the original (1-5 pt) score for the upland attribute, and translate “yes” or “no” ratings from the PFC checklist into either a score of “5” or “1” for the riparian items. Then average these four scores together. Enter this average score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.8 Indicator 15: PFC indicators relating to exotic weeds: Upland Rangeland Health Attribute (URHA) 16 (invasive plants).** Based on our field experience and the literature cited below, we argue that if the above indicator relating to exotic weeds is failing to meet the Standards and Guidelines, and other causes can be ruled out, then grazing is the cause of these assessment sites failing to meet the standards for healthy uplands.

One particularly insidious result of cattle grazing in arid western ecosystems is the spread of exotic grasses and weeds. Grazing aids the spread and establishment of alien species in three ways: 1) dispersing seeds in fur and dung; (2) opening up habitat for weedy species; and, 3) reducing competition from native species by eating them (Fleischner 1994). Studies that have found increased densities, cover or biomass of exotic plant species in grazed versus ungrazed sites include Green and Kaufman (Oregon -1995), Drut (Oregon - 1994) and Harper et al. (Utah - 1996).

Once they are established (often assisted by cattle grazing), weeds negatively impact western arid ecosystems in numerous ways. Weed infestations reduce biodiversity (Randall 1996), increase fire frequency (Esque 1999, Brooks et al. 1999), disrupt nutrient cycling (Vitousek 1990), alter soil microclimate (Evans and Young 1984), reduce effectiveness of wildlife habitat (Davidson et al. 1996, Knick and

Rotenberry 1997), and can expedite loss of topsoil in xeric environments (Lacy et al. 1989).

The ability of cattle to increase a site's susceptibility to invasion has received the most attention from the scientific community. Sites become invasible due to increased bare soils as a result of grazing, which offer greater opportunity for weed establishment, with less competition (Gelbard and Belsky, in prep, and references within). Evans and Young (1972) found that increased soil erosion [caused by grazing] also loosens surface soils and helps bury seeds. Exotic seeds adapted to more erosion-prone environments will benefit from this while natives likely will not. Deposition of nitrogen-rich livestock dung also increases invasion of nitrophilous weeds such as cheatgrass by stimulating germination and enhancing growth over that of native plants (Evans and Young 1975, Smith and Nowak 1990, Trent et al. 1994, and Young and Allen 1997). Finally, cattle grazing can further compound the above impacts by creating warmer and drier soil microclimates, through soil compaction, and loss of plant, microbiotic crust and litter cover. The resulting warmer, drier microclimate reduces the competitive vigor of many native grasses (Piemeissal 1951, Archer and Smeins 1991), thus further increasing viability of aggressive exotics.

Other studies have found that grazed riparian areas suffer increases in exotics, upland species, and sub-dominant species that are released from competition when dominant wetland plants are grazed down (Great Basin-Schulz and Leininger 1990, eastern Oregon-Green and Kauffman 1995). The spread of wetland exotics, namely tamarisk, has been aided by grazing throughout the west (Ohmart and Anderson 1982, Hobbs and Huenneke 1992).

The Park Service agrees that livestock grazing as currently practiced promotes weed infestation. In assessing Glen Canyon National Recreation Area, the Park Service concluded that "[m]ost studies done on the Colorado Plateau and adjacent parts of the Great basin are in general agreement on the effects of livestock grazing on arid and semi-arid vegetation." Glen Canyon EA at 8 (citations omitted). Based on these studies, the Park Service determined that grazing results in a general decline of native palatable bunchgrasses, especially needle-and-thread and Indian ricegrass, while sod grasses, and undesirable native species thrive. *Id*. at 8-9. Where grazing pressure is more intense, the Park Service found that livestock use can "completely eliminate" bunchgrasses, cause decline in sod grasses and result in the invasion and even domination of exotic plants such as cheatgrass. *Id*. at 9. The BLM also admits that livestock are one of the "spreading agents" for noxious weeds, and that "[l]ivestock can bring in noxious weeds and invasive plants from other areas or spread these species within allotments." *E.g.* Bluff Bench EA at 6; Church Rock EA at 6; Stevens EA at 6; and Summit EA at 11.

*Special consideration of URHI 16 –Invasive plants*: Indicator 16 also deserves extra scrutiny, especially if the assessment site is failing to meet standards for this indicator. Somewhat similar to the case made above for RLH indicator 12 (F/S Groups), this is also a quantitative indicator and can be linked to a presumed quantitative standard of zero (as laid out in both the Management Plan objectives, and E.O. 11312).

*Scoring Indicator 15 (Invasive plants)*: Use the same score from the original field checklist for Upland Rangeland Health Attribute 16 for the scoring for Indicator 15. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

**3.2.9 Indicator 16: PFC indicators relating to cryptobiotic soils: Upland Rangeland Health Attribute (URHA) 8 (soil surface resistance to erosion) and URHA 18 (biological soil crusts).** While the *Interpreting Indicators of Rangeland Health* manual does not include the words "biological soil crust" in the title of the indicator, the technical reference manual makes clear that this indicator is indeed meant to measure soil crusts. Based on our field experience and the literature cited below, we argue that if the above indicator relating to cryptobiotic soils is failing to meet the Standards and Guidelines, and other causes can be ruled out, grazing is the cause of these assessment sites failing to meet the standards for healthy uplands.

Cryptobiotic crusts, which were historically widespread in western arid lands, are being rapidly depleted across rangelands today. These crusts increase the stability of otherwise easily erodible soils, increase water infiltration in a region that receives limited precipitation, and increase fertility of xeric soils often limited in essential nutrients such as Nitrogen and Carbon (Johansen 1993, Belnap et al. 1994).

Cattle are highly destructive to the fragile cryptobiotic crusts that exist on many BLM lands on the Colorado Plateau. Cryptibiotic crusts are only prominent components of ecosystems in which large-bodied herbivores have been absent from recent evolutionary history; such as in the Colorado Plateau and other regions of the arid west. Under these circumstances, cryptobiotic crusts are easily damaged by livestock (Navajo National Monument, AZ - Johansen et al. 1981 and Brotherson et al. 1983; Utah - Anderson et al. 1982; northern AZ - Beymer and Klopatek 1992; northwest New Mexico - Floyd-Hanna et al. 2000).

While the previously cited studies were conducted on the Colorado Plateau, the majority of studies that have investigated the impacts of cattle grazing and other disturbances on cryptobiotic soils have actually been conducted in southern Utah. These studies paint a vivid picture of the damage done to biological soil crusts. For example, heavy grazing reduced crusts by 98.5% and light grazing reduced crusts by 52.3% at the Desert Experimental Range in southern Utah (Marble 1990). Cryptobiotic crust cover was seven times greater in an ungrazed part of Canyonlands National Park than in a grazed area (Kleiner and Harper 1972). Nitrogenase activity levels in cryptobiotic crusts decreased anywhere from 30% to 100% in disturbed plots relative to undisturbed plots, and that threshold friction velocities (the force required to detach soil particles from the surface) were significantly higher in undisturbed cryptobiotic crusts than in disturbed plots (Moab area - Belnap 1996, Belnap and Gillete 1997). Relict, never-grazed site in the Kaiporwits Basin had significantly more cryptobiotic crust cover than both a light-moderately winter grazed site and a site that had not been grazed for 10 years (Jeffries and Klopatek 1987). Cryptobiotic crust cover more than doubled over a ten year period of rest from grazing in Canyonlands National Park (Kleiner 1983). Lastly, Jayne Belnap, a respected authority on cryptobiotic soils, reports that cattle grazing has greatly impacted cryptobiotic crust integrity within the Grand Staircase-Escalante National Monument (Belnap 1997).

The deleterious effects of cattle on cryptobiotic crusts are not easily repaired or regenerated. The recovery time for the lichen component of crusts has been estimated at about 45 years (Belnap 1993). At this time the crusts may appear to have regenerated to the untrained eye. However, careful observation will reveal that the 45 year-old crusts will not have recovered their moss component, which will take an additional 200 years to fully come back (Belnap and Gillette 1997).

There are numerous secondary effects once crusts are trampled by cattle. Destruction of crusts increases wind and water erosion of surface soils that were previously protected by the crusts (Howard Wilshire). This can trigger rapid loss of the underlying topsoil (Webb 1983). The destruction of cryptobiotic soils by cattle can reduce nitrogen fixation by cyanobacteria, and set back the nitrogen economy of these nitrogen-limited arid ecosystems decades. A severe loss of nitrates to plants is a significant threat in typically nitrogen poor arid environments, and may even eventually lead to desertification (Belnap 1995). Once crusts are destroyed, ecosystem structure can be furthered altered when bare ground is available for colonization by exotic weeds (*see* Gelbard, in review, and references within). In addition, the breaking up of physical and microbiotic soil crusts increases surface roughness, which favors cheatgrass germination (Tisdale and Hironaka 1981, Stohlgren, in press). The relationship of crust destruction and weeds is further supported by evidence that intact cryptobiotic crusts reduce or prohibit weed establishment by preventing weed seed germination (Eckert et al. 1986, Mack 1989). Even small reductions in crusts can lead to diminished productivity and health of the associated plant community, with cascading effects on plant consumers (Davidson et al. 1996).

The BLM has noted that "[m]uch of the literature acknowledges that mircophytic crusts do increase water infiltration, provide soil stability, and increase nutrient availability." Bluff Bench EA at 16; Summit EA at 18; Stevens EA at 14; Church Rock EA at 17. The agency also admits, "livestock grazing will impact microphytic crusts to some extent through trampling/destruction." *Id*. In assessing Glen Canyon National Recreation Area, the Park Service also found that grazing adversely affects soil crusts, stating that "[h]eavy or intense, long-term grazing activity has a negative affect on soil productivity by altering soil horizon development and nutrient cycling." Glen Canyon EA at 15.

Use the same score from the original field checklist for Upland Rangeland Health Attribute (URHA) 8 and URHA 18 for the scoring for Indicator 16. Enter this score on the *Determination that Grazing is the Cause* checklist (Appendix A).

## 3.3 Scoring the Livestock Use Indicators and Specific Habitat Indicators

In order to make a final determination using the proposed method herein, the user should gather all existing information on utilization, stocking rate, season of use, and trend. Maps depicting riparian areas, water sources, and topography (slope) are also needed. Perhaps most importantly, both upland rangeland health assessments (using *Interpreting*

*Indicators of Rangeland Health*), and riparian PFC assessments (Using Tech. Ref. 1737-9) would have had to be already completed by the BLM.

For the first five indicators (the suite of Livestock Use Indicators), the user should assign a score of 1-5 based on the information provided above (Tables 2-4, 6 and 7). For the next 9 indicators (the Specific Habitat Use Indicators) the user should follow a different course of action depending on whether the area at issue is an upland or riparian zone. In the case of the upland rangeland health indicators, the assessor should assign the same score that that indicator received from the original upland range assessment using *Interpreting Indicators of Rangeland Health*. The individual riparian PFC indicator scores, on the other hand, did not receive numerical ratings when they were originally assessed in the completed riparian PFC assessment. Rather, these indicators simply receive a "yes" or a "no" rating. To use those ratings in our proposed determination method, translate "yes" scores into a 5 and "no" scores into a 1.

We invoke a simple strategy using the "preponderance of evidence"[11] to make the final determination of whether current livestock grazing practices are the cause of failure to meet the Standards and Guidelines on an allotment or pasture. Appendix A explains the process in more detail, but simply put, many more scores of "1" and "2" on the *Determination that Grazing is the Cause* checklist (Appendix A), and very few scores of "4" and "5" would lead the user to conclude that "grazing is the cause" of resource impairment.

## 3.4 Other factors that can help make the determination that livestock grazing causes impairment

There are a few other factors that are important in the determination process, but are not included directly into our proposed determination procedure, chiefly because these factors are either harder to directly tie to livestock use, or they are not one of the specific habitat indicators included in BLM's upland and riparian PFC assessments. However, it is important that the Monument staff keep the below factors in mind as they carry out determinations, as there are many indications that the below factors are also seriously impacted by livestock grazing

**3.4.1 Failure of RMP/AMP to achieve ecological goals**. BLM uses resource management plans (RMP) and livestock grazing allotment management plans (AMP) to establish goals for livestock management. Goals can include measurable ecological conditions that BLM uses to assess grazing practices. For example, the Upper Hackberry AMP states as a goal that a key forage species, Indian rice grass should cover 6% of the ground. Trend monitoring uses permanent plots to measure the ground cover of this key species. Other goals may set measurable goals for shrubs, wildlife species, or specific grazing prescriptions.

[11] This standard comes from BLM itself. It is fairly easy to meet the "preponderance of the evidence" standard. For example, in the context of a civil trial, where this standard is applied, the jury is instructed to find for the party that, on the whole, has the stronger evidence, however slight the edge may be. Black's Law Dictionary (7th Ed. 1999). In other words, the preponderance of the evidence will show that grazing is a significant factor in the non-compliance where the greater weight of the evidence suggests that it is, even if there remains some reasonable doubt that grazing is a significant factor.

As one undertakes the determination process, its important to review the goals BLM set for the allotment in past planning efforts to see if monitoring shows achievement of goals related to habitat condition and grazing use. By putting such goals into planning documents relevant to grazing management, the agency is asserting that changes in grazing practices will lead to the attainment of these goals. The conclusion must be, therefore, that where these goals are not met, it more than likely because grazing practices have not be changed, or have not been changes sufficiently, to achieve the goal.

**3.3.2 Wildlife habitat function.** In order to maintain viable populations of expected wildlife species in an allotment, habitats must function to meet the needs of these species. While we do not undertake an exhaustive literature review to outline the connection between livestock grazing and the ability of native habitats to function for native species (chiefly because we do not include this factor as a primary indicator in our proposed determination method necessarily because the connection is hard to directly make) it is demonstrated frequently that livestock grazing can degrade habitats for native wildlife (see Kraussman 1996, and many references therein). While the upland rangeland health assessment process does include some indicators for habitat structure, most of the habitat function needed for wildlife is not captured in either the upland or riparian assessments BLM currently conducts.

We suggest two additional data sources to assist in evaluating the function of habitat for wildlife on Monument grazing allotments. The first looks at species at risk as indicators of habitat function. Monitoring and survey data for these species, especially those species listed as endangered or threatened,[12] provide better information on functioning habitat than that available for most other wildlife species. The second data source relies on the riparian PFC assessment process developed by team of independent scientists and presented to the BLM last year (Appendix B). This biological riparian assessment includes a section specifically suited to judging the function of wildlife habitat.

In sum, as functioning wildlife habitat is often deleteriously affected by livestock grazing, any information that the Monument has on native and sensitive wildlife viability and habitat could prove helpful during the determination process on an allotment. If habitat for native wildlife on the impaired allotment or pasture is found to be non-functioning or at risk, livestock grazing is likely the cause.

[12] Grazing in endangered species habitat is particularly problematic. BLM must pay particular attention to degraded resource conditions in potential or existing habitat for special status species. The Fundamentals and Standards and Guidelines require that habitats for special status species, including species listed under the Endangered Species Act, be restored and maintained. At the same time, researchers have documented that livestock grazing has a significant adverse effect on various special status species, including Mexican spotted owl, southwestern willow flycatcher, and several plant species, including Townsend's aprica (*Townsendia aprica*), Wright's fishook cactus (*Sclerocactus wrightii*), and Winkler's pincushion (*Pediocactus wrinkleri*) cactus (see Jones 2001, and references therein). Thus, in the Monument, where these species or their habitat exists, or could exist, and this habitat is not in a desirable condition, more likely than not, livestock grazing is directly or indirectly responsible for habitat degradation.

# SECTION 4: OTHER POSSIBLE CAUSES FOR AN AREA FAILING TO MEET THE RANGELAND HEALTH STANDARDS

Section 3 references an overwhelming body of literature demonstrating that livestock grazing as currently practiced has myriad impacts to a broad array of ecosystem components; this section references scientific studies that demonstrate that other possible causes – such as wildlife, historic grazing, drought, and poor soils – are unlikely to be major factors contributing to impairment.

## 4.1 Wildlife Herbivory Is Unlikely To Be A Significant Cause Of Impairment

According to the literature, there are few situations where wild herbivores are a significant factor leading to an area failing to meet rangeland health standards. In those past instances where the BLM has suggested that wildlife is the cause of impairment, the agency does not invoke any scientific literature that demonstrates that wildlife are the most likely source of impairment. Below are relevant references to literature that demonstrate, when livestock and native, wild ungulates are both present in an area, a solid majority of grazing-related impacts are attributable to the domestic, non-native grazers.

Wild grazers and browsers do not utilize forage in the same manner as domestic livestock, and wild grazers and browsers use riparian areas and water sources in a different manner than do domestic livestock. An intensive study of riparian and stream health in the Apache-Sitgreaves National Forest in Arizona found that impacts to riparian areas were generally low, even though it was known that these riparian areas were used quite heavily by elk (Rocky Mountain Research Station 2002).

In another study in Oregon, researchers examined the effects of wild ungulates (deer and elk) and domestic sheep browsing on the growth, structure, and reproductive effort of willows (Brookshire et al. 2002). With the use of exclosures, large herbivore effects on willows were studied in an area browsed by native mammals only and an adjacent area in which domestic sheep also lightly grazed during summer months. Willows inside exclosures responded with pronounced increases in height, crown area, and basal stem diameters while the stature of browsed plants outside exclosures stayed constant or declined. In the area browsed by both sheep and wild herbivores, the size of browsed plants remained at pre-treatment levels for the duration of the study.

The only wildlife species that are likely to have a significant impact on riparian areas are elk, moose, bison, and beaver (personal communication, Robert Ohmart). Moose and bison are largely absent from southern Utah rangelands, and therefore cannot be responsible for impairment. Impacts of beaver are limited to the harvest of cottonwoods, willows, and the bulbs of some herbaceous species of vegetation; they do not cause widespread trampling, nor do they cause a general reduction in herbaceous vegetation. Because the impacts caused by beaver are so distinct, it should be easy for BLM to identify situations where beaver are causing impairment, and it should be easy for the agency to provide information to support their conclusions. Elk may sometimes be a significant factor in causing ecosystem impairment in southern Utah, but this is unlikely in most instances. The number of elk in a riparian area and the amount of time they spend there are critical variables. The relative impacts of elk and cattle grazing can be estimated by comparing cow pies and elk pellet groups. If BLM contends that elk are causing impairment, the agency should be able to provide concrete evidence to support its assertion.

Studies that focus on competition and behavioral interactions between livestock and wild ungulates usually find that deer in particular, but elk as well, are less frequent in areas used by livestock (Dusek 1975, Bowyer and Bleich 1984, Loft et al.1993). The fact that wild ungulates use areas grazed by livestock less frequently can both be attributed to behavioral avoidance (Loft et al.1993), and to the fact that deer and cattle have very different diets (Mackie 1970, Dusek 1975, Austin and Urness 1986, Kie 1996). If wild ungulates generally avoid areas used frequently by cattle, then it would be reasonable to conclude that grazing impacts found in those areas would be caused by livestock.

Wild grazers and browsers are also more evenly distributed across the land and thus do not cause the same type of concentrated, severe impact as livestock do (Willers 2002). Wild, grazing herbivores in expansive, unfenced grazing systems tend not to remain stationary, migrating instead towards optimal grazing conditions. Defoliation caused by native grazers passing through an area removes older plant tissues and promotes the growth of new shoots, a co-evolved situation allowing for rapid recovery of habitat. Fenced lands and management for maximum yields of sedentary domestic livestock inhibit such recovery. Confining native grazers in such fenced-in situations has a similar negative effects (Frank 1998). A study conducted in the Henry Mountains looked at the different grazing patterns of cattle and bison (Van Vuren1982). Rangelands close to streams and lakes were especially prone to overgrazing because cattle congregate in areas close to water. Bison distributed grazing pressure more widely because they grazed steep slopes and areas distant from water. Since bison are nomadic, the plants they forage on have more time to recover.

In a more general sense, many of the scientific papers cited above in other sections lend credence to the notion that impacts from livestock grazing as currently practiced far exceed any possible impacts from wildlife. These studies often allege a comparison between livestock-grazed lands and "ungrazed" lands. However, the "ungrazed lands" in the studies were most likely subject to grazing from wildlife. Therefore, the studies actually compare livestock-grazed areas to wildlife-grazed areas. The studies overwhelmingly show much more damage to natural resources in those areas grazed by domestic livestock.

Because of the conclusive evidence, the BLM must bear the burden of proof that wildlife are a significant factor leading to a low rangeland health assessment. The studies just describe present the kinds of field data collection needed. In order to establish that wildlife are a significant factor, BLM will need to have evidence that large numbers of elk, bison, and (in the case of riparian areas) beavers are in the area. Field transects of habitat use (browse, grazing, tracks, scat) should be coupled with wildlife population surveys to demonstrate this. Vegetation monitoring should include relevant ecological reference sites and relict sites where wildlife may have access but not livestock. If wildlife is a significant cause of impairment, then those sites inaccessible to wildlife but accessible to cattle should not be impaired and areas accessible to wildlife and not cattle should be impaired.

## 4.2 Historic Overgrazing Is Not The Cause Of Contemporary Problems

Alone, resource impairment should not be blamed on “historic” grazing practices, as distinguished from “current” grazing practices. In other words, the literature does not support the idea that historic grazing practices are responsible for damage to ecosystem values, while current grazing practices are not – **unless** current grazing practices are designed specifically for recovery and differ radically from historic practices. Thus, to say that current grazing practices need not be changed because resource damage was caused by past grazing practices is not supportable unless current grazing practices include elements such as cessation of grazing, light stocking and utilization rates, grazing during non-growing seasons only, and removal of cattle from riparian areas.

Areas do recover from livestock grazing if grazing is drastically reduced or eliminated. In the context of forage production, Holechek and his colleagues make clear that light utilization and light stocking rates allow overgrazed areas to recover: “In the more arid shrubland ranges of the Southwest and intermountain regions, light grazing can be a useful means of improving forage production . . . .” Holechek 1998, pg. 191. Indeed, Holechek goes so far as to define light stocking rates as those that allow forage recovery: “Light grazing means a degree of herbage utilization that allows palatable species to maximize their herbage producing ability. Holechek 1999, pg. 12. The authors concluded that while “heavy stocking” consistently caused a downward trend in ecological condition, “light stocking” resulted in an upward trend. Holechek, et al. (1999, pg. 13). As explained above, Holechek and his colleagues recommend utilization levels of less than 30% to allow for recovery of productivity.

Importantly, Holechek and his colleagues are concerned only with the recovery of forage or productivity, not the recovery of ecosystem values. Where these resources are to be recovered, the literature confirms that total, long term rest is effective. Potter, L.D., and J.C. Krenetsky (1967) found that grass densities and total ground cover tripled following 25 years of non-grazing. Blydenstein, et al (1957) similarly determined that perennial grass densities and the palatable shrub Krameria grayi increased in a Sonoran desert grassland protected from grazing for 50 years, and were most taken by the notable increase in overall plant cover and density. More recently, Anderson, et al. (2001) found landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years of rest. Analyzing riparian areas, Platts and Nelson determined that herbaceous vegetation can recover within several growing seasons and woody vegetation within 5-10 years if grazing stress is removed from a deteriorated riparian area

At the same time, others have concluded that short-term rest from grazing may not be sufficient to allow for recovery of ecosystem values. McPherson et al. (1990) concluded that "[t]he effects of long-term continuous cattle grazing persisted 5 years after removal of livestock" and that the "succession following grazing will proceed slowly or will be unpredictable." In a study of the Kaiparowits Basin, Jeffires and Klopatek (1987) compared heavily grazed sites, a site10 years into recovery from heavy grazing, and a relict, never-before grazed site. The authors found that the relict site had significantly more herbaceous cover (comprised mostly of perennial grasses) than all other sites. There were no significant differences between the heavily grazed site and the recovering site for any of the measured parameters, leading the authors to conclude that recovery from grazing can take a very long time indeed.

Thus, where the temptation is to blame resource degradation on "past" grazing practices, rather than current practices, BLM must establish that current practices are sufficiently light and long lasting to allow for recovery of ecosystem values. Otherwise, current grazing practices must be implicated as causing resource impairment – even though less invasive than previous strategies, these practices are not protective enough to allow the area to heal. Where minimal grazing levels do not allow for significant resource improvement, elimination of livestock grazing for long periods of time is warranted. Moreover, BLM Handbook 4180-1 states that current practices do not necessarily have to be the cause of failure to meet Standards to justify a management change (BLM Tech. Manual H-4180-1, pg III-16).

## 4.3 Drought Is Not The Cause Of Impairment

Current knowledge leads to the conclusion that drought and is not, by itself, a significant factors for certain areas failing to meet the Standards and Guidelines. The vegetative communities of the Monument have undergone countless droughts over the past few thousand years, many of them severe, yet these past droughts did not serve to change species composition or structure dramatically, as numerous scientific studies have found livestock grazing to do in the arid West.

The precipitation data we have for the Monument tells us that droughts are very common in this part of Utah. Below we feature data from three locations with long-term precipitation records in the vicinity of the Monument. These include, from southwest to northeast – the town of Kanab, Kodachrome Basin State Park, and the town of Escalante. Table 9 provides a summary of annual precipitation statistics for these locations.[13] The statistics were calculated for years of record with no more than one day of missing data in any given month. Drought is considered to follow the definition of the Society of Range Management (SRM 1989), which defines drought as years with less than 75% of the average annual precipitation.

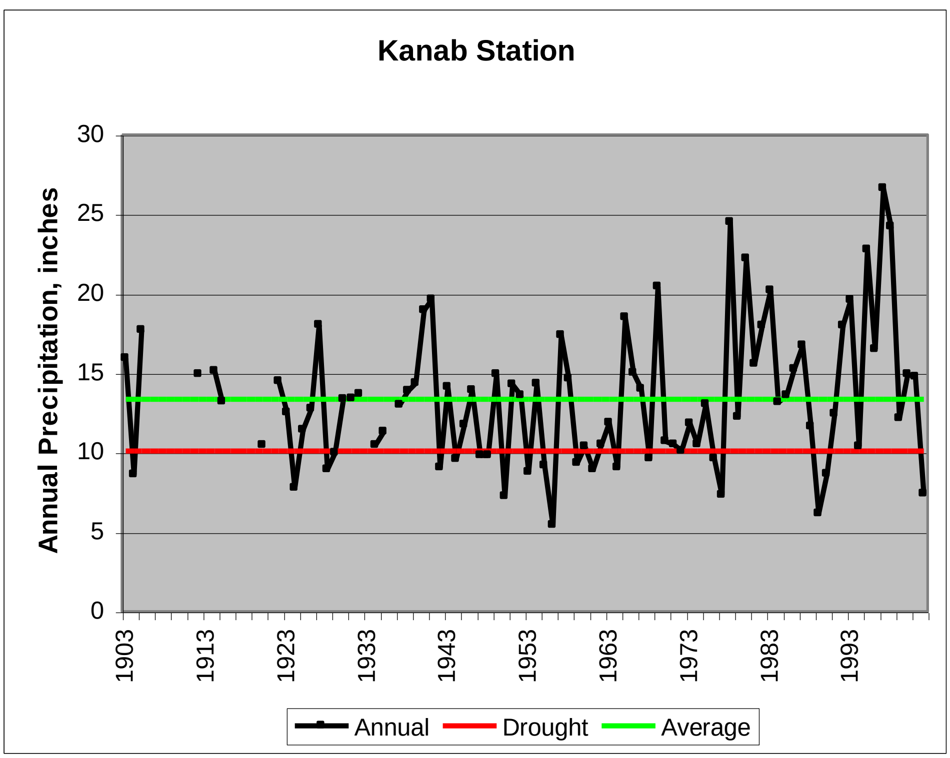
[13] The data was obtained from the Western Regional Climate Center database which can be found on line at http://www.wrcc.dri.edu/index.html.

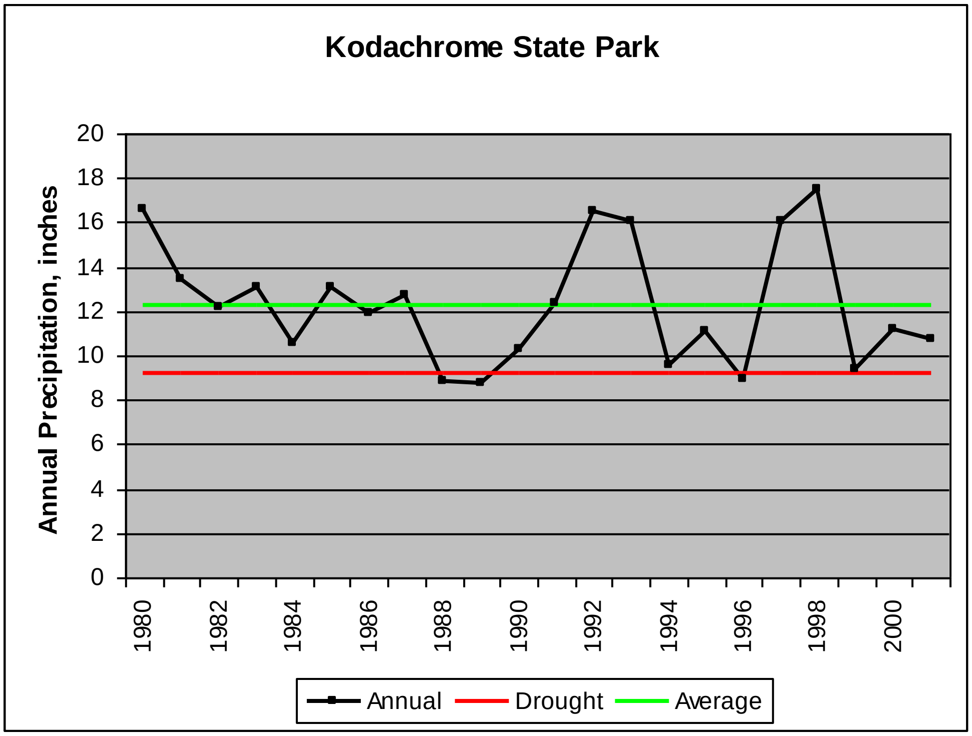
**Table 9. Precipitation Statistics for GSENM from Western Regional Climate Center**

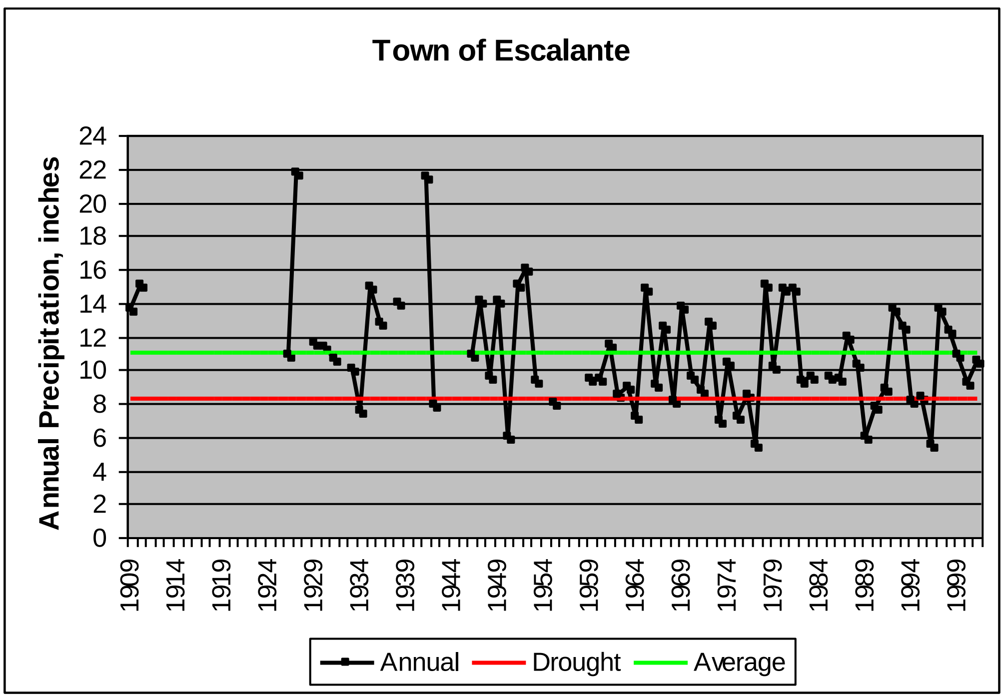
| Description | Kanab | Kodachrome | Escalante |
|---|---|---|---|
| Period of Record | 1903 – 2002 | 1980 – 2001 | 1909 - 2001 |
| Years of Record | 86 | 22 | 65 |
| Average, inches | 13.4 | 12.3 | 10.9 |
| Range, inches | 5.43 – 26.61 | 8.74 – 17.49 | 5.49 – 21.46 |
| Year below average | 46 | 12 | 39 |
| Percent years below average | 53.4 | 54.5 | 60.0 |
| Drought threshold, inches | 10.0 | 9.2 | 8.2 |
| No. Drought Years | 21 | 3 | 13 |
| Percent years below drought threshold | 24.4 | 13.6 | 20.0 |

During the 89 years records were kept, drought occurred for at least one station in 27 years, or 30.3% of the time. Figure 4 provides graphs for each location and shows the extreme variations in annual precipitation experienced across the Monument. From inspection of Figure 4, it is evident that there were many more years when the annual precipitation was very near the drought threshold. For example, at Kanab there were 30/86 years, or 34.8% of the time when the drought threshold was either approached or exceeded. Kodachrome experienced these conditions in 5/30 years or 16.6% of years and at Escalante, 39/65 years or 60% of years approached or exceeded the drought threshold.

Figure 4 (below and following page) shows annual precipitation for the period of record in the GSENM region.






The above data tells us that drought is a normal occurrence in southern Utah, at least for the past 100 years. Paleological records help recount about normal patterns and cycles for southern Utah over an even greater time period. A study in Capitol Reef National Park (Cole et al. 1997) used packrat middens to describe vegetation changes in the region. The authors found that pre-settlement middens contained abundant macrofossils of plant species palatable to livestock, such as winterfat (*Ceratoides lanata*) and Indian ricegrass. Their midden analysis demonstrated that drastic vegetation changes, unprecedented during the last 5,000 years, occurred in this part of southern Utah between roughly 1800 and the present. Species typical of overgrazed range, such as snakeweed, rabbitbrush (*Chrysothamnus nauseosus*), and Russian thistle (*Salsola iberica*) were not recorded in middens prior to the introduction of grazing animals. These changes occurred against a background of regular droughts, yet these droughts were not severe enough to change the entire nature of the vegetation; these droughts did not nearly represent the level of disturbance that the advent of livestock grazing did almost 200 years ago.

In yet another relevant study, actually recently conducted in the Monument, Harris and Asner (2003) used field measurements and remotely senses hyperspectral imagery to identify a grazing gradient (of decreasing amounts of bare soil) that radiates out 1.4 km from the water source. Important to our discussion on grazing and drought, this grazing gradient was confirmed during a period of above-average rainfall.

Six out of the last 10 years have been drought years on the Monument. But it must be underscored once again that drought is not in and of itself the reason for resource degradation. Rather, it is drought combined with land management that is "not prepared" for severe drought. A prime example of this problem is the disastrous situation that ensued over the past few years on 50-mile mountain.

This part of the Monument received only 30% of the average annual precipitation in 2000. On September 25 of that year the Monument's Rangeland Management Specialist flew over the entire Lake Allotment and stated: "the uplands have been depleted of grass and much of the browse has been eaten. The riparian areas are in deplorable condition! They have been trampled into oblivion. It will take more than one year for them to heal. Conditions grow worse each day" (Allotment Supervision Record, 1. Lake Allotment, 2000). The 2000 forage utilization records for the Lake Allotment demonstrate that average utilization levels for all pastures in the allotment in 2000 were a shocking 90% for uplands and 99% for riparian areas. The Rock Creek-Mudholes allotment was in similarly alarmingly poor condition; during the 2000 grazing season, average utilization levels in this allotment were from 73% to 90% in the uplands and 90% in the riparian areas. These data provide convincing evidence that the Monument is not prepared for extreme drought situations, and that BLM is unable to respond to the problem until it is too late.

In sum, drought, an almost ever-present "background" condition in the Monument and across the arid intermountain West, will rarely ever be the sole cause of impairment when resources are degraded.

## SECTION 5: CONCLUSION

In this paper, we provide BLM with scheme for determining when livestock grazing is a significant factor in the failure of an area to comply with the Fundamentals and Standards and Guidelines. The procedure is based on sound science, field work and extensive experience analyzing livestock grazing and the impacts it has on ecosystem values. We begin with factors tied to livestock use that are highly indicative of grazing as the cause of resource damage. We next focus on many of the same indicators BLM uses in its upland and riparian rangeland health assessment, using these to discover the connection between damage to ecosystem values and livestock grazing. We then suggest that other factors are rarely the cause of undesirable conditions, and recommend means for documenting the few cases in which these factors may lead to non-functioning ecosystems. Finally, we have attached a sample checklist that implements our recommended analysis.

Whether or not this checklist ultimately proves useful, we are confident in our analysis and citation to the literature, which overwhelmingly concludes that in almost all cases where livestock grazing occurs, particularly as grazing is practiced in the Monument, this use is a significant factor in the failure of an area to support healthy and sustainable ecosystems. Given this reality, the BLM must fully explain and provide evidence for any conclusion it makes that livestock grazing is not the cause of damage to uplands and riparian areas in the Monument. Indeed, the Monument is saddled with the burden of proof in this determination process. The published literature already suggests that grazing causes harm, thus the burden of proof is on GSENM to show it does not. Hence, the Monument should assume grazing has caused impairment unless the BLM can produce positive proof that another factor is to blame. That other factors contribute to impairment is undoubted; the BLM has the burden of proof to show that ONLY those other factors and NOT grazing is the cause of not meeting Standards.

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