A COMPREHENSIVE LITERATURE REVIEW OF THE EFFECTS OF LIVESTOCK GRAZING ON NATURAL RESOURCES

Prepared To Disclose The Effects of Livestock Grazing
At Proper Use
On The Dixie National Forest

United States Department of Agriculture
Forest Service
Intermountain Region
Dixie National Forest

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(Photo Inset)

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This literature reference document was compiled by resource specialists of the Dixie National Forest. Contributing scientists were:

Dave Grider, Dixie NF Range Staff Officer
Dale Harris, Cedar City RD Supervisory Range Conservationist
Evan Boshell, Powell RD Supervisory Range Conservationist
Jim Bayer, Dixie NF Soil Scientist
Janice Staats, Dixie NF Hydrologist
Steve Robertson, Dixie NF Fisheries Biologist
Debra Kary, Escalante RD Wildlife Biologist
Priscilla Summers, Cedar City RD Wildlife Biologist
JoAnne Stenten, Teasdale RD Wildlife Biologist
Marian Jacklin, Dixie NF Archeologist
Max Molyneux, Dixie NF Landscape Architect
Ric Rine, Dixie NF Forest Planner

THE AUTHORS

DAVE GRIDER is range and fire staff officer for the Dixie National Forest, Intermountain Region, Forest Service, Cedar City, UT. He is also the project leader for the Dixie NF's 1995 grazing permit reissuance process. He has a B.S. degree in range management from New Mexico State University. He joined the Forest Service in 1976. He worked as a range conservationist on the Gila, Cibola, Fishlake, and Wasatch-Cache NF's and as a District Ranger on the Toiyabe NF.

DALE B. HARRIS is the supervisory Rangeland Management Specialist on the Cedar City Ranger District, Dixie National Forest, Cedar City, Utah. He has a B.S. Degree in range management from Brigham Young University. He joined the Forest Service in 1965. He has worked as range conservationist on the Humboldt, Fishlake, Toiyabe and Dixie NF's.

EVAN BOSHELL is supervisory Rangeland Management Specialist on the Powell Ranger District, Dixie National Forest, Panguitch, UT. He has a B.S. Degree in Range Management from Utah State University. He joined the Forest Service in 1975. He has worked as a range conservationist, wildlife and watershed staff officer on ranger districts on the Kaibab and Apache/Sitgreaves National Forests.

JIM BAYER is Forest soil scientist for the Dixie National Forest, Intermountain Region, Forest Service, Cedar City, UT. In addition, he represents the Regional Office for soil quality control and soil correlation on soil resource inventory activities on National Forest lands in the States of Utah and Nevada. He has a B.S. Degree in soil science from California State Polytechnic College. He began work as a soil scientist with the Soil Conservation Service in 1966 and worked in various locations in Washington and New Mexico. In 1974, he transferred to the Forest Service as the Forest soil scientist on the Sequoia NF in California. He transferred to Utah as the zone soil scientist for the Dixe, Fishlake and Manti-LaSal National Forests in 1975.

JANICE STAATS is the Hydrologist on the Dixie National Forest. She has a B.S. degree in Watershed Science from Utah State University. She has worked as a Hydrologist since 1987 for the U.S. Geological Survey in New York, White Mountain National Forest in New Hampshire, Challis National Forest in Idaho, and the Dixie National Forest in Utah.

STEVE ROBERTSON is the Forest Fisheries Biologist for the Dixie National Forest, Intermountain Region, Cedar City, UT. He has a B.S. Degree in fisheries management from Utah State University and a M.S. in zoology from University of Nevada at Reno. He joined the Forest Service in 1980. He worked as a Forest Fisheries Biolgist, District Wildlife Biologist, and District Resource Officer on the Stanislaus National Forest and as a District Resource Officer and Zone Fisheries Biologist on the Idaho Panhandle National Forest.

DEBORAH KARY is the East Zone Wildlife Biologist, Dixie National Forest, Intermountain Region, assigned to the Escalante Ranger District. She started with the Forest Service in 1989 as a range conservationist on the Ochoco NF in Oregon. She received dual B.S. degrees in Wildlife/Environmental Law and Gen. Agri/Rangeland Science from Oregon State University in 1991 and then transferred to the Fremont NF as Assistant to the Forest Wildlife Biologist/TES Coordinator. She has an M.S. degree in Natural Resource Management/Wildlife and a minor in Restoration Ecology with emphasis in Great Basin and High Desert ecology. She has worked as a wildlife biologist on Ranger Districts of the Fremont and Tongass NFs.

PRISCILLA R. SUMMERS is the West Zone Wildlife Biologist, Dixie National Forest, Intermountain Region. She has a B.S. Degree in Natural Resource Management from Humboldt State University in California, 1974. She joined the Forest Service in 1974 and worked as a Recreation Technician on the Siskiyou (1974-1978) and Winema (1978-1987) National Forests. In 1986 she returned to Humboldt State University for classes to convert to Wildlife Biologist series. She has worked as Wildlife Biologist on the Fremont NF from 1987 to 1994, and the Dixie National Forest from 1994 to the present.

JOANNE STENTEN is a wildlife biologist for the Dixie National Forest, on the Teasdale and Escalante District, Teasdale, UT. She has a B.S. Degree in Renewable Natural Resources, with a major in Wildlife Manangement from the University of Arizona. She has worked as a Forestry Technician and a Wildlife Biologist on the Teasdale and Escalante Districts since 1989, when she joined the Dixie National Forest.

MARIAN JACKLIN is the Archaeologist for the Dixie National Forest, Intermountain Region, Forest Service, Cedar City Utah. She has a Master's Degree in Anthropology with emphasis in Prehistoric Archaeology from Brigham Young University. Prior to joining the Forest Service in 1987 she worked as an archaeologist for several private and state consulting firms in the western United States, Syria, and The Navajo Nation.

MAX MOLYNEUX is the Landscape Architect, Recreation and Wilderness Sub-Staff for the Dixie National Forest, Intermountain Region, Forest Service, Cedar City, Ut. He has a Bachelor of Landscape Architecture and Environmental Planning Degree from Utah State University. He joined the Forest Service in 1970. He worked as a Landscape Architect on the Uinta, Ochoco, Grand Mesa, Uncompahgre, Gunnison, and Dixie National Forests.

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INTRODUCTION

This paper is prepared as a reference document for reviewing accumulated research literature describing the effects of livestock grazing under two conditions: 1) Proper Use and 2) No Grazing. It was assumed that, generally, the effects of livestock grazing on resources has been historically and recently researched and these effects are known and documented. The dilemma was that they were not assimilated in a ready-reference-type document that could aid in disclosure for effects analysis processes. This paper proposes to do that.

Each chapter was compiled and written by a resource specialist employed on the Dixie National Forest, Intermountain Region, U.S. Forest Service. Chapters include discussions of the effects of livestock grazing on 1) Vegetation Defoliation, 2) Soils, 3) Hydrology/Watersheds, 4) Fisheries, 5) Wildlife and wildlife habitats, 6) Cultural Resources, 7) Recreation, and 8) Socio- Economics. Effects on TES species is not reviewed in this paper, as the Endangered Species Act requires that Biological Evaluations or Assessments must be completed for any proposed actions. These documents will be prepared separately as addendums to environmental assessments.

Although this document is prepared for the purpose of facilitating National Environmental Policy Act (NEPA) procedures on the Dixie NF, the supporting literature citations are broadly based and are applicable for rangelands west-wide.

This paper focuses on the effects of livestock grazing at proper use. However, most research and field studies compare over-use with no use at all. The difference is always dramatic. Platts (1982) concluded that many study sites were chosen in the most degraded areas and do not represent the overall range condition. He noted that many of these studies do not identify whether the grazing strategy and intensity of use were being either properly or improperly managed. Heady (1984) stated "The current penchant for describing the bad effects of overgrazing far over-shadows descriptions of successful...grazing programs and the good results from proper grazing." Vallentine concludes that even scientists, sometimes knowingly but probably more often unknowingly, report comparisons of the impact of "no livestock grazing" with "livestock grazing", when often all that was compared was severe livestock use, much beyond the pale of proper use but with no qualification made as to this aspect.

The reviewer is cautioned to avoid making the mistake of judging proper grazing by the results of overgrazing. May and Sommes (1981) concluded that livestock grazing either by sheep or cattle is not inherently bad. Streamside areas have historically been grazed by herbivores with varying degrees of impact, both positive and negative. They found that the critical element influencing effects of grazing is the management of grazing activities.

Stoddart & Smith (1943) stated that no use at all is not normal for vegetation and only abnormal use has resulted in range deterioration. Holechek et al. (1989) and Pieper & Heitschmidt (1988) discuss the theory that range herbivores have been grazing and browsing on range plants for eons, suggesting that herbivores and the vegetation on which they feed co-evolved in a mutualistic manner and that grazing may enhance the long-term reproduction and survival of some species. Marlow (1990) clarifies that the grazing behavior of native animals resulted in less than 10% of use on riparian areas. Consequently, riparian areas developed under light grazing pressure: short term heavy use with long periods of rest.

Cattle evolved in a different environment with different behavior patterns--high grasses where they had to stay in one location to keep grass production down. Certain degrees of defoliation can increase plant productivity. Removal of apical dominance by grazing or browsing has long been understood as one means of increasing productivity.

Utilization standards have been developed based on scientific research on common rangeland species (Clary and Wester 1988, Clary 1995, Crider 1955, Richards et al. 1987, Richards and Caldwell 1985, Shepard 1971, Valentine 1990). They are based on ecological principals, management concerns, and averages for representative floristic lifeforms (grasses, grasslikes, and shrubs). Measurement of utilization is based on the annual production of above-ground biomass of plants and is stratified by management type, rangeland ecosystem conditions, and by broad groups including upland, riparian, browse, crested wheatgrass seedings, and alpine ecosystems (Padgett 1995).

Forage utilization standards and guidelines are developed to ensure, with proper implementation and management, the achievement of identified future conditions of forest rangeland resources. Properly managed livestock grazing, permitted within standard and guideline limits, is designed to cause no significant impacts to rangeland resources.

Based on 1) analyses of existing and desired future resource conditions, conducted by interdisciplinary resource teams (IDTs), 2) application of the forage utilization allowable use standards and guidelines prescribed in the Dixie National Forest Land and Resource Management Plan (Forest Plan)(USDA 1986), 3) review of current research and grazing management recommendations for the Intermountain Region (Clary and Webster 1989), 4) field examination and recommendations from the Intermountain Region Ecologist (Winward 1995), and 5) consideration of limiting resource factors, the following grazing conditions are presented by the Dixie National Forest as "proper use":

Any one of these standards will indicate the proper time to remove livestock from that pasture or allotment.

These standards are within the parameters prescribed in the Dixie National Forest Land and Resource Management Plan (LRMP) but provide more definitive criteria. An appropriate amendment to the LRMP will be implemented to assure universal, Forest-wide application. This is not an all-inclusive listing of proper use criteria. Proper use criteria are determined by application of limiting factors such as presence of Threatened, Endangered or Proposed and Sensitive fish or wildlife species or critical/sensitive resource areas. Therefore, some utilization prescriptions may be less than these maximum standards. Any one of these standards will indicate the proper time to remove livestock from that pasture or allotment:

Proper Use Criteria

1. Upland forage utilization mostly limited to no more than 50% of current year's growth, but varying in specific pastures from 40-60%.

2. Utilization of crested wheatgrass seedings up to 60% of current year's growth, with management options to intensively graze at higher use levels to maintain the health of the seedings.

3. For VERY EARLY and EARLY SERAL STATUS HYDRIC species, in riparian streamside "greenline"s, associated meadows, wet meadows not influenced by streams, and Forest Plan designated 9B INTENSIVE RIPARIAN MANAGEMENT AREAS, SIX-INCH stubble height remaining at

growing season's end to provide improvements in plant vigor, composition, and density and to provide vegetative biomass for streambank protection during the spring run-off.

4. For MID-TO-LATE SERAL STATUS HYDRIC species, in riparian streamside greenline"s, associated meadows, and wet meadows not influenced by streams, FOUR-INCH stubble height remaining at growing season's end to provide improvements in plant vigor, composition, and density and to provide vegetative biomass for streambank protection during the spring run-off.

5. For NON-HYDRIC species, in riparian streamside areas, associated meadows, and meadow areas not influenced by streams, TWO-INCH stubble height remaining at growing season's end.

6. During SPRING and SUMMER, both HYDRIC and NON-HYDRIC species, in riparian streamside areas, associated meadows, and meadow areas not influenced by streams, MAY BE GRAZED BELOW THE MINIMUM FALL STUBBLE HEIGHT STANDARD, provided that livestock removal is timely and complete to allow REGROWTH, by the end of the growing season (FALL), of hydric species to either the four or six inch stubble height requirements depending on seral status, and REGROWTH of non-hydric species to a minimum two-inch stubble height.

7. If grazing occurs after the growing season, stubble height standards (two inch on non-hydric and four-to-six inch on hydric species in riparian areas) must be maintained.

8. No more than 20% of the streambanks show bank sloughing, animal tracks, dislodged stones and/or trampling from livestock.

9. Riparian area browse use does not exceed 50% of new leader production.

10. In order to maintain native food and cover for a variety of goshawk prey species, grazing utilization of grasses and forbs in goshawk nest areas and post-fledgling family areas (PFAs) would average 20% or less by weight, and not exceed 40% in any given area, and shrub utilization would average 40% or less by weight, and not exceed 50% in any area. Within any PFA effects area (600-acre area), the maximum opening size for which utilization constraints are applied is 2 acres for Ponderosa Pine and mixed species types and 1 acre for spruce-fir types. In foraging areas (6000-acre area), the maximum opening size for which utilization constraints are applied is 4 acres for Ponderosa Pine and mixed species types and 1 acre for the spruce-fir type. Within PFAs with active nests, construction of improvements would not be allowed from March 1st through September 30th. Within PFAs with inactive nests, improvement construction activities would not be allowed from March 1st through August 1st.

Proper Use Criteria:

Dixie NF - Maximum Allowable Forage Use Criteria					
UTILIZATION BY SERAL STAGE					
Vegetation Type	Very Early	Early	Mid	Late	Comments * SH = Stubble Height
Riparian Hydric Species	6" SH	6" SH	4" SH	4" SH	Remaining at end of growing season
Riparian Emphasis Management Areas	6" SH	6" SH			Remaining at end of growing season
Hydric Species in wet meadows not influenced by streams	6" SH	6" SH	4" SH	4" SH	Remaining at end of growing season
Non-hydric Species in Riparian Areas	2" SH	2" SH	2" SH	2" SH	Remaining at end of growing season
Upland Species	50%	50%	50%	50%	Varying in specific unit from 40-60%
Wheatgrass Seedings	60%	60%	60%	60%	Management option to exceed 60% use to maintain healthy seedings
Riparian Browse	<50%				New Leader Production
Streambanks	<20% disturbance				Sloughing, trampling, dislodged stones, animal tracks
Goshawk Post-Fledgling Family Areas (PFAs)	Pond Pine/ Mixed Species	Grass/Forb	Avg 20% NTE 40%		Applies in up to 2-acre openings in 600-acre areas
Goshawk Post-Fledgling Family Areas (PFAs)	Pond Pine/ Mixed Species	Shrub	Avg 40% NTE 50%		Applies in up to 2-acre openings in 600-acre areas
Goshawk Post-Fledgling Family Areas (PFAs)	Spruce-Fir	Grass/Forb	Avg 20% NTE 40%		Applies in up to 1-acre openings in 600-acre areas
Goshawk Post-Fledgling Family Areas (PFAs)	Spruce-Fir	Shrub	Avg 40% NTE 50%		Applies in up to 1-acre openings in 600-acre areas
Goshawk Foraging Areas	Pond Pine/ Mixed Species	Grass/Forb	Avg 20% NTE 40%		Applies in up to 4-acre openings in 6000-acre areas
Goshawk Foraging Areas	Pond Pine/ Mixed Species	Shrub	Avg 40% NTE 50%		Applies in up to 4-acre openings in 6000-acre areas
Goshawk Foraging Areas	Spruce-Fir	Grass/Forb	Avg 20% NTE 40%		Applies in up to 1-acre openings in 6000-acre areas
Goshawk Foraging Areas	Spruce-Fir	Shrub	Avg 40% NTE 50%		Applies in up to 1-acre openings in 6000-acre areas

Exceeding any one of these standards in a monitoring area will indicate the proper time to distribute livestock away from that monitoring site onto available feed in other areas of the pasture or allotment. If distribution efforts are unsuccessful at maintaining proper use criterion within the monitoring site, then livestock may be required to be removed from the pasture or allotment.

EFFECTS OF VEGETATION DEFOLIATION BY LIVESTOCK

Dave Grider, Range Staff Officer
Dale Harris, Cedar City Ranger District Range Conservationist
Evan Boshell, Powell Ranger District Range Conservationist

The Dixie National Forest is proposing to permit livestock grazing at proper use levels as described in the introduction.

PROPER USE

To adequately describe proper use, the relationship between allowable use and proper use must first be understood.

Allowable Use. The Dixie National Forest Land & Resource Management Plan (Forest Plan) prescribes utilization standards by grazing system and range type (USDA, 1986):

GRAZING SYSTEM/RANGE TYPE ALLOWABLE USE

Rest-Rotation System Up to 60 % use on Heavy Use Pastures (IV-36)
Deferred Rotation System Up to 60 % use on wet meadows & reseedings (IV-36)
Season-long System Maximum 60 % use in riparian areas (IV-41)
General Riparian Areas Maximum 50 % use of current year's browse (IV-41) General Riparian Areas Maintain 70 % ground cover (IV-41)
General Upland Sites Up to 50% use (IV-36)
Big Game Winter Range Browse use limited to that not needed by big game (IV-100, IV-105)
Designated Riparian Areas Up to 60 % use in Rest-rotation systems (IV-138)
Designated Riparian Areas Up to 50% use in Deferred-rotation systems (IV-138)
Designated Riparian Areas Up to 50% use of browse new leader growth (IV-138)

The Intermountain Region Range Analysis Handbook--FSH R4-2209.21, 1993, ch. 0, par. 05, page 1--defines allowable use as: "The degree of utilization considered desirable and attainable on various specific parts of an allotment considering the present nature and condition of the resource, management objectives, and level of management" (USDA 1993). Allowable use is based on the morphological and physical characteristics of forage species and is the amount of use that can occur for a specified period of time while meeting basic resource needs and associated resource management goals--FSH R4-2209.21, 1993, ch. 20, par 29, pg. 3.

The allowable use concept is based on the fact that plants can withstand removal of a part of their current year's growth and still achieve normal growth the following year. The following characteristics of plant physiology and growth must be considered in determining allowable use (Frazier 1979):

--1. About one third of a grass plant's roots die naturally each year.
--2. Herbaceous perennials store food reserves in their roots, but woody plants store their reserves both above and below the ground.

--3. The formation of sugars, starch, proteins, and other foods is first dependent on the photosynthetic process in the leaves (seldom the stems) of plants.
--4. Plants do not get food for their maintenance and growth from the soil. They obtain only the raw materials needed for photosynthesis and subsequent food elaboration. Green plants are therefore entirely dependent on green leaf tissue for their survival.
--4. When leaves are removed from plants, food-producing capacity is reduced. Close defoliation of green growth year after year eventually depletes food reserves and kills the plant.
--5. Food reserves are lowest when new shoots are about half grown and about half of the food reserves are stored by flowering time.
--6. Most food reserves of grasses are stored by the time shoots are full grown or when seed is ripe.

As referenced by Frazier (1979), in 1975 H.E. Dietz tabulated how progressively greater removals of leaf volume during the growing season affect stoppage of root growth:

% LEAF VOLUME REMOVED	% ROOT GROWTH STOPPAGE
10	0
20	0
30	0
40	0
50	2-4
60	50
70	78
80	100 (for 12 days)
90	100 (f0r 18 days)

Grazing capacities are based on allowable use allocations for a mimimum three-year period on season-long grazing allotments and a minimum of a full rotation on rest or deferred systems--FSH R4-2209.21, 1993, ch. 20, par 29, pg. 3 (USDA 1993).

Proper Use. Proper use is determined from allowable use and is the level of grazing utilization that can be permitted on an area considering the need to maintain or reach desired conditions while at the same time considering all limiting factors. The Intermountain Region Range Analysis Handbook--FSH R4-2209.29, 1993, ch. 0, par. 05, pg. 6 (USDA 1993) describes proper use as being determined by..."The limiting factor or factors which will be measured on a particular site. It could be percent utilization of forage, impact on other resources or uses, or any other measurable factor on a particular site".

Proper-use criteria is developed from interdisciplinary input--FSH R4-2209.29, 1993, ch. 20, par. 41.9, pg. 11 (USDA 1993), for example: fish surveys, ecological type transects, research findings, coordination requirements, observations, and good judgement. It is necessary that proper-use criteria be based on the factor which becomes critical first--the limiting factor. The limiting factor, as to the degree of utilization allowed, may be seral condition; the degree of use of key hydric species; trampling of streambanks and resultant damage to fisheries; degree of use allowed in critical wildlife habitats; the presence of Threatened & Endangered plants, wildlife, or fish; season of use; class of livestock; type of grazing system; esthetics; etc.

First priority for use of the vegetative resource should provide maintenance or improvement of the basic resources of soil, water, and vegetation. Whatever percentages of the vegetative resource which must be reserved to maintain the basic resource is allocated first--FSH R4-2209.29, 1993, ch. 20, par. 29.2.1, pg.

7 (USDA 1993). After the needs of soil, water, and vegetative resources are provided, the other resources, such as livestock grazing, wildlife, and esthetics, can be considered.

Proper use is based on five principals that are fundamental to the ecological characteristics of the land (Busby 1979; DeBenedetti & Parsons 1983; Pieper & Heitschmidt 1988):

1. Utilize the range with the proper kinds of use. Each area of range has soil, vegetation, topographic, and climatic characteristics which makes it suitable for some uses but unsuitable for others.
2. Utilize the range at the proper intensity. Each area of range has a level of use that cannot be exceeded without causing deterioration of the land. However, an area can withstand some degree of soil compaction, vegetation harvest, and other use impacts without causing undue deterioration.
3. Utilize the range during the proper season. Soils and plants--two basic range resources--are more susceptible to damage during certain times of the year.
4. Utilize the range at the proper frequency. The frequency and severity of defoliation of individual plants and species of plants varies depending upon preference and availablity. The result is that most preferred plants will be defoliated more frequently or severely than less preferred plants.
5. Utilize all suitable range areas with uniform and proper distribution. Livestock distribution is a common problem in rangeland environments; however, moving use from an area of concentration to an unused or underused area is essential to proper management.

Utilization standards are important. However, you have to be careful when using off-the-shelf utilization standards, such as take half and leave half, and four-to-six inch residual stubble height (Chaney et al. 1993). Each situation must be independently evaluated. Trial and error may be required. Standards will have to be changed as vegetation responds.

Key-plant and key-area concepts have proven highly useful to managers in evaluating frequency and intensity of use on rangeland vegetation. The Intermountain Region (R-4) Rangeland and Ecosystem Analysis and Management Handbook (USDA 1993) defines key area and key species:

Key Area: A relatively small portion of rangeland which because of its location, grazing or browsing value, and/or use, serves as a monitoring and evaluation site. (A key area guides the general management of the entire area of which it is a part, and will reflect the overall acceptability of current grazing management over the range).

Key Species: (1) Forage species whose use serves as an indicator to the degree of use of associated species. (2) Those species which must, because of their importance, be considered in the management program.

Holechek (1989) further defines key management species as those on which management of grazing on a specific range is based. The key species and key area serve as indicators of management effectiveness. Generally, when the key species and key area are considered properly used, the entire pasture is considered correctly used.

PROPER USE OF HERBACEOUS VEGETATION

Herbaceous vegetation includes grasses, grasslikes, and forbs (nonwoody flowering plants). In general, cattle prefer grasses and grasslikes over forbs, but preferences depend on season of use and available forage.

Recent research has shown that the amount of root growth, which was previously thought to be important for maintaining plant vigor over time, may in fact have no effect. Early studies by Crider (1955) aimed at measuring the results of grazing on the subsequent amount of root growth, found that 40 percent utilization (oven dry weight) of smooth brome and Kentucky bluegrass resulted in an annual increase in root growth ranging from 10 percent (smooth brome) to 77 percent (Kentucky bluegrass). Over time, this should translate into increased vigor of existing grasses and eventually a replacement of undesirable species with more desirable species.

More recently, however, Richards and Caldwell (1985) and Richards et al. (1987) showed that it is the removal of meristematic tissue that has a greater impact on a plant's ability to maintain vigor and reproductive capability over time. Valentine (1990) noted that Total Available Carbohydrates (TAC) are a pool of nonstructural carbohydrates, from which plants can get materials that allow them to offset fluctuations in the levels of sugars needed for maintenance, respiration, initial growth, and many other functions. Valentine went on to mention that moderate levels of TAC may be as advantageous to plants as high levels. This indicates that some removal of vegetation is not detrimental to plants. Valentine noted that adequate levels of TAC food reserves:

1. Maintain overall high plant vigor;
2. Support perennial plant function during dormancy, principally respiration;
3. Enable earlier and more rapid regrowth following dormancy or severe defoliation;
4. Promote extensive root and rhizome growth;
5. Increase both vegetative reproduction and seed reproduction;
6. Give higher drought, frost, and heat tolerance;
7. Maintain high resistance to insect and disease injury; and
8. Promote root nodulation in legumes.

Valentine (1990) went on to note that prolonged depletion of TAC by overgrazing or in combination with severe restriction of environmental resources required for growth can result in reduced root growth, tiller bud development, rhizome development, forage yield, and even death (particularly when combined with some adverse environmental factor such as drought).

Studies on defoliation that removed apical meristems (actively growing portion of plants at tips of leaves and branches) in switchgrass resulted in "substantially greater decline in TAC than lighter levels of defoliation that did not remove apexes" (Anderson et al. 1989). Therefore, the removal of actively growing meristematic tissue has the potential for greatly effecting carbohydrates reserves and all those functions noted by Valentine (1990) above. Olson and Richards (1989) stated that the ability of plants to recover from herbivory depended on the availability of meristematic tissue. They went on to note that, in general, if current meristematic tissue is not removed plants are capable of recovering and long-term productivity and competitiveness are not adversely effected. Anderson (1991) noted that severe defoliation of wheatgrass when vegetative growth is rapid and meristematic tissue is being elevated is most detrimental. As a result, timing of grazing is an important consideration when monitoring use.

Padgett (1995) states that when developing utilization standards, proper use considers the physiological requirements for maintaining plant health and vigor as well as management considerations such as streambank stability, ground cover, soil compaction, wildlife habitat, fish habitat, etc. Padgett references Rassmussen (1994) noting that, in general, proper use of key grass species is 50-60 percent on sites considered to be in satisfactory condition. Rassmussen noted that the "take half, leave half" rule of thumb insures that there is sufficient meristematic tissue remaining for maintenance of the existing plants. Translated, this means that plant communities will be able to maintain their existing status with 50 percent use. Communities that are in less than satisfactory condition, however, will not see any improvement in their ecological status. Even though heavier grazing after plants are no longer producing actively growing meristematic tissue may not negatively impact the long-term productivity of those plants, we feel that other resource impacts (including those to soils, streambanks and stream channels) require that we maintain utilization at these levels (Padgett 1995).

Research shows that crested wheatgrass can withstand higher grazing levels than many other perennnial grasses (Richards and Caldwell 1985) and that it does, in fact, maintain higher vigor when used at higher levels. For that reason allowable use on dormant crested wheatgrass on satisfactory condition rangelands is 60 percent.

Standards for use in riparian areas have been studied by many authors. Clary and Webster (1988) compiled information from numerous sources and recommended that "utilization of streamside herbaceous forage should be limited to about 65 percent of the current growth, and livestock should be removed by July 15 to allow sufficient time for plant re-growth". Utilization based on current growth, however, does not translate directly to utilization based on total annual production. The authors went on to note that recommendations of 40-50 percent utilization (approximately 3 to 4 inches of residual stubble height) will maintain plant vigor. They noted, however, that additional stubble height (e.g. 6 inches or more) might be necessary to protect riparian ecosystem function. The authors noted that "Vigorous woody plant growth and at least 6 inches of residual herbaceous plant height at the end of the growing/grazing season typified the riparian areas in excellent, good, or rapidly improving condition." This stubble height was shown to equate to average use levels of 24 to 32 percent.

Standards for stubble height, rather than percent utilization, are noted for riparian communities occurring along the "greenline" only. The "greenline" is defined as the first plant communities dominated by perennial vegetation as you proceed outward from the center of the channel. The amount of forage left along the stream's edge has been found to be important in catching sediments during runoff periods, both from the stream channel as well as from overland flow (Clary and Webster 1988). The trapping of sediment is critical in the rebuilding of streambanks as well as the maintenance of water quality. Greenline standards, however, cannot be applied to many subalpine and alpine riparian ecosystems. Here plants rarely reach heights at full maturity equal to those of the standards. At these elevations utilization standards for greenline are determined by using nongreenline riparian standards with emphasis on streambank trampling standards.

PROPER USE FOR WOODY VEGETATION

Woody vegetation includes shrubs and trees, and is refered to as browse when discused in terms of use by wildlife or livestock. Shrubs are the primary source of woody plant utilization by wild and domestic ungulates and they are the focus of this document. The measurement of browse utilization is based on current year's growth. Utilization standards for browse are based not only on the physiological ability of individual woody plants to withstand use and produce additional browse, but also on the ability of plants to reproduce and maintain their populations by adding new individuals. In addition, ecosystem impacts (soil compaction, erosion, ground cover, etc.) can be detrimental if excessive use occurs on woody or herbaceous vegetation in any given area. Mountain big sagebrush, oak, serviceberry, bitterbrush, curlleaf mountain mahogany, and birchleaf mountain mahogany are among those species identified to monitor.

Kovalchik and Elmore (1991) document that early season upland grasses have crude protein levels of 15 to 17 percent, but levels fall below 5 percent as grasses mature. As this occurs, cattle increase the amount of available palatable forbs and browse in their diets and soon move into the riparian zone. Then a shift to willows occurs as riparian forage supplies become exhausted, usually toward the end of the grazing season.

Limited research was found on impacts of utilization on various browse species. Shepherd (1971) studied impacts on big sagebrush, oak, serviceberry, bitterbrush, and birchleaf mountain mahogany. Austin (1990) studied impacts of pruning on curlleaf mountain mahogany in northern Utah. It was not clear from this study whether percentages of vegetation removal were based on current year's growth or on total production. The author found that pruning intensities greater than 50 percent on winter range plants resulted in increased tree mortality; pruning intensities less than 50 percent typically resulted in an increase in forage production. On summer range mortality increased when pruning intensities exceeded 70 percent. Thompson (1990) found that top pruning of curlleaf mountain mahogany can have various positive impacts including increased limb growth and more available browse. Both of these studies (Austin 1990; Thompson 1990) were based on mechanical treatment aimed at improving browse production and were not necessarily intended to mimic use by wild and domestic ungulates. They do, however, indicate that this species has higher productivity when used than when left unused.

Satisfactory condition for browse species in big game winter range is described based on the maintenance of stands of vigorous, reproducing plants and healthy ground cover conditions for maintenance of healthy watershed conditions. Utilization standards are defined above taking into consideration improvement or maintenance of these conditions. While some shrubs, like mountain mahogany, can actually be more productive with use levels in excess of 60 to 80 percent, we do not feel that this allows for maintenance of watershed conditions. In addition, because some of these shrubs only produce flowers on second year growth, use levels that greatly reduce the amount of second year growth will reduce the ability of those plants to flower and reproduce (Padgett 1995).

NARROWING THE SCOPE OF ANALYSIS

This paper will focus on the effects of livestock grazing on rangeland vegetation. The analyses conducted during 1995 by Dixie National Forest IDTs identified the following existing environments and conditions to which grazing prescriptions will be applied and for which disclosure of the effects of grazing is sought:

--1. High-elevation/alpine ecosystems; moderate and low-elevation riparian ecosystems; upland ecosystems; and seeded, vegetative-type conversions
--2. Satisfactory and unsatisfactory condition riparian areas
--3. Deferred-rotation and rest-rotation grazing systems
--4. Grazing by cattle and sheep

An in-depth literature review establishes that the effects of vegetation defoliation is not markedly different for the factors in any of these four categories. Summarily, they indicate that although the prescriptive use (proper use) may vary by category, the effects of foliage removal are the same.

HIGH ELEVATION/ALPINE RIPARIAN ECOSYSTEMS

Alpine areas are those above treeline with short growing seasons, often with shallow soils and low growing grasses and sedges. Some areas with deeper soils do exist in alpine ecosystems although these areas are still subject to short growing seasons and relatively low productivity when compared to lower elevation sites. Range readiness occurs in mid-July, with senescence generally occurring by mid-September. Ground cover provides protection with a diversified vegetative cover that stabilizes soil and provides for watershed conditions that absorb surface runoff and contribute to meeting water quality standards, stream stabilization and healthy habitat for fish and wildlife populations. Ground cover is at least 85 percent of potential and is characterized by perennial vegetation, moss, litter, and/or naturally occurring rock. Both livestock grazing and recreation activities are managed to maintain and protect the inherent ecological values of these fragile ecosystems. Because of the short growing season, shallow topsoils, and low-growing vegetation, these high-elevation ecosystems require special proper-use considerations. To substantially reduce the intensity and use of key riparian/meadow areas on the Dixie National Forest's Boulder Top alpine area, grazing was limited to a maximum of 40 percent in bluegrass vegetation types, with a 4-inch minimum stubble height requirement for sedge/rush species (USDA 1995). Padgett (1995) contends that stubble height standards cannot be applied to many subalpine and alpine riparian ecosystems. Here plants rarely reach heights at full maturity equal to those of the standards. At these elevations, percent utilzation with emphasis on streambank trampling standards are recommended. In preparation of the Riparian Guidelines for Grazing for the Caribou National Forest it was realized that some species may not naturally grow to a desired length, or natural conditions such as a drought may stagnate growth. The Uinta's recommendation, if this occurs, is that percent utilization may be a better parameter than stubble height (USDA 1995). Roath (1980) noted that when Kentucky bluegrass is the dominant grass in an alpine riparian zone it exerts major control over the relative stability of the associated vegetation communities. He concluded that since Kentucky bluegrass has been demonstrated to be highly tolerant of defoliation, grazing at an intensity such as to reduce and maintain the grass at a stubble height of about an inch had small impact on vigor and cover. Padgett (1995) concludes that alpine riparian areas in degraded condition will take longer to improve than will other riparian ecosystems. And within riparian ecosystems, those areas with continuous or nearly continuous sources of water (e.g. greenline communities) will improve at a even quicker rate. Alpine ecosystems may be the slowest to recover because of the short growing season, and where shallow topsoils have eroded the length of time to recover will be even longer.

As discussed above, high-elevation/alpine riparian areas are fragile and sensitive to livestock grazing. Lower levels of grazing intensity and utilization levels are recommended for key riparian systems within this type. The following literature citations do not specifically differentiate alpine areas, but rather rely on the application of lower levels of utilization. Effects of defoliation are generally applicable.

SATISFACTORY/UNSATISFACTORY RANGES

Holechek (1989) recommends that if ranges are in good or excellent condition, maintaining them in a stable condition may be the best management strategy. However, if they are in poor or fair conditions, management that is aimed at "improvement" may be indicated. Most literature (Frear 1983, Buckhouse et al. 1979, Chaney et al. 1990, Buckhouse 1981, May and Sommes 1982, Clary and Webster 1989, Chaney et al. 1993) documents that light to moderate grazing/proper stocking levels sustains and improves degraded rangeland areas, restoring long-term productivity. Leonard (1988) reported that in many instances, proper stocking levels and grazing practices improve declining range and riparian areas faster than total exclusion of livestock. Elmore (1988) suggested that 3 to 4 inches of stubble height would maintain plant vigor and sustain riparian conditions. However, Clary and Webster (1989) recommend that a residual standing height of 4 to 6 inches is necessary to improve riparian ecosystem function. Holechek (1989) presents utilization guidelines for range types using a table showing the percent use of key species for moderate grazing. He displays percentages in a 10 percent range, indicating that ranges in good condition can withstand the higher utilization level; those in poor condition should receive 10 percent less utilization. Padgett (1995) noted that while there are no data that specifically state how long it will take a community to change from unsatisfactory to satisfactory condition, the amount of time it takes to move toward Desired Future Condition (DFC) can be decreased through increased rest, lower utilization levels, and/or rehabilitation. He recommends utilization levels for unsatisfactory rangelands be 10 percent lower than those for satisfactory condition ranges. Chaney et al. (1993) concur that common, moderate utilization standards may be inappropriate for some degraded riparian plant communities.

As discussed above, studies have shown that moderate levels of livestock grazing have positive effects on maintaining, sustaining, and improving rangelands that are in either satisfactory or unsatisfactory condition. The rate of recovery of unsatisfacory condition ranges is expedited by decreasing levels of intensity and lowering levels of utilization. The following literature citations do not specifically differentiate effects between unsatisfactory and satisfactory ranges. The effects of vegetation defoliation, as cited, are the same, with the rate of recovery of unsatisfactory ranges being determined by lower levels of utilization.

GRAZING SYSTEMS

Control of the frequency and severity of defoliation of individual plants is the basic principle of range management (Peiper and Heitschmidt 1988). Since livestock are selective grazers, the frequency and severity of defoliation of individual plants or species of plants varies depending upon preference and availability. The result is that most preferred plants will be defoliated more frequently or severely than less preferred plants. Because of this preference, many riparian areas fail to respond favorably to management strategies (Platts and Nelson 1985). Most riparian areas are contained within much larger management units or pastures--broad combinations of lands that mix riparian zones with the upland zones. It is now widely recognized that streamside environments are different from other terrestial systems, and so need specialized management (Platts 1980). Most grazing strategies were designed without specialized management of riparian areas emphasized--irregardless of the grazing system employed, livestock concentrate in these attractive areas, making frequency and intensity of use the primary management emphasis.

In an intensive literature review Clary and Webster (1989) concluded that vegetation appears to be more affected by grazing intensity than by grazing systems. They reiterate that the success of grazing systems depends in part upon managerial control of intensity and severity of forage utilization. In a 1987 review of 250 miles of riparian areas on the Sawtooth National Forest, no single grazing strategy was found to be effective in every riparian area situation (USDA 1987). Eight years of research at Meadow Creek, Starkey Experimental Forest and Range, Wallowa-Whitman National Forest, in northeastern Oregon, indicated that herbage production was increased 1-to 4-fold through timing and intensity of grazing (Bryant 1985). Rest-rotation, deferred-rotation, and season-long grazing systems were tested. Although there was no statistically different changes in plant composition among the systems, the production of riparian vegetation increased dramatically when utilization was 70% or less. Although specially designed grazing systems that control degree and timing of use in the riparian area can be highly beneficial, experience in riparian areas has generally failed to show an advantage to any specific grazing system (Clary and Webster 1989). They maintain that as long as good management is practiced--managerial control of time, place, and degree of forage utilization coupled with adequate fencing, good distribution of water and salt, and adequate riding to ensure uniform distribution--the specific grazing system employed may not be significant. In referencing Van Poolen and Lacey (1979), Clary and Webster suggest that managers should place more emphasis on proper stocking intensity and less on grazing system implementation.

Stocking rate has more influence on vegetation productivity than any other grazing factor (Holechek et al. 1989). However, Tohill and Dollerschell (1990) point out that grazing duration, the major cause of overgrazing is unaffected by livestock reductions. Remaining livestock continue to seek out regrowth (selective grazing of preferred plants) while the number of ungrazed plants increases (overrest). Holechek (1989) summarizes the management requirements of livestock grazing into four basic factors: regulation of grazing intensity, timing, frequency, and selectivity (differential grazing of range plants). Because intensity governs the amount of leaf area remaining for photosynthesis, it is of the most importance.

As discussed above, studies have shown that grazing systems have had little or no correlation with either upland or riparian conditions; grazing intensity and timing were more important. As a result, citations listed herein provide information, without differentiation, related to the effects of grazing on both species composition and herbage production.

VEGETATION SPECIES COMPOSITION AND PRODUCTION

Rangeland vegetation may be altered by livestock through (1) herbage removal, (2) physical damage to vegetation by trampling and browsing, and (3) altering the growth form by removing terminal buds and stimulating lateral branching (Kaufman & Krueger 1984; Szaro 1989). These alterations may effect vegetation in two ways: (1) Species composition and (2) Herbage Production (Martin 1972). These two effects are so closely connected and interdependent that most literature does not discuss them separately. As a result, citations listed herein provide information, without differentiation, related to the effects of grazing on both species composition and herbage production.

CLASS OF LIVESTOCK

Cattle grazing within the Dixie National Forest is usually permitted for cows with calves at their sides. A herd composed of cow-calf combinations is often characterized by poor livestock distribution over the range because the cow is unwilling to travel long distances with a calf at her side. This is particularly important when water is poorly distributed, because the cow needs abundant water for milk production. Cows are often retained in the base herd 6 to 10 years. Such cows develop traditional patterns of grazing that may not provide good distribution. In general, cows scatter over the range best in the spring and fall when the weather is cooler and less energy is dissipated in movement.

Cattle tend to congregate in riparian areas because they provide shade, cooler temperatures, water, and an abundance of forage. Many observers have noted that cattle spend a disproportionate amount of their time in riparian zones (Ames, 1977; Kennedy, 1977; Thomas, et al. 1979: Roath & Krueger 1982; Van Buren 1982; Gillen et al. 1984).

Cattle selectively seek out riparian areas and within these zones they selectively graze preferred grass species. Cattle, normally, are only occasionally influenced by herding activity, and are usually left alone to seek there own level of distribution and use. Cattle often stay in riparian areas after forage is scarce even when they don't find a full day's ration. Because of this habitual pattern and the intensive use made by cattle near water, Swanson (1986) notes that areas around water troughs have long been considered by many as "sacrifice areas". Cattle utilize riparian vegetation more closely and consistently than native wildlife, affecting three important influences: the removal of herbage, trampling of soil, and dissemination of seed (USDA 1951). Platts (1981) summarized the effects of livestock grazing on riparian vegetation: "Grazing can affect the streamside environment by changing, reducing, or eliminating vegetation bordering the stream." Impacts caused by livestock are primarily a function of the timing, frequency, and intensity of use.

In the spring, cattle often avoid riparian zones because of cold temperatures, soil wetness, and forage immaturity (Krueger 1983). Therefore, spring grazing encourages cattle to graze uplands where forage maturity and climate are more favorable compared to the riparian zone (Platts 1984). As a result, spring-grazed riparian zones have less than half the cattle occupancy compared to fall use (Krueger 1983). As spring grazing precludes late-summer use, willow browsing is light and seedling survival high (Kovalchik and Elmore 1991).

Cattle are primarily grass eaters, but they do consume forbs and shrubs, such as bitterbrush and mountain mahogany. Because they have only lower incisors and comparatively thick lips, they ordinarily graze no closer than 1 to 2 inches from the ground (Hall 1985).

Sheep prefer to graze the upper half of slopes and ridgetops, and it is difficult to get them off steep slopes once they are established there. Sheep are generally attended by a herder who actively influences distribution and use intensities. Thick brush acts as a barrier to grazing sheep even though there are travel ways through the brush. On most summer allotments, sheep will graze upslope after leaving their afternoon watering and bedding site. They will then come together and bed down for the night on a ridgetop or some other high vantage point. They instinctively use these high points for protection and vantage. Sheep do not like to night bed in thick trees or in the bottoms of basins or depressions [R4 Rangeland Ecosystem Analysis and Management Handbook, Supplement to FSH 2209.21,32.22 (USDA 1993)]. Under proper management, sheep are expected to have little onsite effect on riparian-stream environments (Platts 1981). May and Sommes (1981) reported that many of the riparian areas grazed by sheep show insignificant effects on stream habitat.

In general, sheep prefer forbs and, because of their small mouths and thin lips, easily crop vegetation to within 0.5 inch of the ground (Hall 1985).

As discussed above, studies have shown that proper grazing by sheep has insignificant effects on rangeland vegetation. As a result, citations listed herein provide information, without differentiation, related to the effects of grazing on both species composition and herbage production.

SCOPE OF ANALYSIS FOR THE DIXIE NATIONAL FOREST

This paper is prepared to disclose the effects of vegetation removal by livestock. The objectives are to specifically address the effects of livestock grazing at proper use levels on:

--1. Riparian systems
--2. Upland sites
--3. Vegetatively manipulated and seeded sites

DIXIE NATIONAL FOREST RIPARIAN AREAS

Riparian Definition: The Dixie National Forest Land and Resource Management Plan EIS (USDA 1986b) defines a riparian ecosystem as: "A transition between the aquatic ecosystem and the adjacent upland terrestial ecosystem and is identified by soil characteristics and distinctive vegetation communities that require free or unbound water".

These riparian areas usually have visible or physical characteristics reflecting this water influence. Stream sides, lake borders, or marshes are typical riparian areas. At a minimum, riparian areas include all land within 100 feet of the high water marks of lakes, streams, and marshes (USDA 1986b).

Although most streamside zones are riparian, some are not. Examples of non-riparian sites are those areas where the sagebrush ecosystem reaches the water's edge, where the streamside zone is composed of bedrock, where streams are bordered by steep-sided canyon lands, or where streamside environments are composed of boulders or rubble (Platts 1979). Swanson (1986) notes that different riparian areas have different potentials. Some will produce trees that provide shade and nesting habitat for birds, and others will produce lush meadow vegetation as their best crop. Most riparian areas support a diversity of vegetation types which may encompass only a small area. Some streams can support productive fisheries and others never could.

A riparian zone is characterized by grasses, woody shrubs, trees, and other vegetation. It maintains a relatively high water table and acts as a sponge by holding water in streambanks, therby raising the water table in the surrounding area and providing a more stable stream flow (GAO, 1988, pg.8). Diversity of vegetation is an important characteristic of riparian areas in good condition (Chaney et al. 1990). Unlike adjacent terrestial communities, water is more readily available for plant uptake in riparian zones, and duration of this free, unbound water may influence community composition (Youngblood et al. 1985).

Late seral communities, especially along the greenline, are stable by nature; they are dominated by deep rooted, often rhizomatous, species which take several years (5-7 years) to show the effects of changes in management. It is especially important, when monitoring late seral to PNC riparian sites to also monitor physical conditions of the stream channels. Streambanks and channel characteristics will respond more quickly to increased impacts than will the stable vegetation. Conversely, these late seral communities may show improvement more quickly because the desireable plant communities are already in place. In contrast, early to mid seral greenline communities will show downward trends more quickly because they are typically dominated by weakly rooted species that are more easily displaced through continued surface disturbance and through water action against stream banks lacking adequate protection because of the weak rooting systems. Early seral greenlines will take more time to improve because the species necessary to colonize and develop into communities stable enough to hold streambanks are not well represented (Padgett, 1995).

Communities associated with streams and rivers may have to contend with frequent scouring or deposition resulting from flooding. Riparian communities found along seeps or springs that have constant high water tables may be limited by continual accumulation of organic material (Youngblood et al. 1985).

Kindschy (1987) emphasizes that "only one factor can be dominant in limiting the successional advancement of riparian vegetation. Typical primary factors are hydrologic scouring due to high volume spring runoff, steep shoreline relief, livestock grazing, or a lack of suitable soil. Reduction or removal of this limiting factor will enable progressive vegetative succession until the next limiting factor is reached. Reduction or removal of any secondary factor will have little effect if the primary factor is not similarily reduced." Swanson (1988) observed that many streams have straightened and become steeply incised and lost access to their floodplains. He defines this situation as passing a threshold beyond which there is no return to previous conditions. He says, "Land managers must avoid simply attacking that which is most ugly....The lowest priority streams, even if they are the ugliest, are unlikely to respond to management. Stream energy is concentrated and management inputs are likely to be wasted where a stream has downcut and is totally confined in the bottom of a gully."

Winward (1994) notes that Utah streams with gradients less than .5 percent are usually dominated by herbaceous species; shrubs and trees are most often absent. Streams with gradients between .5 and 1.5 percent usually have patchy willows or trees present. Where gradients range between 1.5 and 3.0 percent, large willows and trees become very prominent. Winward notes that in general, almost all of the dominant natural species that occur in riparian settings are extremely strong, deep-rooted species. As such, their major role is in buffering the forces of moving water (Winward 1994).

Rosgen (1994) classified streams by types A-G, with A being described as steep to very steep (4 to 10% slope) cascading, step/pool streams. Type B streams are moderately entrenched riffle dominated channels with gradients between 2 and 4 percent. Type C streams are low-gradient, meandering streams with broad, well-defined floodplains; slope is less than 2 percent. Clary and Webster (1989) noted that grazing conflicts with riparian-dependent resources were usually not severe in Type A stream channels or in most type B stream channels. Generally, these stream channels are in narrow valleys occupied by woody species and are armored by rocks providing resistance to erosion and trampling damage. The greatest conflicts occurred in type B channels with medium- to fine-textured, easily erodable soil materials and most type C channels. The latter channel types are typically associated with meadow complexes that are attractive to livestock and are often important fishery habitats. In these channel types a vigorous plant community is important for protecting streambanks against erosive forces and for trapping sediments.

All riparian zones within the Dixie National Forest have four things in common: (1) They create well-defined habitat zones within the much drier surrounding areas; (2) they make up a minor portion of the overall area; (3) they are generally more productive in terms of biomass--plant and animal--than the remainder of the Forest; and (4) they are critical sources of diversity within the Forest ecosystem.

To properly manage, protect, and enhance riparian-dependent resources, the riparian areas on the Dixie NF have been categorized into two types: (1) High-elevation/Alpine riparian areas and (2) Mid-elevation and Low-elevation riparian areas.

High-elevation/Alpine riparian areas include blue spruce, Douglas-fir, subalpine fir, willow-alder, carex, and Kentucky bluegrass communities. This zone also includes areas above timberline and is associated primarily with streams and meadows above 9000 feet in elevation within the Aquarius Plateau and Northern Markagunt Plateau landform subregions on the Cedar City, Escalante, and Teasdale Ranger Districts. Precipitation ranges up to 40 inches per year; most of which comes as snow. The growing season is only 60-70 days with temperatures varying from summer-time 80 degree readings to winter lows of -30 degrees. These are fragile ecosystems, having short growing seasons, often shallow soils, and low growing vegetation. All high-elevation/alpine riparian areas on the Teasdale, Escalante, and Cedar City Ranger Districts are considered by the Intersciplinary Team of range conservationists, fisheries biologist, hydrolgist, and soils scientist to be preponderantly in good condition with some areas in fair condition.

Mid-elevation and low-elevation riparian areas occur at elevations between 2800 feet near St. George on the Pine Valley Ranger District and 9000 feet on the mountain plateaus on the Cedar City, Powell, Escalante, and Teasdale Ranger Districts. These riparian areas include communities dominated by ponderosa pine, sage-brush, pinyon-juniper, willow-alder, gambels oak, cottonwoods, and carex-rush species. Precipitation ranges from 10 inches to 40 inches at the higher elevations. Summer temperatures range between 80 degrees and over 100 degrees in the lower elevations. Growing seasons vary from 80 days to near 180 days.

DIXIE NATIONAL FOREST UPLAND RANGELAND AREAS

Uplands are higher elevaton, in general, than the alluvial plain or low stream terrace; land above the foot slope zone of the hill slope continuum. The uplands include vegetation types other than the relatively narrow strip along streams or small patches around seeps or springs or along the shoreline of lakes or ponds. The uplands used mainly by livestock on the Dixie are pinyon-juniper (reseedings), sage/grass, mahogany, oakbrush, aspen, and high elevation grasslands.

The vegetation zones and plant associations found in the uplands are result of, or are influenced by, the changes in climate, elevation, and aspect. Upland range ecosystems are those typically dominated by sagebrush, juniper, mountain brush, mahogany, maple, oak, forb, dry meadow, or seeded grass plant communities. The desired future condition is to improve or maintain stable watershed conditions by maintaining vegetation with healthy ground cover and plant communities dominated by desired perennial grasses, forbs, with a range of shrub cover. Associated herbaceous and woody vegetation provides for plant communities that are diverse in seral status and structure and provide food and habitat for game and nongame animals, songbirds, raptors, and reptiles, forage for livestock, and a variety of recreational opportunities and aesthetic values. Degradation of water quality or long-term soil site productivity, as a result of ground disturbing uses, is not significant within the watershed that they occur. Ground cover of at least 85 percent of potential is characterized by perennial vegetation, moss, litter, and naturally occurring rock. Management emphasizes the inherent biological, physical, hydrologic, and aesthetic values of these rangeland sites.

Big game winter range is included in the uplands ecosystem. These sites consist of rangelands along lower elevations of the forest (typically south-facing slopes where winter snows are the first to melt) that provide browse for big game during winter months. On the Wasatch-Cache National Forest portion of the north slope of the Uinta Mountains they are primarily those dominated by birchleaf mountain mahogany; on the western Uinta Mountains, Bear River Range, and the Wasatch Mountains they include birchleaf and curlleaf mountain mahogany, oak, mountain brush, and sagebrush communities; and on the Stansbury Mountains they are primarily curlleaf mountain mahogany and sagebrush communities. Use of browse species on big game winter range is at a level that not only provides for the continued maintenance of existing vegetation, but also provides for reproduction and replacement of decadent and dead individuals within the stands. Ground cover of at least 85 percent of potential is characterized by perennial vegetation, moss, litter, and naturally occurring rock. Management emphasizes the inherent biological, physical, hydrologic, and aesthetic values of these rangeland sites.

Aspen ecosystems are those dominated by aspen or those where aspen have been temporarily replaced by herbaceous and/or shrub-dominated communities through natural or management activities. These areas are dominated by aspen trees with a variety of age classes across the landscape, representing a variety of seral stages. Associated herbaceous and woody vegetation is highly variable and is dominated by desired perennial grasses and forbs with a range of shrub cover. Ground cover of at least 85 percent of potential is characterized by perennial vegetation, moss, litter, and naturally occurring rock. Aspen is managed to provide wildlife habitat, recreational opportunities, livestock forage, wood products, aesthetic values, and plant and animal diversity. Degradation of water quality or long-term soil site productivity, as a result of ground disturbing uses, is not significant within the watershed that they occur.

Relative community preference by livestock often changes during the grazing period due to changing levels of forage availability and quality among plant community types. Non-forage vegetation factors also influence sites animals select to graze, rest, and bed down. Timber harvesting methods also affect site selection by grazing animals. Slope is an important factor affecting grazing distribution in hilly or mountainous country, but its effect varies greatly among kinds of grazing animals. The location and number of watering points on grazing lands is important in controlling the movement, distribution, and concentration of grazing animals. Past experience appears to play a prominent role in which plants and plant parts individual grazing animals select and also in the sites they choose to graze.

DIXIE NATIONAL FOREST RANGELAND RESEEDINGS

The Dixie National Forest Land and Resource Management Plan (USDA 1986a) states "To date, approximately 142,000 acres of depleted rangeland on the Forest have been reseeded. For the most part, these seedings have been successful and provide a large proportion of the forage consumed by livestock and big game on the Forest". These manipulated and seeded areas are primarily within the following described treatment areas:

--Pinyon-Juniper/Crested Wheatgrass - These areas are described as being pinyon and/or juniper trees removed through either chaining, burning or cutting and then the area is seeded with mixtures of range grasses and some forbs. The dominate species being crested wheatgrass.

--Sagebrush/Crested Wheatgrass - These areas are described as having sagebrush removed through either use of primarily a Dixie Harrow, herbicide or burning and then the area seeded with mixtures of range grasses and some forbs. The dominate species being crested wheatgrass.

--Grassland/Smooth Brome grass - These areas are described as having Smooth Bromegrass seeded in depleted vegetation areas in sagebrush zones and at higher elevations. Holechek (1988) recommended 45-55 percent utilization levels on rangelands seeded with intermediate, pubbescent, and tall wheatgrass; smooth brome; and orchardgrass.

The Forest Plan desired future condition for Management Area (6A)--Livestock Grazing (USDA 1986a) states: "Areas where vegetation manipulation practices have been accomplished will be maintained for optimum forage production".

DIRECT EFFECTS OF VEGETATION DEFOLIATION BY LIVESTOCK

The Draft Environmental Impact Statement prepared for Rangeland Reform '94 (USDI/USDA 1994) disclosed effects of livestock grazing at proper use (the Proposed Action). In reviewing Environmental Assessments for 16 grazing allotments on the Dixie National Forest, prepared since 1986, it is concluded from those documents that this disclosure of effects is applicable to the Dixie National Forest:

Uplands: In the long term uplands would either be meeting objectives or moving towards objectives.

Sagebrush: Implementing standards and guidelines would improve properly functioning condition, ecological condition, and trend in sagebrush communities. In the long term, perennial grasses and forbs would increase faster in areas that have 12 inches or more of precipitation. Trend in the lower precipitation areas would not significantly change over the long term. The amount of palatable browse would slightly increase under the ecosystem approach to management and standards.

Pinyon-Juniper: Changing grazing practices on areas susceptible to degradation in pinyon-juniper ecosystems would allow the grass and shrub component of the ecosystem to increase in vigor. The effect on the pinyon-juniper community, however, would be slight, especially where crown density is high.

Mountain and Plateau Grasslands: In the short term, proper use would result in increased production of palatable grasses and forbs, height and density of existing grass stands, residual vegetation materila carried over the winter, and litter and fine organic material at the soil surface. Native bunchgrasses would increase, and undesirable shrubs, forbs, and grasses would decrease.

Riparian/Wetland/Aquatic: In the long term proper use would lead to improvements in riparian conditions that support special status species, maintain water quality, contribute to watershed function, and improve an area's ecological conditions. The height, width, and amount of vegetation would become more diverse. The canopy would become more closed. Streambanks would become more stable. And native riparian vegetation communities would become reestablished. In the long term, riparian areas would either be meeting or moving towards objectives.

Coniferous and Deciduous Forests: With grazing at proper use, native plants in the coniferous and deciduous forest types would increase. Palatable plants would increase in abundance, density, and vigor, especially understory forbs, grasses such as fescues and bluegrasses, and shrubs such as bitterbrush and currants. Overall changes would strongly depend on fire and timber management.

Alpine Grasslands: Implementing proper use standards and guidelines would increase vegetation vigor in nonfunctioning areas of alpine grasslands and also improve vegetative trend. Nonfunctioning areas would slowly recover under cold temperatures and short growing seasons.

SUMMARIZED LITERATURE REVIEW
OF THE DIRECT EFFECTS OF VEGETATION DEFOLIATION
BY LIVESTOCK GRAZING AT PROPER USE

I. GENERAL EFFECTS OF PLANT DEFOLIATION BY LIVESTOCK

1. Water is the primary limiting factor to plant production on most rangelands (Holechek et al. 1989).
2. Conservation use would help improve upland and other vegetation conditions (USDI/USDA 1994).
3. Incorporating standards and guidelines into a new term grazing permit would improve rangeland conditions (USDI/USDA 1994).
4. A certain minimum residue of dry matter should always be present on rangelands to maintain forage plant vigor (Holechek et al. 1989).
5. Grazing can occur frequently and during critical periods if sufficient leaf area remains to sustain a high level of photosynthesis (Holechek et al. 1989).
6. The most critical period for foliage removal for many plant species is from the floral initiation through the seed development (post bloom). This period is critical because the plant's demand for photosynthetic products is high and opportunity for regrowth is often low, due to the approach of less favorable temperature and soil moisture conditions (Holechek et al. 1989).
7. Most plants can have some of the top material removed and still remain in productive condition. The amount that can be removed depends to a large degree on the species of the plants (Holechek et al. 1989).
8. Since plants are photosynthetically inactive during the dormant period, grazing during this time is the least critical period for foliage removal (Holechek et al. 1989).
9. Plant growth is largely a function of meristematic tissue, where cell division occurs. In grasses the primary meristematic regions are apical and intercalary (internodal). In shrubs, terminal buds produce hormones that suppress the development of lateral buds. When the terminal bud is removed, such as the case with browsing, the lateral buds may be released and twig production enhanced. Consequently, light browsing may have a stimulating effect on brose productivity (Holechek et al. 1989).
10. Proper grazing provides positive effects to plant physiology: (a) Increased photosynthesis, (b) Increased tillering, (c) Reduced shading, (d) Reduced transpiration loss, (e) Inoculation of plant parts with growth-promoting substances, (f) Reduction of excessive mulch accumulations that may physically and chemically inhibit vegetative growth (Holechek et al. 1989).
11. Herbage production on most ranges can be substantially increased by switching from heavy to moderate or light grazing intensities (Holechek et al. 1989).
12. Plants show a marked response to the timing of rainfall, other climatic factors, and grazing. Grazing is more subtle in its effect on plants. Moderate grazing is less likely to affect vegetation over the long term than continuous heavy grazing (USDI/USDA 1994).
13. Grass species that have a higher proportion of culmless (stemless) shoots are more resistant to grazing than those with a larger proportion of reproductive culms, partly because they are adapted for tolerance to grazing rather than for seed production (Holechek et al. 1989).
14. Grasses ordinarily do not suffer an injury to the terminal bud with grazing. The bud lies close to the ground during the early season, and only during flowering-head formation is the growing bud grazed. When the grass leaf has become differentiated, the meristematic activity of the leaf tip practically ceases and there remains active tissue only near the base of the leaf, where cell division and growth take place. Meristematic tissue at the leaf base is not likely to be injured by grazing (Stoddart and Smith 1943).
15. When a broadleaf is eaten, the meristematic tissue, which lies adjacent to the veins, is inevitable injured. However a limited amount of use may be desireable, for it tends to make the plant less "rank" and more bushy and leafy (Stoddart and Smith 1943).

16. Grass may be stimulated to produce lateral branches at its basal nodes, resulting in a thicker stand (Stoddart and Smith 1943).
17. A moderate amount of herbage clipping does not reduce the total herbage production (Stoddart and Smith 1943).
18. Grazing usually results in some degree of adverse impact on the plants being grazed. If adequate vigor, litter, and reproduction needs are provided, the plant can achieve complete recovery (USDA 1971).
19. If use that will cause significant seasonal impacts is scheduled during other times of the year, range deterioration can be prevented (Busby 1979).
20. If management plans are prepared and administered under an interdisciplany approach, many of the adverse impacts can be minimized or eliminated (May and Sommes 1981).
21. Properly managed livestock grazing that is integrated with other uses of the federal lands shows no incompatibility with a high-quality environment (Heady et al. 1974).
22. Contrary to popular belief, the most damaging time to graze a grass plant is not in the early spring. The plant is well able to recover from grazing then, as long as enough soil moisture remains for good regrowth (Swanson and Torell 1990).
23. Defoliation under proper use will leave enough of the meristematic tissue and carbohydrate reserves so that the long term productivity of the forage plant will not be altered (Trlica 1977).
24. Some defoliation often promotes greater plant vigor than no defoliation at all (Heady 1984).
25. The effects of grazing upon TAC levels by the end of the growing season depend upon the number of times the plant is grazed and the proportion of the photosynthetic tissue allowed to remain after each grazing (Cook 1966c).
26. The effects of defoliation on a grass tiller in the vegetative stage will depend on which portions of the shoot are removed. If most of the leaf blades only are removed, the effect on growth rate of vigorous plants will be minimal if growing conditions are good (Walton 1983).
27. The time of year and phenological stage in which the plant is subjected to defoliation will have a great bearing on the severity of defoliation the plant can tolerate (Caldwell 1984).
28. The degree of defoliation during the growing season should allow enough leaf area to remain to provide carbohydrates for regrowth, rather than prolong dependence upon stored TAC (Burns 1984, Walter et al. 1985).
29. Opimum grazing management avoids repeated, severe defoliation of the forage plant or individual tillers without a recovery period. If the nongrazed periods are too short, the regrowth of plant tillers may be regrazed before ready; if the grazing periods are too long, tillers may be regrazed before the recovery interlude begins (Kothmann 1984).
30. In excess of 40-60 percent removal of the above-ground portion of the plant reduces growth of roots and regrowth of tops and sometimes subsequent seed production (Crider 1955).
31. Defoliation in the boot stage had the most impact on total production, regrowth the following spring, and root growth (Ganskopp 1988).
32. Grazing after seed maturity injures plants less and is beneficial for both seed and rhizome reproducing plants (Stoddart et al. 1975).
33. Species with high growing points tend to be most sensitive to grazing; the fact that grasses withstand stress better than forbs may be attributed, in part, to the relative positioning of the growing points (Branson 1953).

II. EFFECTS OF VEGETATION DEFOLIATION IN RIPARIAN ECOSYSTEMS

1. Over 25 years of observation, short-term cattle use was often followed by rapid re-establishment of important riparian species (Kindschy 1987).
2. Timing influences the utilization of vegetation in streamside areas, demonstrating the tendency of cattle to avoid wet streamside zones early in the season (Platts and Nelson 1985).
3. The timing, numbers, and duration of livestock use are the key factors that must be set and monitored to assure proper livestock management in healthy and degraded riparian areas (Chaney et al. 1990).
4. If managed properly, grazing within riparian communities and along streams is compatible with other resources (Chaney et al. 1990).
5. By grazing pastures containing riparian areas early, livestock were less inclined to concentrate on riparian vegetation and better utilized adjacent upland forage (Chaney et al. 1990).
6. In order to establish realistic objectives for riparian areas, it is important to know the vegetative potential of the site under proper grazing management (Chaney et al. 1990).
7. Proper grazing management can restore the long-term productivity of most riparian areas and associated uplands (Chaney et al. 1990).
8. Studies, representative of a wide range of riparian area conditions, problems, and opportunities, demonstrate that the productivity of degraded riparian areas can be restored, usually with a net gain in livestock forage (Chaney et al. 1990).
9. On low gradient streams through alluvial valley bottoms, particularly where the stream carries a large sediment load at high flows, the right grazing strategy can produce dramatic recovery of riparian vegetation and streambanks (Chaney et al. 1990).
10. Riparian zones have a remarkable ability for rapid recovery; and once in good condition, they are capable of supporting managed livestock grazing (Buckhouse 1981).
11. Where Kentucky bluegrass (Poa pratensis) is the dominant grass in a riparian zone it exerts major control over the relative stability of the associated vegetative communities. Since Kentucky bluegrass has been demonstrated to be highly tolerant to defoliation, grazing at an intensity such as to reduce and maintain the grass at a stubble height of about an inch has small impact on vigor and cover (Buckhouse 1981).
12. Frosts or hard freezes on upper elevation wet meadows makes the forage unpalatable in the fall (Bedunah and Willard 1987).
13. Low-growing grasses and sedges in alpine ranges can be damaged by grazing, so these sites are rather fragile (Bedunah and Willard 1987).
14. Eight years of studies at Starkey Experimental Station indicate a highly controlled grazing system is required to manage riparian pastures at the proper use level. Therefore, the riparian utilization standards, developed by the FS Pacific Northwest Region, incorporated slightly lower values to compensate for this discrepency in control (Volland 1990).
15. Late season meadow use, approaching 60 percent, showed no effect on riparian vegetation composition (Kaufman 1982
16. Willow in the Lake States (linear twig growth) can withstand 50-percent annual utilization of leader material with little affect on production (Aldous 1952).
17. Habitat alteration (of streambanks) occurred at rates exceeding 65 percent use (Platts 1981).
18. The variability in utilization criteria in the literature indicates a sophisticated grazing system is probably necessary for grazing riparian herbaceous vegetation at a proper use level to protect riparian areas (Volland 1990).
19. The literature varies considerable in the grazing intensity of riparian areas that is considered sustainable. Studies reflecting moderate use levels (60-70 percent on key species) did not appear to affect vegetation composition. However, since the elevational extent and geographical positioning

between upland and riparian types dictated that riparian areas be included with upland grassland and forested sites within the same pasture, the FS Pacific Northwest Region reduced riparian utilization standards 10 to 15 percent to reflect this dichotomy between research and operational environments (USDA/R6 1990).

20. Based on research conclusions, the only time that improvement of streamside habitats will be when grazing pressures are reduced from heavy to moderate or light (Pieper and Heitschmidt 1988).

21. Production of floodplain vegetation can be improved within several grazing regimes without causing negative impacts on the aquatic system (Bryant 1985).

22. High country streams and cattle are compatible--if appropriate grazing plans are used. Depleted streamside zones can actually be rejuvenated while sustaining grazing--if cattle are on a regimented grazing system, and pastures receive less than 70 percent pf their potential use (Frear 1983).

23. Eight years of research at Meadow Creek, Starkey Experimental Forest and Range, Wallowa-Whitman National Forest indicated that while plant composition did not change appreciably, annual production of herbage increased 1-to 5-fold in both riparian and floodplain zones (Bryant 1985).

24. Deferred grazing offers promise for balancing grazing use on the preferred streamside zones with use on the less palatable upland vegetation (Platts 1985).

25. Specially designed grazing systems that control degree and timing of use in the riparian area can be highly beneficial (Clary and Wbster 1989).

26. Spring grazing of riparian areas usually results in a better distribution of use between the riparian area and adjacent uplands (Clary and Webster 1989).

27. Careful control of grazing pressure results in maintenance of the streambank vegetation and limitation of trampling, hoof slide, and accelerated streambank cave-in (Clary and Webster 1989).

28. A minimum herbage stubble height of at least 4 to 6 inches should be left at the end of the grazing season if grazing occurs after frost in the fall (Clary and Webster 1989).

29. For pastures grazed in the fall, the retention of 4 to 6 inches of residual stubble will normally deter significant feeding on willows and most other riparian woody plants (Clary and Webster 1989).

30. Pastures grazed in the spring only should be limited to about 65 percent of the current growth (Clary and Webster 1989).

31. Streamside utilization of herbaceous forage in summer-grazed pastures should not exceed 40 to 50 percent of the current growth (Clary and Webster 1989).

32. Fall use of streamside vegetation should not exceed about 30 percent (Clary and Webster 1989).

33. Genera commonly represented in riparian areas such as dogwood, maple, cottonwood, willow, and birch appear to be more resistant to foliage and twig removal than genera common to xeric uplands. Light to moderate grazing generally appears to have little adverse effect and in some cases may stimulate growth (Clary and Webster 1989).

34. Little information is available on how proper grazing affects willow communities except for observations that leaving a residual herbaceous stubble of about 4 inches usually results in little or no use of willows (Clary and Webster 1989).

35. Woody riparian vegetation can improve with livestock grazing, even with heavy (80 percent) use on grass species, as long as the use on the willows is regulated (Grette 1990).

36. Spring use of 40 percent, summer use of 50 percent and fall use of 60 percent have resulted in significant improvements within the spring/fall range in the riparian zone. Willows have re-established throughout the streamcourse; the sheer banks have continued to erode and slough off into the stream channel, sediments trapped by the beaver ponds; the channel base is building and the vertical walls are changing into vegetated slopes (Fowler 1990).

37. Livestock grazing under well-managed strategies can use riparian forage in compatibility with riparian-stream environments (Platts 1986).

38. Proper riparian grazing strategies will, at a minimum, (1) limit grazing intensity and season of use to provide sufficient rest to encourage plant vigor, regrowth, and energy storage; (2) ensure sufficient

vegetation during periods of high flow to protect streambanks, dissipate stream energy, and trap sediments; and (3) control the timing of grazing to prevent damage to streambanks when they are most vulnerable to trampling (Chaney et al. 1993).

39. Proper utilization standards are important. However, you have to be careful when using off-the-shelf utilization standards such as, take half and leave half, and four-to six-inch residual stubble height. Stream character (sandy loam vs. gravelly well-drained soils)--not the forage utilization rate--determined the effect of livestock grazing on the riparian area and on water quality (Chaney et al. 1993).

40. The effects of cattle grazing first appear on the stream banks and riparian vegetation. Habitat alteration occurs at utilization rates of 65 percent or more, and alteration is insignificant when utilization is less than 25 percent (Platts 1981).

41. With proper livestock intensity and distribution, the forage in high elevation meadows can be utilized without placing undue stress on the stream and its riparian environment (Platts 1981).

42. Sheep find willows very palatable, but do little damage to stands if good herding practices are followed. Cattle prefer willows less than do sheep, but are more destructive when they congregate in riparian areas (Smith 1982).

43. Willows become a principal source of cattle browse as other more palatable forage resources are depleted or as the palatability of the alternate forage decreases. Therefore most browsing damage to willows occurs in late summer (Kaufman et al. 1983).

44. As long as palatable herbaceous forage is available in the riparian zone, willow utilization will remain minor (Kaufman et al. 1983).

45. Utilization based on current year's growth of riparian browse in satisfactory condition of 50% and unsatisfactory condition of 40% is based on not only the physiological ability of individual woody plants to withstand use and produce additional browse, but also on the ability of plants to reproduce and maintain their populations by adding new individuals (Padgett 1995).

46. Relatively ungrazed areas,on the Yellowstone River, with mature cottonwood forest have a diverse and dense understory shrub layer dominated by redosier dogwood (Cornus stolonifera), western serviceberry (Amelanchier alnifolia), common chokecherrry (Prunus virginiana), western snowberry and woods rose, various species of willows (Salix spp.), and currants and gooseberries (Ribes spp.). With moderate grazing, there is an increase in western snowberry and woods rose, with a corresponding decrease in both the abundance and canopy cover of the other shrubs (Boggs and Weaver 1992, p. 51).

47. Late-season use can be made more effective for willow stands by removing cattle at 45 percent forage use or delaying grazing until regrowth of upland grasses, at which time cool temperatures in the riparian zones disperse cattle to uplands (Kavalchik and Elmore (1991).

48. Light to moderate livestock use, leaving a 4- to 6-inch stubble, appears compatible with protection of the riparian area and native trout habitat (Hall 1985).

49. With proper grazing intensity, timing and distribution of animals, forage can be utilized without undue stress on the stream and riparian environment. Rest rotation and 25 percent or less riparian herbage utilization will protect a stream (Platts 1981).

50. Some palatable plants respond favorably under light or moderate grazing. Light to moderate clipping stimulates many shrubs to greater vegetative growth than no clipping, but lowers flower and seed production. Presumed benefit by grazing: stimulation of herbage production, builds drought tolerance, encourages early spring growth with less mulch remaining, aids in dessiminating seeds, plants seeds through trampling, encourages water infiltration by contoured livestock trails, fertization of the range (Ellison 1960).

III. EFFECTS OF VEGETATION DEFOLIATION IN RANGE UPLAND ECOSYSTEMS

1. Eight years of research at Meadow Creek, Starkey Experimental Forest and Range, Wallowa-Whitman National Forest indicated that proper utilization under most grazing systems produced almost twice as much herbage as the ungrazed plots, further indicating that improvement of vegetative biomass can best be accomplished or accelerated with proper grazing instead of protection (Bryant 1985).
2. Vegetation response under deferred grazing was superior to season-long continuous use and works best where considerable differences exist between the palatability of plants and the convenience of areas for grazing (Holechek 1983).
3. Benefits from rest that occurs in a rest-rotation strategy may be nullified by the extra use that occurs on the grazed pastures (Holechek 1983).
4. Properly managed upland areas in the 12-inch or more precipitation zone may significantly improve within 20 years (USDI/USDA 1994).
5. Proper use on key species on upland grasslands is commonly stated at 50-60 percent. These proper use levels assume good condition rangeland with adequate livestock distribution and a rotational grazing system (USDA/R6 1990).
6. Light to moderate grazing generally appears to have little adverse effect and in some cases may stimulate growth (Skovlin 1984).
7. An evaluation of 34 grazing systems that were in place for 10-20 years in southwestern Montana showed that utilization of deciduous woody species appeared to increase as duration of grazing treatments increased. This documents the need to adjust the duration of grazing treatments based upon site-specific monitoring results that include woody species utilization. It was found that each management pasture is different, and a few days difference in utilization could be significant. Observations of cattle indicated that utilization of deciduous woody species increased about late August and remained heavy through the fall period. Close monitoring is required to avoid excessive use on woody species during this period. Leaving a 6 inch stubble height provided for vigorous woody plant growth (Myers 1989).
8. Grazing systems designed for uplands should be used only where their negative effects on willows can be mitigated by strict enforcement of riparian forage use to prevent the switch from grazing to browsing. Otherwise, their use will result in downard condition trends in willow-dominated plant associations (Kovalchik and Elmore 1992).
9. A 9-year clipping study on a grass-shrub range where plants were clipped weekly, removing most of the leafage at a time when the plants were manufacturing food for growth and storage, showed that clipped plants produced an average of only 53 percent as much total herbage as plots clipped only at the end of the growing season. The decrease in herbage production was similar for four species treated (USDA 1968).
10. While grazing systems such as deferred or rotation have improved the condition of most upland range in the last 50 years, they encourage concentrated livestock use in riparian zones during mid- and late-summer periods and have resulted in minimal improvements in riparian conditions (Platts 1986).
11. When controlled, grazing animals can have positive influences on vegetative resources: (1) removal of excessive vegetation that may negatively affect net carbohydrate fixation and increase water transpiration losses, (2) Maintaining an optimal leaf area index of plant tissue, (3) Trampling seed into the ground, (4) Reducing excessive accumulations of standing dead vegetation and mulch that may chemically and physically inhibit new gowth, (5) Inoculating plant parts with saliva that may stimulate plant regrowth (Holechek 1981).
12. Research shows that lightly or moderately grazed plants are more productive than those left ungrazed (Holechek 1981).

13. Repeated, close use to 1- to 2-inch stubble during the growing season results in a decrease of bunchgrasses. This downward trend results in a mid-seral or an early seral condition (Hall 1985).
14. Given ranges in good condition, 60 percent was considered maximum use on these key species (i.e., proper use), above which stand productiveness would be affected (Pickford and Reid 1948).
15. Studies on the Edwards Plateau of Texas suggest that even decreaser plants need some grazing in order to remain vigorous and productive (Reardon and Merrill 1976).
16. Studies on the Wasatch Plateau of three perenial forbs considered important in deer and domestic sheep diets concluded that valerian and ligusticum can tolerate a maximum of 50 percent utilization without substantially affecting plant vigor or regeneration capability (Julander 1968).
17. Improved production and quality of forage results from rotation grazing practices (Walton et al. 1981).
18. Plant vigor and range condition would be improved; however, areas currently in unsatisfactory condition would be slower to respond (Launchbaugh and Owensby 1978).
19. Utilization levels on upland grassland should be higher than on upland forested cover types in satisfactory condition. Studies indicate that upland shrub criteria could be set at proper use levels, since experienced utilization levels will probably fall below proper (Pickford and Reid 1948).
20. The concept of desired or allowable use is even less clear with shrubs which have perennial parts and buds above ground. A major question with shrubs may not be the percent use of current year's growth but the amount and timing of use of buds (Dahl and Hyder 1977).
21. Studies showed that non-use of shrubs resulted in vegetation stagnation with an average reduction in productivity of 70 percent in bitterbrush and 36 percent in big sagebrush (Tueller and Tower 1979).
22. Mechanical topping of overmature bitterbrush shrubs in the northern intermountain area, averaging 50 percent canopy removal every 6 years, resulted in a flush of new twig growth and a several-fold increase in browse yield (Ferguson 1972).
23. Clipping stimulated bud elongation and growth in bitterbrush but not in big sagebrush (Bilbrough and Richards 1978).
24. Under certain conditions, browsing stimulates the growth of shrubs (Garrison 1953).
25. TAC reserves of four-wing saltbush and antelope bitterbrush were most sensitive to a single defoliation (90%) at the seen-shattering stage (Menke and Trlica 1983).
26. Defoliation after maturity, during late fall and winter, generally has the least effect, either detrimental or beneficial, on subsequent growth or TAC levels in either grasses or shrubs (Heady 1984 and Garrison 1972).
27. Deferred-rotation grazing--possibly more appropriately referred to as rotationallate dormancy non-grazing--has been suggested for use on Intermountain salt-desert shrub ranges. Not only does this system of grazing provide occasional protection against defoliation during the breaking of plant dormancy in late winter, it also assures a forage supply saved for late winter (Hutchings 1954).
28. Utilization of bluebunch wheatgrass varied from a high 69 percent to a low of 38 percent over a 10-year period, without detriment to the stand (Harris 1954).
29. Grazing animals affect upland plant communities in several interelated ways (Balph and Malecheck, 1985) including plant defoliation, nutrient removal and redistribution through exreta, and mechanical impacts on soil and plant material through trampling.
30. The main influence on site selection for grazing by cattle on shortgrass range in Colorado was concluded to be dietary preference, but this was modified by constraints such as the location of water (Semft et al., 1982m 1995a).

IV. EFFECTS OF VEGETATION DEFOLIATION IN CRESTED WHEATGRASS SEEDINGS

1. Fall tillers of crested wheatgrass were stimulated in growth rate by early spring grazing, unaffected or reduced by midspring grazing, and reduced by late spring grazing; midspring defoliation also stimulated the emergence of axillary spring tillers, but they contributed little additional forage because growth was limited by summer drought in this cold-desert ecosystem in Utah. Prolific tiller production enables crested wheatgrass to tolerate grazing well (Olson and Richards, 1989) .
2. Crested wheatgrass produced up to 18 times more new tillers immediately following a severe defoliation than did bluebunch wheatgrass. Moderate grazing, in contrast to heavy grazing, after the beginning of internode elongation did not reduce tiller number per plant the following year. The reduction in tiller numbers under heavy grazing was due to higher overwinter mortality rather than an inadequate number of tillers emerging in the fall. Tiller numbers in April were suggested as a measure of potential to produce forage for the year (Richards et al. 1987).
3. Shifting from a tall, upright growth form to a shorter, more spreading growth form as a defensive response to long-term heavy grazing has also been observed in a number of grass species, including crested wheatgrass, western wheatgrass, needle-and-thread, and the gramas. The shorter growth, often accompanied by an increase in total number of plants, is more resistant to grazing because livestock are less able to physically remove as much of the foliage as in the larger, more upright growth form (Vallentine, 1990).
4. TAC-related advantages attributed to crested wheatgrass include: (1) rapid accumulation of abundant leafage, i.e., photosynthetic potential, (2) moderately early accumulation of TAC reserves, and (3) relatively high storage levels (Hyder and Sneva 1959).
5. It is morphological-developmental flexibility, including resource partitioning between above and below-ground plant parts, rather than large amounts of stored TAC that accounted for rapid recovery following grazing. Other factors adding to high grazing tolerance in crested wheatgrass are apparently (1) delay and then rapid elevation of flowering culms, (2) short basal internodes, (3) a short preflowering period, and (4) a low degree of apical dominance (Richards et al. 1987 and Richards 1984).
6. Heavy grazing of crested wheatgrass in alternate years in Nevada studies produced a downward trend at two of three locations studied. Moderate grazing each year was concluded better than alternate-year rest after heavy use. One year's complete rest did not compensate for overgrazing in the previous year (Robertson et al., 1970).
7. However, forage production and plant vigor of heavily grazed crested wheatgrass in Idaho has been restored by letting it rest a year or two, or by deferring grazing, or just alternating the timing of grazing during the growing season (Sharp, 1970).
8. Alternate year full grazing and rest of seeded crested wheatgrass and crested wheatgrass-brome units on Diamond Mountain in northeastern Utah increased annual forage production. However, it was concluded that such high-producing stands could withstand full grazing more often than every other year (Laycock and Conrad, 1981).
9. The utilization of crested wheatgrass plants growing side by side in central Utah have been observed to range from 15 to 80% for cattle and 5 to 90% for sheep (Cook, 1966a).
10. In related studies, 25% of the crested wheatgrass plants were commonly ungrazed during typical spring grazing with cattle (Norton et al., 1983).
11. Light grazing of crested wheatgrass has encouraged the development of wolf plants more than moderate use; and yearlong rest has stimulated wolf plant development even more. The development of wolf plants, even under intensive grazing, is favored by delaying the start of grazing too long into the spring (Currie and Smith, 1970; Sharp, 1970).
12. Yearling heifers appear less effective than mature cows in preventing seedstalk development due to being more selective and discriminating in their foraging habits (Hedrick et al., 1969).

13. Cattle have an aversion to these large plants that carry over winter an abundance of straw, and the degree of defoliation declines as the plant size and the amount of straw increases. Such large bunchgrasses become progressively less attractive to cattle, eventually dying out in the center; reversal of this trend with overall moderate levels of utilization becomes difficult (Norton et al., 1983).
14. Although 80% utilization in the spring annually removed wolf plants of crested wheatgrass, stands on central Utah foothills range deteriorated to about 30% of potential after 7 years of such grazing treatment (Cook, 1966a).
15. In contrast, wolf plants were effectively controlled by heavy spring grazing every third or fourth year while permitting recovery from the occasional intensive, early spring grazing in following years. During the special treatment years, tripling the normal stocking density and grazing for a few weeks in early spring after the new growth reaches seberal inches long was suggested. When set aside for intensive grazing during the boot stage in late spring, that pasture would thus be prepared to sustain the main grazing pressure early the following spring (Norton et al. 1983).
14. Mechanical removal if seedstalks has also resulted in substantial grazing of the wolf plants of crested wheatgrass (Norton and Johnson, 1986).
15. In Nevada, clipping, crushing, or dragging effectively removed the coarse old growth from established crested wheatgrass plants (Artz and Hackett, 1971).
16. Guidelines for grazing seeded grassed in the ponderosa pine zone in Colorado included leaving a 2-inch average stubble height for crested wheatgrass and Russian wildrye, two plants tolerant of moderately close grazing, but a 4-inch stubble height for smooth brome an intermediate wheatgrass, these less tolerant of close grazing on the same site (Johnson, 1959).
17. Grazing crested wheatgrass more lightly than 2-inch stubble resulted in the development of wolf plants, which was associated with stand depletion because of severe grazing of the grazed plants (Currie and Smith, 1970).
18. Full use stubble heights for crested wheatgrass were also set at 2 inches in southern Canada (Lodge et al., 1972).
19. But at 3 inches on semi-arid foothill range in central Utah (Frischknecht and Harris, 1968).
20. Recommended use rates of crested wheatgrass is 60-70 percent. Optimal forage utilization rates were found to be slightly over 70 percent (Holechek 1988).
21. This is not significantly different from the 65-70 percent rate recommended in the literature (Currie and Smith 1970, Springfield 1963, Sharp 1970, Smoliak et al. 1981, Frischknect and Harris 1968, and Springfield and Reid 1967).
22. On crested wheatgrass pastures in central Utah that had been grazed by sheep in the spring for seven consecutive years, the heavily utilized pastures (88 percent use) showed a decrease in grass production with most grass clumps having died in the middle. Crested wheatgrass plants were small, and there was a marked increase in growth of Russian thistle (Salsola kali) (Bleak and Plummer 1954).
23. Light (59 percent) and moderate (71 percent) uses resulted in maintenance of "good" production, with some decline with age of the stand noted. Stand longevity can be extended by light to moderate grazing use (Currie and Smith 1970, Sharp 1970).

INDIRECT EFFECTS OF VEGETATION DEFOLIATION BY LIVESTOCK

The range-watershed complex is never static, but constantly undergoes change. Normally the change is very slow and is marked by the progressive invasion of certain species and elimination of others. Such orderly change is called "succession".

Indirect effects of grazing defoliation at proper use is expressed primarily through secondary succession--orderly change where vegetation has been disturbed.

Although history is replete with documentation of the cumulative effects of overgrazing, history also documents that regulated grazing at proper use causes positive, beneficial secondary succession:

Chaney et al. (1990) reported that the extensive range deterioration began with severe overgrazing--native perennial grasses were virtually eliminated from vast areas and replaced by sagebrush, rabbitbrush, mesquite and juniper, and by exotic plants or shallow-rooted native vegetation less suited for holding soils in place. This severe overgrazing catalyzed the natural response of secondary succession, which is the sequential changes in vegetation composition resulting from some disturbance.

Ellison et al. (1951) reported that "If one were to reconstruct the past, he would find an example of secondary succession on practically every area of high mountain range in the Intermountain Region. Vegetation has improved generally, both in kind and in amount, where management has replaced the exploitive grazing practices of early days. Although permanent plot and photographic records attest the improvement that has occurred in many places, there are no records on most of the range. These changes are recognizable today only in the indicator aspects of vegetation and soil--healed gullies, former wind-scoured depressions now clothed with vegetation, etc.".

Persistence of a soil and plant cover through the centuries during recurring periods of dry and wet years as a normal feature of climate is proof that the range-watershed complex is resilient enough to absorb these natural impacts rather than be destroyed by them. For centuries the various components of the complex have had to adjust themselves to changes other than those in weather--fire, and changes in grazing use by wildlife, for example. That a soil mantle and vegetal cover have persisted is the best possible evidence that the adjustments have been made successfully and hence that balance between the various components has been maintained throughout. Thus an intact soil mantle is a record of a long period of balance. Evidence that the soil mantle has been recently destroyed is proof that some powerful stress, of greater magnitude than normal stress of the environment, has been placed upon it (Ellison et al. 1951).

Examples of secondary succession--orderly change in which a soil mantle, or at least part of a mantle, is present--may be seen wherever vegetation has been disturbed. Many secondary successions under grazing are undesirable trends, usually resulting from differences in palatability of different species to a given kind of grazing animal. The most palatable species are grazed closest and are handicapped; the least palatable species are passed by and, in relation to the others, are encouraged. The result is a trend toward a stand containing a smaller proportion of palatable plants and a larger proportion of unpalatable plants. Other factors than palatability may play a part in secondary succession due to grazing--growth form, physiological requirements, and season of development in relation to time of grazing, may be just as important (Ellison et al. 1951).

Grazing at proper use will change undesired succesional trends to desired trends and will stabilize destructive change induced by overgrazing. Proper use and prescribed changes in timing, frequency and intensity of use will 1) reduce overuse in key areas, 2) result in better distribution and more even use of forage plants, and 3) reduce the frequency of individual plant exposure to trampling and grazing which is beneficial to preferred plant species. Plant species are more or less tolerant to defoliation depending on the timing of grazing. The likelihood of a plant being grazed is also variable, due to seasonal differences in animal forage preferences (Archer and Smeins 1991). The application of deferred-rotation grazing systems will vary the timing of plant exposure to grazing each year. Thus, species favored one year may be less favored in another year. This will equalize the competitive interaction between species, and will result in maintaining species diversity and productivity. Proper grazing management aids in the recruitment and persistence of desired forage species (Jones and Mott 1980). The combination of reduced intensity, reduced frequency, and rotational timing of grazing use will reduce defoliation and trampling of forage plants. This will provide more plant material to maintain sheltered,moist microclimates, and will result in improving the competitive ability of key forage plants. This will ultimately result in increased density and productivity of desired rangeland forage species.

Research literature suggests that riparian areas be grazed in early spring, or fall, in order to reduce grazing impacts on riparian areas (Myers 1989, Clary and Webster 1989, Skovlin 1984). Grazing under deferred-rotation systems will alow grazing to occur early, mid, and late season. This will vary the timing of plant exposure to grazing each year. Thus, species favored one year may be less favored another year. While this will maintain species diversity, density, and productivity within riparian/meadow areas, the mid-season grazing which these areas would periodically sustain would limit the shift towards more deeply rooted perennial plants and the opportunity for rapid successional change to desired conditions.

CUMULATIVE EFFECTS OF VEGETATION DEFOLIATION BY LIVESTCOK

The regulations for implementing the National Environmental Policy Act (NEPA) require federal agencies to analyze and disclose cumulative effects--effects that result from the incremental impact of an action "when added to other past, present, and reasonably forseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time" (40 CFR 1508.7).

Although history is replete with documentation of the cumulative effects of overgrazing, history also documents that regulated grazing at proper use has resulted in steady improvement of rangeland conditions.

Accurate data of the kind and amount of grazing use that occurred on western rangelands prior to 1935 are scarce. However, historical descriptions of the period from early settlement to 1935 provide much useful information. Historical records indicate that large numbers of cattle and sheep grazed most areas of the "free range" (those lands not claimed by homesteaders and thus belonging to the "public") by 1880. This use was unregulated, and considerable damage to the plant and soil resources occurred. Probably the poorest rangeland conditions occurred between 1885 and 1935 (Busby 1978).

Busby (1978) reported that in all fairness to early livestock operators, it should be noted that poor farming, timber, and burning practices also contributed to poor range conditions, floods, and dust storms. Platts (1979) concurs, stating that documenting and evaluating the effects of livestock grazing is difficult because nature causes similar alterations and effects. Livestock grazing can cause annual microchanges in the environment that accumulate over many decades. Platts notes that these subtle changes are difficult to detect, whereas environmental changes from such sudden catastrophies as flood damage are usually readily observed and measured.

Esplin et al. (1928) described the situation found on many Utah rangelands presently included in the National Forest system:

"After about 1884 or 1885 there no longer were any unoccupied ranges, at least in Central Utah. Sheep grazing developed a 'tramp' aspect, as a result of which there was more or less frenzied struggle, especially for early spring ranges. Five or six years of unremitting competition on crowded ranges greatly reduced the vegetative cover. In regions where the intensity of overgrazing was cumulative, great areas of bare dusty hillside replaced previously well-covered forage areas. Spring freshets (floods) came with sudden and augmented volume. Heavy summer showers pored down the gullies and flooded neighboring farm lands, and even towns".

Chaney et al. (1990) reported that the extensive range deterioration began with severe overgrazing--native perennial grasses were virtually eliminated from vast areas and replaced by sagebrush, rabbitbrush, mequite and juniper, and by exotic plants or shallow-rooted native vegetation less suited for holding soils in place. This severe overgrazing catalyzed the natural response of secondary succession, which is the sequential changes in vegetation composition resulting from some disturbance.

Ellison et al. (1951) reported that "If one were to reconstruct the past, he would find an example of secondary succession on practically every area of high mountain range in the Intermountain Region. Vegetation has improved generally, both in kind and in amount, where management has replaced the exploitive grazing practices of early days. Although permanent plot and photographic records attest the improvement that has occurred in many places, there are no records on most of the range. These changes are recognizable today only in the indicator aspects of vegetation and soil--healed gullies, former wind-scoured depressions now clothed with vegetation, etc.".

These deteriorated rangeland conditions prompted public action. The Forest Service was created in 1905, the Grazing Service in 1934, and the Soil Conservation Service in 1935. With passage of the Taylor Grazing Act in 1934, the primary cause given for such universal deterioration of the nation's rangelands was poor management, with public rangelands treated as "free range", open to any number of livestock and subject to no regulations designed to maintain its productivity.

Although range conditons on every acre have not improved to the level that many would like, much progress has been made. Busby (1978) reported that management by the Forest Service between 1905 and 1935 resulted in 77 percent of the National Forest lands being classified in an improving trend. Platts (1979, 1982) agreed with this interpretation, but pointed out that the improvement was based mainly on data collected from drier portions of the rangeland and did not take into account the still deteriorated condition of riparian areas. The 1988 Public Rangelands Report on riparian areas (GAO 1988) cited that "While successes have been achieved, their number is small compared with the area still needing restoration...there are many thousands of miles of riparian areas that need restoration".

Implementing standards and guidelines would lead to improvement in riparian conditions that support special status species, maintain water quality, contribute to watershed function, and improve an area's ecological conditions. The overall hydrologic function of riparian-stream systems would improve. Streambanks would become more stable (USDI/USDA 1994). Stubble height standards are also expected to improve riparian area plant vigor, protect streambanks from excessive trampling damage, entrap sediment, deter excessive feeding on willows, encourage late seral, bank stabilizing plants and generally improve riparian area health (USDA 1992).

Livestock grazing on federal lands is not the only factor that affects rangeland vegetation. Climate, recreation and wildlife use, management practices on adjoining lands, and the introduction and spread of alien weeds are also key considerations. Vegetation condition and status cannot be predicted by considering changes in livestock management alone. Most public ranges in the United States are managed under a multiple-use philosophy in which an attempt is made to accommodate all legitimate rangeland use demanded by society.

Bahre (1991) agrees that climatic oscillations since 1870 have resulted in short-term fluctuations in vegetation but insists that long-term directional changes, including degradation of riparian habitats and spread of exotic species, have resulted from human disturbances, including overgrazing by cattle. He concludes that human intervention is needed to restore the West to ecological health. To contrast the effects of overgrazing with grazing at proper use, Heady et al. (1974) stated that livestock grazing is being managed and integrated with other uses of federal lands and that there is no evidence that well-managed grazing of domestic livestock is incompatible with a high-quality environment.

Increasing human activities and a growing demand for resources multiply impacts on the environment and create cumulative effects of the combined impacts of multiple activites such as timber harvest and road building, watershed and water quality, recreation activities, and grazing.

Livestock affect watershed properties by removal of plant cover and through the physical action of their hooves. Livestock grazing at proper use provides upland watersheds in good condition thereby reducing off-site, non-point source stream pollution. A healthy, vigorous vegetative biomass, maintained through proper utilization, in riparian areas, traps sediment, prevents erosion, and actually builds meadows. Holechek et al. (1989) conclude that in the near future, range management practices will be geared primarily toward water production rather than forage production in the states of Arizona, California, Texas, and New Mexico. Limited data indicate that moderate or light grazing can increase groundwater and runoff compared to no grazing, without having a detrimental impact on the watershed or water quality (Liacos 1962, Hanson et al. 1970, Lusby 1970). Under light or moderate grazing intensities, adequate vegetation is maintained to protect the site, but excessive vegetation that causes water losses by transpiration and evaporation is removed. The cumulative effect of grazing at proper use on the physical resource is positive.

Busby (1978) noted that livestock use on public lands is lower than it ever has been in this century and therefore concluded that resource managers must look more and more to range uses other than livestock as causes of range deterioration. He recommends considering the impacts of off-road vehicles, camping, hunting, fishing, boating, back-packing, improved roads and highways, improvised trails, and recreational housing. He emphasizes that the trends of each of these is exactly opposite that of livestock grazing--up and not down..."Each of these uses is at its highest level ever and is growing every year. And each of these uses has an impact on the environment."

Holechek et al. (1989) reported that recreational use of rangelands in the United States increased 500 percent between 1965 and 1980, with much of the increase resulting from the rapid human population increase in the 11 contiguous western states combined with rising affluency and leisure time. In 1989, Holechek predicted that if current trends continue in the 11 western states, it appears likely that recreational value will exceed livestock grazing value on most rangelands within the next 15 to 20 years.

Holechek et al. (1989), referring to a 1986 study done by Sanderson on the Malhuer National Forest in eastern Oregon, points out that 241 dispersed recreationists responded most favorably to photos showing environmental scenes where livestock were grazed but range management practices were least visible. Campers, generally, did not mind seeing cattle from a distance on open areas, but they did not want cattle present near camping sites. Off-road vehicle travel is also cited as being potentially as damaging as severe overgrazing.

Mining can cause severe pollution of the aquatic and riparian environment by increasing sediment production, altering pH, discharging heavy metals and causing stream channel and stream flow alterations. Timber harvest can increase runoff and flooding which in turn can erode streambanks and their vegetation. Roads and road construction can bring about a major increase in sediment load to streams. Potential damages to the riparian environment are the elimination of sensitive vegetation species and proliferation of more tolerant species, direct acute effects to all vegetation, and erosion of the streambanks due to loss of vegetation (Duff et al. 1980). Moore (1976) estimated that in the west, grazed rangelands were second only to cropland in sediment production. However, Duff et al. (1980) strongly contend that when properly implemented and supervised, grazing could become an important management tool benefiting fish and wildlife riparian habitats. They conclude that proper maintenace of riparian vegetation provides: 1) streambank stabilization and erosion control which reduces bedload sediment, thereby helping to maintain intergravel water flows and in turn the supply of oxygen available to incubating fish eggs and alevins; 2) a filtering device to settle out sediments and reduce downstream siltation; 3) shade to maintain suitable water temperatures for aquatic resources; 4) organic debris to feed aquatic insects which are essential in the diets of many fish; 5) stability to minimize stream damage from torrential floods; 6) overhanging bank cover from the roots of trees, shrubs, and herbaceous vegetation to provide fish with protective cover and terrestial insect food; and 7) groundwater recharge by its ability to absorb runoff.

In summary, livestock grazing at proper use; considering combined effects of the activities of timber harvest, watershed management, recreation use, road building, and mining; will have the following cumulative effects:

1. Continued general improvement of deteriorated rangelands.
2. Improvement of deteriorated riparian communities.
3. Stabilization of stream channels and stream banks.
4. Reduction of non-point pollution of stream systems.
5. Enhancement of watershed conditions and water quality--maintenace of stocking levels while increasing the supply of water for municipal watersheds,
6. Acceptable compatibility with recreation uses--maintenance of stocking levels while recreational use of rangelands increases.
7. An ameliorating effect on adverse impacts caused by timber harvest, mining, and roads and road construction.

DIRECT/INDIRECT EFFECTS OF NO GRAZING ON FORAGE VEGETATION

In numerous studies of riparian grazing impact, investigators concluded that total removal of livestock was necessary to restore ecosystem health. Along Mahogany Creek, Nevada, reduction in grazing had little benefit; only a complete removal brought about habitat improvement (Dahlem 1979; Chaney et al. 1990). Ames (1977) found that even short-term or seasonal use is too much and compared mere reductions in livestock numbers to letting "the milk cow get in the garden for one night". In a recent comparison of 11 grazing systems, total exclusion of livestock offered the strongest ecosystem protection (Kovalchik and Elmore 1992). As Davis (1992) put it, "If the overgrazing by livestock is one of the main factors contributing to the destruction of the habitat, then the solution would be to ...remove the cause of the problem."

Ellison (1960) concluded that there was no evidence to support the claims that grazing benefits plants. Belsky (1986) reported that in the last quarter century there has been no new evidence that renders Ellison's conclusion any less accurate today. Pieper and Heitschmidt (1988) concurred with Belsky, especially for arid and semi-arid rangelands. They suggest that destocking is the quickest, surest, and most viable way to reduce current deterioration trends wherever they are occurring.

Much of the research literature compares the effect of no grazing with effects of severe (even destructive) overgrazing, with the desired effect being recovery. The lack of abundant comparisons with grazing at proper use does not answer with clarity that no grazing is more beneficial than proper grazing. Buckhouse (1981) states, "What is less clear, however, is what constitutes overgrazing on any given system; to what degree geologic events are operating independent of grazing; and what ameliorating effects might grazing systems, season of grazing, and animal behavior modification have".

A riparian restoration effort on Camp Creek, in northeastern Oregon's Blue Mountains, involved the fencing of a stream corridor and periodic observation of the resulting changes. Claire and Storch (1977) noted that when Campcreek was fenced in 1964, the streamside was devoid of a shrub canopy and exposed streambanks were common. They reported that by 1974, though the condition of the stream outside the fenced section remained unchanged, inside alder and willow shrub canopy was providing up to 75 percent shade to the stream. They further noted that maximum water temperatures outside and downstream from the exclosure averaged 12 degrees Fahrenheit higher than those samples taken within the fenced area. They found that daily water temperature fluctuations averaged 27 degrees outside compared to 13 degrees inside the fenced area. Fish composition was such that within the fenced area, game fish made up 77 percent of the population while game fish comprised only 24 percent of the fish population outside the fence. Since 1968, Camp Creek has been opened to livestock grazing again, providing late-season (after August 1) grazing which is carefully monitored. Since grazing has been reintroduced, Claire and Storch reported that no measurable change in fish population had been identified as a result of proper grazing. This study suggests that 1) degraded environments will need management intervention to achieve short-term restoration and 2) proper use of healthy ecosystems can be made without causing succesional regression.

Platts (1984) confirms that, except for eliminating grazing entirely, fencing the riparian stream corridor provides the best chance for rehabilitating degraded riparian habitats in the shortest time. It is noted by some authors that severe overgrazing that has resulted in regressive succession, or even destructive change, severely delays or halts successional advance even with the removal of livestock. Holechek et al. (1989) reports that when shrub species in the genera of Juniperus, Artemesia, Larrea, and Adenostoma dominate a rangeland as a result of overgrazing, recovery is very slow when grazing pressure is removed. Improvement in productivity of palatable forage species can best be accomplished by reducing the influence of these shrubs through burning, herbicides, or mechanical control. Ellison et al. (1951) notes that accelerated erosion may continue under its own momentum until all the soil is lost, even though grazing is eliminated.

Holechek et al. (1989) claims that positive effects of controlled grazing compared to no grazing are most likely in areas receiving over 400 mm (approximately 16 inches) of average annual precipitation. Below this level of precipitation, excessive accumulations of vegetation usually do not occur, due to aridity.

Lacey and VanPoolen (1981) compared 11 studies throughout the west and found that protected areas produced an average of 68% more herbage than comparable areas grazed at a "moderate" rate. However, permanent removal of grazing will not gaurantee maximum herbaceous plant production. Volland (1978) found that a protected Kentucky bluegrass meadow reached peak production in 6 years and then declined until production was similar to the adjacent area grazed season-long. Similar results were reported by Bryant (1988) and Green (1989) in northeastern Oregon. Clary and Webster (1989) report that the accumulation of litter over a period of years seems to retard herbage production in wet meadow areas. Thus, some grazing of riparian areas could have beneficial effects. This is a response similar to that documented by Branson (1985). Heady (1984) contends that some defoliation often promotes greater plant vigor than no defoliation at all. From their studies on the Edwards Plateau of Texas, Reardon and Merrill (1976) suggested that even decreaser plants need some grazing in order to remain vigorous and productive. Hayes (1978) studied three meadows and their associated streams in the Idaho batholith. One of these meadows was ungrazed and the two others were grazed under a rest-rotation grazing management system. He found that occurrence of degradation during spring discharge along ungrazed streambanks was significantly greater than degradation along the grazed streambanks. Hayes suggested that ungrazed or unburned meadows may in fact suffer from a lack of vegetative vigor, and thus be susceptible to undercutting.

While there is abundant documentation of positive changes when removing livestock from deteriorated rangelands, a review of research literature indicates that there may be little difference in the effects of no grazing and grazing at proper use (rather than over-grazing). Bryant (1985) states that total exclusion of all human activites from riparian areas, is unlikely to return those areas to pristine conditions. Hall (1985) offers the same conclusion with regard to effects on wildlife: "Even if livestock grazing were excluded from public lands in the Great Basin, the resulting circumstances would not provide optimum habitat conditions". Permanent removal of grazing will not guarantee maximum herbaceous plant production. The accumulation of litter over a period of years seems to retard herbage production in wet meadow areas. Thus, some grazing of riparian areas could have beneficial effects (Clary and Webster 1989).

Despite defoliation of willow cuttings in the grazed pastures (2 year study in early and late summer)there was no significant effect on willow survival or growth compared to no grazing (Conroy and Svejcar 1991). Removal of grazing destabilizes some systems. Grazing increases the chances of some species survival and moderate grazing can enhance community and landscape diversity (West 1993). Livestock exclusion may be appropriate to begin stream recovery. Livestock and riparian systems can coexist if season and intensity of use is controlled (Elmore and Beschta 1987).

The Draft Environmental Impact Statement prepared for Rangeland Reform '94 (USDI/USDA 1994) discloses the effects of livestock grazing at proper use (the Proposed Action) and the No Grazing alternative. A comparison of the effects suggests that similar effects are expected, with the exception that short-term general improvement would be more rapid with no grazing. Long-term effects of no grazing may have decreasing benefits when compared to grazing at proper use:

Uplands--No Grazing: For uplands in deteriorated condition, removing livestock would immediately benefit forage vegetation. To the extent that livestock grazing would inhibit or prevent reaching the desired ecological condition, permanent livestock removal would result in better ecosystem health. No grazing would also have undesirable effects in some upland vegetation zones, especially those that evolved under the grazing pressure of large native herbivores. No grazing would result in little or no change in upland vegetation conditions in shrub- or pinyon-juniper-dominated areas. To significantly change, these areas would need a catalyst to disrupt the dominance of woody plants. More herbaceous vegetation, resulting in more standing litter would increase the potential for wildfire, which might become that catalyst.

Sagebrush--No Grazing: In the sagebrush ecosystem, no grazing would improve grass cover, soil cover, water infiltration rates, and plant vigor and reproduction, as climate and soil potential allow. Communities dominated by woody shrubs would not significantly improve until woody plants were reduced by such means as fire, mechanical treatment, or even livestock. The percent composition of plants would resemble the late seral stage in some but not all areas, because vegetation communities representing all seral stages are needed to maintain biodiversity. In areas having less than 10 inches of annual precipitation, sagebrush communities would not significantly improve in 20 years except for nonfunctioning areas whose vegetation is being treated. Without treatment, trend in the lower precipitation areas would not significantly change over the long term.

Pinyon-Juniper--No Grazing: Removing livestock from pinyon-juniper ecosystems would allow the grass and shrub component of the ecosystem to increase in vigor where the pinyon-juniper canopy is not closed. Livestock removal would also reduce soil disturbance to crytobiotic crusts. Only practices such as prescribed fire and mechanical and chemical treatment would allow biodiversity to return, and the pinyon-juniper ecosystem might take a long time to recover.

Mountain and Plateau Grasslands--No Grazing: Most mountain grassland plant species would rapidly increase in response to a lack of grazing pressure. Bare soil would decrease. The vegetation's structural complexity would increase. Plant material in the ecosystem, including litter and decaying organic material, would increase. Seed and vegetative plant reproduction would increase in the short term. The long term response would depend on the presence of wildlife and fire to stimulate vegetative succession.

Riparian/Wetland/Aquatic--No Grazing: No grazing would result in rapid restoration of watershed stability and proper functioning riparian resources. In the short term, meadow plant vigor would rapidly increase in response to livestock removal. The amount of bare soil would decrease. Structural complexity of all the vegetation would increase, and the amount of plant material in the ecosystem as litter and decaying organic material would increase. Water infiltration rates would increase in response to increased root production by more vigorous grasses. Livestock removal should also result in decreased soil compaction and thus increased infiltration rates. Vegetation and seed plant reproduction would increase in the short term. The additional litter and standing plant matter would help stabilize the system, be incorporated into the meadow soil-building process, and lead to more increases in water storage capacity and plant growth and reproduction. Vigor and reproduction might decline in the long term (perhaps after 10 to 20 years, depending upon climate, water table availability, presence of other ungulates, and current conditions) due to a buildup of vegetation residue preventing sunlight from reaching the lower portions of the plants. In addition, no grazing would allow for some riparian-wetland resources historically lost to be restored, where a potential for such recovery still exists.

Coniferous and Deciduous Forests--No Grazing: In the short term, understory plants in coniferous and deciduous forests would rapidly increase in response to a lack of grazing pressure. Bare soil would decrease. The vegetation's structural complexity would increase. Plant material in the ecosystem, including litter and decaying organic material, would increase. Seed and vegetative plant reproduction would increase in the short term. The long term response would depend on other influences, most notably fire and timber harvesting.

Alpine Grasslands--No Grazing: Removing livestock from alpine ecosystems would increase the vigor of upland vegetation in overgrazed areas. But these ecosystems would only slowly recover from overgrazing because of cold temperatures and short growing seasons.

CUMULATIVE EFFECTS OF NO GRAZING

The regulations for implementing the National Environmental Policy Act (NEPA) require federal agencies to analyze and disclose cumulative effects--effects that result from the incremental impact of an action "when added to other past, present, and reasonably forseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time" (40 CFR 1508.7).

High mountain lands of the Intermountain West have great significance and importance to its people, even though they make up only a small fraction of its total area. From these highlands the accumulation of winter snow yields yearlong stream flow, the lifeblood of the Intermountain country. They provide summer grazing for domestic herds and for wild game. They furnish timber for local sawmills. And finally, their forests, streams, and rugged landscape provide an opportunity for enjoyment and inspiration to all (Ellison et al. 1951).

The demand for forage on national forest lands is expected to remain constant in the long run (USDI/USDA 1994). The Society for Range Management (1985) concluded that "range foraging by livestock is both economically and culturally significant in all parts of the world". Changes to provide protection and recovery of federally listed species and their habitats and to comply with the Clean Water Act are likely to result in declines in livestock use on federal lands over the long term (USDI/USDA 1994).

Many areas of the West already are economically stressed by poor quality of water yielded from rangeland watersheds. Increasing urban populations will place ever greater demands on surface and groundwater, which in many areas are limited, shrinking, resources (Chaney et al. 1993). Lack of water is the major limitation on human population growth and economic development in the western United States. In the near future, range management practices will be geared primarily toward water production rather than forage production (Holechek et al. 1989). Population growth in many rural communities, while contributing to economic growth and diversification, will continue to diminish the relative importance of agriculture in those communities. Communities that continue to lose population and whose economies are in decline may be further strained by decreases in livestock production (USDI/USDA 1994).

If present trends of urbanization continue in the 11 western states, it appears likely that recreational value will exceed livestock grazing value on most rangelands within the next 15 to 20 years (Holechek et al. 1989). Maintaining game animals in a wild state, while harvesting primarily to keep populations in check and to reduce cycle extremes in numbers has been traditional in North America; this has sometimes been referred to as game harvesting. In contrast, the concept of game ranching has come into vogue, spreading throughout much of the West (Vallentine 1990). Increasingly, ranchers are finding they can derive significant income from the sale of products other than livestock, such as hunting privileges, wildlife viewing, and horseback riding (Holechek et al. 1989). Increased outfitter and guide activites, which encourage more recreational use of rural areas and offer more income-earning potential to ranches, might contribute to population growth and, in turn, accelerate changes in land use away from agriculture (USDI/USDA 1994).

Many recreational uses, particularly those forms involving off-road vehicle travel, if unregulated, affect the range more severely than does livestock grazing. To prevent range destruction in the future, regulation of recreation on public rangelands will be increasingly necessary (Holechek et al. 1989).

The Society for Range Management (1985) recognizes the value of livestock as a management tool to bring about desired trends or changes in certain plant communities to improve forage production, water conditions, wildlife habitat, recreational and aesthetic quality, and other tangible and intangible products. The objective of rangeland management, according to Wilson (1986), is not an ungrazed "climax" vegetation but rather grazing land that is productive and resilient. Very large tracts of climax sagebrush is not optimum habitat for most wildlife species in the Great Basin (Hall 1985).

EFFECTS OF LIVESTOCK GRAZING TO THE SOIL RESOURCE

James T. Bayer, Soil Scientist, Dixie NF

This paper is being written to discuss the impacts livestock grazing may have on the soil resource. Additionally, it discusses what the Forest Service, and in particular what the Dixie National Forest does, to insure that livestock grazing does not adversely impact long-term soil productivity.

I. What Constitutes Damage to Long-Term Soil Productivity?

The Forest Service Intermountain Region has developed the R-4 Supplement to FSH 2509.18 which establishes soil quality standards and guidelines and defines detrimental changes in soil qualities that can be created due to management. The following information is from the R-4 Supplement.

Soil Quality Standards. Soil resource management will be consistent with the Forest Service goal of maintaining or improving long-term soil productivity (NFMA) and soil hydrologic function.

Soil Quality Guidelines. Management activities can damage soils by compaction, puddling, displacement, severe burning or organic matter loss. Damage from accelerated surface erosion or mass movement can occur during or following management activities. Soil damage is detrimental when it adversely affects hydrologic function or causes site productivity losses. Soil quality guidelines provide for the maintenance of soil properties that affect soil productivity and hydrologic function.

It is difficult to assure that land use management will not have detrimental effects on hydrologic function and site productivity. However, we can set limits of disturbance, or "thresholds", beyond which we are reasonably confident that there will be long term losses in inherent productivity or hydrologic function. Our best estimates of these "thresholds" are called guidelines. The guidelines represent the upper limit of tolerable disturbances. Detectable losses of soil productivity and hydrologic function will occur if disturbances exceed the guidelines.

The guidelines used as indicators of soil quality and as measures of conformance to soil quality standards are:

1. Soil Disturbance. Detrimentally disturbed soil is soil that has been detrimentally displaced, compacted, puddled, or severely burned. At least 85 percent of the total area within an activity area must have soil that is in satisfactory condition. Soil displacement is the movement of soil from one place to another. It can be caused by animal or human activities. Detrimental soil displacement is the loss of either 5 centimeters or one-half of the humus enriched top soil (A-horizon), whichever is less, from an area that is 1 meter by 1 meter or larger. Soil compaction is simply a reduction in volume. It generally occurs when stresses are applied to soils with sufficient magnitude to deform and compress them. Substantial compaction in any 5-centimeter increment in the top 30 centimeters of soil is considered to be detrimental. Compaction that doubles the soil strength or that decreases soil porosity by 10 percent or more from the undisturbed values is considered to be substantial. Soil puddling is a physical change in soil properties due to shearing forces that alter soil structure and reduce infiltration and permeability. Detrimental puddling may occur in conjunction with detrimental compaction. Soils are most susceptible to damage by puddling and compaction when they are very moist.

2. Ground Cover. Ground cover consists of vegetation, litter, and rock fragments greater than three-fourths inch in diameter in contact with the soil. It also includes perennial canopy cover that is within 3 feet of the ground. Best management practices are those that provide sufficient soil protection to limit erosion to near natural rates. The minimum cover, following the cessation of disturbance in an activity area, should be sufficient to prevent erosion from exceeding the rates of natural soil formation or the soil loss tolerance. Erosion rates are dependent on soil erodibility, erosivity, and slope gradient and length.

3. Above-Ground Organic Matter. Some litter or large woody debris may be required to retain nutrients and microorganisms necessary to supply and cycle nutrients needed to maintain site productivity. The above-ground organic matter also provides for on-site moisture retention.

4. Severely Burned Soil. The main effect of burning is organic matter and nutrient loss. Ground cover and above ground organic matter guidelines set some limits on these losses. Soil humus losses, structural changes, hydrophobic characteristics and sterilization are additional effects of burning. Detrimental severely burned soil results in the loss of either 5 centimeters or one-half of the naturally occurring litter layer, whichever is less.

The previous information defines detrimental changes in soil qualities that may occur due to management, and discusses Regional soil quality standards and guidelines that have been established. To briefly summarize, long term soil productivity and hydrologic function can be adversely impacted if soils are detrimentally disturbed (displaced, compacted, puddled, severely burned) or if there is too little ground cover or above-ground organic matter (litter, large woody debris). The R-4 Supplement sets thresholds for these parameters. It is the responsibility of the Forests to propose livestock grazing strategies and appropriate mitigation to ensure that the thresholds are not exceeded.

II. What Effect Does Livestock Grazing Have on the Soil Resource?

The potential effects of livestock grazing on the soil resource can be described as (1) impacts on uplands, and (2) impacts on riparian areas. Following is a description of what researchers have found concerning the kinds of impacts livestock grazing can have on the soil resource.

A. Grazing Impacts on Uplands

The grazing of domestic livestock affects the productivity of rangeland soils mainly through the modification of hydrologic properties. The primary means by which this is accomplished are the reduction of vegetative cover (defoliation) and by trampling of the soil surface (Blackburn et al., 1980: Pieper and Heitschmidt, 1988). Other effects of importance include nutrient redistribution and alterations in seedling dispersal (Woodmansee, 1978; Walker, 1981; Pieper and Heitschmidt, 1988).

1. Defoliation. Defoliation of forage plants, as the result of herbivory by grazing animals, can result in substantial losses of protective surface cover if grazing is severe (Hart, 1993).

Vegetative cover protects the soil surface from raindrop impact, slows runoff, and enhances infiltration rate (Thurow et al., 1984; Taylor, 1989). Raindrop impact affects the soil surface by detaching and transporting soil particles, as well as through the breaking up of soil aggregates (Brady, 1990; Thurow, 1991). Decreases in vegetative cover, including both standing vegetation and litter, result in less organic matter being available for incorporation into the soil (Hart, 1993). Organic matter content is important for soil aggregate formation (Blackburn et al., 1980; Thurow, 1991). As aggregated soils are more porus, destruction of aggregates may result in decreased infiltration rates and increased erosion (Blackburn et al., 1980; Thurow, 1984). Infiltration and erosion potential are both closely correlated to aggregate size and above ground biomass (Warren et al., 1986a, 1986b, 1986c). Continued losses of above ground biomass will eventually be followed by losses of root biomass, further reducing soil aggregation (Thurow, 1991). Overall declines in herbage biomass, organic matter content, and aggregate stability have been repeatedly shown to be correlated with increasing grazing intensity (Weltz et al., 1989; Heitschmidt, 1990).

2. Trampling. Trampling of the soil surface by grazing animals can impact soil properties directly through a variety of means, including: (1) the reduction of vegetative cover and decreased soil surface protection, with effects as described above; (2) the churning or tilling of the soil by hoof action, sometimes referred to as the "herd effect" (Savory and Parsons, 1980); (3) the degradation of surface crusts of physical and biological origin; and (4) the compaction of the surface and sub-surface of the soil (Hart, 1993).

Physical Crusts can be formed by the clogging of surface pores by water-dispersed soil particles, especially during heavy rains (Hart, 1993). The soil surface becomes somewhat sealed and infiltration is therefore impeded. When the surface dries, a hard crust is often formed which can restrict seedling emergence (Brady, 1990). Maintenance of adequate surface cover and aggregate stability are important in preventing the formation of surface crusts (Thurow, 1991). Although trampling degrades these crusts, the beneficial effects are short-lived because the soil remains disaggregated and subject to re-sealing during the next rainfall (Thurow, 1991).

Microphytic crusts are biological in origin, formed by communities of non-vascular plants, fungi, and other associated organisms (West, 1990). There is clear evidence that microphytic crusts are highly susceptible to degradation by intensive trampling (Brotherson et al., 1983; Harper and Marble, 1988; Beymer and Klopatek, 1992). Mosses and lichens appear more susceptible than cyanobacteria (Anderson et al., 1982; West, 1990), and in general, crusts are more easily damaged by trampling during dry seasons (Marble and Harper, 1989).

Numerous studies have related soil compaction by livestock to decreases in infiltration, and to increases in sedimentation and erosion (Lull, 1959; Gifford and Hawkins, 1978; McCalla et al., 1984a, 1984b; Warren et al., 1986a; Pieper and Heitschmidt, 1988). The effects of trampling by livestock are largely site specific, and are influenced by grazing intensity (Willat and Pullar, 1983), soil texture (Van Haveren, 1983; Scholl, 1989), and soil water content (Warren et al., 1986a, 1986b). Over most soil textural classes, trampling increases soil bulk density and decreases macropore space (Warren et al., 1986b; Stephenson and Veigel, 1987). Reductions in macroporosity cause decreases in infiltration and hydraulic conductivity, leading to increased runoff and erosion (Van Haveren, 1983; Scholl, 1989). Coarse-textured soils are least susceptible to bulk density increases due to trampling, while fine-textured soils appear most susceptible (Van Haveren, 1983; Scholl, 1989). Trampling of moist or wet soils may produce surface crusts which can further impede infiltration (Warren, 1986a).

B. Grazing Impacts on Riparian Atreas

Livestock grazing can affect the riparian environment by changing, reducing, or eliminating vegetation, and by actually eliminating riparian areas through channel widening, channel aggrading, or lowering of the water table (Platts, 1991).

Impacts to riparian vegetation induced by livestock can basically be separated into: (a) compaction of soil, which increases runoff and decreases water availability to plants; (b) herbage removal, which allows soil temperatures to rise and increases evaporation to the soil surface; and (c) physical damage to vegetation by rubbing, trampling, and browsing (Severson and Boldt, 1978).

C. What Does the Dixie NF Do to Ensure That Livestock Grazing Does Not Adversely Impact Long-Term Soil Productivity?

As stated earlier, it is the responsibility of the Forests to propose livestock grazing strategies and appropriate mitigation to ensure that the thresholds for soil resource protection are not exceeded. On the Dixie National Forest this has been accomplished through direction established in the Dixie National Forest Land Management Plan and through the development of Allotment Management Plans.

1. Dixie NF Land and Resource Management Plan (Forest Plan).

The Dixie NF LMP lists a number of standards and guidelines that are designed to protect the soil resource and ensure that Regional soil quality standards are met to maintain long-term soil productivity.

Following is a list and description of those standards and guidelines.

a. General Forest Direction: (applies to all Management Areas)
1. Desired Future Condition: a) Riparian areas will only be moderately impacted (p.IV-21), b) Water quality and soil productivity will be maintained (p.IV-22), c) Condition of riparian areas will be maintained or if necessary improved (p.IV-22).

b. Management Area Direction:
1. Remove livestock from allotments for remainder of the grazing season when proper use is reached (p.IV-36).
2. Special protection and management will be given to land and vegetation for a minimum of 100 feet from the edges of all perennial streams, lakes and other bodies of water or to the outer margin of the riparian ecosystem if wider than 100 feet (p.IV-41).
3. Prescribe livestock grazing systems to achieve riparian objectives.
4. Prevent livestock and wildlife grazing which reduces the percent of plant cover to less than the amount needed for watershed protection and plant health (p.IV-48).

c. Standards & Guidelines:
1. For riparian areas - (maximum 60% use on forage, 50% use on browse, 70+% ground cover).
2. Livestock and wild herbivores allowable forage use by grazing system and forage type are:
3. Rest rotation system - Up to 60% on heavy use pastures; up to 50 % use on other use areas.
4. Deferred rotation system - Up to 50% on all species except crested wheatgrass reseedings and wet meadows where 60% is allowable.

d. Management Area 9A:

1. Desired Future Condition: Riparian ecosystem remains healthy and viable. Water quality is not impaired below existing levels and is improved in some areas. Stream channel stability is maintained, or in areas where it is severely degraded, is improved to at least minimally acceptable standards (p.IV-135).

2. Management Area Direction: a) Livestock grazing is at a level that will assure maintenance of the vigor and regenerative capacity of the riparian communities (p.IV-135), b) Maintain proper stocking and livestock distribution to protect riparian ecosystems (p.IV-138),

3. Standards & Guidelines: a) Livestock grazing in riparian areas will be controlled by the following levels of utilization: Grass/Forb/Willow vegetation types: Rest Rotation: use up to 60%; Deferred Rotation: use up to 50% and browse utilization within the riparian ecosystem will not exceed 50% of new leader production.

2. Allotment Management Plans

Every allotment on the Dixie National Forest has an Allotment Management Plan developed for it. A range analysis was completed for each allotment to determine which lands within the allotment were suitable for grazing and what the grazing capacity for the allotment was. Based on the range analysis, a grazing system was proposed that would allow for forage utilization by livestock while at the same time, provide for the health and vigor of the forage over time. The AMP defines numbers of animals, season of use, and type of grazing system. Allotments are typically divided into pastures and livestock enter the lower elevation pastures earlier in the grazing season and use higher elevation pastures later in the season. Deferred rotation or rest rotation grazing systems are used to ensure that plant vigor is maintained by not grazing the same pastures during the same time each year. Forest Plan standards and guidelines that relate to grazing are a part of the AMP. These standards and guidelines establish utilization levels and help determine when livestock need to move from one pasture to the next and when they should be removed from the allotment.

D. Grazing Impacts to the Soil Resource on the Dixie NF

The previous sections of this paper have discussed (1) Regional guidelines that have been established to determine what the thresholds are for determining when soils are adversely impacted and long term soil productivity is at risk, (2) the kinds of impacts to the soil resource that research has found associated with livestock grazing, and (3) what the Dixie National Forest has done through Allotment Management Plans and Forest Land Management Plan direction to ensure that soil quality standards are not exceeded.

Following is a discussion of the impacts to the soil resource associated with livestock grazing on the Dixie National Forest and how those impacts relate to soil quality standards.

1. Direct and Indirect Effects of Grazing at Proper Use

a. Uplands

Ground Cover. Livestock grazing reduces the amount of ground cover. The Allotment Management Plans and Forest Plan direction determine a grazing system, season of use, and restrict the amount of forage that can be removed. The season of use and utilization standards are based on what research has found is needed to protect the soil from excessive erosion and to maintain plant health and vigor. When proper utilization is reached, livestock are moved to the next pasture or removed from the allotment. Livestock on/off dates are further dictated by the climatic events of each year, i.e. during drought years, season of use may be shorter than normal or there may be a temporary reduction in numbers of livestock allowed to graze the allotment.

In my 20 years experience on the Dixie National Forest, I have been on many of the pastures of the various allotments on all of the five Ranger Districts. It is my opinion that grazing at the 50 percent utilization level (60 percent on Crested Wheatgrass seedings) maintains plant vigor and adequate ground cover to keep erosion rates within allowable thresholds. I know of no area on the Forest where soil erosion is a problem when livestock are removed once proper utilization has been reached.

Soil Disturbance. Soil disturbance consists of displacement, compaction and puddling. Livestock grazing on the Dixie NF causes some soil displacement, compaction and puddling.

Soil displacement occurs on some of the steeper slopes used by livestock (steep hillsides with a series of trails across the contour are evidence of soil displacement). Most of the displacement caused by livestock does not exceed the threshold established to be classified as "detrimental".

Livestock grazing causes soil compaction, particularly when grazing occurs on moist soils. When soils are saturated or near field capacity, puddling may also occur. The thresholds for "detrimental" soil compaction and puddling are only being exceeded where livestock concentrate or trail in to water or around salt grounds, and along stock drive ways.

The season of use and on/off dates established in the AMP help limit livestock use when soils are too moist in the spring and remove livestock at the appropriate times in the fall. Additionally, high elevation pastures are grazed later in the grazing season when soils are drier. In years where an extremely heavy snow pack or a very wet spring occurs, the dates livestock are allowed on to the allotment are delayed to allow soils to dry out sufficiently so that compaction/puddling damage is minimized. Some compaction/puddling damage occurs during summer thunderstorms common to the higher elevations, but these storms are generally not widespread and the detrimental damage is limited to where livestock concentrate.

In summary, some detrimental displacement, compaction, and puddling occur due to livestock grazing on uplands, but it is limited to areas of livestock concentrations. The soil quality standard of having at least 85 percent of the soils within the activity area in satisfactory condition is being met. I would estimate that less than 1 percent of the uplands are receiving detrimental soil disturbance.

Above-Ground Organic Matter. Above-ground organic matter consists of litter and large woody debris. Livestock grazing only affects litter. Large woody debris refers to material greater than 3 inches in diameter and is associated with forested areas and livestock have little if any impact on this parameter.

Livestock grazing causes some loss of litter, primarily through trampling. The utilization standards in the AMP's that restrict the amount of forage removal also ensure that sufficient litter remains on site for erosion protection. Utilization studies and other monitoring has shown that when the utilization standards are being met, there is adequate ground cover (vegetation and litter) to protect the soil from excessive soil erosion. Only the areas of heavy livestock concentrations (around water developments, salt grounds, and livestock drive ways) are ground cover/ litter amounts lower than desired for adequate soil protection.

Microphytic Crusts. There are portions of the Dixie National Forest where soils have microphytic crusts. These are primarily associated with sandier soils formed from sandstone parent materials, generally at the lower elevations of the Forest. The crusts help provide stability of the soil aggregates and crust damage could lead to erosion problems (particularly wind erosion). Some allotments that have soils with microphytic crusts have been closed to grazing. Those allotments that have soils with these crusts that are grazed experience some damage to the crusts through trampling. Generally the areas with these microphytic crusts are located in the pinyon/juniper vegetation types and have minimal amounts of forage that would attract livestock. To date, there are no soil erosion problems associated with livestock degradation of microphytic crusts.

Severely Burned Soils. Upland areas of the Dixie NF are subject to occasional wildfires. Additionally, prescribed fire is occassionally used to improve rangeland and/or wildlife habitat.

Numerous wildfires occur on the Dixie NF each year. Most are quite small, generally only a few acres in size, however occassionally a large wildfire occurs, burning several thousand acres of land. Three such fires have occurred over the past 20 years. When wildfire burns in heavy concentrated fuels such as timber or dense brushlands, soils can be severely burned. In the most recent large fire on the Dixie (Uinta Flat fire) which burned approximately 8000 acres, 75 percent of the area received a high intensity burn and 60 percent of the area had water repellant (hydrophobic) soils. Emergency watershed rehabilitation funds were used to seed those portions of the burned area that were subject to erosion damage. On another large fire (Oak Grove fire) which burned approximately 6000 acres, about one half of the burn was seeded for watershed protection. Even the untreated area came back to a dense stand of native grasses, forbs and resprouted brush species, providing good watershed protection. Some erosion damage occurred from summer thunderstorms immediately following the fire, however ground cover was excellent the following year and continues to provide good protection from erosion.

Prescribed fire used for rangeland type conversions and/or wildlife habitat improvement projects seldom burn at a high enough intensity to severely burn the soil. Prescriptions are designed to control the rate of spread and fire intensity. Prescribed fires are generally small in size, and are designed to burn in patterns rather than one single large block. Mitigation is incorporated into the prescription to protect water quality and riparian areas and to minimize erosion. The prescribed fires that have occurred on the Forest have been quite successful in obtaining suitable amounts of ground cover from grass, forbs and resprouting browse and aspen.

b. Effects of Grazing at Proper Use on Riparian Areas

Ground Cover. Livestock tend to concentrate in riparian areas due to the abundance of forage, the presence of water, and the cooler temperatures. The Dixie NF LMP and the Allotment Management Plans set standards and guidelines for proper use in riparian areas which are designed to maintain plant health and vigor and to maintain the proper functioning of the riparian ecosystem. These standards and guidelines are based on research and include limits on percent utilization of forage and browse species, and stubble height, which all relate to percent ground cover. Livestock are to be moved when these limits are reached.

Grazing of riparian areas at proper use levels results in stable riparian herbaceous vegetation, generally in a late seral stage. Late seral plant communities have strong root systems that help hold the soil in place and resist erosion. The most recent research (Winward, 1995) indicates that proper use on riparian areas should be 4 inches of stubble height on key hydric species on the green line at the end of the growing season for riparian areas in mid to late seral stages and 6 inches of stubble height for riparian areas in very early and early seral stages. In addition livestock must be removed from a pasture when heavily used portions of the riparian area (away from the green line) reach a 2 inch stubble height; or when 20 percent of the green line shows bank sloughing, animal tracks, dislodged stones and/or trampling from livestock; or when adjacent uplands show heavy use in excess of proper use utilization standards; or if proper use of woody species is exceeded. If these proper use guides are followed, riparian areas will improve (Winward, 1995).

Soil Disturbance. Soil disturbance consists of displacement, compaction and puddling. Livestock grazing on riparian areas of the Dixie NF causes some soil displacement, compaction and puddling.

Soil displacement occurs primarily on streambanks where livestock gain access to water. Some areas exceed the threshold established to be classified as "detrimental", however this is minimal on riparian areas grazed at the 50 percent utilization level. Detrimental displacement has been observed where livestock cross riparian areas or where they access water, particularly along brushy riparian areas where access is difficult and therefore more concentrated. The amount of detrimental displacement on properly grazed riparian areas is well below established soil quality thresholds.

Livestock grazing in riparian areas causes compaction and puddling. Compaction and puddling reduce infiltration of water into the soil and reduce permeability (water moving through the soil). The degree of compaction and puddling that occurs with 50 percent utilization does not appear to adversely impact the hydrologic functioning of the soil. Riparian areas grazed at 50 percent utilization have healthy late seral stage plant communities. To my knowledge there has been no damage or loss of long term soil productivity where riparian areas have been grazed at the 50 percent utilization level.

Severely Burned Soil. Fire will generally burn out as it approaches the moist riparian areas. Occassionally, a wildfire will be large enough or of high enough intensity to burn across or through a riparian area. Due to the moistness associated with riparian areas, the burn is generally of low intensity. The primary adverse effect is that some of the tree species along the riparian area are killed and there is a temporary loss of shading. The herbaceous and shrub vegetation typically responds quite quickly following a fire. There are typically no adverse impacts to riparian area soils from burning.

c. Cumulative Effects of Grazing at Proper Use

A multitude of multiple use management actions occur on lands administered by the Dixie National Forest. These include such things as timber sales; watershed rehabilitation projects; wildlife and fisheries habitat improvement projects; recreational developments such as campgrounds, trails for hiking, biking, ATV's, snowmobiles, etc., ski areas; mining and oil and gas development; utility corridors; roads; fire control; etc.

All multiple use projects implemented on the Dixie NF go through a NFMA/NEPA analysis. Any project that results in soil disturbance has appropriate best management practices (Soil and Water Conservation Practices) prescribed to minimize soil disturbance and to be within soil quality guidelines.

Timber sales and associated road construction are the principle soil disturbing activities occurring on the Forest. Generally, these areas provide little if any forage for grazing livestock. Some areas provide transitory range following logging for several years until the canopy closes in. The proper use standards and guidelines associated with livestock grazing ensures that soil quality standards are not violated. The amount of large woody debris, duff and litter in forested areas minimizes the effects of compaction, puddling and displacement.

In summary, livestock grazing (includes wildlife use) typically occurs on lands not used for other major soil disturbing activities. Consequently there are few cumulative impacts.

The 1995 Intermountain Region Supplement to Soil Management Handbook states that "no more than a total of 15% of an activity area may have detrimentally disturbed soil". Activity areas are defined as "a land area impacted by a management activity, excluding specified transportation facilities, dedicated trails and mining excavations and dumps". The principal other kinds of uses/management activities that occur on forage producing areas of the Forest are primarily recreation. The kinds of detrimental soil disturbance associated with recreation on forage producing areas consists of off-road recreational vehicle use and hunting and fishing. Off road vehicles cause some soil displacement and compaction/puddling and fisherman cause some trampling (compaction) along streambanks. These adverse impacts are very localized and minor in areal extent.

It is estimated that detrimental soil disturbance associated with livestock grazing occurs on less than 1 percent of the land area. Cumulatively, the Dixie National Forest is well within the threshold of having at least 85 percent of the land with soil in satisfactory condition. Only activity areas where timber sales occur do we occassionally approach the 15 percent threshold.

Therefore, looking at the Forest as a whole, grazing has little impact on the total cumulative effect of management activities on the soil resource.

It should be noted that through agressive fire control, some of the upland areas have vegetative cover types that are becoming mature/decadent. Areas with these decadent cover types (particularly pinyon-juniper, sagebrush and mountain shrub) have reduced ground cover compared to pre-settlement times when fire was still an important part of the ecosystem. The reduced ground cover is a result of the mature shrubs and trees extensive root systems and active evapotranspiration rates which use much of the moisture these sites receive (Winward, 1995). The result is a reduced abundance of the grass/forb component in the species mix associated with these cover types. Reduced ground cover results in less soil protection and increased runoff and soil erosion.

Some of the upland areas on the Forest with decadent stands of these cover types are approaching the ground cover threshold for soil protection. The Forest has treated approximately 142,000 acres of these cover types over the past 45 years. The treated areas showed significant improvement in ground cover conditions, however, some of the older treatment areas are now showing evidence of woody species encroachment and should be scheduled for retreatment.

The majority of the decadent stands of woody vegetation that are approaching the ground cover threshold are on lands classified as unsuitable for livestock grazing. These areas are typically steep and/or have little forage present to attract livestock. There are little if any cumulative effects of grazing on the amount of ground cover on those sites, however those stands will continue to have reduced ground cover as the canopy closes in. Without treatment (prescribed fire, spraying) the ground cover threshold will be crossed and erosion will increase to the point that the soil loss tolerance thresold will be reached. Without treatment, conditions will build to the point that a catastrophic wildfire will likely occur (Winward, 1995). A large wildfire in these vegetative cover types will likely result in a significant increase in erosion the first two years following the fire with adverse impacts to riparian and fisheries values.

2. Direct and Indirect Effects of No Grazing

a. Uplands:

Ground Cover: With no livestock grazing, the amount of vegetative ground cover would increase over what now occurs under current conditions. Wildlife grazing/browsing would continue. Utilization levels would be considerably lower than occur with livestock grazing. Erosion rates would be slightly lower than under current conditions. (Erosion rates would not differ significantly from current conditions because (1) livestock grazing doesn't create a lot of ground disturbance, except in concentrated use areas such as around water, salt, etc. and (2) proper use standards provide sufficient ground cover to intercept rainfall and disperse and trap runoff and sediment.)

Soil Disturbance. With no livestock grazing there would be less soil displacement, compaction and puddling. Under current conditions, most of the detrimental soil disturbance is associated with concentrated use areas (around water developments, salt grounds, bedding grounds and along stock drive ways). Wildlife use around water developments would result in some continued detrimental soil disturbance, but it would be too a lesser degree than current conditions. Conditions would improve around areas currently used as stock drive ways, salt grounds and bedding grounds.

Above-Ground Organic Matter. No livestock grazing would result in reduced loss of litter due to the lack of trampling effects related to livestock grazing. There would be no effect on large woody debris (material greater than 3 inches diameter). As discussed above under ground cover, the erosion rates would be slightly less due to the increased percent of vegetation and litter.

Microphytic Crusts. The lack of livestock grazing would result in less damage to microphytic crusts that occur on some areas of the Forest with coarse textured soils. These areas typically occur on lower elevations which are used as deer winter range and will still experience some damage in concentrated deer use areas. To date, neither livestock nor wildlife use has caused any significant erosion problems. Without livestock grazing, conditions should improve slightly.

b. Riparina Areas:

Ground Cover. With no livestock grazing, riparian areas should respond quite rapidly, similar to what is now occurring in the several riparian demonstration areas that occur on the Forest. The streams should tend to narrow and deepen. The occurrence of overhanging banks should increase. The hydrologic functioning of the soil should be optimum and in time the riparian ecosystem should become extremely stable and resistant to damage from unusual storm events.

The most notable result of no livestock grazing compared to current conditions would probably be the increase in woody species and the shading effect of shrubs (primarily willows). Vegetation would progress towards potential natural vegetation.

Soil Disturbance. With no livestock grazing, the only compaction/puddling and displacement that would occur within the riparian areas would be due to wildlife use which would be minimal.

c. Cumulative Effects of No Grazing

Through agressive fire control, some of the upland areas on the Forest have vegetative cover types that are becoming mature/decadent. Areas with these decadent cover types (particularly pinyon-juniper, sagebrush and mountain shrub) have reduced ground cover compared to pre-settlement times when fire was still an important part of the ecosystem. The reduced ground cover is a result of the mature shrubs and trees extensive root systems and active evapotranspiration rates which use much of the moisture these sites receive (Winward, 1995). The result is a reduced abundance of the grass/forb component in the species mix associated with these cover types. Reduced ground cover results in less soil protection and increased runoff and soil erosion.

Some of the upland areas on the Forest with decadent stands of these cover types are approaching the ground cover threshold for soil protection. The Forest has treated approximately 142,000 acres of these cover types over the past 45 years. The treated areas showed signicant improvement in ground cover conditions, however, some of the older treatment areas are now showing evidence of woody species encroachment and should be scheduled for retreatment.

The upland areas with decadent stands of woody species will continue to have reduced ground cover as the canopy closes in. Without treatment (prescribed fire, spraying) the ground cover threshold will be crossed and erosion will increase to the point that the soil loss tolerance thresold will be reached. Without treatment, conditions will build to the point that a catastrophic wildfire will likely occur (Winward, 1995). A large wildfire in these vegetative cover types will likely result in a significant increase in erosion the first two years following the fire with adverse impacts to riparian and fisheries values.

E. CONDITION OF RIPARIAN ECOSYSTEMS - A PROFESSIONAL OPINION:

Over time, heavy use on riparian areas in excess of proper use standards can lead to degraded riparian ecosystems and eventual loss of these ecosystems. Overgrazing can lead to reduced plant vigor and decreased stream bank stability. A degraded riparian ecosystem is susceptible to damage from high runoff events. As streams degrade, the water table can be lowered and riparian areas can essentially be drained, resulting in loss of these ecosystems.

Many of the riparian areas in the western United States were in this condition due to overgrazing at the turn of the century. Many of the National Forests in the west were established for watershed protection to correct these overgrazing problems.

On the Dixie NF, numerous watershed restoration projects were implemented to rehabilitate the eroding watersheds. Range analysis was completed, grazing capacities were determined and allotment management plans were implemented. Over time, livestock reductions have occurred and proper use guidelines based on the latest research have been established.

The result of all these measures has been to stabilize the riparian areas. There has been steady improvement of the riparian ecosystems over the past 90 years, i.e. they are in much better condition than they were at the turn of the century, however, under current management, many of the riparian areas on the Forest are receiving use in excess of what research is currently recommending for proper use. Since livestock tend to concentrate on riparian areas, they do not show very rapid improvement. Riparian demonstration projects across the Forest show that rapid improvement of riparian ecosystems can occur.

Overall, my opinion of the condition of the riparian areas on the Dixie NF is that they are fairly stable, but far from being in as good a condition as they should be. I believe the riparian areas are in much better condition than they were when the Forest was established, however our riparian demonstration projects show that we could have much healthier riparian ecosystems than now exist. As we monitor our allotments and as we learn from new research, and as the wants and needs of our publics change over time, we alter our management accordingly. This has resulted in continuous improvement of our riparian areas over time. Based on the latest research, it appears that current management guidelines are falling somewhat short of recommended proper use standards. The Dixie NF will continue to work on improving riparian area health through implementation of appropriate proper use standards.

EFFECTS OF LIVESTOCK GRAZING ON THE HYDROLOGY AND WATER QUALITY

Janice Staats, Dixie NF Hydrologist

Introduction

Livestock grazing affects watershed properties by alteration of plant cover and soil compaction from the physical action of animal hooves. Early livestock growers were generally unaware of the grazing limits of soil and vegetation (Council for Agricultural Science and Technology 1974, p. 275). Serious concern about national forest management and grazing developed in the late 1920s. But concern did not grow about the effects of livestock grazing on biotic resources until the early 1970s (Meehan and Platts 1978, p. 275). Historic heavy use on some rangelands on the Dixie National Forest did result in changes in vegetation and hydrologic conditions. With better grazing management, recovery has occurred or is still in process, especially in the uplands.

According to Meehan and Platts (1978, p. 275) range practices significantly affect water yield, peak stream discharge, stormflow runoff, and associated water quantity and quality factors. Most studies to date have focused on infiltration, sediment accrual, and increased bacterial concentrations through the addition of animal wastes to streams. There have also been some studies on nutrient enrichment to the aquatic environment. Most of the studies have been comparing no grazing to heavy grazing or an unreported grazing intensity. In order to draw conclusions regarding the effects of grazing with the proposed action and no action, I discuss the effects of heavy grazing that are prevalent in the literature, and light to moderate grazing when found.

The key to maintaining healthy hydrological conditions on rangelands is through grazing practices that develop and maintain a good plant cover. The success of any grazing program geared toward watershed maintenance and enhancement is best measured by the residue of living and dead vegetation (mulch) it maintains on the site throughout the year (Holecheck et al. 1989 p. 407). Resilience to rare hydrologic events is an attribute of healthy riparian zones (Platts 1986, p. 42; Debano and Schmidt 1989, p. 4).

The proposed action is to graze at "proper use". "Proper use" is defined as a degree of utilization of current year's growth which, if continued, will achieve management objectives and maintain or improve the long-term productivity of the site (Society for Range Management 1989). The amount of "proper use" should then be developed based on the physiological requirements for maintaining plant health and vigor as well as management considerations such as streambank stability, soil compaction, fish and wildlife habitat, etc., which can result in use levels lower than that which a plant can physiologically withstand. In Platts (1981) he states, "with proper grazing intensity, timing and distribution of animals, forage can be utilized without undue stress on the stream and riparian environment". The challenge is determining "proper use" for each streamtype and associated riparian complex that leads to satisfactory condition and the desired condition.

Al Winward, Intermountain Regional Ecologist spent August 1-2, 1995 with the Dixie National Forest West Zone Interdiscplinary Team looking at allotments on the Pine Valley Ranger District. He pointed out what in his experience "proper use" should be which applies forest-wide, and how to decide when to move livestock from pasture to pasture and off the allotment. It includes several components:

1. 6 inch stubble height at the end of the growing and grazing season on riparian areas with a very early to early seral greenline. 4 inch stubble height at the end of the growing and grazing season on riparian areas with a mid to late seral greenline.

2. 2 inch stubble height at the end of the growing and grazing season on "riparian islands" - those portions of riparian areas away from the greenline that are slightly higher and drier than the rest of the riparian area. These are often dominated by Kentucky bluegrass and Redtop.

3. 20% streambank impacted by fresh disturbance such as bank breakage and hoof prints.

4. If there is a sensitive upland area that is a key area, pre-determined percent use on the key species.

5. Browse utilization reaches a pre-determined point.

So the Proposed Action includes these "proper use" components.

Clary and Webster (1989) compiled information from numerous sources and on page 2 recommended that residual stubble should be at least 4 to 6 inches in height to provide sufficient herbaceous forage biomass to meet the requirements of plant vigor maintenance, bank protection, and sediment entrapment. They noted that recommendations of 40-50 percent utilization (approximately 3 to 4 inches of residual stubble height) will maintain plant vigor, however, additional stubble height might be necessary to protect riparian ecosystem function. Special situations such as a critical fisheries habitat or easily eroded streambank may require stubble heights of greater than 6 inches. When desired conditions or recovery do not occur or are progressing too slowly, further changes in management practices are warranted. Platts (1989, p. 106) also stressed that for deferred rotation or any grazing system the importance of having a sufficient amount of herbage remaining at the end of each grazing treatment, especially at the end of the late grazing period for fishery needs.

A few cattle remaining in a pasture after the prescribed use period can negate the benefits of a good system. Ninety percent compliance with a grazing system is not adequate (Myers 1989, p. 120).

When monitoring late seral to PNC riparian sites it is important to also monitor physical conditions of the stream channels. Streambanks and channel characteristics will respond more quickly to increased impacts than will the late seral vegetation. Late seral communities in low vigor may show improvement more quickly because the desirable plant communities are already in place. Early to mid seral riparian communities will show downward trends more quickly because they are typically dominated by weakly rooted species that are more easily displaced through continued surface disturbance and through water action against streambanks lacking adequate protection because of the weak rooting systems. Early seral greenlines will take more time to improve because the species necessary to colonize and develop into communities stable enough to hold streambanks are not well represented.

A needed change in a management prescription is not bad or a sign of failure, but a positive part of dynamic riparian management. When conditions are not satisfactory, or recovery does not occur or is progressing too slowly, further changes in management practices are warranted. We still have a tremendous amount to learn about riparian management and proper use, and many times we have to experiment to find the best solutions (Hancock 1989, p. 3).

It appears that rest-rotation grazing schemes and/or specialized grazing schemes in which riparian zones are treated as special use pastures have been the most successful at riparian ecosystem maintenance

(Kauffman and Krueger 1984, p. 435). No grazing system can insure proper use of small riparian areas within extensive upland range (except fencing). The most successful riparian management alternative on public lands to date has been intensive livestock management by permit holders (Storch 1979). Herding livestock on a somewhat daily basis has been successful in limiting the number of livestock that visit streambottoms and improving utilization of upland areas (Kauffman and Krueger 1984, p. 435).

HYDROLOGY

Infiltration and Runoff

Many studies have shown that as grazing intensity increases water runoff increases. The primary causes are soil compaction and resulting reduction in infiltration rate, as well as ground cover depletion. Published infiltration studies were reviewed and summarized by EPA (1979) and Gifford (1981). EPA (1979, pages 27 and 32) states that heavy grazing defined as greater than 55% utilization causes a significiant effect on infiltration rates. Gifford (1981, p. 150) states that statistical analyses indicate there is a difference in infiltration rates associated with ungrazed, light/moderate, and heavy grazing intensities. Moderate and light grazing intensities have similar infiltration rates, and heavy grazing causes definite reductions in infiltration rates over moderate and light grazing intensities. No specific utilization percentage was given for the different grazing intensities. This is summarized in Table ***1.
Table ***1. Generalized residual constant infiltration rates experienced at the end of a long storm (f_c) by grazing intensity.

Intensity	f_c (inch/hour)
Ungrazed	1.60
Light/Moderate	1.25
Heavy	0.80

Increased runoff increases sheet and rill erosion, resulting in stream sedimentation. Increased peak runoff also increases stream energy for bank erosion, downcutting, and gully formation. Reductions in water infiltration and storage reduce the magnitude and duration of low flows.

Future infiltration rates are highly dependent on grazing intensities and recovery processes. Recovery varies with soil texture, antecedent moisture conditions, freeze-thaw relations, cover conditions, specific grazing system utilized, etc., But the limited amount of data available in the literature does show recovery can take place with rest and/or light to moderate grazing intensities (Gifford 1981, p. 150). A summary of infiltration and recovery studies in EPA (1979, p. 23) shows three to thirteen years of nonuse or reduced grazing is required for restoration of infiltration rate.

Where historical heavy grazing intensities occurred on the Dixie National Forest, there was a decrease in infiltration and increase in runoff with the associated adverse impacts on sheet and rill erosion and water quality constituents. Since some riparian areas have continued to receive heavy use of over 55% utilization to date, the infiltration rate is probably still adversely impacted in those areas. Most upland sites except around water developments are not heavily grazed and would have infiltration rates commensurate with light/moderate grazing intensities (see Table ***1).

Channel Morphology

Stream channels are composed of a mosaic of channel units such as riffles and pools which have distinctive shapes and locations within the stream channels. Riffles and pools have distinct differences in average velocity, depth, and substrate. Channel morphology reflects a balance between the influx of sediment, water, and woody debris to a stream, the streams' ability to transport sediment and woody debris, and the strength of the banks. The channel morphology and flow characteristics adjust if any of these factors change. A change in morphology results in a change in the quantity and quality of aquatic habitat.

Livestock grazing can affect channel morphology by accrual of sediment, alteration of channel substrate, disruption of the relation of pools to riffles, and widening of the channel. One study in southcentral Montana showed that the average eroded channel width and average water width was considerably greater in the grazed area than in the ungrazed, the percent of total stream as riffles was greater in grazed areas, and that the percent of total stream as pools and runs was greater in the ungrazed area (Gunderson 1968). The grazing intensity in the grazed area was not reported (in Meehan and Platts 1978).

Streambank stability is determined by the soil's ability to resist displacement and by vegetative cover and streamflow characteristics. In channel types with medium- to fine-textured soil materials, a vigorous late seral plant community is important for protecting streambanks against erosive forces and for trapping sediments. Vegetation has the most controlling influence on width/depth ratio and stability on C, DA, E, and G type channels, and a moderate influence on B, D, and F type channels (***see Appendix A from Rosgen 1994). The potential for reaches with utilization levels higher than 60% to impact streambanks is very high (Shepard 1992, p. 245). Many researchers have shown that stream channel and/or streambank alterations occur at utilization levels about 60% (Hayes 1978; Platts 1982; Platts and Nelson 1985). Clary and Webster (1989) recommended four to six inches herbaceous stubble height in the fall after grazing to protect streambanks.

In Platts and Nelson (1989, p. 80) it states, "Where sedges can become dominant, they clearly create the most optimal streambank structure. Even under grazed conditions, some of the optimum bank characteristics were associated with this community type. Thus, moderate grazing pressure after viable sedge communities have become reestablished may be acceptable, the the managers responsible must ensure the Carex spp. community types do not revert to less favorable communities like POPR (Poa pratensis)." They do not define what percent utilization or stubble height moderate grazing is, but give many differences in riparian components between a pasture grazed at an average of 63% and ungrazed, and call 62% utilization on POPR "heavily used".

Vegetation and cover on the streambanks is also important as an insulator. Bohn (1989, p. 70) found that cover moderated daily fluctuations in soil temperatures and greatly reduced the number of days that the soil temperatures crossed zero, suggesting fewer freeze-thaw cycles and less opportunity for frost-heaving. Repeated freeze-thaw cycling has shown to reduce the strength of soils. Weakening the internal structure of a streambank with repeated freeze-thaw cycles leaves the bank vulnerable to accelerated failure due to gravity, streamflow, ice flows, and animal trampling.

In Platts (1989) the author makes a rating from poor to excellent on how compatible different grazing strategies are with fisheries and achieving desired streambank stability, brushy species condition, seasonal plant regrowth, etc., Continuous season-long (cattle) is rated poor. Deferred (cattle) is rated poor to fair. Deferred-rotation (cattle) is rated fair. Rest-rotation (cattle) is rated fair to good. Rest rotation (sheep) is rated good to excellent. Riparian pasture (cattle or sheep) is rated good. Corridor fencing (cattle or sheep) is rated good to excellent. Rest or closure (cattle or sheep) is rated excellent. He makes the statement that fair rated strategies like Deferred to be successful must leave a sufficient amount of herbage at the end of each grazing treatment, especially at the end of the late grazing period. Platts did not rate some strategies for sheep. In my opinion, with a herder controlling sheep use in riparian areas, sheep allotments would rate out one step higher than cattle. For example Deferred (sheep) would rate fair to good, and Deferred-rotation (sheep) would rate good.

Woody Species in the Riparian Area

Woody species with diverse age structure where such species are part of the natural system are important for pool formation, stability, shade, insulation, energy dissipation, aquatic food input, and wildlife habitat. Perennial streams with 0.5 - 4.0 percent slope are best areas for willow and other woody species. There should be 3 times as many seedling/sprout and young/sapling as there are mature, decadent, and dead for future replacement (Winward 1995).

Sheep find willows very palatable, but do little damage to stands if good herding practices are followed. Cattle prefer willows less than do sheep, but are more destructive when they congregate in riparian areas (Smith 1982).

Skovlin (1984) stated that light to moderate grazing generally appears to have little adverse effect and in some cases may stimulate growth, but no percent utilization is described. The USDA Forest Service Intermountain Region has Utilization Standards for Key Indicator Species (1993) which calls for 45% utilization of shrubs in satisfactory condition, 35% utilization of shrubs in unsatisfactory condition. It goes on to say that the figures represent the best estimate of acceptable use levels which will provide for maintenance or improvement of these ecosystems. The Dixie National Forest Plan Riparian General Direction Standard is a maximum 50 percent use of current year's growth on browse species in riparian areas (Dixie National Forest 1986, p. IV-41), and the 9A Management Area Standard is 50% of new leader production (p. IV-138). Wasatch-Cache National Forest (1995, p. 2-14 and 2-16) states that utilization based on current year's growth of riparian browse in satisfactory condition of 50% and unsatisfactory condition of 40% is based on not only the physiological ability of individual woody plants to withstand use and produce additional browse, but also on the ability of plants to reproduce and maintain their populations by adding new individuals. Al Winward, Regional Ecologist says that if you have a 4-6 inch stubble height on the greenline hydric species as described under "proper use" in the fall after grazing, willows and other woody species in the riparian areas will not only be maintained, but will also be able to reproduce and grow (Winward 1995).

Kovalchik and Elmore (1992, p. 114) observed that for mid- to late-season grazing cattle begin using the current annual growth on willows when riparian forage use reaches about 45% of total available forage (4-6 inch stubble height). Use increases again at 65% (2-4 inch stubble height), and cattle eat all the willow they can when utilization is 85% or more (<2 inches). With continued overuse, dead and dying plants suggest former willow abundance. Excessive grazing may eliminate a willow stand within 30 years. Elmore (1991) has found that if cattle are moved from pasture to pasture with a three pasture rest rotation system with no regard to use on willows, the woody vegetation can slowly decline while the sedges, rushes, and grasses prosper.

After studying grazing effects on the Yellowstone River, Boggs and Weaver (1992, p. 51) make the following observations. They do not define grazing intensities by percent utilization or stubble heights. Relatively ungrazed areas with mature cottonwood forest have a diverse and dense understory shrub layer dominated by redosier dogwood (Cornus stolonifera), western serviceberry (Amelanchier alnifolia), common chokecherrry (Prunus virginiana), western snowberry and woods rose, various species of willows (Salix spp.), and currants and gooseberries (Ribes spp.). With moderate grazing, there is an increase in western snowberry and woods rose, with a corresponding decrease in both the abundance and canopy cover of the other shrubs. If there is heavy grazing, the more palatable shrubs will be eliminated leaving woods rose and western snowberry, which can form a nearly impenetrable understory. If the heavy grazing is severe enough, shrubs can be eliminated and the understory will be converted to an herbaceous one dominated by species such as Kentucky bluegrass (Poa pratensis), common timothy (Phleum pratensis), and smooth brome (Bromus inermis). During the process of converting from a diverse, dense shrub understory, the stand will open up, resulting in a drier site. Once the stand has converted from a shrub-dominated understory to one that is dominated by a variety of introduced herbaceous species, the ability to return to site to its former state (shrub dominated) is very difficult. It may be possible, but it will require a drastic change in management. Therefore, if the desired condition is to maintain the stand in a shrub-dominated understory state, management must change before the site is degraded.

Inventory on 250 miles of riparian areas on the Sawtooth National Forest in Idaho showed that a reduction of shrubs in the riparian plant community appeared to be due to grazing of young reproduction age classes rather than due to the mechanical damage to the older shrub age classes by rubbing and bedding (Clary and Webster 1989). Severe overgrazing almost invariably is detrimental to willow communities (Kauffman and Krueger 1984).

Myers (1989) made an evaluation of 34 grazing systems that were in place for 10-20 years in southwestern Montana. Utilization of deciduous woody species appeared to increase as duration of grazing treatments increased. This documents the need to adjust the duration of grazing treatments based upon site-specific monitoring results that include woody species utilization. He found each management pasture is different, and a few days difference in utilization could be significant. Observations of cattle indicated that utilization of deciduous woody species increased about late August and remained heavy through the fall period. Close monitoring is required to avoid excessive use on woody species during this period. Leaving a 6 inch stubble height provided for vigorous woody plant growth.

Grazing systems designed for uplands should be used only where negative effects on willows can be mitigated by strict enforcement of riparian forage use to prevent the switch from grazing to browsing. Otherwise, use will result in downward condition trends in willow-dominated plant associations (Kovalchik and Elmore 1992, p. 118).

WATER QUALITY

Water quality impacts of grazing livestock are associated with the amount, duration, and timing of runoff, erosion and sedimentation, pathogens, nutrients, water temperature, and dissolved solids. Water quality can be protected and/or enhanced through application of the present knowledge of scientific and technical principles of livestock management on rangelands (EPA 1979 p. 109). The continued propagation of aquatic life is a good indication of water quality.

Clean Water Act and Utah Antidegradation Policy

As required by the Clean Water Act as amended, the State of Utah has adopted a Water Quality Antidegradation Policy that requires maintenance of water quality to protect the instream Beneficial Uses existing as of 1975. All surface water geographically located within the outer boundaries of USDA National Forests whether on public or private lands are designated as Category 1 High Quality Waters. This means no new point sources of pollution will be allowed, and nonpoint sources of pollution will be controlled to the extent feasible through implementation of Best Management Practices (BMPs) or regulatory programs (Utah Division of Water Quality 1994).

The Clean Water Act as amended also directs each State to establish a Nonpoint Source Management Plan. In the Utah Nonpoint Source Management Plan (1989), several watersheds were identified as high priority for the implementation of control measures. These watersheds were identified because of nonpoint source impacts to water quality and the potential for improvement using criteria described in the assessment. These are not the only watersheds in the state with nonpoint source impairments, but represent the most visible problems. These watersheds provide a starting point for the targeting of resources toward nonpoint source problems (Utah 1989, p. 92). This should be taken into consideration when setting Dixie National Forest priorities for allotment administration, monitoring, and Allotment Management Plan environmental analysis.

Table ***2. Utah Priority Watersheds for Nonpoint Source Pollution Control and Associated Allotments on the Dixie National Forest. C = cattle, S = sheep

Watershed #/Name	Problem Parameters	Allotment
16030006-024/Shoal Creek	Nutrients	Black Hills C
		Bull Valley C
		Enterprise C
		Gunlock C
		Terryshoal Cr C
15010008-080/Gunlock	Nutrients, TDS	Black Hills C
		Bull Valley C
		Gunlock C
		Magotsu C
		Pine Valley C
16030001-030/Panguitch Lake	Nutrients, TSS	Butler Creek C
		Dry Lakes/Bunker C
		Haycock Cr S
		Haycock Mtn/Brian Head S
		Little Valleys C
		Panguitch Lake C
		Red Creek C
		Sage Valley/Horse Val S
		Sidney Valley C
		Three Creeks C
		Warren Bunker S
		White Canyon C
15010008-010/Upper Long Valley	Nutrients, TDS	Harris Flat C
		Seaman Canyon C
		Shingle Mill C
		Spencer C

16030002-050/Otter CreekNutrients, TSSDeer Creek S

16030002-040/KoosharemNutrients, TSSBlue Fly C

Clark Mountain C
Deer Creek S
Pines C

16030002-020/East ForkNutrients, TSSPines C

16030002-010/Bryce CanyonNutrients, TSSBlue Fly C

Crawford Cr C
East Fork C
Kanab Cr C
Lower Blubber C
Robinson Canyon C
Upper Blubber C

16030002-030/AntimonyNutrients, TSSAntelope Spring S

Coyote C
Lake Philo S
Pine Creek S
Polywog Lake S
Jones Corral C

14070003-030/AwapaNutrients, TSS, TDSDark Valley C

Donkey Meadows S
Govt Point S
North Slope C
Surveyors Lake S

The State of Utah Division of Water Quality and USDA Forest Service Intermountain Region have agreed through a 1993 Memorandum of Understanding to use Forest Plan Standards & Guidelines and the Forest Service Handbook (FSH) 2509.22 Soil & Water Conservations Practices (SWCPs) as the BMPs to meet the water quality protection elements of the Utah Nonpoint Source Management Plan. The Dixie National Forest Plan has Riparian area objectives and grazing utilization guidelines. The utilization guidelines are maximum levels, but should conditions warrant, stricter standards can be applied to ensure quality conditions for resource protection needs. Stricter standards will require additional environmental analysis on a site-by-site basis. SWCPs 17.01 through 17.04 were designed to restore deteriorated range and maintain all range in a productive state (USDA Forest Service 1988). The components of the BMPs such as amount of utilization, numbers of livestock, season of use, livestock distribution techniques, etc., were discussed by the Interdisciplinary Teams and made a part of each proposed action.

In the MOU the Forest Service also agrees to conduct internal reviews of BMPs by annually examining a representative sample (target 10%) of projects which may significantly impact water quality and prepare written evaluation reports. Summaries of these reports will be provided to the State. To fully comply with the Utah Antidegradation Policy and the Clean Water Act, yearly grazing BMP reviews need to be conducted, as well as timber harvest, roads, recreation and watershed rehabilitation projects.

Section 303(d) of the Clean Water Act

Under Section 303(d) of the Clean Water Act as amended, each state is required to identify those waterbodies that do not meet Water Quality Standards, and work towards identifying and correcting pollution problems. Streams and/or watersheds that are involved in the permit issuance on the Dixie National Forest and are on the 303(d) list are as follows:

Table ***3. LIST OF PERMIT ISSUANCE ALLOTMENTS WITH 303(d) LIST WATERS. DO = dissolved oxygen, TSS = total suspended solids, TDS = total dissolved solids

WaterbodySpecific Pollutant

Pine Valley Ranger District

Burgess Ranch CattleSanta Clara R. DO, Temperature,
TSS, TDS
East Pinto CattleNew Castle Res.Nutrients, DO
Iron TownNew Castle Res.Nutrients, DO
Magatsu CattleSanta Clara R . DO, Temperature,
TSS, TDS
Terryshoal Creek CattleEnterprise Res.Nutrients, DO
West Pinto CattleNew Castle Res.Nutrients, DO

Cedar City Ranger District

Butler CattleSevier R & Panguitch CrTDS, Iron Nutrients
Deep Creek SheepN Fk Virgin R & tribsTemp, Iron, TDS, TSS
Dry Lake/Bunker CattleSevier R & Blue Spr CrTDS, Iron Nutrients
Haycock Creek SheepSevier R & Panguitch LkTDS, Iron Nutrients
Haycock Mountain/Brian Head SheepSevier R & Panguitch CrTDS, Iron Nutrients
Little Valleys CattleSevier RTDS, Iron
Lone Pine CattleN Fk Virgin R & tribsTemp, Iron, TDS, TSS
North Fork CattleN Fk Virgin R & tribsTemp, Iron, TDS, TSS
Red Creek CattleSevier R & Red Cr ResTDS, Iron Nutrients, DO, pH
Sage Valley/Horse Valley Sheep Sevier R & Clear CrTDS, Iron Temp, Nutrients
Shingle Mill CattleMuddy Cr & tribsIron, TDS, TSS
Sidney Valley CattleSevier R TDS, Iron

Powell Ranger District

Deer Creek SheepSevier RTDS, Iron
Don Spring CattleSevier RTDS, Iron
Clark Mountain CattleSevier RTDS, Iron
Hatch CattleSevier RTDS, Iron
Heward Canyon CattleParia R & tribsTDS, TSS
Lower Kanab CattleKanab Cr & tribsTDS, TSS
Lower Robinson CattleParia R & tribsTDS, TSS

Sheep Creek CattleSevier RTDS, TSS
Willis Creek CattleParia R & tribsTDS, TSS

Escalante Ranger District

Boulder CattleEscalante R & tribsNutrients, TDS
Cameron Wash CattleParia R & tribs TDS, TSS
Coyote CattleEscalante R & tribsNutrients, TDS
North Creek CattleEscalante R & tribsNutrients, TDS
Upper Valley East CattleParia R & tribs &TDS, TSS Nutrients
Escalante R & tribs

Teasdale Ranger District

Dark Valley CattlePine Cr ResNutrients, DO, pH
Donkey Meadows SheepEscalante R & tribsNutrients, TDS

In order to not contribute to the further impairment of 303(d) listed waters, upland watershed conditions should not contribute to degradation of riparian conservation areas, and riparian areas should be in good health and functioning properly as evidenced by the amount of late seral community types (see Appendix B). Woody species should have a diverse age structure where such species are part of the natural system (0.5 - 4.0 percent slope on perennial streams). Plants should exhibit high vigor. Streambank vegetation should protect streambanks and dissipate energy during high flows. Grazing intensity should be in the low/moderate range in order not to decrease infiltration rates past that threshold (see Table ***1).

Temperature

Utah Division of Water Quality has State Standards for water temperature in those streams designated to have the Beneficial Uses of 3A cold water aquatic life, 3B warm water aquatic life, and 3C nongame aquatic life (see Table ***4). The majority of the streams on the Dixie National Forest have the Beneficial Use Designation of 3A cold water aquatic life.

Table***4. Numeric Temperature Criteria for Aquatic Wildlife in the Utah Water Quality Standards (UT Division of Water Quality 1994, R317-2-14).

	3A cold water aquatic life	3B warm water aquatic life	3C nongame aquatic life
Max Temperature	20C (68F)	27C(81F)	27C(81F)
Max Temperature Change	2C (4F)	4C (7F)	4C (7F)

Grazing can have an effect on water temperature by reducing canopy or overhanging bank vegetation, contributing to channel widening and shallowing, or reducing summer low flows. The increase of temperature from removal of shading is due almost entirely to the additional input of incoming shortwave radiation. One study showed that streamside cover, such as overhanging banks, brush, and debris, was 76.4 percent greater in an ungrazed area than in a grazed area (Gunderson 1968). Van Velson (1979) found average water temperatures dropped from 24 C to 22 C after 1 year of livestock exclusion on a creek in Nebraska. Claire and Storch (unpublished) compared stream temperatures between an area that had been grazed season long (June 1 - October 15) and an area that had been rested for 4 years and, thereafter, grazed only after August 1. The maximum water temperatures outside and downstream from the exclosure averaged 7 C higher than those sampled within the exclosure. Daily fluctuations of water temperatures averaged 15 C outside the exclosure as compared to 7 C inside the exclosures.

In addition to the 303(d) list, areas where temperature has been measured and was over the State Standard from Dixie National Forest data located in the Watershed files from 1974-76 are:

Allotment	Stream
West Pinto Cattle	Pinto Creek (Pine Valley District)
Haycock Creek Sheep	Panguitch Creek (Cedar City District)
Haycock Mtn/Brian Head Sheep	Panguitch Creek (Cedar City District)
Pine Creek Cattle	Pine Creek (Escalante District)

Nutrients

The Utah Division of Water Quality has set standards for the amount of certain nutrients according to the Beneficial Use designations (see Table ***5). Ammonia is also in the State Standards and can be a problem if animal wastes are concentrated. Ammonia toxicity is dependent upon the temperature and pH of the waterbody. The equations to calculate the criteria concentrations are in UT Division of Water Quality 1994. Nutrients may stimulate algae and aquatic plant growth. At excessive levels, aquatic plant growth may contribute to low dissolved oxygen levels during nighttime respiration and high pH during the day which may be detrimental to Beneficial Uses of Water, especially in lakes and reservoirs.

Table***5. Numeric Nutrient Criteria in Utah Water Quality Standards (UT Division of Water Quality 1994, R317-2-14).

	1C Domestic	2B Secondary Contact Rec	3A cold water aquatic & 3B warm water aquatic life
Nitrate as N (mg/l)	10	4	4
Phosphate as P (mg/l) in streams		0.05	0.05
Phosphate as P (mg/l) in lakes & reservoirs		0.025	0.025

The impact of grazing on nutrient enrichment is a function of livestock waste concentration, opportunity for runoff of waste into the receiving stream, and increased sediment delivered to a stream. Soil erosion can be a primary source of phosphorus, whereas nitrogen usually reaches aquatic systems in dissolved forms (Mohaupt 1986). The risk of nutrient enrichment from waste is low in arid rangelands where animal wastes are distributed and runoff is comparatively light. The risk is high where cattle have direct access to lakes and reservoirs below the high water line. A healthy riparian area is very important for the uptake of these nutrients. Vegetation buffer the stream from direct waste input and assimilates the nutrients into plant tissue (Bauer and Burton 1993, p. 9).

Water quality data from 1974-76 show that nitrate levels (NO3) are well below the State Standard across the forest. Phosphate levels (PO4) are over the State Standard in many of the water samples taken. Data is stored in the Watershed files in the Supervisor's Office.

Total Dissolved Solids

Total Dissolved Solids (TDS) consist of a series of ions (commonly called salts) as well as dissolved organic compounds. The principal inorganic anions dissolved in water include the carbonates, chlorides, sulfates and nitrates. The principal cations are sodium, potassium, calcium, and magnesium. Salts enter streams from dissolution of rock and soil, from atmospheric precipitation which contains ions from both natural and fossil fuel sources, and from activities such as water treatment releases, de-icing of roads, and the concentrating effects of irrigation.

Dissolved solids can cause harm to fish and other aquatic organisms at sufficiently high levels, reduce yields of some irrigated crops, cause corrosion of pipes and water-using appliances, and cause increased use of soaps and detergents. Utah Division of Water Quality has set a State Standard for those waters designated with the Beneficial Use 4 Agriculture of 1200 mg/l TDS.

Binkley and Brown (1993, p. 7) reported that forest and range vegetation, or grazing activities, apparently do not add significantly to the salt content of streams. But, healthy riparian areas have been shown to act as sinks for nitrogen, calcium, magnesium, potassium sulfate, and phosphorus (Green and Kauffman 1989). Johnson et al. (1978) reported that there was a statistically significant increase in TDS after the grazing season which indicated that some livestock waste products may have eventually reached and enriched the stream, probably from the action of rain showers.

Sediment

Sediment is the major nonpoint pollution problem from rangelands in the Western United States. Poor management of livestock grazing greatly accelerates erosion. Increased erosion from heavily grazed lands is from increased energy of raindrops that fall directly on soil; reduced trapping of mobilized sediments by plants and plant debris; and reduced infiltration rates that result from soil compaction.

Total Suspended Solids (TSS) are the undissolved substances in water, consisting mostly of fine soil particles that are carried along in streamflow. Suspended sediments result largely from erosion, both natural and from human management activities. Suspended solids increase turbidity and transport plant nutrients, heavy metals, pathogens, and other potential pollutants attached to the soil particles. Such particles can settle in streams and lakes impairing fish habitat (especially spawning ability). There is no State Standard for total suspended solids, but nonpoint source evaluations by Utah Division of Water Quality personnel have determined those areas considered to need sediment control.

Utah's Water Quality Standards do not include a fine sediment in substrate criterion. The Forest Plan has a Standard & Guideline for fishery streams that no more than 25 percent of the stream substrate should be covered by inorganic sediment less than 3.2 mm in size (Dixie National Forest 1986, p. IV-33).

Table ***6. Sediment Monitoring Data on the Dixie National Forest

AllotmentStreamDate% fine sediments

several	Mammoth Creek above Tommy199122 +/- 6
several	Mammoth Creek above Tommy199223 +/- 8
several	Mammoth Creek below Tommy199137 +/- 7
several	Mammoth Creek below Tommy199237 +/- 6
several	East Fork Sevier below Podunk199242 +/- 7
several	East Fork Sevier @ USGS 199152 +/- 5
several	East Fork Sevier @ USGS199243 +/- 2
Pine Creek CPine Creek above campground199150 +/- 3
Pine Creek CPine Creek above campground199249 +/- 3
East Slope CPleasant Creek below campground199151 +/- 3
Dark Valley CPine Creek in riparian demo area199146 +/- 5
Dark Valley CPine Creek in riparian demo area199248 +/- 2

Interpreting this data needs to take cumulative effects into account from roads, etc., but shows that instream sediment does not meet the Forest Plan Standard and Guideline in 10 of 12 measurements.

Studies show little difference between grazing systems other than short-duration grazing on sediment production (short-duration caused an increase in sediment production) (Holechek et al. 1989, p. 406).

Utah has a Water Quality Standard for turbidity. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, and soluble colored organic compounds. The clarity of a natural body of water is a major determinant of the condition and productivity of that system. Displacement of fish occurs as turbidity reaches 50 nephelometric turbidity units (NTU). Turbidity affects the ability of salmonids to sight feed and over time, reducing growth at levels near 25 NTU for 10 days. Effects on gill tissue at comparable turbidity have been observed after 5-7 days (Harvey 1989, p. 10).

Waters designated to have the Beneficial Uses 2B Secondary Contact Recreation and 3A Cold Water Aquatic Life should not have a turbidity increase over 10 (NTU). Since range allotment pastures are often large and are at the very headwaters of watersheds, it is usually not possible to monitor this parameter with an upstream control monitoring station and a monitoring station below the grazing activity. During 1974-76 several stations were monitored for turbidity. On those streams that had more than one station, none exceeded the 10 NTU standard (see Table ***7). The upstream station was not a control, and it is not known what the grazing management was at the time the samples were collected and analyzed, but it does give an indication that turbidity increase is not a problem. The data is located in the Watershed files in the Supervisor's Office.

Table ***7. Turbidity samples from Dixie National Forest with the largest difference between Upstream/Downstream Stations.

AllotmentStream StationDistrictMonthUpstream/Downstr eam NTU

West Pinto CPinto CreekPine ValleyAug2.30/9.40
Castle Valley SMammoth CreekCedar CityMay4.70/7.80
Castle Valley S &
Horse Valley SBlue Springs CreekCedar CityJuly3.40/3.90
Red Creek CRed CreekCedar CitySept7.2/13.0

Dissolved Oxygen

Organic material from waste products and decaying plants requires oxygen in order to be decomposed by bacteria. This decay process lowers the dissolved oxygen available for fish and aquatic invertebrates to potentially lethal levels. Nutrients may stimulate algae and aquatic plant growth. At excessive levels, aquatic plant growth may contribute to low dissolved oxygen levels during nighttime respiration and high pH levels during the day which may be detrimental to Beneficial Uses of Water, especially in lakes and reservoirs.

Table ***8. Numeric Dissolved Oxygen Criteria in the Utah State Standards (UT Division of Water Quality 1994, R317-2-14.

Dissolved Oxygen 1C Domestic,3A cold water3B warm water3C nongame
mg/l2A Primary aquatic lifeaquatic life& 3D
Contact, &waterfowl
2B Secondary
Contact
Recreation

30 day average6.55.55.0
7 day average9.5/5.06.0/4.0
1 day average8.0/4.05.0/3.0 3.0
minimum5.5

The first number in the column is for when early life stages are present, second number is for when all other life stages are present.

Livestock grazing effects on dissolved oxygen is tied to their effects on nutrient input into the system, which is a function of livestock waste concentration, opportunity for runoff of waste into the receiving stream, and increased sediment delivered to a stream. Water quality monitoring in the 1970s did not identify dissolved oxygen as a problem in any stream sampled, including Santa Clara River which is on the 303(d) list for dissolved oxygen.

Iron

The Utah State Standard for maximum iron in waters designated for aquatic wildlife is 1000 ug/l. Iron problems are prevalent where it is present in the soil as insoluble ferric compounds. Solution of measurable amounts of iron from such solids does not occur as long as dissolved oxygen is present. Under anaerobic conditions, however, the ferric iron is reduced to ferrous iron, and solution occurs without difficulty. This could be a problem where impounded surface water supplies develop anaerobic conditions in the hypolimnion (Sawyer and McCarty 1978, p. 464-466). Otherwise the high iron content is probably coming from the groundwater. Livestock grazing might effect the amount of iron in water by the increase in erosion of soils high in iron and the subsequent sedimentation to lakes and reservoirs.

pH

pH is a measure of the hydrogen ion activity in a solution. The solubility of metal compounds contained in sediments or suspended material is affected by pH. The pH range which is not directly lethal to fish is 5 - 9; however the toxicity of several common pollutants is markedly affected by pH changes within this range (EPA 1986, p. 227-229).

pH increases in lakes and reservoirs when nutrients are added and there is high production of algae and macrophyte photosynthesis. This causes the pH to go above 9 in some situations (Judd personal communication 1995). The State Standard for pH for all Beneficial Uses of water is a range of 6.5-9.0.

Livestock grazing effects pH by adding nutrients to the system and is a function of livestock waste concentration, opportunity for runoff of waste into the receiving stream, and increased sediment delivered to a stream.

Coliform and 2B Secondary Contact Recreation Beneficial Use

Bacteria from the intestinal tract of warm-blooded animals are indicators of fecal contamination and the presence of microbial pathogens. Fecal coliform bacteria is not pathologically harmful itself, but is a useful indicator of the likely presence and concentration of associated harmful bacteria which do constitute a threat to public health. All waters of the State of Utah are designated as having the Beneficial Use 2B Secondary Contact Recreation which has the following corresponding fecal coliform standard:

2B Secondary Contact Recreation Bacteriological Standard (30-day geometric mean) (number/100 ml)
Maximum Total Coliforms 5000/ml
Maximum Fecal Coliforms 200/ml
(Utah Division of Water Quality 1994, R317-2-14 Numeric Criteria)

Studies have shown that livestock grazing increases fecal coliform counts over natural amounts without grazing (Doran and Linn 1979; Gary et al. 1983; Tiedeman et al. 1987). Buckhouse and Gifford (1976) found that coliform bacteria stayed within a few feet of the manure on a dry Utah rangeland, and that in arid rangelands any effect on water quality would derive from feces deposited near or in the stream. Kunkle (1970) related bacterial densities in water to land use patterns in Vermont. He found an increase in fecal coliform counts when cattle were adjacent to the stream as opposed to further away. However, he determined that only a minor fraction of the total available live bovine fecal material ever washed into the stream. He concluded, therefore, that only the area immediately adjacent to the stream, rather than the entire watershed, is of major importance in terms of introducing this sort of pollution into the stream. On rangeland sites in Reynolds Creek in southwestern Idaho, geometric mean values did not exceed 50/100 ml (ARS 1983).

Fecal coliform monitoring was conducted 1975-76 on the Dixie National Forest. Single samples were taken in a 30 day period between May and October so no geometric mean can be calculated. Samples taken in August 1975 exceed the state standard of 200/ml in Pinto Creek (1060/ml), Enterprise Reservoir (>1000/ml), and Red Creek (708 and 546/ml) (see Table ***9). At the time they were taken and analyzed the State Standard was 2000/ml for Class C waters so no problem was identified.

Table ***9. Fecal Coliform Results, Dixie National Forest, 1975-76 (Dixie National Forest 1976)

AllotmentStream StationDistrictRangen# exceedences

West Pinto CPinto Creek B-4Pine Valley0-6060
West Pinto CPinto Creek B-5Pine Valley18-106061

Terryshoal Creek CEnterprise Reservoir C-6Pine Valley0->100051
Terryshoal Creek CEnterprise Reservoir C-7Pine Valley0-13850
Terryshoal Creek CLittle Pine Creek C-8 Pine Valley0-4620
Haycock Creek SIpsom Creek J-27Cedar City0-985 0
Castle Valley SBlue Springs Creek K-28Cedar City0-11450
Horse Valley S Blue Springs Creek K-29Cedar City0-12250
Castle Valley SMammoth Creek E-11Cedar City050
Castle Valley S Mammoth Creek E-12Cedar City0-650
none Mammoth Creek E-13Cedar City0-1250
Red Creek CRed Creek N-32Cedar City0-70841
Red Creek CRed Creek N-33Cedar City 0-546 41
East Fork CEast Fork Sevier P-35Powell0-2650
Boulder CBoulder Creek R-42Escalante020
North Creek C North Creek S-43Escalante0-220
Pine Creek CPine Creek T-44Escalante1-6040
Coyote C Antimony Creek W-49Escalante030
Pine Lake CPine Lake X-50Escalante0-2650
Pine Lake CPine Lake X-51Escalante0-205 0

This data is consistent with the research studies showing fecal coliform from dispersed livestock grazing generally does not cause a violation of the State Standard for Secondary Contact Recreation. Where exceedences occur due to concentration of livestock in riparian areas, they will need to be addressed in cooperation with the Utah Division of Water Quality's nonpoint source program.

Sheep and Cattle

Where sheep grazing includes proper herding, forage use, and groundcover requirements it is compatible with riparian needs (Platts 1989 p. 109). When sheep are forced to concentrate on riparian-stream areas they adversely affect these environments similar to cattle impacts (Platts 1981, p. 6).

Alpine Riparian

Alpine riparian areas on the Dixie National Forest have a shorter growing season than mid/low elevation riparian areas. In many cases, hydric species grow to similar heights and compositions in both areas. Range readiness is usually later in the summer so livestock go onto those ranges later. If a high elevation riparian area does not have growth sufficient to use the 4-6 inch stubble height, utilization measurements would be used.

Executive Order 11990 of May 24, 1977 (Wetlands)

This executive order requires the Forest Service to take action to minimize destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 11988 of May 24, 1977 (Flood plains)

This order requires the Forest Service to provide leadership and to take action to (1) minimize adverse impacts associated with occupancy and modification of flood plains and reduce risks of flood loss, (2) minimize impacts of floods on human safety, health, and welfare, (3) restore and preserve the natural and beneficial values served by flood plains.

DIRECT AND INDIRECT EFFECTS OF LIVESTOCK GRAZING AT PROPER USE

Because riparian and stream systems are complicated, dynamic, and different streamtypes react to natural and man-caused impacts differently, it is difficult to write the exact effects livestock grazing has on them. But since the activity is occurring directly on the riparian and streamside area, we know it does have a direct effect on the plants, soils, and stream channels.

From EPA 1979, 55% utilization is generally the transition between moderate and heavy grazing intensity which causes a significant decrease in infiltration. Since the proposed actions are for a maximum of between 50-60% we would be right at or near that transition. So infiltration rates would be expected to continue to be from approximately 3/4 to 1/2 the natural rates (at or near existing rates) in grazed areas (see Table ***1).

With the continuing decrease in infiltration, there would be a corresponding continuation of increased runoff and erosion at or near existing rates. Instream substrate in some areas would continue to not meet the Forest Plan Standard and Guideline of no more than 25 percent inorganic sediment less than 3.2 mm in size (see Table ***6). But since all the components of "proper use" are expected to maintain or improve where needed riparian health, this alternative is expected to move us towards desired riparian and stream conditions. Turbidity is expected to be within State Standards based on the discussion of turbidity data from the 1970s in the introduction.

The iron content in Piute Reservoir is a concern for those allotments draining into the Sevier River. The decreased infiltration rate causes a continuation of the increased runoff and erosion. The extent of how much erosion and sedimentation the Dixie National Forest lands are contributing to Piute Reservoir is not known, but is estimated to be low. Water samples collected in Mammoth Creek, Blue Springs Creek, Ipson Creek, Clear Creek tributary to Panguitch Lake, Tropic Reservoir, Kings Creek tributary to East Fork Sevier River, and Antimony Creek show iron to be below the State Standard.

As stated before, researchers have shown that stream channel and/or streambank alterations occur at utilization levels about 60%. Riparian areas in satisfactory condition (mid to late seral greenline) need at least 4 inch stubble to be maintained, and unsatisfactory condition (very early to early seral greenline) need 6 inch stubble to be improved (Winward 1995). With our five proper use components described in the introduction, it is very likely that we can be moving toward the desired conditions of mid to late seral community types, stable streambanks, diverse age class structure of woody species, meeting State Water Quality Standards, and not contributing to further impairment of Utah High Priority Watersheds and 303(d) listed waters.

4-6 inch stubble height in the fall at the end of grazing as described above, and woody species utilization at 50% would maintain and even improve the woody species in the riparian area. It may not be the same composition as an ungrazed area, but the amount needed and function would be there or would slowly recover for the benefit of hydrology and water quality related parameters.

With 4-6 inch stubble height, water temperatures in areas that are above State Standards would be expected to slowly improve in the long-term, due to growth of woody species which would provide more shade to the streams, and the slow process of narrowing and deepening of channels from improved vegetative conditions.

Grazing strategies that disperse rather than concentrate livestock appear best when fecal contamination of streamwaters is a concern (Holechek et al 1989). This is also important for nutrients, pH, dissovled oxygen, and total dissolved solids. The "proper use" components are expected to give us our desired riparian condition, so the riparian areas would function as nutrient sinks with this alternative. The risk of nutrient enrichment from waste is high where livestock have direct access to lakes and reservoirs below the high water line. Nutrient enrichment affects dissolved oxygen and pH, and continuation of being above the State Standards is expected in lakes and reservoirs where problems already exist. Dissolved oxygen would meet State Standard on streams. Coliform levels are expected to be within State Standards, except occasionally where cattle concentrate in or very near water, based on the discussion of coliform data from the 1970s in the introduction.

Based on all these water quality and physical parameters, this alternative is not expected to contribute to the further impairment of Utah Priority Watersheds for Nonpoint Source Pollution Control and 303(d) listed waters, except where livestock have direct access to lakes and reservoirs below the high water line. The 4-6 inch stubble height and other "proper use" components are the Regionally recommended Best Management Practices. We would be in compliance with the Clean Water Act and Utah Antidegradation Policy by maintaining the Beneficial Uses of water, using Best Management Practices, and sharing our livestock grazing implementation monitoring results with Utah Division of Water Quality. Also we would meet EO 11990 in minimizing the degradation of wetlands, and EO 11998 in restoring and preserving the natural and beneficial values served by flood plains.

The rate of improvement of unsatisfactory upland and riparian areas will be dependent on how quickly and strictly the Standard & Guidelines are implemented. Therefore, the importance of monitoring and adjusting grazing strategies to meet objectives is paramount to successfully recovering areas in unsatisfactory condition.

CUMULATIVE EFFECTS OF LIVESTOCK GRAZING AT PROPER USE

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonable foreseeable actions of the agency and others. Other activities on the Dixie National Forest that affect the hydrology and water quality include road construction, timber harvesting, watershed restoration, and recreation activities.

Measurements of instream substrate over the Forest Plan Standard of 25% (see Table ***6) are assummed to be attributed to cumulative effects of natural erosion and ground disturbing activities. Cumulative effects can also be observed in the lakes and reservoirs on the 303(d) list (see Table ***3) where nutrients are high causing problems with dissolved oxygen and pH, and the Utah Priority Watersheds for Nonpoint Source Pollution Control where nutrients, total suspended solids, and total dissolved solids are targeted for control practices by the State (see Table ***2). Other considerations regarding cumulative effects are:

1. Developed recreation, road construction and timber harvest activities are designed using Best Management Practices to protect the hydrology and water quality. There are thresholds for the amount of a watershed that should be in roads and harvest treatments, and these are analyzed on a case-by-case basis during environmental analysis.

2. Some open roads across the forest need maintenance. They lack drainage and are concentrating water flow and moving sediment off roads into drainages.

3. People driving in the spring and summer when roads are wet cause ruts in roads which concentrates flows and moves more sediment off roads and into streams.

4. People recreating in riparian areas can cause compaction and lowered infiltration rates. This effect can be locally significant, for example portions of the Santa Clara River through the Pine Valley Recreation Area, but is not as wide spread across the forest as other impacts.

All of these effects combined together do continue to contribute to a decrease in infiltration and increased erosion and sedimentation. These things have been happening for many years before the Utah Antidegradation Policy was set to maintain the Beneficial Uses of water as of 1975. To be in compliance with the Clean Water Act and Utah Antidegradation Policy, we must maintain the Beneficial Uses, use Best Management Practices, and share our implementation monitoring results with Utah Division of Water Quality. Taking past, present, and foreseeable actions into account, we would be in compliance. More emphasis needs to be placed on Beneficial Use monitoring such as fish habitat surveys so we can document the maintenance of Beneficial Uses, and BMP implementation monitoring on all land disturbing activities.

DIRECT/INDIRECT EFFECTS OF NO GRAZING

Recovery of infiltration rates would progress towards rates commensurate with no grazing. With greater infiltration there would be less runoff and erosion.

Composition of hydric species and plant vigor would be expected to increase and progress in seral stage toward potential natural community. The riparian grasses would increase in vigor; standing dead material may then increase, resulting in lower plant vigor unless grazing by wildlife removes this dead material periodically (Clary and Webster 1989, p. 7).

Streambank stability would be expected to increase. Sediment trapping at the greenline and in the floodplain would work toward narrowing and deepening stream channels. Where the potential for woody species exists, it would be expected to have regeneration and in time a diverse age class structure.

No further impairment would be contributed to Utah Nonpoint Source priority watersheds or 303(d) listed waters from livestock grazing activities. Water quality would be expected to improve in those parameters that are affected by fecal contamination. The Beneficial Uses of water would be maintained or improved, and we would be in compliance wiht the Utah Antidegradation Policy, the Clean Water Act, EO 11990 (wetlands), and EO 11988 (flood plains).

CUMULATIVE EFFECTS OF NO GRAZING

Riparian and stream conditions would be expected to improve forest-wide as described under direct and indirect effects.

1. Developed recreation, road construction and timber harvest activities are designed using Best Management Practices to protect the hydrology and water quality. There are thresholds for the amount

of a watershed that should be in roads and harvest treatments, and these are analyzed on a case-by-case basis during environmental analysis.

2. Some open roads across the forest need maintenance. They lack drainage and are concentrating water flow and moving sediment off roads into drainages.

3. People driving for recreation in the spring and summer cause ruts in roads which concentrates flows and moves more sediment off roads and into drainages.

4. People recreating in riparian areas can cause compaction and lowered infiltration rates. This effect can be locally significant, for example portions of the Santa Clara River through the Pine Valley Recreation Area, but is not as wide spread across the forest as other impacts.

All of these effects combined continue to contribute to a decrease in infiltration and increased erosion and sedimentation. Since grazing is widespread across the forest and infiltration rates would recover over time, an improvement in water quality would be expected. The Beneficial Uses of water would be maintained or improved, and we would be in compliance with the Utah Antidegradtion Policy, the Clean Water Act, EO 11990 (wetlands), and EO 11988 (flood plains). More emphasis needs to be placed on Beneficial Use monitoring such as fish habitat surveys so we can document the maintenance of Beneficial Uses, and BMP implementation monitoring on all land disturbing activities.

Glossary

geometric mean - take the logrithim of each sample, average the logrithims, and then take the antilog of that average.

hypolimnion - a zone of water in a lake extending from thermocline to the bottom, with temperature fairly uniform and cold.

Effects of Livestock Grazing and No Grazing
on the Fisheries and Aquatic Macroinvertebrate Resources

Steve Robertson, Dixie NF Fisheries Biologist

Introduction

There are four general components of an aquatic system that can be affected by livestock grazing - streamside vegetation, stream channel morphology, shape and quality of the water column and the structure of the soil portion of the streambank (Behnke and Raleigh 1978, Marcuson 1977, Platts 1979, and Platts 1981). Direct and indirect to fish, fish habitat and aquatic macroinvertebrates are derived from each one of these components. The degree to which these effects are expressed is determined by the type, intensity, duration, and timing of grazing activities. Riparian areas are often grazed more heavily than upland zones because they have flatter terrain, water, shade, and more succulent vegetation (Holscher and Woolford 1953, Armour 1977, Duff 1983, Platts and Nelson 1985). Generally, in grazed areas, stream channels contain more fine sediment, streambanks are more unstable, banks are less undercut, and summer water temperatures are higher than is the case for streams in ungrazed areas; therefore salmonid populations are reduced (Armour 1977, Behnke and Zarne 1976, Platts 1983).

Livestock use of riparian ecosystems can affect the streamside environment by changing, reducing, or eliminating vegetation bordering the stream (Behnke and Raleigh 1978, Platts 1979). Channel morphology can be changed by widening and shallowing of the streambed, gradual stream channel trenching, or braiding, depending on soils and substrate composition (Behnke and Raleigh 1978, Marcuson 1977, Platts 1979). The water column can be altered by increasing water temperatures, nutrients, suspended sediments, bacterial counts, and by altering the timing and volume of water flow (Behnke and Raleigh 1978, Rauzi and Hanson 1966, Platts 1979). Grazing can also cause bank sloughing, create false or retreating banks, and accelerate sedimentation resulting in silt degrading spawning and food producing areas (Behnke and Raleigh 1978, Platts 1981, Platts 1979). These impacts on the water column can result in decreased fish biomass (Behnke and Raleigh 1978, Duff 1977).

Riparian vegetation plays a critical role in influencing the health and condition of fish habitat and aquatic macroinvertebrate communities. It provides cover for fish, stabilizes streambanks, helps control stream temperature, provides food for fish and aquatic macroinvertebrates.

Cover

The importance of cover to fish has been documented in numerous studies that show a decline in salmonid abundance as stream cover is reduced (Boussu 1954) and an increase in abundance as cover is added (Hunt 1969, 1976, Hanson 1977). Binns and Eiserman (1979) found that cover was highly significant in determining fish biomass in Wyoming streams; as cover increased, fish populations increased.

Trees, brush, grasses and forbs each play an important role in building and maintaining productive streams (Platts 1991). Trees provide shade and streambank stability because of their large size and massive root systems. As trees mature and fall into or across streams, they not only create high quality pool habitat and riffles for fish, but their large mass also helps to control the slope and stability of the stream channel. Tree fall, therefore, is important and often essential for maintaining stream stability.

Brush not only protects the streambank from water erosion, but when lower branches overhang the stream, it adds hiding cover for fish. Brush also builds streambank stability through its root systems and litterfall. Grasses form the vegetative mats and sod banks that reduce surface erosion and mass wasting of streambanks. Streamside vegetation needs to be vigorous and dense and have enough species diversity in order to form layers over the ground (Platts 1991). Each vegetative type plays an important role in forming and protecting the aquatic habitat. Grasses and grass-like plants, especially sod forming types, help build and bind bank materials and reduce erosion. As well sodded banks gradually erode from increased flow events, they create undercuts which provide important resting and hiding places for salmonids (Heede and Rinne 1990). In other cases, the root systems of grasses and other plants trap sediment to help rebuild damaged banks. All of these vegetative components that make up healthy streambanks can be damaged by improper grazing practices. The sloughing and collapse of streambanks caused by improper livestock grazing is probably the greatest effect livestock can have on fish populations. Elimination of vegetation and caving in of streambanks are among the principal factors contributing to the decline of native trout in western streams (Behnke and Zarne 1976, Behnke 1977).

Riparian vegetation is also important to aquatic macroinvertebrates. Nearly all aquatic insects spend a part of their life cycle in a terrestrial habitat, usually but not always, in the riparian vegetation zone. Feeding, pupation, emergence, mating, and egg laying may all occur in this zone depending on the species (Erman 1984). As impacts occur in a stream, diversity decreases but population size of some species may increase. The change is generally in a direction of large-sized species being replaced by small species (Wallace and Gurtz 1986). Erman et al. (1977) found that the abundance of smaller aquatic macroinvertebrates rose significantly in streamside zones without buffer strips. This resulted from increased light due to the loss of riparian vegetation, increased sediments, and increased algal growth. This could affect the amount of energy expended by fish and other animals dependent upon aquatic macroinvertebrates for food. For example, it is unlikely that a dipper or larval salamander could survive on a diet of very small mayfly larvae even if it could collect them. The numbers needed to substitute energetically for a large stonefly or caddisfly would be prohibitive (Erman 1992).

Influences of streamside vegetation on allochthonous (produced outside the stream) and authocthonous (produced within the stream) food resources for aquatic invertebrates are potentially reflected in the trophic structure of invertebrate assemblages and relative composition of feeding-functional groups (ie, classification based on food acquisition). These links may show up in the growth rates, abundance and community structure of macroinvertebrate consumers in the stream (Gregory et al. 1991). The abundance and composition of detritivore assemblages in streams are determined in large part by the plant composition of riparian zones (Vannote et al. 1980).

Streambank Stability

Natural surface erosion and mass wasting of streambanks occur over long periods of time but usually in equilibrium with bank rebuilding processes (Platts 1991). During the past century, however, this equilibrium has been upset and banks have been destroyed much faster than they can be rebuilt. During high flow events, water moving at high velocity transports large amounts of sediment within streams. As it rises up and then over its banks, it flattens flexible streamside vegetation such as willows and grasses into mats that lay against the streambank and adjacent ground. These mats reduce the water velocity along the stream edge which aids in the deposition of sediments. In turn, these sediments contribute nutrients to the bank soils, resulting in increased plant production and vigor. A compact mass of vegetation along a streambank can contribute substantially to the entrapment of sediments needed to build and maintain healthy, productive streambanks (Platts 1991).

Channel morphology is strongly influenced by streambank stabilization from riparian vegetation and large woody debris (Keller and Swanson 1979). Complex lateral habitats, such as backwaters, eddies, and side channels, are created by the interaction of streamflow and lateral roughness elements that include living vegetation and large woody debris. These areas provide critical refuge during floods and serve as rearing areas for juvenile fish (Moore and Gregory 1988a,b).

Streams in the intermountain region of North America are often icebound in the winter which can also affect fish habitat. When spring thaw occurs, the ice breaks up and begins to drift. This ice often accumulates into shifting dams which causes the water to leave the channel. Where streamside vegetation is insufficient and protective mats are absent, the banks erode; grazing, by depleting vegetation, can accelerate this erosion (Platts 1981b).

When animals graze directly on streambanks, mass erosion from trampling, hoof slide, and streambank collapse and cause soil to move directly into the stream. The only way a streambank can remain in equilibrium is to trap enough sediment so that it can maintain the process of rebuilding.

Sedimentation in streams reduces pool depth, alters substrate composition, reduces interstitial space, and causes braiding of channels (Beschta and Platts 1986; Hicks et al. 1991; Everest et al. 1987; Clifton 1989; Lisle 1982; Megahan et al. 1980; Robison and Beschta 1990; and Sulivan et al. 1987). These changes have potential for reducing stream productivity for fish.

Fine sediment deposited in spawning gravel can reduce water flow between gravel particles, leading to depressed dissolved oxygen concentrations, and can physically trap emerging fry in the gravel (Koski 1966; Meehan and Swanston 1977; Everest et al. 1987). Research has demonstrated that when fine sediment levels in spawning gravels reaches 30 percent, fry emergence is reduced to 40 percent (Everest and Harr 1982). Higher sediment levels further reduces the success of fry emergence. Hall and Lantz (1969) showed that even moderate sediment deposition can be detrimental to trout populations.

Chapman and McLeod (1987) conducted an extensive review of the effects of sediment on fish and concluded that:

1. Survival to emergence of salmonid embryos tends to decrease as the proportion of fine sediment increases in the redds.
2. Loss of pool volume due to sediment deposition reduces suitability of a stream for adult salmonids.
3. Macroinvertebrate biomass and diversity decrease where fines predominate. Also aquatic insect density declines at embededness levels above about 66 or 75 percent.
4. From the available data, they inferred that as embededness increases, winter carrying capacity for salmonids declines.

Water Temperature.

Streamside vegetation shades the stream and therefore influences water temperature. Summer stream temperatures have probably increased in western streams over the past century as streamside vegetation has been reduced (Platts and Nelson 1989). These resulting warmer temperatures may also explain the shift from salmonid species to non-game fish species which are generally more tolerant of higher water temperatures. Conversely, streams can be too cold for trout survival. This occurs when winter temperatures fall low enough to form anchor ice on the bottom of the stream. Streams with little or no vegetative cover are very susceptible to anchor ice formation (Platts 1991).

The ability of plants to control stream temperature is dependent upon several factors including stream size, aspect, elevation, and height and density of adjacent vegetation. Riparian vegetation intercepts and reduces the intensity of solar radiation and reduces back-radiation during cold months. It provides daytime cover in the form of shade, especially along the margins of streams. These shaded streamside areas are often preferred habitats of juvenile salmonids.

Plant morphology has a great influence on controlling stream temperatures. Grass crowns can provide modest overhanging cover but are usually too short to keep much solar radiation from reaching the water, except along very small streams. The larger the stream, the higher the streamside vegetation must be to effectively intercept the sun's rays over water. On very large streams, only trees provide effective shading. In small to medium-size streams, which are the predominant streams on the Dixie National Forest, brush is usually sufficient to moderate water temperatures but grasses and forbs have little effect.

Trout are the management indicator species used to assess the effects of management activities on other aquatic species with similar habitat requirements. The predominant trout species on the Dixie include rainbow, brook and brown trout. Rainbow trout prefer water temperatures ranging from 13-21^{o} C. Brook trout prefer temperatures ranging from 14-19^{o} C. but will exhibit poor growth in water temperatures much greater than 19^{o} C. Brown trout exhibit most rapid growth between 7-19^{o}C but seem to prefer temperatures in the upper half of this range (Moyle 1976). Two sensitive trout species, Bonneville cutthroat trout and Colorado cutthroat trout are also present in a few streams on the Forest and have temperature requirements similar to the trout species listed above. Other species present in a few of the streams include the Virgin spinedace (threatened), leatherside chub (Category 2), and desert sucker. These species can generally tolerate warmer water temperatures than salmonid species.

Food Production

Streamside vegetation provides habitat for terrestrial insects, which are important food for salmonids and other fish species. This vegetation also directly provides organic material to the stream, which makes up about 50 percent of the streams nutrient energy supply for the food chain (Cummins 1974). In some headwater streams, Cummins and Spengler (1978) found that riparian vegetation provides up to 90% of the organic matter necessary to support headwater stream communities. Riparian vegetation also provides habitat for terrestrial insects which fall directly into the stream and are an important food source for fish. Detritus from terrestrial plants is a principal source of food for aquatic invertebrates that eventually become food for fish (Minshall 1967). Removal of streamside vegetation can therefore affect the diet of fish by reducing production of both terrestrial and aquatic insects (Chapman and Demory 1963).

Grazing Strategies and Fisheries Compatibility

Platts (1991) conducted preliminary evaluations of various livestock-grazing strategies and related them as to their compatibility with fish needs. For each strategy Platts considered several factors including (1) level at which riparian vegetation is commonly used, (2) control of animal distribution, (3) streambank stability, (4) brushy species condition, (5) seasonal plant regrowth, and (6) streambank rehabilitation potential. Each strategies compatibility with fishery needs was rated on a scale from 1 (poorly compatible) to 10 (highly compatible). Strategies and ratings ranged from continuous season-long use by cattle (rating 1) to rest or closure (rating 10). The following were compatibility ratings for the strategies proposed in this analysis: deferred cattle - 3; rest rotation cattle - 5; rest rotation sheep - 8.

Although Platts did not provide a rating for a deferred sheep strategy I would rate it a 5 to 6 due to the herders ability to move sheep from riparian areas and that sheep are grazers that usually prefer slopes and upland areas and therefore tend to graze streambanks less than cattle do.

The following discusses the effects of livestock grazing at proper use and with no grazing to fisheries and aquatic resources as related to predicted changes in the macroinvertebrate community, instream habitat, cover, and fish production.

DIRECT/INDIRECT EFFECTS OF LIVESTOCK GRAZING AT PROPER USE

Clary (1988) suggested that average utilization levels of 24 to 32% were obtained when riparian graminoids were grazed to a 6 inch stubble height, that average use levels of 37 to 44% were obtained when grazing to a 4 inch stubble height, and that average use levels of 47 to 51% were obtained when grazing to a 3 inch stubble height. Elmore (1988) thought that 3 to 4 inches of stubble height would maintain plant vigor, provide streambank protection, and aid deposition of sediments to rebuild degraded streambanks. Although the 3-inch stubble height requirement may be adequate to maintain plant vigor, it may not be adequate to protect riparian ecosystem function (Meyers 1989). Clary and Webster (1989) recommend that the residual stubble or regrowth should be at least 4 to 6 inches in height to provide sufficient herbaceous forage biomass to meet the requirements of plant vigor maintenance, bank protection, and sediment entrapment. Meyers (1989) showed that vigorous woody plant growth and at least 6 inches of residual herbaceous plant height at the end of the growing/grazing season typified the riparian areas in excellent, good, or rapidly improving condition. This 6 inches of residual plant cover appeared to provide adequate streambank protection and sediment entrapment during high streamflow periods. Platts (1982) suggested that 25% use or less, did little to alter riparian habitat. Research has shown that streambank and/or stream channel alterations occur at utilization levels about 60 percent (Hayes 1978; Platts 1982; Platts and Nelson 1985).

Riparian areas with a 4-inch or greater stubble height requirement and with a mid to late seral greenline or with a 6-inch stubble height requirement with very early to early seral greenline, will result in improved vegetative conditions along the stream channel. Clary and Webster (1989) found that 4-inch stubble heights or greater resulted in little or no use on willows. Four and 6-inch stubble heights are effective at trapping sediments which serve to rebuild streambanks and provide more suitable conditions for the growth of more deeply rooted perennial plants and shrubs. As such, these areas will see an improvement in streambank stability and a corresponding decrease in sediment in the stream. The rate at which this occurs would be dependent upon the existing condition of the riparian areas and uplands, soils, vegetation and continuance of other uses. Results of these improved conditions will be (1) slightly lower water temperatures for coldwater fish species as overhead cover increases, (2) less sediment entering the stream, (3) improved spawning habitat and conditions for egg incubation, (4) organic matter falling into the stream from overhanging vegetation will increase which will result in increased macroinvetebrate diversity and abundance and more food for fish, (5) width:depth ratio should gradually improve as the channel becomes narrower and deeper, and (6) increased instream cover (deeper pools, more undercut streambanks) and overhead cover for trout. Together, these improved conditions could result in increases in the streams capability to produce more game and non-game fish.

CUMULATIVE EFFECTS OF GRAZING AT PROPER USE

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonably foreseeable actions of the agency and others. Many streams in the west are in their present degraded condition partly because many small annual effects have accumulated to become major detriments to fisheries; western streams reflect a century of these cumulative effects (Platts 1991). Cumulative effects of land use on aquatic systems are also often difficult to detect because the aquatic systems themselves are dynamic and naturally variable. Activities that are being considered in this cumulative effects analysis for fisheries include road construction, timber harvest, watershed restoration, livestock grazing, recreation activities, water diversions, and special uses.

Implementation of BMP's for activities on the Forest (timber sales, road construction, etc) will help to minimize impacts, primarily from sediment, to the aquatic resources. There are expected to be some short-term increases in sediment to those streams affected by an activity but these are anticipated to be minimal and of short duration. Small, short duration increases in sediment are not likely to alter the fishery or aquatic macroinvertebrate community within a stream. In addition, there are thresholds for the amount of acres within a watershed that could be in roads or harvest treatments. These are analyzed on a case-by-case basis during the environmental analysis.

Watershed restoration projects will help stabilize areas that are currently sediment sources. This will reduce the potential for sediment being transported to stream channels and improve instream conditions for game and non-game fish species as well as macroinvertebrate populations.

Recreational use can also negatively effect aquatic fauna by increasing sediment in a stream from runoff from roads and trails, compacting and lowering infiltration rates, degrading or removing riparian vegetation, and degrading water quality.

Improper grazing practices, such as overuse, can negatively impact fisheries and aquatic macroinvertebrates for the reasons discussed in the introduction above. Conversely, good grazing practices can result in improved riparian conditions for the same reasons explained earlier.

Water diversions can have dramatic, negative effects on riparian vegetation and instream fauna by altering the natural flow regime. These effects are a result of high, flood flow conditions that can occur several times a year, month or week and dewatering sections of stream for periods of time.

DIRECT/INDIRECT EFFECTS OF NO GRAZING

Conditions that exclude livestock use would result in the fastest recovery rate of riparian vegetation, stream channel morphology and instream habitat conditions for fish and aquatic macroinvertebrates.

Once grazing is eliminated, the composition of hydric species, shrubs (such as willow), and plant vigor is expected to increase and progress towards a seral stage of potential natural community. The rate at which this occurs would be dependent upon the existing condition of the riparian areas and uplands, soils, vegetation and continuance of other uses. Several studies that have excluded livestock grazing have shown substantial changes in habitat conditions. Claire and Storch (1983) found that willow cover in an ungrazed area within a livestock exclosure provided 75 percent more shade to the stream than was found in the adjacent grazed area where willows were less abundant. Platts (1991) reviewed 21 studies, and conclusions drawn from them, of the responses of riparian habitats and fish populations to livestock grazing. Twenty of the 21 studies showed that riparian and stream habitats had been degraded by livestock grazing, and that these habitats improved when grazing was prohibited. Marcuson (1977) found that ungrazed sections of Rock Creek, Montana, had 82 percent more vegetative cover per unit of stream length than did grazed areas. Van Velson (1979) found remarkable increases in the amount of riparian vegetation adjacent to Otter Creek, Nebraska, once cattle grazing was eliminated.

As vegetation increases towards late seral or potential natural community types, streambank stability is expected to increase. Winget and Reichert (1977) found that livestock grazing adjacent to selected Utah streams reduced bank stability by 59 percent. In other Utah studies, Berry and Goebel (1978) observed that where livestock exclosures were used, streambank stability increased 100 to 740 percent.

As canopy cover over a stream increases, especially shrub cover, summer water temperatures should decrease as a result of increased shade on the stream surface and as a result of the stream channels becoming deeper and narrower. The rate of temperature change would be a slow process and once again dependent upon the existing condition of the riparian areas, soils, vegetation and continuance of other uses.

Fish response studies to grazing impacts often have biases in study design that often prevent reaching conclusive determinations (Platts 1991). Platts felt, however, that the evidence from all of the studies he reviewed showed that fish abundance and biomass decline in the presence of grazing. In a study on Rock Creek, Montana, Gunderson (1968) reported that brown trout biomass was 31 percent greater per unit area in a stream reach flowing through an ungrazed section than an adjacent grazed section.

As a result of no grazing, streambank trampling and bank sloughing from permitted livestock would not occur on the ungrazed allotments. The formation of undercut banks and complex lateral habitats would increase the fastest under this alternative. Hiding cover and rearing areas for fish would, therefore, also increase.

Sediment levels in the streams as a result of no grazing would decrease as a result of increased bank stability and decreased streambank trampling. This should increase egg and fry survival by reducing the amount of fines in spawning gravels. The aquatic macroinvertebrate community should shift towards species that are less tolerant of fine sediment. Species diversity should increase and there could be a change from small-sized species to larger species (Wallace and Gurtz, 1986).

CUMULATIVE EFFECTS OF NO GRAZING

Cumulative effects are those direct and indirect effects that result from the proposed action or alternatives when added to other past, present, and reasonably foreseeable actions of the agency and others. The cumulative effects of no grazing differ from the cumulative effects described for proper use in that riparian and stream conditions would be expected to improve on those streams where livestock grazing is eliminated. The effects are similar to those direct and indirect effects described for no grazing. The rate at which streams recover will be faster than with grazing, but will be dependent on numerous factors including existing condition of the riparian ecosystem, other continued uses in the riparian areas, vegetation composition, etc. Other activities that are being considered in this cumulative effects analysis for fisheries include road construction, timber harvest, watershed restoration, livestock grazing, recreation activities, water diversions, and special uses.

Implementation of BMP's for activities on the Forest (timber sales, road construction, etc) will help to minimize impacts, primarily from sediment, to the aquatic resources. There are expected to be some short-term increases in sediment to those streams affected by an activity but these are anticpated to be minimal and of short duration. Small, short duration increases in sediment are not likely to alter the fishery or aquatic macroinvertebrate community within a stream. In addition, there are thresholds for the amount of acres within a watershed that could be in roads or harvest treatments within a watershed. These are analyzed on a case-by-case basis during the environmental analysis.

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EFFECTS OF LIVESTOCK GRAZING ON WILDLIFE AND WILDLIFE HABITATS

Debra Kary, Wildlife Biologist, Escalante Ranger District
Priscilla Summers, Wildlife Biologist, Cedar City Ranger District
JoAnne Stenten, Teasdale Ranger District

I. Wildlife Game Species

Practices for the simultaneous management of livestock and wildlife in the Great Basin constitute a complex series of tradeoffs involving biology, economics, legal requirements, and social pressures. Livestock with their attendant use of forage, compete directly with some species of wildlife for forage; they create adverse effects for some wildlife through social interactions or produce a complimentary situation for some wildlife species. depending on the intensity of livestock grazing and the season of use. Hall (1985) contends that no matter what the land manager does or does not do, the habitat of some species will be enhanced and that of others diminished.

The Dixie National Forest is proposing to issue 10 year permits to authorize the grazing of domestic livestock on grazing allotments with maximum allowable utilization rates generally ranging between 40-60%, with a minimum 4 inch stubble height on hydric species within riparian areas. The effects of sheep grazing in riparian and upland areas is expected to be minimal. Sheep prefer to graze on slopes and upland pastures, but occasionally may concentrate in areas to access water. These effects can be controlled and minimized by proper herding techniques. Assuming proper herding techniques and utilization are followed, sheep grazing should have little or no effect on any of the following species or their habitats.

Application of proper use will be used to evaluate the direct and indirect effects on the all of the following species.

Management Indicator Species are required by the National Forest Management Act (NFMA), this act requires Forests to select a group of representative wildlife and fish species. By monitoring their populations and habitat relationships, we use this information to better understand the dynamics within these complex ecosystems. The Dixie National Forest has selected 12 Management Indicator Species to reflect the diverse habitat structure found within the Forest (Dixie LMRP 1986).

IA. Rocky Mountain Mule Deer (Odocoileus hemionus): MIS species -Dixie National Forest

Mule deer were selected as a Management Indicator Species in the Dixie National Forest Land and Resource Management Plan to indicate the health of grass/forb, sagebrush, mountain brush, pinyon-juniper, sapling-mature aspen, and mature conifer. Mule deer have value as Management Indicator Species because the distribution of cover/forage and other habitat related factors required to maintain healthy populations of deer are also habitat requirements by many other species (Dixie NF-LRMP 1986).

Mule deer are the most abundant big game species on and adjacent to the Forest. They occupy a diversity of habitats including brushy and wooded area, broken country, and open plains. Within the Great Basin and Colorado Plateau mule deer occur at a variety of elevations (5,000-10,000 feet) during the summer months. In winter, high elevations usually accumulate snow to depths that preclude deer use. Seasonal migrations of varying distances are necessary for deer to take advantage of nutrient-rich forage supplies in the mountains in summer and to escape deep snow in the winter (Wallmo 1981). Lower elevations are hot and arid, with herbaceous vegetation largely dried out by late summer, leaving a residual of poor-quality forage for wintering deer (Wallmo 1981). Deer depend on a variety of plant communities - a mosaic of both woody vegetation and grass/forbs.

Numerous studies of deer and cattle competition have been conducted on forests and ranges of western North American (Leckenby et al. 1985, Loft et al. 1991, Mackie 1978). Deer and cattle compete for forage; however, moderate cattle use, which removes rough grass, can enhance these areas for deer (Hall 1985). Many studies show that livestock (cattle and sheep) often eat the same forage species but the overlap varies with range, season, and class of livestock (Loft Leckenby et al. 1985, Loft et al 1991).

There are many grazing regimes proposed to enhance both livestock and deer foraging areas, some are proponents of summer grazing with the theory being that cattle grazed in the summer, exposes green forage for deer in the fall (Leckenby et al. 1985). Grazing livestock on mule deer range at appropriate times minimizes direct competition for available forage and assures continued health of range plants (Leckenby et al. 1985). It is critical that livestock be removed from deer winter range when soil moisture is still adequate to permit grasses to grow new leaves to replenish nutrient reserves in their roots (Leckenby et al. 1985).

Riparian zones are of great importance to mule deer. They satisfy requirements for cover, food, water and plant species diversity in limited area. The greatest potential for direct effects between mule deer and livestock would occur within riparian zones, this is due inpart to the limited number of acres in riparian habitats and their extensive use during fawning periods (May 16-July 1 on the Dixie NF).

Loft et al.(1991) studied female mule deer and cattle interaction in the Sierra Nevada range, they were interested in determining if cattle influenced female mule deer home range selection. Their findings were that the greatest effect of cattle on habitat selection by female mule deer occurred during late summer, especially in preferred habitat types (riparian/meadow areas). They also found that female mule deer shifted habitat use by reducing their use habitats preferred by cattle and increasing their use of habitats avoided by cattle (Loft et al. 1991).

Loft (1991) suggests that high quality forage may be limited on some summer ranges grazed by cattle, thus contributing to suboptimal nutrition for female mule deer and their offspring. Kie et al.(1991) found that deer spend more time feeding and less time resting with increased cattle stocking rates (direct and indirect effect) and this could lead to increased predator success on offspring and thereby, an increased mortality rate among young or lower fecundity due to suboptimal nutrition of doe during critical stages of pregnancy.

IA1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

IA1a. Uplands

Under proper grazing of uplands by livestock, mule deer will experience no direct or indirect effects. Consequently, these actions are not cumulative with other past, present or future actions. Therefore, no cumulative impacts are expected on mule deer in uplands areas under the proposed action of proper-use grazing.

IA1b. Riparian Areas

According to Kie (1991) and Loft(1991), under any use regime there is the potential for livestock grazing in riparian areas to have direct and indirect effects. These effects can be mitigated with the use of exclosure fencing in areas where these conflicts arise.

IA2. Direct, Indirect, and Cumulative Effects of No Grazing

As noted in Hall(1985), grazing can have a benefical effect on forage quality by removing the rough, or dried seedheads and stems, while leaving the more palatable leaves for deer or elk to graze later in the season.

The potential exists that under a NO ACTION (no grazing) alternative, forage quality and production could decline for ungulate species (mule deer and elk).
However, implementation of the No Action Alternative would not be cumulative with past and present activities that have reduced the health and vigor of riparian and upland pastures across Forest lands. Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

IB. Rocky Mountain Elk (Cervus elaphus nelsoni): MIS species -Dixie National Forest

Rocky Mountain elk once occupied the entire state of Utah (Murie 1951, in Thomas and Toweill 1981). They were extirpated at the turn of the twentieth century, with the possible exception of a small number of elk in the Uinta Mountains (Hancock per comm. 1976 in Thomas and Toweill 1981).

A reintroduction program was instituted by Utah Division of Wildlife Resources between 1912-1915; by 1925 the elk population increase was of concern to many cattle and sheep ranchers, causing the Utah Legislature to form the "Board of Elk Control" to reduce elk competition with livestock on national forest lands (Thomas and Toweill 1981).

Elk were selected as a Management Indicator Species in the Dixie National Forest Land and Resource Management Plan to indicate the health of grass/forb, sapling-mature aspen, and sapling-old growth conifers. They were selected as a Management Indicator Species for many of the same reasons as deer - habitat related factors required to maintain healthy populations of deer and elk are similar to the habitat requirements of many other species to maintain their populations and due to public interest for hunting and viewing purposes (Dixie NF-LRMP 1986). Winter range is a critical habitat requirement for all ungulate species, on the Dixie National Forest elk winter range is located in Management Area 5A-Big Game Winter Range. This area typically occurs on lower elevation foothills, benches, and valleys at the base of mountains and plateaus; the dominant vegetation is pinyon-juniper, Gambel's oak mountain shrub and sagebrush (Dixie LMRP 1986).

The findings of numerous studies, especially those involving elk-cattle relationships, now indicate that elk rapidily move from an area with the onset of cattle grazing, at least to the extent that ungrazed areas are available within normal home ranges (Mackie 1985, Roberts & Becker 1981, Willard 1986). Mackie (1985) further states that wherever distributional overlaps occur between elk, deer and cattle, opportunities for conflict, both direct and indirect can exist. His findings suggest that elk and cattle have very similar diets on most ranges (Mackie 1985).

Livestock must be removed from elk winter range when soil moisture is still adequate to permit grasses to grow new leaves to replenish nutrient reserves in their roots (Leckenby et al. 1985).

Loft et al. (1991) suggests that high quality forage may be limited on some summer ranges grazed by cattle, thus contributing to suboptimal nutrition for female mule deer and their offspring. Kie et al.(1991) found that deer spend more time feeding and less time resting with increased cattle stocking rates (direct and indirect effect) and this could lead to increased predator success on offspring and thereby, an increased mortality rate among young or lower fecundity due to suboptimal nutrition of doe during critical stages of pregnancy.

IB1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

IB1a. Uplands

Under proper grazing of uplands by livestock, mule deer will not experience direct or indirect effects. Consequently, these actions are not cumulative with other past, present or future actions. Therefore, no cumulative impacts are expected on mule deer in uplands areas under the proposed action of proper-use grazing.

IB1b. Riparian Areas

According to Kie (1991) and Loft(1991), under any use regime there is the potential for livestock grazing in riparian areas to have direct and indirect effects. These effects can be mitigated with the use of exclosure fencing in areas where these conflicts arise.

IB2. Direct, Indirect, and Cumulative Effects of No Grazing

As noted in Hall(1985), grazing can have a benefical effect on forage quality by removing the rough, or dried seedheads and stems, while leaving the more palatable leaves for deer or elk to graze later in the season. The potential exists that under a NO ACTION (no grazing) alternative, forage quality and production could decline for ungulate species (mule deer and elk).

However, implementation of the No Action Alternative would not be cumulative with past and present activities that have reduced the health and vigor of riparian and upland pastures across Forest lands. Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

IC. Merriam's Wild Turkey (Meleagris gallopavo merriami): MIS species- Dixie National Forest

The Merriam's turkey is a management indicator species for mountain brush, pole-mature aspen, and mature-old growth conifer on the Dixie National Forest. Turkeys have been transplanted on all Districts of the Forest, with good populations existing until approximately 1973. Since that time, populations have declined (Dixie LRMP 1986).

Evaluation of turkey habitat on the Dixie National Forest (Shaw 1991), suggests that winter range may be a major factor limiting the turkey population at present. Winter range is a narrow ecotone between ponderosa pine and pinyon-juniper vegetation types. During the winter months, turkeys depend on mast and seed heads of herbaceous vegetation for food. Shaw (1991) found that a general lack of herbaceous vegetation relative to the requirements of turkeys on potential winter range.

Production of mast is known to be sporadic in all southwestern habitats, hence turkeys require a variety of food producing species in order to survive. Either extreme drought limiting mast production and seed heads or deep snows covering available food for extended periods can lead to starvation. The winter range appears to be susceptible to both extreme events, hence drastic fluctuation is turkey numbers may be expected. If the population is to survive these extremes, availability of food-producing species is essential.

Little or no scientific research has been documented on the Merriam's turkey winter food sources in the pinyon-juniper/ponderosa pine vegetative types (Bonebreak, pers. comm.). A desired future condition would therefore include increased knowledge of native vegetation which provides important winter turkey food source and could be used to improve turkey winter range. Hoffman et al. (1993) reported a preference for south-facing slopes, due in part to shallower snow depths and the sun's warmth.

In addition, to winter range another critical habitat is nesting and brooding areas. These are characterized by tall grasses, dense, low growing vegetation, and shrubs (pinyon/juniper, sagebrush and grassland type community)(Shaw And Mollohan 1991). Hens tend to nest on slopes with dense stands of low vegetation (oak thicket), or where slash from previous harvest activities provides hiding cover for the nest (Shaw & Mollohan 1992). Zeedyk (1987) found that nests were often located at the base of trees or stumps with horizontal screening, such as slash or shrub growth at ground level. Lockwood (1987) noted the propensity of hens to return to the same general area to nest; He further noted that a high percentage of the nests occurred near water.

IC1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

Generally, on National Forests throughout the Southwest, direct conflicts between wild turkey and livestock-use are declining as stocking levels are reduced to capacity of the range and rest-rotation management systems are implemented (Phillips 1982). Even with proper-use grazing there is an inherent risk of livestock disturbing nesting hens or directly stepping on the eggs.

This could mitigated by grazing pastures without nesting turkey first, in the Dixie National Forest wild turkeys lay eggs and brood from April 15 thru July 1st. After that time livestock could safety graze within these units.

Removal of vegetation adjacent to a nest can increase the risk of predation on that nest (Zeedyk 1987).

Timber harvest activities within wild turkey nesting and winter range has lead to a decline of habitat quality, through loss of roost trees, hiding cover, mast producing trees, and loss of dead and down material used in nesting/hiding cover through the post-sale slash treatments (Phillips 1980).

These impacts can be mitigated through timing restrictions, proper grazing, and alternative methods of slash treatment or areas with no slash treatment.

IC2. Direct, Indirect, and Cumulative Effects of No Grazing

Implementation of the No Action Alternative would not be cumulative with past and present activities that have reduced the health and vigor of riparian and upland pastures across Forest lands.

Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

ID. Sage Grouse (Centrocercus urophasianus): Species of Concern-UDWR

Sage grouse are neither a sensitive, threatened, or endangered species, they are however, a species-of-special-interest to the Utah Department of Wildlife Resources. Consequently, the effects of the proposed action (proper-use livestock grazing) will be analyzed in this document.

Sage grouse depend almost entirely on forms of sagebrush, primarily big sagebrush, for food from October through May and for cover throughout the remainder of the year. In spring, males prefer relatively open, rather than dense, sagebrush cover for strutting grounds. May move up to 50 miles or more throughout the year; occupies areas with exposed sagebrush during winter (DeGraaf et al. 1991).

In winter, feeds entirely on sagebrush leaves. Prefers Wyoming big sagebrush to Mountain big sagebrush, thus maximizing proteins and minimizing monoterpenes (DeGraaf 1991). In other seasons, such as spring, feeds on forbs, grasses and insects (Ehrlich et al. 1988, Marshall 1992).

Usually nests beneath sagebrush in a shallow depression on the ground. Locates nests in drier sites close to strutting grounds where shrub cover is less than 50 % and vegetation is 10 to 20 inches tall. Delong et al. (1995) finding suggest tall grass and medium-height shrub cover provides the greatest amount of canopy and lateral cover for nesting grouse. Hens move young broods to moist areas, where there is a plentiful supply of insects and green plant material(DeGraaf et al. 1991, Ehrlich et al. 1988).

ID1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

Even with proper-use grazing there is an inherent risk of livestock disturbing nesting hens or directly stepping on the eggs. This could mitigated by grazing pastures without leking/strutting grounds, or nesting areas first, in the Dixie National Forest, sage grouse strut or are on their breeding grounds from March 15 to June 1st, brood their eggs from May 5th to July 7th. After that time livestock could safety graze within these units. Or build exclosure fences around strutting and brooding grounds that would exclude livestock, but not grouse.

Removal of vegetation adjacent to a nest, lateral cover, can increase the risk of predation on that nest by mammalian predators (DeLong et al. 1995).
Past grazing activities, and range improvements for livestock (Pinyon/juniper and sagebrush treatment, brush removal and re-seeding with crested wheatgrass) within sage grouse nesting and winter range has lead to an overalldecline of habitat quality, through loss of preferred sagebrush species, hiding and nesting cover and forbs (DeLong et al. 1995, Gregg et al. 1994).

These impacts can be mitigated through timing restrictions, proper grazing, and exclosure fencing around known leking areas.

ID2. Direct, Indirect, and Cumulative Effects of No Grazing

Implementation of the No Action Alternative would not be cumulative with past and present activities on Forest lands. Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

II. Bird Species

Little information is available on the effects of "proper use" by livestock and few guidelines are available on what the allowable use of riparian plant communities should be to maintain ecosystem integrity (Clary and Webster 1989, Bock 1992). Where little or no information regarding the effects of proper grazing or use is available, conclusions are based on known effects of grazing on vegetation and known habitat requirements of the species.

Ways in which cattle grazing can affect bird wildlife or their habitats include: 1) reducing the species composition, vigor, size and density of vegetation (principally shrubs) which can reduce cover from predators or parasitism, or reduce the amount and/or shape of vegetation required for suitable habitats, 2) physically knocking bird nests or young to the ground 3) increasing numbers of brown-headed cowbirds who parasitize bird nests (Knopf et al. 1988) and 4) reduction of herbage and biomass that can reduce insect populations on which some bird wildlife species feed.

Livestock directly alter streamside vegetation by trampling, rubbing and grazing on herbaceous plants and browsing on shrubs (Platts 1990). Clary and Webster (1989) have found little information on how grazing affects willow communities (which may comprise the shrub thickets used by yellow-breasted chats) except for observations that leaving a residual herbaceous stubble of about 4 inches usually results in little or no use of willows.

Elmore (Clary and Webster 1989) has suggested that in some areas the use on willows begins when use on herbaceous plants reaches about 45%. Kovalchik and Elmore (1992) observed that for mid to late-season grazing cattle begin to use the current annual growth on willows when riparian forage use reaches about 45% of total available forage (4-6 inch stubble height). Use increases again at 65% (2-4 inch stubble height), and cattle eat all the willow they can when utilization is at 85% or more (less than 2 inches). With continued overuse, dead and dying plants suggest former willow abundance. This is evident on some streams on the Dixie National Forest. Excessive grazing may eliminate a willow stand within 30 years. Elmore (1991) has found that if cattle are moved from pasture to pasture with a three pasture rest rotation system with no regard to use on willows, the woody vegetation can slowly decline while the sedges, rushes and grasses prosper.

Summer grazed pastures (late spring and summer) generally differ from winter-grazed (fall through winter) pastures in verticle and horizontal structure (Knopf et al. 1988). Summer grazed pastures tend to contain bushes that are larger with lower branches missing, more widely spaced, contained a higher proportion of dead branches and tended to be located closer to the streambank (Knopf et al. 1988). Clary and Webster (1989) suggest that cattle avoid many riparian areas when wet soil conditions exist. Thus, riparian use and effects on willow and other shrubs may vary between sites or vary by year depending upon soil moisture. Schulz and Leininger (1990) found that willows grazed at 65% from mid-June through October in in areas that experienced heavy past grazing, were not able to grow as tall on streambanks even though grazing pressure had been reduced by 2/3 over the levels of 50 years ago.

Al Winward, Intermountain Regional Ecologist, has found that riparian condition and health will improve with a 4" stubble on the greenline at the end of the grazing or growing season (which ever comes first) for riparian areas in good condition and a 6" stubble for those needing recovery or a 2 inch stubble on adjacent impacted areas. This improvement includes willow reproduction and condition (Winward, pers. com.). He also prescribes other "and/or" criteria to consider (such as site impacts, willow condition, and upland condition) for determining proper time to move cattle off the pasture.

Further, he states that it is critical that no cattle be present in the pastures before or after the prescribed season because even one or two cows can cause the standards to be exceeded and thereby not meet riparian objectives for a healthy ecosystem (Winward, pers. com.).

Pastures with reseeded areas are expected to incur some invasion by sagebrush within the next ten years. In these pastures, species richness of nongame birds, including neotropical bird species, would increase (McAdoo 1989). Sagebrush control to maintain these reseedings for livestock forage have the potential to reduce numbers of neotropical species dependent upon shrubs or shrub/grass habitats (McAdoo 1989, Castrale 1982). To mitigate these effects it is recommend that treatments be strips no more than 100 meters with untreated strips 100-200 meters wide.

Browse use should be monitored regularly so that moving the livestock off the pasture will be based on what ever limiting factor is reached first (i.e. herbaceous or browse utilization).

IIa. Yellow-breasted Chat

The Yellow-breasted chat was originally designated as a Management Indicator Species in the Dixie National Forest Land and Resource Management Plan (USDA 1986) to indicate the health of riparian-shrub-tree vegetation types. Since this designation, it has been determined that the yellow-breasted chat is not a suitable indicator for this habitat because of the variability of riparian areas that are present and the varying elevation ranges of these riparian areas present on the Dixie National Forest. Some of these riparian areas are inherently not suitable for yellow-breasted chats (for example high elevation alpine riparian areas). Therefore, a Forest Plan Amendment process was undertaken to replace the yellow-breasted chat with habitat conditions and macroinverbrate biotic condition index (BCI).

Habitat characteristics described in the amendment for the desired condition include vegetative structural guidelines, guidelines for native species composition, and vegetative cover. These criteria are to be used in concert with criteria from a hydrology and range standpoint when assessing the conditions of riparian habitats. BCI will be addressed in the Fisheries discussions.

Yellow-breasted chat is a neotropical migratory bird; it breeds in North America and spends the winter months in Mexico, southern Texas, and Yucatan south to western Panama (American Ornithologists' Union 1957). It returns to the breeding range in most of the continental United States during March, April and May (American Ornithologists' Union 1957). Fall migration begins after a molt in August or September in Indiana (Thompson and Nolan 1973). Exact dates of arrival and departure in Utah are not known but arrival is estimated to be on or about early May and departure in September.

Habitat for the yellow-breasted chat consists of dense brush or scrub, especially along streams and at swamp margins (Erhlich et al. 1988). Chats have been found in areas of high vegetation density and shrub cover and where percentage of bare ground is low (compared to other species in a ground-shrub guild) (Sedgwick and Knopf 1987). On the Dixie National Forest high elevation, alpine riparian areas are not considered to be as suitable yellow-breasted chat habitat as the lower elevation areas. Diet of the adult chat consists of insects and berries whereas the young are apparently fed only insects (Erhlich et al. 1988).

IIA1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

IIA1a. Sheep Grazing

Effects of sheep grazing, in general, tend to occur on uplands rather than riparian areas (Bowns 1986). In addition, sheep grazing on the Dixie National Forest occurs generally at high elevations (over 7,500 feet with many allotments over 9,000 feet) where riparian areas are not as conducive to providing yellow-breasted chat habitat. Many of the permittees haul water into the pastures, which also minimizes effects to riparian areas. Sheep permittees have herders that tend the sheep so that use is controlled. As a result, riparian areas tend to remain unaffected except in localized areas where the sheep access water. Sheep grazing would have little to no effect to yellow-breasted chats or their habitat or to the habitat characteristics described in the proposed Forest Plan Amendment described above.

IIA1b. Cattle Grazing

Yellow-breasted chats are most likely to respond negatively to increasing levels of cattle grazing (Sedgwich and Knopf 1987). Studies done on cattle grazing in riparian areas have found that increased frequency of grazing on an annual basis correlated significantly with decreases in bird abundance, shrub volume, and shrub heights, (Taylor 1986) which affects yellow-breasted chat habitat suitability.

Proper use, as defined by the Dixie NF, in spring and summer pastures in good, fair, or poor condition would be expected to be maintained or improve. Rationale for this conclusion is based on the assumption of regrowth to at least a 4-inch stubble after the cattle are removed. In addition, spring and summer pastures presently in good condition that have been grazed at 50-60% utilization following standards in the Forest Plan (USDA 1986) are apparently able to withstand this amount of use.

Proper us ein fall pastures in good, fair, or poor condition would also be expected to maintain desired riparian tree/shrub habitat conditions and/or yellow-breasted chat habitat. Existing populations of the yellow-breasted chat or riparian shrub/tree habitat characteristics in good condition would be expected to be maintained with spring,summer, or fall grazing with proper use. Potential physical disturbance to nests would not occur with fall grazing.

In allotments with a rest rotation system, riparian areas in good condition would be expected to maintain or improve these conditions. In riparian areas that are in fair to poor condition, grazing at 50% and/or 3" stubble height in a rest rotation system would be expected to maintain the existing condition or improve slowly. The rested year, if truely rested, would allow regeneration of willows and other riparian shrubs or trees to become a part of the riparian ecosystem, even with a fall grazing pattern.

Although brown-headed cowbirds have been documented on the Dixie National Forest, populations and extent of habitats used by this species is not known. Yellow-breasted chats are frequent hosts for brown-headed cowbirds (Ehrlich et al. 1988). In general, grazing, especially spring and summer grazed pastures, would encourage presence of brown-headed cowbirds and parasitism of yellow-breasted chats by the brown-headed cowbird (where yellow-breasted chats currently exist).

In riparian areas where introduced plant species are present, such as exotic saltcedar or tamarisk (***Tamarix chinensis) grazing can encourage their establishment by reducing competition from native species which have lost their vigor and quantity by grazing. Grazing at proper use may allow maintenance or an increase in native species which could slow the establishment or spread of introduced species. Presence of introduced species would be expected to continue to increase at some level regardless of cattle grazing unless some management activity attempts to slow or control them. Introduced plant species are generally not beneficial to wildlife because they do not provide the cover, and food which is preferred or needed for some wildlife species or provide the host for insects that are preferred or needed for some wildlife, particularly birds (Hunter et al. 1988).

IIA2. Direct, Indirect, and Cumulative Effects of No Grazing

N grazing in lower elevation riparian areas that are lacking thick shrubby habitats with verticle and horizontal structure, and have the potential to obtain this structure, would result in increased habitat for the yellow-breasted chat. Riparian areas degraded by heavy livestock use tend to improve quickly when livestock are removed (Rickard and Cushing 1982, Stuber 1985). Riparian vegetation, streambanks, and stream channel conditions in Utah showed dramatic improvement with eleven years of protection (Platts and Nelson 1985).

Verticle and horizontal structure of woody species where they presently exist would expect to become more complex. Regeneration would become more prevalent where the potential exists. Where current shrub structure is scattered and individual plants are mushroom shaped, no grazing would allow filling in forming more contiguous thickets and individual plants with crowns extending to or near the ground. In the long term continuous growth of willows into impenetrable thickets may eventually reduce available water in the stream (Winward, pers. com.).

Riparian systems along perennial streams with gradients of .5% to 4% have the potential to grow willows because the velocity of the water with these gradients are sufficient to create scoured exposed soil needed to regenerate willows (Winward, pers. com.). In areas with these gradients that presently have few willows the No Action Alternative would allow growth of willows and other woody species and improve habitat for the yellow-breasted chat as well as other riparian shrub dependent species.

In riparian areas with no potential for thick shrubby habitats the No Action Alternative would have no effect on yellow-breasted chat or other riparian shrub dependent species. No grazing on these systems would enhance grasses, forbs, and hydric species such as Carex but would not produce the thick shrubby habitat needed for yellow-breasted chats.

No grazing would discourage presence and parasitism of the yellow-breasted chat by brown-headed cowbirds. It is not known to what extent brown-headed cowbirds occur on the Dixie National Forest (although their presence has been documented). Yellow-breasted chats are frequently used as host species (Ehrlich et al. 1988). In general, decreased brown-headed cowbirds would be beneficial to yellow-breasted chats.

Cumulative Effects: The effects described under proper grazing would apply to No Grazing and is incorporated here by reference. The only difference is that elimination of grazing would increase the amounts of mid to late seral stages in riparian areas in the long term. Yellow-breasted chat habitat would be expected to be maintained.

IIB. Neotropical Migratory Birds

Habitat requirements of neotropical migratory birds differ by species. For example, birds nesting in open habitats have been significantly affected by grazing whereas cavity-nesters have been essentially unaffected (Good and Damback 1943, Butler 1979, Bock 1992). Aerial, bark and canopy insectivores have been less influenced by grazing than species feeding on nectar, insects, or seeds in the understory or on the ground (Szaro and Rinne 1988).

Most neotropical migratory birds that are negatively influenced by grazing are those dependent on herbaceous ground cover or shrubs (Bock et al. 1992, Knopf et al. 1988) and/or that may be especially vulnerable to cowbird parasitism (Bock et al. 1992). Habitat structure is generally important to birds. Changes in vegetation that affect neotropical migratory birds include conversions of species composition, changed vegetation density and verticle/horizontal structure (Schultz and Leininger 1990), and by reducing cover or increasing edge allowing increased predation (Terborgh 1992) and/or parasitism by brown-headed cowbirds (Terborgh 1992, Sedgwick and Knopf (1988).

Examples of changes in species composition decreasing bird abundance and species richness include cottonwood/willow to tamarisk (Hunter et al. 1988) and native grasses to cheatgrass (Bock et al. 1993). An example of species composition changes that enhance bird species richness is sagebrush invasion of crested wheatgrass seedings (McAdoo et al. 1989). Reduction of herbage and biomass could reduce numbers of insects on which some neotropical birds feed.

Riparian woodlands are habitats that provide the highest diversity and abundance of neotropical migratory birds (Bock et al. 1992). Therefore, management of riparian ecosystems have a high potential for significantly affecting many neotropical migrants (Bock et al. 1992). Few species appear to benefit from grazing in riparian habitats, and those that do benefit are not restricted to riparian communities (Bock et al. 1992).

IIB1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

The yellow-breasted chat is a Neotropical migratory bird species, and the discussion regarding the effects of grazing on species dependent upon riparian shrub thicket habitats would also apply to other neotropical migratory bird species requiring this structure. Therefore, the effects to species requiring this habitat are the same and are incorporated here by reference.

Elimination of riparian vegetation has a decidedly negative impact on the associated bird community (Knopf et al. 1988). Species such as willow flycatchers, Lincoln's sparrows and white-crowned sparrows appear to be intolerant of structure depicted by mushroom-shaped shrubs that are widely spaced (Knopf et al. 1988). Different strata of vegetation have differenty vulnerabilities to grazing. The upper canopy can be indirectly affected if grazing the young trees does not allow regeneration of this component (Knopf 1988).

Based on these findings, spring or summer grazing at 3 inch stubble height or 50% of herbaceous and browse plant species in riparian areas in poor condition (low plant vigor, composition and structure as well as hydrologic charactertistics discussed in the Hydrology section) may result in some improvement if past grazing has exceeded this amount. Riparian areas in poor condition would not be expected to improve. Neotropical birds that respond negatively to grazing would be expected to be absent or in low numbers in areas with poor riparian conditions. Conversely, those that respond positively to grazing would be expected to increase or be maintained. Inadvertent physical trampling or bumping young in nests on the ground or in low shrubs or trees could occur with spring or early summer grazing.

Grazing at 3 inch stubble height or 50% of herbaceous forage in fall-grazed pastures that are in good condition would be expected to maintain the existing condition in riparian habitats (Clary and Webster 1989). Neotropical migratory birds that depend part or wholey on riparian habitats would be expected to remain nearly the same, depending upon wheather, flooding or other factors affecting reproductive success. No physical damage to nests or young would occur with fall grazing.

Fall grazing of riparian habitats in poor condition would be expected to maintain the existing poor condition. Some improvements might be noticeable if grazing has greatly exceeded this in the past, however, conditions would still be considered poor.

Upland habitats, including shrubsteppe, montane coniferous and juniper woodlands, are also important for neotropical migratory birds. Unfortunately, little information is available regarding the effects of grazing on these habitats as they relate to neotropical migratory birds. However, verticle and horizontal structure and complexity of vegetation has been demonstrated to be an important element in maintaining habitat for avifauna in uplands as well as riparian areas (McAdoo et al. 1989, Knopf et al. 1988, Medin 1990, Castrale 1982, Sieg 1991).

Grazing (sheep or cattle) at 50% of current year's growth would be expected to maintain verticle and horizontal structure and complexity where it presently exists. In pastures without these characteristics, structure and complexity would be expected to continue to be lacking and bird species richness would be low.

Sheep tend to graze on forbs which may cause grasses to be more prevalent. Some neotropical migratory birds depend upon forbs and seeds of grasses and forbs for food (for example hummingbirds forage on flowers to obtain nectar and sparrows forage grass or forb seeds). Available flowers and seeds may be fewer in uplands grazed by sheep but grazing is not expected to be uniform, therefore, there would still be flowers and seeds available.

Cumulative Effects: Cumulative effects for the yellow-breasted chat described above would also apply to neotropical migratory species depending upon this riparian shrubby habitat and is incorporated here by reference.

Other activities that could affect neotropical migratory birds would primarily include those that affect vegetation; timber sales, prescribed burns, other grazing permits and elk reintroduction. Cumulative effects of these activities would provide increased variety of seral stages in existing plant communities, particularly an increase in early stages in the short term. This would decrease habitats for some neotropical species while increasing habitats for others. The overall effect of increased variety of seral stages would be increased species richness. The cumulative effects of grazing at proper use with other activities would be expeced to maintain population viability of all neotropical migratory species currently existing in the long term.

IIB2. Direct, Indirect, and Cumulative Effects of No Grazing

Effects described above for the No Action Alternative on yellow-breasted chat would apply to other neotropical migratory birds requiring this type of habitat and therefore is incorporated here by reference.

In uplands that are in good condition, it would be expected that plant species composition and vigor would remain the same or slightly increase. Species abundance may increase and structural composition may become more complex in localized areas. In uplands in poor condition it would be expected that plant composition, vigor and abundance would increase and verticle and horizontal structure would become more complex. This would be expected to increase bird abundance and bird species richness.

Riparian areas in good condition would be expected to maintain essentially the same condition, with localized increases in verticle and horizontal structure as well as some increased plant abundance. Neotropical bird populations, therefore, would expect to stay the same or experience some increases in localized areas. Riparian areas in fair or poor condition would be expected to increase in plant vigor, abundance and structural characteristics, which would be expected to increase bird species abundance and richness.

Brown-headed cowbird parasitism would be expected to decrease in areas where no grazing promotes thicker wider riparian vegetation. Narrow, linear willow riparian areas may make areas especially attractive to cowbirds (Sedgwick and Knopf 1988) and patchy shrub/willow habitats are more easily penetrated for parasitism.

IIC. Passerine Birds

Juniper woodlands provide important habitat for wintering passerine birds (Sieg 1991). Higher bird densities and greater species richness has been observed in juniper stands when compared to grasslands. Results of Sieg's research (1991) indicate that Rocky Mountain juniper woodlands contribute nesting habitat, migratory corridors and winter food and cover for birds generally restricted to forested sites and enhances grasslands by providing increased edge habitat for birds requiring some woody cover. Sagebrush/grasslands are also important habitats for wintering or resident birds.

IIC1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

Passerine birds have been identified by the Utah Division of Wildlife Resources as a group to consider when analyzing effects of grazing.

The effects of grazing at proper use described for the yellow-breasted chat and Neotropical migratory birds would also apply to passerine birds and are therefore incorporated here by reference. Passerines not addressed in these previous discussions include resident and wintering species.

Juniper woodlands provide important habitat for wintering passerine birds (Sieg 1991). Higher bird densities and greater species richness has been observed in juniper stands when compared to grasslands. Results of Sieg's research (1991) indicate that Rocky Mountain juniper woodlands contribute nesting habitat, migratory corridors and winter food and cover for birds generally restricted to forested sites and enhances grasslands by providing increased edge habitat for birds requiring some woody cover. Sagebrush/grasslands are also important habitats for wintering or resident birds.

Seed-eaters that may winter in these habitats (dark-eyed juncos or horned larks for example) depend upon seeds remaining through the winter for food. At higher elevations species such as rosy-finches depend upon seed along alpine areas at snowlines during fall and spring. Grazing at 50% utilization in these habitats in good condition is expected to maintain some seed at the end of the grazing season and maintain the vigor of plants in these habitat types. Grazing on the uplands is often not evenly distributed and areas with abundant seed would be expected. Therefore, populations of passerines wintering in these habitats would be expected to be maintained at current levels.

Grazing at 50% on these habitats that are in poor condition would be expected to be maintained in this poor condition or continue to deteriorate depending upon how poor the conditions.

Cumulative Effects: Cumulative effects of proper grazing on passerine birds would include those effects to habitats described under yellow-breasted chat and neotropical migratory birds and is hereby incorporated by reference. Other activities that affect vegetation on which passerines depend include primarily timber sales and prescribed burns. These activities increase the variety of seral stages in various plant communities which would increase habitat for some passerines and decrease habitat for others. Habitats that could be most limiting from all these activities would be late seral plant communities. No grazing would likely increase late seral stages in riparian areas and grass communities but not forested plant communities. Therefore, no grazing and other activities overall would have no cumulative effects on the viability of passerine birds.

IIC2. Direct, Indirect, and Cumulative Effects of No Grazing

The effects of no grazing on passerine birds would include the effects described for yellow-breasted chats and neotropical migratory birds and are incorporated here by reference.

No grazing on upland areas would allow more seeds available for food for seed-eating resident or wintering birds This may help survival of these populations through the winter. No grazing on uplands in poor condition would allow growth of grasses forbs and shrubs which would increase verticle and horizontal diversity, benefiting passerine birds. In habitats in good condition increased verticle and horizontal diversity would not be expected to be as apparent or affect passerine bird populations measurably.

Cumulative Effects: Cumulative effects of this alternative on passerine birds would include those effects to habitats described under yellow-breasted chat and neotropical migratory birds and is hereby incorporated by reference. Other activities that affect vegetation on which passerines depend include primarily timber sales and prescribed burns. These activities increase the variety of seral stages in various plant communities which would increase habitat for some passerines and decrease habitat for others. Habitats that could be most limiting from all these activities would be late seral plant communities. No grazing would likely increase late seral stages in riparian areas and grass communities but not forested plant communities. Therefore, no grazing and other activities overall would have no cumulative effects on the viability of passerine birds.

IID. Northern Flicker: Dixie NF Management Indicator Species (MIS)

The northern flicker (Colaptes auratus) has been designated as a Management Indicator Species in the Dixie National Forest Land and Resource Management Plan (USDA 1986) to indicate the health of mature aspen and conifer woodlands. Flickers are found in woodlands from Alaska to Mexico and coast to coast. Three sub-species are currently recognized: C. a. mearnsi, C. a. auratus and C. a. cafer.

The Colaptes auratus cafer, or red-shafted flicker, is common throughout the west and will interbreed with the other subspecies and produce hybrids where their ranges overlap (Terres 1991). They are generally found with the mature conifer and aspen types, but are also found in other forest types up to timberline, as well as near human dwellings and agricultural areas.

The northern flicker is a primary cavity nester, and is an indicator species for other wildlife requiring snags for nesting, roosting and foraging habitat. They will often seek shelter before sundown in one of their roost holes located in trees, but will also drill holes in the sides of barns and houses for winter roosts (Terres 1991). Males play a major role in selecting a nest site and dig out a hole using their bills. They will often reuse old nest holes where 5-10 eggs are laid on top of a mat of wood chips at the bottom of the hole.

The diet of the northern flicker is quite varied. Approximately 75% of its diet is composed of insects that includes ants (45%), beetles, wasps, grasshoppers, crickets, bugs, lice, caterpillars, grubs and other flying insects. The remainder of its diet is composed of fruits, berries and seeds from numerous plant species.

A decline in the number of flickers since the 1950s may be partially due to increased competion with the aggressive starling for the flickers' nesting hole (Terres 1991).

IID1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

There would be no direct or indirect effects on the northern flicker. The flicker's critical habitat element of dead standing trees would not be affected by grazing at proper use.

Because there are no direct or indirect effects of grazing on flickers or their habitat, these actions are not cumlative with other past, present, or future effects.

IID2. Direct, Indirect, and Cumulative Effects of No Grazing

There would be no direct or indirect effects on the northern flicker. The flickers critical habitat element of dead standing trees would not be affected by the elimination of grazing.

Because there are no direct or indirect effects of grazing on flickers or their habitat, these actions are not cumlative with other past, present, or future effects.

IIE. Western Burrowing owl (Athene cunicularia hypugaea): Species-of-Special-Concern- U.S. Fish & Wildlife Service

A medium-small owl of open or arid areas that is often seen in daylight. Preys upon insects, small mammals, reptiles and occasionally small birds (Ehrlich et al. 1988).

In Utah, their preferred habitat is arid grasslands and desert shrublands of the Great Basin (Lindsey & Poswiatoswski 1993). Often found where vegetation is sparce or the soil has been disturbed through over-grazing, agriculture, fire or construction (Marshall 1991).

Nesting occurs in mammal burrows which the owls may modify or renovate; ground squirrel, prairie dog, or abandoned badger burrows are most often used (Ehrlich et al. 1988, Lindsey & Poswiatoswski 1993, Marshall 1991). Burrows are often lined with either cow or horse dung, this is thought to mask nesting odors (Ehrlich et al. 1988, Marshall 1991). Desertion is the major cause of nest loss; Marshall(1991) found this occurred when nests were within 360 feet of each other. This was attributed to competition between owl pairs for a limited food supply (Marshall 1991).

Haug and Oliphant (1990) noted that during their study of burrowing owl movements in central Saskatchewan, grazed pastures were avoided for foraging in relation to their abundance. They suggest this occurred because overgrazing by livestock removed all the vegetation that small mammals would use as cover and a food source for grasshoppers.

Declines in populations numbers are thought to be a direct effect from pesticides, control programs (prairie dogs, and ground squirrels) and loss of habitat due to urbanization.

ID1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

Under proper grazing of uplands by livestock, owls will not experience direct or indirect effects. Consequently, these actions are not cumulative with other past, present or future actions. Therefore, no cumulative impacts are expected on burrowing owls under the proposed action of proper-use grazing.

ID2. Direct, Indirect, and Cumulative Effects of No Grazing

Implementation of the No Action Alternative would not be cumulative with past and present activities across Forest lands. Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

III. Bat Species

Of the 44 bat species that inhabit North America, 6 species are listed as endangered and 18 are candidates for federal listing as threatened or endangerd with the USFWS. Although a few individual colonies number in the millions, bats in general rank as the most endangered land mammal in the United States. Some of the actual and potential threats to bats include: loss of roosting habitat due to mine and cave closures and snag removal, vandalism and human disturbances within maternity colonies and hibernacula, pesticide poisoning and loss of surface water (Lengas 1994, Tuttle 1994).

Because some bats feed on insects over water, and most require between 6 and 100 feet of open water to drink, loss of surface water in the west may threaten many bat populations. Although properly managed livestock grazing is generally compatible, unwise livestock use is considered the most common cause of deteriorated riparian areas in western rangelands (Kovalchik et al. 1992).

Willows, sedges and rushes have strong root systems that hold streams together. Woody species, such as willow, provide channel stability and resistance to erosion. With an aggrading channel, a rising water table stores more wet season water, slows the water's release and may allow yearlong flows (Elmore and Beschta 1987). Healthy functioning riparian ecosystems also provide habitat for a diverse and abundant plant community and insect population that are attractive to numerous foraging bat species.

Livestock alter reparian areas by trampling, rubbing, grazing and browsing. Given the opportunity, cattle will spend between 5 to 30 times longer in a riparian area compared to adjacent upland areas. Riparian areas are selected by livestock because of higher forage volumes, greater palatability, nearness to water and desirable microclimatic conditions (Clary and Webster 1989). Over time, excessive cattle use reduces or eliminates riparian vegetation, modifies streambed and channel morphology, increases stream channel width, increases stream sediment transport and lowers the surrounding water table (Clary and Webster 1989).

Little information is available on how well managed grazing systems affect riparian streams that in turn affect suitable bat foraging habitat. Some studies on riparian health indicate that a minimum of 4 inch stubble height, remaining on hydric species at the end of the season is needed to maintain plant vigor, composition and density for streambank protection for riparian areas in the mid-to-late seral stage (Clary and Webster 1989). But, as much as 6 inch stubble height may be necessary in the very early to early seral stage to ensure streambank recovery and improvement (Winward 1995). Other "proper use" conditions for ripararian areas, accepted by the Dixie National Forest, include: a minimum of two inch stubble height on transitional species between upland and riparian areas at the end of the season; a maximum of 20% accelerated streambank disturbance; and a maximum of 50% utilization of new leader growth on riparian browse species. Livestock would need to be removed from the riparian system when one of these conditions are present to maintain or improve riparian functions (Winward 1995).

The eight bat species considered below have been brought to our attention by the United States Fish and Wildlife Service (USFWS) as species of concern. Six of the eight bat species are candidates for federal listing as endangered or threatened. The other two have either declining populations or their status is unknown. Life histories of the individual bat species will be addressed separately below. Because the effects of the Proposed Action and No Action would be similar for these species, they will be lumped together under those headings.

IIIA. Life Histories

IIIA1. Myotis californicus*** (California myotis)

The California myotis is a small bat of special concern because its population status is unknown. They have not been proposed for federal threatened or endangered listing with the USFWS at this time, however. These bats range from the Alaskan panhandle to Baja California and Chiapas, Mexico, with distribution often disjointed in many areas (Simpson 1993). The subspecies *** Myotis californicus stephensi occurs in the Colorado River and Great Basin regions (Bogans 1974).

Habitat for the California myotis includes desert and semidesert regions as well as grasslands and ponderosa pine stands. During the summer, this species roosts alone or in small groups in narrow crevices on rocky hillsides, mine tunnels, man-made structures, hollow trees, and under loose slabs of bark (Krutzsch 1954, Lengas 1994). This species also roosts on small desert shrubs, rock outcrops and on the ground (Hirshfeld et al., 1977). No California myotis were observed at any of the bat survey locations on the Dixie National Forest in July-August, 1994 (Lengas 1994).

Foraging usually begins soon after sunset and is greatest in the early hours of the evening. It hunts and feeds rapidly then retires to a night roost for a brief rest, after which it resumes hunting (Woodsworth 1981). The California myotis is a short-range forager, flying slowly, yet with a darting flight pattern, usually less than 15 feet above the ground ((O'Farrell et al. 1967). Hunting typically takes place along margins of tree clumps, around the edge of the tree canopy, over water and well above ground in open country (Woodsworth 1981). Scat and stomach analysis indicate that ***M. californicus consumes mainly lepidopteran (moths and butterflies) and dipteran (flies) prey with smaller amounts of coleopteran (beetles) and hemipteran (bugs) prey in eastern Oregon (Whitaker el al., 1981.)

Breeding occurs in late autumn over most of the distributional range, except in California when it occurs in early spring. The females gather in large maternity colonies, usually located in a narrow crevice, and produce one young/year during early summer (Krutzsch 1954). The potential reproductive life span of the California myotis is 15 years (Duke et al. 1979).

IIIA2. Myotis ciliolabrum ****(Western small-footed bat)

The western small-footed bat is a Canidate species with the United States Fish and Wildlife Service (USFWS) with C2 status. Current information indicates that proposing to list as endangered or threatened is possible. Appropriate, but substantial biological information is not on file to support an immediate rulemaking however.

The western small-footed myotis occurs statewide in Utah (Hall 1981, Zeveloff 1988). This bat is found in a variety of habitats that include desert and semi-desert regions as well as in forested stands and along watercourses (Zeveloff 1988). It generally occurs at moderate elevations (Ingles 1965, Armstrong 1972) in habitats that contain rocky outcrops with deep crevices, where it prefers to roost, but it has also been known to roost under loose bark and in buildings (Legas 1994). Despite its small size, the western small-footed bat hibernates throughout its summer range in rock crevices, caves and mines (Lengas 1994). A total of 3 ***Myotis ciliolabrum individuals were documented in Water Canyon of the Pine Valley District and in Mammoth Creek of the Cedar City District during bat surveys in June 1994 (Lengas 1994).

The western small-footed bat is an aerial forager, flying low among the trees and brush. Prey includes a variety of small insects, but they seem to prefer beetles to other available insects (Black 1974).

A single young is produced between May and July. Although this bat is generally a solitary species, it has been reported that mothers will remain with the newborns in small maturnity colonies of up to 20 individuals.

IIIA3. Myotis evotis***(Long-eared myotis)

The long-eared myotis is a candidate species with C2 status for federal threatened or endangered listing with the USFWS. Two subspecies are recognized: Myotis evotis pacificus*** and the Myotis evotis evotis***. These species occur in temperate western North America and are found from central British Columbia and southern Saskatchewan and Alberta southward along the Pacific Coast to Baja California, eastwardly through Montana and Idaho to the western Dakotas and from Nevada, Utah, Wyoming and Colorado to New Mexico and Arizona (Manning et al. 1989). The M. e. evotis occurs throughout the state of Utah.

The long-eared myotis occurs mostly in forested areas, but has also been known to occur in a variety of habitats where suitable roost sites are available (Lengas 1994). Habitats where this bat has been observed or collected include: short-grass prairie, semiarid shrublands, chaparral, agricultural areas, open meadows, water courses, reservoirs, deciduous forest edges, dry coniferous forests and sub-alpine timber (Manning et al. 1989). Day-time roost sites are frequently in buildings, but they have also been found roosting in hollow trees, behind loose slabs of bark, in caves and mines, in fissures of rocks, sinkholes and latrines (Manning et al. 1989). A total of 21 Myotis evotis*** individuals were documented along Mammoth Creek on the Cedar City Ranger District during two surveys that occurred in June and August of 1994.

Females form small maternity colonies of 12 to 30 individuals in the summer, where a single young is born. Males, and perhaps non-breeding females, live singly or in small groups occasionally occupying the same site as a maternity colony but roosting apart (Cowan et al. 1960). Although little is known about hibernacula, this species is believed to seek winter retreats primarily in caves and abandoned mines and migrate short distances between summer and winter habitat (Manning et al. 1989).

The Myotis evotis*** emerges as early as 0.5 h after sunset, but in general, is considered a late forager, often emerging after midnight (Dalquest 1948, Vaughan 1954). These bats are categorized as hovering gleaners, often foraging by picking prey from the surface of foliage, tree trunks, rocks and the ground (Findley 1987). They tend to fly in a slow, straight course, about 12 m above the ground, while searching for emerging prey (Ingles 1949). Although moths are the major food source for the long-eared myotis, they will also consume beetles, flies, sawflies, bugs and aphids.

IIIA4. Myotis thysanodes*** (Fringed myotis)

The fringed myotis is a candidate species with C2 status for federal threatened or endangered listing with the USFWS. Three subspecies are recognized: Myotis thysanodes aztecus***, M. t. thysanodes***and M. t. pahasapensis***. There geographic distribution ranges in western North America from British Columbia to Veracruz and Chiapas (O'Farrell et al. 1980). The subspecies M. t. thysandodes*** occurs throughout the state of Utah.

The fringed myotis occurs primarily at elevations between 4,000-7000 feet in desert, grass and woodland habitats, but is also found up to 9350 feet in spruce-fir habitat (O'Farrell et al. 1980). Oak and pinyon woodlands appear to be the most commonly used vegetative association. Roost sites have been located in mine tunnels, caves and buildings, and may serve as a day or night roost sites (Pearson et al. 1952). The fringed myotis is known to migrate, and it is speculated that fall migration is of short distances to lower elevations or southern areas where they can be periodically active in winter. No Myotis thysanodes*** were observed at any of the bat survey locations on the Dixie National Forest in July-August, 1994 (Lengas 1994).

Foraging activity for the fringed myotis appears to be greatest between 1 and 2 hours after sunset. Their flight is slow and highly maneuverable with foraging occurring in proximity to vegetative cover, typically over watercourses. About 73% of their diet is made up by beetles, although moths and other insects are consumed as well (Black 1971).

Spring migration into a maternity roost usually occurs in mid to late April. During the summer, adult males are totally segregated from the maternity colony (O'Farrell et al 1980). This species appears to be easily disturbed by human presence, particularly before giving birth females become even more secretive (O'Farrell et al 1980). One young per female is born each year. These newborn bats are deposited in a cluster separate from the adult roost sites. Females periodically fly to the newborn cluster, nurse a young and then return to the adult roost. At night, the young are tended by 2-10 adult females, which suckle and retrieve fallen individuals when necessary. The rest of the foraging females usually return en masse to the maternity roost near dawn (O'Farrell et al 1980).

IIIA5. Myotis volans*** (Long-legged myotis)

The long-legged-myotis is a candidate species with C2 status for federal listing as threatened or endangered with the USFWS. Four subspecies are currently recognized: Myotis volans volans***, M. v. amotus*** , M. v. interior*** , and M. v. longicrus***. Their geographic distribution ranges in western North America from extreme southeastern Alaska and western Canada to central Mexico. The M. v. interior*** occurs throughout the state of Utah (Warner et al 1984)

The range of the long-legged myotis occurs between 200-12,400 feet, but can usually be found between 6560-9840 feet. Mainland races typically inhabit montane coniferous forests (pinyon-juniper, ponderosa pine, subalpine forests) and riparian areas, and rarely occur in arid lowland areas (Warner et al 1984). This species utilizes a variety of roosts including abandoned buildings, cracks in the ground, crevices in cliff faces and spaces beneath exfoliating tree bark. Night roosts consist of caves and mines that are also used as hibernacula (Schowalter 1980). A total of 3 ***Myotis volans individuals were documented in Water Canyon of the Pine Valley District and in Mammoth Creek of the Cedar City District during bat surveys that occurred in June of 1994 on the Dixie National Forest (Lengas 1994).

The long-legged myotis is active throughout most of the night, although peak activity typically occurs in the first 3 or 4 hours after sunset (Warner et al. 1984). This species is a rapid, direct flier, pursuing prey over long distances through, around, under and over the forest canopy (Fenton et al. 1980). Prey include primarily moths, but a variety of other soft-bodied invertebrates, including flies, termites, lacewings, wasps, bugs, leafhoppers and small beetles are also consumed (Warner et al. 1984).

Female Myotis volans*** store sperm overwinter with delayed fertilization and implantation occurring throughout the summer (Warner et al. 1984). In other myotis species, pregnancies tend to be more synchronized. A single young is produced per female per year in maternity colonies composed of hundreds of individuals. The long-legged myotis is known to live to at least 21 years (Warner et al. 1984).

IIIA6. Myotis yumanensis*** (Yuma myotis)

The Yuma myotis is a candidate species with C2 status for federal listing as threatened or endangered with the USFWS. Its distribution ranges in western North America from southern British Columbia to Baja California and Durango, Mexico (Burt et al. 1976).

Myotis yumanensis*** is attracted to wet areas and is most often found in arid environments including deserts and grasslands. Roost sites are located in caves, mine tunnels and buildings (Burt et al. 1976). Distributional records indicate the ***Myotis yumanensis may occur within the Dixie National Forest, although none were observed during bat surveys on the forest in July-August of 1994 (Lengas 1994).

The Yuma myotis is considered a late forager, and has the habit of flying close to the ground, darting over watercourses searching for small insects. Moths and midges account for a large portion of their diet.

Females roost together with their young in large, clumped colonies in caves and tunnels. Maternity colonies can contain hundreds to thousands of individuals (Tuttle et al. 1994). Usually one young is born between May and June and clings to the mother for a few days following birth (Burt et al. 1976).

IIIA7. Idionycteris phyllotis*** (Allen's big-eared bat)

The Allen's big-eared bat is a candidate species with C2 status for federal listing as treatened or endangered with the USFWS. Geographic distribution of this species ranges throughout Arizona and parts of Nevada, Colorado, southern Utah, California and New Mexico down through southern Mexico. In the southwestern United States, these bats are primarily from the Colorado Plateau, Mogollon Rim, and adjacent mountain ranges (Czaplewski 1983).

Idionycteris phyllotis*** occurs primarily in forested areas that include pine, oak, and riparian woodlands of sycamore, cottonwood, willow and walnut. Occasionally they can be found in more arid environments. Elevation, for this species ranges between 2,600 and 9,800 feet, however, the majority are often found between 3,500 and 7,500 feet. These bats usually occur in close proximity to rocky areas, cliffs, outcroppings, boulder piles or lava flows where they probably roost (Czaplewski 1983). Audible vocalizations of either E. maculatum, I.phyllotis*** , or both were noted along Swain's Creek, in the Cedar City District of the Dixie National Forest, during bat surveys conducted in June and August 1994 (Lengas 1994).

The Allen's big-eared bat emerges relatively late, and is known to forage between 1.5 to 2 hours after sunset until just before dawn. In a closed in forested environment, this species is highly maneuverable, and is able to fly slowly, hover and even fly vertically. Out in the open, they are able to fly quickly and directly from one place to another. Use of these various flight patterns makes this species a highly adaptable forager in a between, within and below canopy environment (Black 1974). Moths are the primary food for the Allen's big-eared bat, but they will also consume soldier beetles, dung beetles, leaf beetles, roaches and flying ants. Most of their food is gleaned from vegetation or other surfaces or is retrieved in flight by individual persuit (Czaplewski 1983).

Females segregate from the males in the summer to form maternity colonies, while males probably remain solitary and roost elsewhere. Young are born sometime between mid June and the end of July in colonies located in mine tunnels and rock piles that contain dozens to about two hundred individuals (Tuttle 1994, Cockrum and Musgrove 1964). The Allen's big-eared bat is docile in nature and will fold its large ears back over its shoulders or coil them in a ram's horn fashion to protect them and while resting (Burt et al. 1976, Czaplewski 1983).

IIIA8. Tadarida brasiliensis*** (Brazilian free-tailed bat)

The Brazilian free-tailed bat is a species of concern because of declining populations. It is not yet a candidate for federal threatened or endangered listing with the USFWS, however (Tuttle 1994). Brazilian free-tails are one of the most widely distributed mammalian species in the Western Hemisphere, extending from southern Oregon east to Nebraska, then south through Oklahoma and Texas, then east through Arkansas, northern Alabama, Mississippi, Georgia and southern North Carolina, south through Mexico, to Central America and portions of South America (Wilkins 1989). This species inhabits the southern four-fifths of the state of Utah where suitable roost sites are available (Lengas 1994). Utah Brazilian free-tailed bats are divided into two regional populations: those bats that summer in southwestern Utah, which migrate into southern California and Baja California during the winter, and those bats that summer in southeastern Utah, which migrate into Jalisco, Sinaloa and Sonora (Glass 1982).

Brazilian free-tailed bats occupy a variety of habitats, but they occur mainly in lowland areas (Lengas 1994). Roost sites are often located in caves, mines, and buildings, yet culverts, bridges, hollow trees and sink holes are also used (Lengas 1994, Wilkins 1989). Caves occupied by this species may be selected for attributes that will allow roomy access and accommodations for millions of bats (Davis et al. 1962). One Tadarida brasiliensis*** was documented while foraging in Swains Creek of the Cedar City District during bat surveys in August 1994 (Lengas 1994).

Mating usually occurs in the winter range at lower latitudes before spring migration. Many males do not migrate northward in spring, but remain in their winter range throughout summer (Glass 1982). Males that migrate north sometimes occupy summer bachelor colonies, usually numbering in the hundreds. Females return northward to give birth and raise their young in maternity colonies that may include up to hundreds of thousands of individuals (Tuttle 1994).

Emergence from roosting sites can be diffuse, showing little group integrity, or it can be dramatic, where individuals exit rapidly in a winding serpentine column extending across the sky for a couple miles (Wilkins 1989). Foraging usually begins about 0.5 hour before sunset, but it can be influenced by the size of the colony, cave openings and climatic factors. Brazilian free-tailed bats may fly 30 miles or more to reach foraging areas (Davis et al., 1962). Groups of bats may cover an area as large as 250 square miles, at speeds over 25 miles per hour and at heights of 9,800 feet or more (Williams et al. 1973). Most foraging and cruising takes place at heights between 20 and 50 feet. Moths provide close to 90% of the Brazilian free-tail bat diet (Ross 1961), but other insects, including ants, beetles and leafhoppers are also taken. On an average, these bats spend nearly 4 hours away from the roost while foraging.

Lifespan for the Brazilian free-tailed bat is about 15 years with predicted survival rate of 70 to 80% (Davis et al, 1962). A variety of vertebrate species prey on this species including American kestrels, Mississippi kites, red-tailed hawks, roadrunners, great horned owls, barn owls, skunks, raccoons, opossum and snakes.

IIIB. Grazing at Proper Use

IIIB1. Direct and Indirect Effects

There would be no direct or indirect effects of grazing at proper use on bat species that forage over riparian areas in satisfactory condition. On the other hand, implementation of "proper use" is expected to provide a beneficial effect to bat species in riparian areas that are in poor condition, by stabilizing streambanks, increasing surface water, and improving plant and insect diversity and abundance for foraging habitat.

The effects of sheep grazing in riparian and upland areas is expected to be minimal. Sheep prefer to graze on slopes and upland pastures, but occasionally may concentrate in areas to access water. These effects can be controlled and minimized by proper herding techniques. Assuming proper herding techniques and utilization are followed, sheep grazing should have little or no effect on bat population viabilitly or their habitats.

Cattle grazing at proposed levels of 40-60% utilization of current year's growth on upland pastures and in the crested wheatgrass reseeds in good condition, would be expected to maintain habitat for bats foraging in the open. On the otherhand, pastures in poor condition, might be expected to improve with varying 40-60% use, assuming livestock are removed early enough to allow plant regrowth for improved plant vigor and site protection. The maintenance of vegetative cover provides important habitat conditions for insects during their lifecycle, resulting in prey availability for these bat species. Furthermore, the developement and maintenance of water sources for livestock use may unintentionally provide beneficial effects to foraging bat species in upland habitats.

IIIB2. Cumulative Effects

Because there would be no direct or indirect effects of grazing on bat species of concern or their foraging habitat in riparian and upland pastures that are currently in satisfactory condition, these actions are not cumulative with other past, present or future effects. Beneficial effects of the Proposed Action in riparian and upland foraging habitat currently in poor condition, is cumulative with other past and present management activities across Forest lands that restrict wildlife, livestock and recreational use through fencing, road closures and enforcement of livestock utilization standards.

IIIC. No Grazing

IIIC1. Direct and Indirect Effects

Elimination of grazing would allow riparian areas that are in unsatisfactory condition, due to past heavy use, to improve. Riparian plant composition and vigor would increase and move toward becoming a potential natural community. Over time, the accumulation of plant litter could retard plant production unless wildlife remove the dead material periodically (Clary and Webster 1989). With the accumulation of ground cover for protection, streambank stability would increase and erosion decrease. Eventually, an aggrading channel and rising water table, may increase surface water and allow yearlong flows in potential sites. These improved conditions would provide suitable habitat for foraging bats by attracting a diverse and abundant prey source and provide surface water for drinking.

Elimnation of grazing in the crested wheatgrass reseeds would eventually convert these sites back to a more natural community as native trees, shrubs, forbs and grasses recolonize former pastures. Increased plant diversity and foliage surface area, would increase prey diversity and abundance, and improve the foraging potential for those bats that are foliage gleaners or that forage next to tree canopies.

Upland pastures in poor condition due to past livestock use, would improve over time with the implementation of the No Action Alternative. Increased plant densities and diversity and maintenance of ground cover throughout the year would be expected to increase bat prey diversity and abundance. On the other hand, bats are often attracted to water that has been developed for livestock use. With the implementation of the No Action Alternative, the maintenance of these water sources would probably be eliminated, unless maintenance continued for wildlife purposes.

IIC2. Cumulative Effects

Implementation of the No Action Alternative would not be cumulative with past and present activities that have reduced the health and vigor of riparian and upland pastures across Forest lands. Activities that have contributed to deteriorating watersheds include livestock/wildlife grazing and trampling and increased recreational use. Elimination of grazing would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

IV. Brian Head Mountainsnail

The Brian Head Mountainsnail (Oreohelix parowanensis) is only known to occur from the type locality, a rock slide near the top of Brian Head Peak (USFWS 1995). This snail probably spends most of its life among rock crevices well below the surface in a large rock slide at an altitude of about 11,200 feet. This area is excluded from grazing as specified in the grazing permit. Therefore, sheep grazing would have no effect on the snail or its habitat.

Elimination of grazing would have no effect on the Brian Head Mountainsnail. There would be no disturbance and to the habitat or the snail.

IIB. Neotropical Migratory Birds

Habitat requirements of neotropical migratory birds differ by species. For example, birds nesting in open habitats have been significantly affected by grazing whereas cavity-nesters have been essentially unaffected (Good and Damback 1943, Butler 1979, Bock 1992). Aerial, bark and canopy insectivores have been less influenced by grazing than species feeding on nectar, insects, or seeds in the understory or on the ground (Szaro and Rinne 1988).

Most neotropical migratory birds that are negatively influenced by grazing are those dependent on herbaceous ground cover or shrubs (Bock et al. 1992, Knopf et al. 1988) and/or that may be especially vulnerable to cowbird parasitism (Bock et al. 1992). Habitat structure is generally important to birds. Changes in vegetation that affect neotropical migratory birds include conversions of species composition, changed vegetation density and verticle/horizontal structure (Schultz and Leininger 1990), and by reducing cover or increasing edge allowing increased predation (Terborgh 1992) and/or parasitism by brown-headed cowbirds (Terborgh 1992, Sedgwick and Knopf (1988).

Examples of changes in species composition decreasing bird abundance and species richness include cottonwood/willow to tamarisk (Hunter et al. 1988) and native grasses to cheatgrass (Bock et al. 1993). An example of species composition changes that enhance bird species richness is sagebrush invasion of crested wheatgrass seedings (McAdoo et al. 1989). Reduction of herbage and biomass could reduce numbers of insects on which some neotropical birds feed.

Riparian woodlands are habitats that provide the highest diversity and abundance of neotropical migratory birds (Bock et al. 1992). Therefore, management of riparian ecosystems have a high potential for significantly affecting many neotropical migrants (Bock et al. 1992). Few species appear to benefit from grazing in riparian habitats, and those that do benefit are not restricted to riparian communities (Bock et al. 1992).

IIB1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

The yellow-breasted chat is a Neotropical migratory bird species, and the discussion regarding the effects of grazing on species dependent upon riparian shrub thicket habitats would also apply to other neotropical migratory bird species requiring this structure. Therefore, the effects to species requiring this habitat are the same and are incorporated here by reference.

Elimination of riparian vegetation has a decidedly negative impact on the associated bird community (Knopf et al. 1988). Species such as willow flycatchers, Lincoln's sparrows and white-crowned sparrows appear to be intolerant of structure depicted by mushroom-shaped shrubs that are widely spaced (Knopf et al. 1988). Different strata of vegetation have differenty vulnerabilities to grazing. The upper canopy can be indirectly affected if grazing the young trees does not allow regeneration of this component (Knopf 1988).

Based on these findings and consultation with Winward (pers. com. 1995), spring, summer, or fall grazing at proper use in riparian areas in poor condition (low plant vigor, composition and structure as well as hydrologic charactertistics discussed in the Hydrology section) would result in some improvement if past grazing has exceeded this amount. Riparian areas in poor condition would also be expected to improve. Habitat for neotropical birds that respond negatively to grazing would be expected to be maintained or increased with proper use in areas with poor riparian conditions, unless brown-headed cowbirds have decreased populations such that they are unable to respond to improved conditions. Species that respond positively to grazing would be expected to be maintained.

Inadvertent physical trampling or bumping young in nests on the ground or in low shrubs or trees could occur with spring or early summer grazing. No physical damage to nests or young would occur with fall grazing.

Upland habitats, including shrubsteppe, montane coniferous and juniper woodlands, are also important for neotropical migratory birds. Unfortunately, little information is available regarding the effects of grazing on these habitats as they relate to neotropical migratory birds. However, verticle and horizontal structure and complexity of vegetation has been demonstrated to be an important element in maintaining habitat for avifauna in uplands as well as riparian areas (McAdoo et al. 1989, Knopf et al. 1988, Medin 1990, Castrale 1982, Sieg 1991).

Grazing (sheep or cattle) at 50% of current year's growth would be expected to maintain verticle and horizontal structure and complexity where it presently exists. In pastures without these characteristics, structure and complexity would be expected to continue to be lacking and bird species richness would be low.

Sheep tend to graze on forbs which may cause grasses to be more prevalent. Some neotropical migratory birds depend upon forbs and seeds of grasses and forbs for food (for example hummingbirds forage on flowers to obtain nectar and sparrows forage grass or forb seeds). Available flowers and seeds may be fewer in uplands grazed by sheep but grazing is not expected to be uniform, therefore, there would still be flowers and seeds available.

IIB2. Direct, Indirect, and Cumulative Effects of No Grazing

Effects described above for the No Action Alternative on yellow-breasted chat would apply to other neotropical migratory birds requiring this type of habitat and therefore is incorporated here by reference.

In uplands that are in good condition, it would be expected that plant species composition and vigor would remain the same or slightly increase. Species abundance may increase and structural composition may become more complex in localized areas. In uplands in poor condition it would be expected that plant composition, vigor and abundance would increase and verticle and horizontal structure would become more complex. This would be expected to increase bird abundance and bird species richness.

Riparian areas in good condition would be expected to maintain essentially the same condition, with localized increases in verticle and horizontal structure as well as some increased plant abundance. Neotropical bird populations, therefore, would expect to stay the same or experience some increases in localized areas. Riparian areas in fair or poor condition would be expected to increase in plant vigor, abundance and structural characteristics, which would be expected to increase bird species abundance and richness.

Brown-headed cowbird parasitism would be expected to decrease in areas where no grazing promotes thicker wider riparian vegetation. Narrow, linear willow riparian areas may make areas especially attractive to cowbirds (Sedgwick and Knopf 1988) and patchy shrub/willow habitats are more easily penetrated for parasitism.

IIC. Passerine Birds

Juniper woodlands provide important habitat for wintering passerine birds (Sieg 1991). Higher bird densities and greater species richness has been observed in juniper stands when compared to grasslands. Results of Sieg's research (1991) indicate that Rocky Mountain juniper woodlands contribute nesting habitat, migratory corridors and winter food and cover for birds generally restricted to forested sites and enhances grasslands by providing increased edge habitat for birds requiring some woody cover. Sagebrush/grasslands are also important habitats for wintering or resident birds.

IIC1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

The effects of grazing at proper use described for the yellow-breasted chat and Neotropical migratory birds would also apply to passerine birds and are therefore incorporated here by reference. Passerines not addressed in these previous discussions include resident and wintering species.

Seed-eaters that may winter in these habitats (dark-eyed juncos or horned larks for example) depend upon seeds remaining through the winter for food. At higher elevations species such as rosy-finches depend upon seed along alpine areas at snowlines during fall and spring. Proper use in these habitats in good condition is expected to maintain some seed at the end of the grazing season and maintain the vigor of plants in these habitat types. Grazing on the uplands is often not evenly distributed and areas with abundant seed would be expected. Therefore, populations of passerines wintering in these habitats would be expected to be maintained at current levels.

Grazing at 50% on these habitats that are in poor condition would be expected to be maintained in this poor condition or continue to deteriorate depending upon how poor the conditions.

IIC2. Direct, Indirect, and Cumulative Effects of No Grazing

The effects of no grazing on passerine birds would include the effects described for yellow-breasted chats and neotropical migratory birds and are incorporated here by reference.

No grazing on upland areas would allow more seeds available for food for seed-eating resident or wintering birds This may help survival of these populations through the winter. No grazing on uplands in poor condition would allow growth of grasses forbs and shrubs which would increase verticle and horizontal diversity, benefiting passerine birds. In habitats in good condition increased verticle and horizontal diversity would not be expected to be as apparent or affect passerine bird populations measurably.

IID. Northern Flicker: Dixie NF Management Indicator Species (MIS)

The northern flicker (Colaptes auratus) has been designated as a Management Indicator Species in the Dixie National Forest Land and Resource Management Plan (USDA 1986) to indicate the health of mature aspen and conifer woodlands. Flickers are found in woodlands from Alaska to Mexico and coast to coast. Three sub-species are currently recognized: C. a. mearnsi, C. a. auratus and C. a. cafer.

The Colaptes auratus cafer, or red-shafted flicker, is common throughout the west and will interbreed with the other subspecies and produce hybrids where their ranges overlap (Terres 1991). They are generally found with the mature conifer and aspen types, but are also found in other forest types up to timberline, as well as near human dwellings and agricultural areas.

The northern flicker is a primary cavity nester, and is an indicator species for other wildlife requiring snags for nesting, roosting and foraging habitat. They will often seek shelter before sundown in one of their roost holes located in trees, but will also drill holes in the sides of barns and houses for winter roosts (Terres 1991). Males play a major role in selecting a nest site and dig out a hole using their bills. They will often reuse old nest holes where 5-10 eggs are laid on top of a mat of wood chips at the bottom of the hole.

The diet of the northern flicker is quite varied. Approximately 75% of its diet is composed of insects that includes ants (45%), beetles, wasps, grasshoppers, crickets, bugs, lice, caterpillars, grubs and other flying insects. The remainder of its diet is composed of fruits, berries and seeds from numerous plant species.

A decline in the number of flickers since the 1950s may be partially due to increased competion with the aggressive starling for the flickers' nesting hole (Terres 1991).

IID1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

There would be no direct or indirect effects on the northern flicker. The flicker's critical habitat element of dead standing trees would not be affected by grazing at proper use.

Because there are no direct or indirect effects of grazing on flickers or their habitat, these actions are not cumlative with other past, present, or future effects.

IID2. Direct, Indirect, and Cumulative Effects of No Grazing

There would be no direct or indirect effects on the northern flicker. The flickers critical habitat element of dead standing trees would not be affected by the elimination of grazing.

Because there are no direct or indirect effects of grazing on flickers or their habitat, these actions are not cumlative with other past, present, or future effects.

IIE. Western Burrowing owl (Athene cunicularia hypugaea): Species-of-Special-Concern- U.S. Fish & Wildlife Service

A medium-small owl of open or arid areas that is often seen in daylight. Preys upon insects, small mammals, reptiles and occasionally small birds (Ehrlich et al. 1988).

In Utah, their preferred habitat is arid grasslands and desert shrublands of the Great Basin (Lindsey & Poswiatoswski 1993). Often found where vegetation is sparce or the soil has been disturbed through over-grazing, agriculture, fire or construction (Marshall 1991).

Nesting occurs in mammal burrows which the owls may modify or renovate; ground squirrel, prairie dog, or abandoned badger burrows are most often used (Ehrlich et al. 1988, Lindsey & Poswiatoswski 1993, Marshall 1991). Burrows are often lined with either cow or horse dung, this is thought to mask nesting odors (Ehrlich et al. 1988, Marshall 1991). Desertion is the major cause of nest loss; Marshall(1991) found this occurred when nests were within 360 feet of each other. This was attributed to competition between owl pairs for a limited food supply (Marshall 1991).

Haug and Oliphant (1990) noted that during their study of burrowing owl movements in central Saskatchewan, grazed pastures were avoided for foraging in relation to their abundance. They suggest this occurred because overgrazing by livestock removed all the vegetation that small mammals would use as cover and a food source for grasshoppers.

Declines in populations numbers are thought to be a direct effect from pesticides, control programs (prairie dogs, and ground squirrels) and loss of habitat due to urbanization.

ID1. Direct, Indirect, and Cumulative Effects of Grazing at Proper Use

Under proper grazing of uplands by livestock, owls will not experience direct or indirect effects. Consequently, these actions are not cumulative with other past, present or future actions. Therefore, no cumulative impacts are expected on burrowing owls under the proposed action of proper-use grazing.

ID2. Direct, Indirect, and Cumulative Effects of No Grazing

Implementation of the No Action Alternative would not be cumulative with past and present activities across Forest lands. Implementation of the No Action Alternative would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

III. Bat Species

Of the 44 bat species that inhabit North America, 6 species are listed as endangered and 18 are candidates for federal listing as threatened or endangerd with the USFWS. Although a few individual colonies number in the millions, bats in general rank as the most endangered land mammal in the United States. Some of the actual and potential threats to bats include: loss of roosting habitat due to mine and cave closures and snag removal, vandalism and human disturbances within maternity colonies and hibernacula, pesticide poisoning and loss of surface water (Lengas 1994, Tuttle 1994).

Because some bats feed on insects over water, and most require between 6 and 100 feet of open water to drink, loss of surface water in the west may threaten many bat populations. Although properly managed livestock grazing is generally compatible, unwise livestock use is considered the most common cause of deteriorated riparian areas in western rangelands (Kovalchik et al. 1992).

Willows, sedges and rushes have strong root systems that hold streams together. Woody species, such as willow, provide channel stability and resistance to erosion. With an aggrading channel, a rising water table stores more wet season water, slows the water's release and may allow yearlong flows (Elmore and Beschta 1987). Healthy functioning riparian ecosystems also provide habitat for a diverse and abundant plant community and insect population that are attractive to numerous foraging bat species.

Livestock alter reparian areas by trampling, rubbing, grazing and browsing. Given the opportunity, cattle will spend between 5 to 30 times longer in a riparian area compared to adjacent upland areas. Riparian areas are selected by livestock because of higher forage volumes, greater palatability, nearness to water and desirable microclimatic conditions (Clary and Webster 1989). Over time, excessive cattle use reduces or eliminates riparian vegetation, modifies streambed and channel morphology, increases stream channel width, increases stream sediment transport and lowers the surrounding water table (Clary and Webster 1989).

Little information is available on how well managed grazing systems affect riparian streams that in turn affect suitable bat foraging habitat. Some studies on riparian health indicate that a minimum of 4 inch stubble height, remaining on hydric species at the end of the season is needed to maintain plant vigor, composition and density for streambank protection for riparian areas in the mid-to-late seral stage (Clary and Webster 1989). But, as much as 6 inch stubble height may be necessary in the very early to early seral stage to ensure streambank recovery and improvement (Winward 1995). Other "proper use" conditions for ripararian areas, accepted by the Dixie National Forest, include: a minimum of two inch stubble height on transitional species between upland and riparian areas at the end of the season; a maximum of 20% accelerated streambank disturbance; and a maximum of 50% utilization of new leader growth on riparian browse species. Livestock would need to be removed from the riparian system when one of these conditions are present to maintain or improve riparian functions (Winward 1995).

The eight bat species considered below have been brought to our attention by the United States Fish and Wildlife Service (USFWS) as species of concern. Six of the eight bat species are candidates for federal listing as endangered or threatened. The other two have either declining populations or their status is unknown. Life histories of the individual bat species will be addressed separately below. Because the effects of the Proposed Action and No Action would be similar for these species, they will be lumped together under those headings.

IIIA. Life Histories

IIIA1. Myotis californicus*** (California myotis)

The California myotis is a small bat of special concern because its population status is unknown. They have not been proposed for federal threatened or endangered listing with the USFWS at this time, however. These bats range from the Alaskan panhandle to Baja California and Chiapas, Mexico, with distribution often disjointed in many areas (Simpson 1993). The subspecies *** Myotis californicus stephensi occurs in the Colorado River and Great Basin regions (Bogans 1974).

Habitat for the California myotis includes desert and semidesert regions as well as grasslands and ponderosa pine stands. During the summer, this species roosts alone or in small groups in narrow crevices on rocky hillsides, mine tunnels, man-made structures, hollow trees, and under loose slabs of bark (Krutzsch 1954, Lengas 1994). This species also roosts on small desert shrubs, rock outcrops and on the ground (Hirshfeld et al., 1977). No California myotis were observed at any of the bat survey locations on the Dixie National Forest in July-August, 1994 (Lengas 1994).

Foraging usually begins soon after sunset and is greatest in the early hours of the evening. It hunts and feeds rapidly then retires to a night roost for a brief rest, after which it resumes hunting (Woodsworth 1981). The California myotis is a short-range forager, flying slowly, yet with a darting flight pattern, usually less than 15 feet above the ground ((O'Farrell et al. 1967). Hunting typically takes place along margins of tree clumps, around the edge of the tree canopy, over water and well above ground in open country (Woodsworth 1981). Scat and stomach analysis indicate that ***M. californicus consumes mainly lepidopteran (moths and butterflies) and dipteran (flies) prey with smaller amounts of coleopteran (beetles) and hemipteran (bugs) prey in eastern Oregon (Whitaker el al., 1981.)

Breeding occurs in late autumn over most of the distributional range, except in California when it occurs in early spring. The females gather in large maternity colonies, usually located in a narrow crevice, and produce one young/year during early summer (Krutzsch 1954). The potential reproductive life span of the California myotis is 15 years (Duke et al. 1979).

IIIA2. Myotis ciliolabrum ****(Western small-footed bat)

The western small-footed bat is a Canidate species with the United States Fish and Wildlife Service (USFWS) with C2 status. Current information indicates that proposing to list as endangered or threatened is possible. Appropriate, but substantial biological information is not on file to support an immediate rulemaking however.

The western small-footed myotis occurs statewide in Utah (Hall 1981, Zeveloff 1988). This bat is found in a variety of habitats that include desert and semi-desert regions as well as in forested stands and along watercourses (Zeveloff 1988). It generally occurs at moderate elevations (Ingles 1965, Armstrong 1972) in habitats that contain rocky outcrops with deep crevices, where it prefers to roost, but it has also been known to roost under loose bark and in buildings (Legas 1994). Despite its small size, the western small-footed bat hibernates throughout its summer range in rock crevices, caves and mines (Lengas 1994). A total of 3 ***Myotis ciliolabrum individuals were documented in Water Canyon of the Pine Valley District and in Mammoth Creek of the Cedar City District during bat surveys in June 1994 (Lengas 1994).

The western small-footed bat is an aerial forager, flying low among the trees and brush. Prey includes a variety of small insects, but they seem to prefer beetles to other available insects (Black 1974).

A single young is produced between May and July. Although this bat is generally a solitary species, it has been reported that mothers will remain with the newborns in small maturnity colonies of up to 20 individuals.

IIIA3. Myotis evotis***(Long-eared myotis)

The long-eared myotis is a candidate species with C2 status for federal threatened or endangered listing with the USFWS. Two subspecies are recognized: Myotis evotis pacificus*** and the Myotis evotis evotis***. These species occur in temperate western North America and are found from central British Columbia and southern Saskatchewan and Alberta southward along the Pacific Coast to Baja California, eastwardly through Montana and Idaho to the western Dakotas and from Nevada, Utah, Wyoming and Colorado to New Mexico and Arizona (Manning et al. 1989). The M. e. evotis occurs throughout the state of Utah.

The long-eared myotis occurs mostly in forested areas, but has also been known to occur in a variety of habitats where suitable roost sites are available (Lengas 1994). Habitats where this bat has been observed or collected include: short-grass prairie, semiarid shrublands, chaparral, agricultural areas, open meadows, water courses, reservoirs, deciduous forest edges, dry coniferous forests and sub-alpine timber (Manning et al. 1989). Day-time roost sites are frequently in buildings, but they have also been found roosting in hollow trees, behind loose slabs of bark, in caves and mines, in fissures of rocks, sinkholes and latrines (Manning et al. 1989). A total of 21 Myotis evotis*** individuals were documented along Mammoth Creek on the Cedar City Ranger District during two surveys that occurred in June and August of 1994.

Females form small maternity colonies of 12 to 30 individuals in the summer, where a single young is born. Males, and perhaps non-breeding females, live singly or in small groups occasionally occupying the same site as a maternity colony but roosting apart (Cowan et al. 1960). Although little is known about hibernacula, this species is believed to seek winter retreats primarily in caves and abandoned mines and migrate short distances between summer and winter habitat (Manning et al. 1989).

The Myotis evotis*** emerges as early as 0.5 h after sunset, but in general, is considered a late forager, often emerging after midnight (Dalquest 1948, Vaughan 1954). These bats are categorized as hovering gleaners, often foraging by picking prey from the surface of foliage, tree trunks, rocks and the ground (Findley 1987). They tend to fly in a slow, straight course, about 12 m above the ground, while searching for emerging prey (Ingles 1949). Although moths are the major food source for the long-eared myotis, they will also consume beetles, flies, sawflies, bugs and aphids.

IIIA4. Myotis thysanodes*** (Fringed myotis)

The fringed myotis is a candidate species with C2 status for federal threatened or endangered listing with the USFWS. Three subspecies are recognized: Myotis thysanodes aztecus***, M. t. thysanodes***and M. t. pahasapensis***. There geographic distribution ranges in western North America from British Columbia to Veracruz and Chiapas (O'Farrell et al. 1980). The subspecies M. t. thysandodes*** occurs throughout the state of Utah.

The fringed myotis occurs primarily at elevations between 4,000-7000 feet in desert, grass and woodland habitats, but is also found up to 9350 feet in spruce-fir habitat (O'Farrell et al. 1980). Oak and pinyon woodlands appear to be the most commonly used vegetative association. Roost sites have been located in mine tunnels, caves and buildings, and may serve as a day or night roost sites (Pearson et al. 1952). The fringed myotis is known to migrate, and it is speculated that fall migration is of short distances to lower elevations or southern areas where they can be periodically active in winter. No Myotis thysanodes*** were observed at any of the bat survey locations on the Dixie National Forest in July-August, 1994 (Lengas 1994).

Foraging activity for the fringed myotis appears to be greatest between 1 and 2 hours after sunset. Their flight is slow and highly maneuverable with foraging occurring in proximity to vegetative cover, typically over watercourses. About 73% of their diet is made up by beetles, although moths and other insects are consumed as well (Black 1971).

Spring migration into a maternity roost usually occurs in mid to late April. During the summer, adult males are totally segregated from the maternity colony (O'Farrell et al 1980). This species appears to be easily disturbed by human presence, particularly before giving birth females become even more secretive (O'Farrell et al 1980). One young per female is born each year. These newborn bats are deposited in a cluster separate from the adult roost sites. Females periodically fly to the newborn cluster, nurse a young and then return to the adult roost. At night, the young are tended by 2-10 adult females, which suckle and retrieve fallen individuals when necessary. The rest of the foraging females usually return en masse to the maternity roost near dawn (O'Farrell et al 1980).

IIIA5. Myotis volans*** (Long-legged myotis)

The long-legged-myotis is a candidate species with C2 status for federal listing as threatened or endangered with the USFWS. Four subspecies are currently recognized: Myotis volans volans***, M. v. amotus*** , M. v. interior*** , and M. v. longicrus***. Their geographic distribution ranges in western North America from extreme southeastern Alaska and western Canada to central Mexico. The M. v. interior*** occurs throughout the state of Utah (Warner et al 1984)

The range of the long-legged myotis occurs between 200-12,400 feet, but can usually be found between 6560-9840 feet. Mainland races typically inhabit montane coniferous forests (pinyon-juniper, ponderosa pine, subalpine forests) and riparian areas, and rarely occur in arid lowland areas (Warner et al 1984). This species utilizes a variety of roosts including abandoned buildings, cracks in the ground, crevices in cliff faces and spaces beneath exfoliating tree bark. Night roosts consist of caves and mines that are also used as hibernacula (Schowalter 1980). A total of 3 ***Myotis volans individuals were documented in Water Canyon of the Pine Valley District and in Mammoth Creek of the Cedar City District during bat surveys that occurred in June of 1994 on the Dixie National Forest (Lengas 1994).

The long-legged myotis is active throughout most of the night, although peak activity typically occurs in the first 3 or 4 hours after sunset (Warner et al. 1984). This species is a rapid, direct flier, pursuing prey over long distances through, around, under and over the forest canopy (Fenton et al. 1980). Prey include primarily moths, but a variety of other soft-bodied invertebrates, including flies, termites, lacewings, wasps, bugs, leafhoppers and small beetles are also consumed (Warner et al. 1984).

Female Myotis volans*** store sperm overwinter with delayed fertilization and implantation occurring throughout the summer (Warner et al. 1984). In other myotis species, pregnancies tend to be more synchronized. A single young is produced per female per year in maternity colonies composed of hundreds of individuals. The long-legged myotis is known to live to at least 21 years (Warner et al. 1984).

IIIA6. Myotis yumanensis*** (Yuma myotis)

The Yuma myotis is a candidate species with C2 status for federal listing as threatened or endangered with the USFWS. Its distribution ranges in western North America from southern British Columbia to Baja California and Durango, Mexico (Burt et al. 1976).

Myotis yumanensis*** is attracted to wet areas and is most often found in arid environments including deserts and grasslands. Roost sites are located in caves, mine tunnels and buildings (Burt et al. 1976). Distributional records indicate the ***Myotis yumanensis may occur within the Dixie National Forest, although none were observed during bat surveys on the forest in July-August of 1994 (Lengas 1994).

The Yuma myotis is considered a late forager, and has the habit of flying close to the ground, darting over watercourses searching for small insects. Moths and midges account for a large portion of their diet.

Females roost together with their young in large, clumped colonies in caves and tunnels. Maternity colonies can contain hundreds to thousands of individuals (Tuttle et al. 1994). Usually one young is born between May and June and clings to the mother for a few days following birth (Burt et al. 1976).

IIIA7. Idionycteris phyllotis*** (Allen's big-eared bat)

The Allen's big-eared bat is a candidate species with C2 status for federal listing as treatened or endangered with the USFWS. Geographic distribution of this species ranges throughout Arizona and parts of Nevada, Colorado, southern Utah, California and New Mexico down through southern Mexico. In the southwestern United States, these bats are primarily from the Colorado Plateau, Mogollon Rim, and adjacent mountain ranges (Czaplewski 1983).

Idionycteris phyllotis*** occurs primarily in forested areas that include pine, oak, and riparian woodlands of sycamore, cottonwood, willow and walnut. Occasionally they can be found in more arid environments. Elevation, for this species ranges between 2,600 and 9,800 feet, however, the majority are often found between 3,500 and 7,500 feet. These bats usually occur in close proximity to rocky areas, cliffs, outcroppings, boulder piles or lava flows where they probably roost (Czaplewski 1983). Audible vocalizations of either E. maculatum, I.phyllotis*** , or both were noted along Swain's Creek, in the Cedar City District of the Dixie National Forest, during bat surveys conducted in June and August 1994 (Lengas 1994).

The Allen's big-eared bat emerges relatively late, and is known to forage between 1.5 to 2 hours after sunset until just before dawn. In a closed in forested environment, this species is highly maneuverable, and is able to fly slowly, hover and even fly vertically. Out in the open, they are able to fly quickly and directly from one place to another. Use of these various flight patterns makes this species a highly adaptable forager in a between, within and below canopy environment (Black 1974). Moths are the primary food for the Allen's big-eared bat, but they will also consume soldier beetles, dung beetles, leaf beetles, roaches and flying ants. Most of their food is gleaned from vegetation or other surfaces or is retrieved in flight by individual persuit (Czaplewski 1983).

Females segregate from the males in the summer to form maternity colonies, while males probably remain solitary and roost elsewhere. Young are born sometime between mid June and the end of July in colonies located in mine tunnels and rock piles that contain dozens to about two hundred individuals (Tuttle 1994, Cockrum and Musgrove 1964). The Allen's big-eared bat is docile in nature and will fold its large ears back over its shoulders or coil them in a ram's horn fashion to protect them and while resting (Burt et al. 1976, Czaplewski 1983).

IIIA8. Tadarida brasiliensis*** (Brazilian free-tailed bat)

The Brazilian free-tailed bat is a species of concern because of declining populations. It is not yet a candidate for federal threatened or endangered listing with the USFWS, however (Tuttle 1994). Brazilian free-tails are one of the most widely distributed mammalian species in the Western Hemisphere, extending from southern Oregon east to Nebraska, then south through Oklahoma and Texas, then east through Arkansas, northern Alabama, Mississippi, Georgia and southern North Carolina, south through Mexico, to Central America and portions of South America (Wilkins 1989). This species inhabits the southern four-fifths of the state of Utah where suitable roost sites are available (Lengas 1994). Utah Brazilian free-tailed bats are divided into two regional populations: those bats that summer in southwestern Utah, which migrate into southern California and Baja California during the winter, and those bats that summer in southeastern Utah, which migrate into Jalisco, Sinaloa and Sonora (Glass 1982).

Brazilian free-tailed bats occupy a variety of habitats, but they occur mainly in lowland areas (Lengas 1994). Roost sites are often located in caves, mines, and buildings, yet culverts, bridges, hollow trees and sink holes are also used (Lengas 1994, Wilkins 1989). Caves occupied by this species may be selected for attributes that will allow roomy access and accommodations for millions of bats (Davis et al. 1962). One Tadarida brasiliensis*** was documented while foraging in Swains Creek of the Cedar City District during bat surveys in August 1994 (Lengas 1994).

Mating usually occurs in the winter range at lower latitudes before spring migration. Many males do not migrate northward in spring, but remain in their winter range throughout summer (Glass 1982). Males that migrate north sometimes occupy summer bachelor colonies, usually numbering in the hundreds. Females return northward to give birth and raise their young in maternity colonies that may include up to hundreds of thousands of individuals (Tuttle 1994).

Emergence from roosting sites can be diffuse, showing little group integrity, or it can be dramatic, where individuals exit rapidly in a winding serpentine column extending across the sky for a couple miles (Wilkins 1989). Foraging usually begins about 0.5 hour before sunset, but it can be influenced by the size of the colony, cave openings and climatic factors. Brazilian free-tailed bats may fly 30 miles or more to reach foraging areas (Davis et al., 1962). Groups of bats may cover an area as large as 250 square miles, at speeds over 25 miles per hour and at heights of 9,800 feet or more (Williams et al. 1973). Most foraging and cruising takes place at heights between 20 and 50 feet. Moths provide close to 90% of the Brazilian free-tail bat diet (Ross 1961), but other insects, including ants, beetles and leafhoppers are also taken. On an average, these bats spend nearly 4 hours away from the roost while foraging.

Lifespan for the Brazilian free-tailed bat is about 15 years with predicted survival rate of 70 to 80% (Davis et al, 1962). A variety of vertebrate species prey on this species including American kestrels, Mississippi kites, red-tailed hawks, roadrunners, great horned owls, barn owls, skunks, raccoons, opossum and snakes.

IIIB. Grazing at Proper Use

IIIB1. Direct and Indirect Effects

There would be no direct or indirect effects of grazing at proper use on bat species that forage over riparian areas in satisfactory condition. On the other hand, implementation of "proper use" is expected to provide a beneficial effect to bat species in riparian areas that are in poor condition, by stabilizing streambanks, increasing surface water, and improving plant and insect diversity and abundance for foraging habitat.

The effects of sheep grazing in riparian and upland areas is expected to be minimal. Sheep prefer to graze on slopes and upland pastures, but occasionally may concentrate in areas to access water. These effects can be controlled and minimized by proper herding techniques. Assuming proper herding techniques and utilization are followed, sheep grazing should have little or no effect on bat population viabilitly or their habitats.

Cattle grazing at proposed levels of 40-60% utilization of current year's growth on upland pastures and in the crested wheatgrass reseeds in good condition, would be expected to maintain habitat for bats foraging in the open. On the otherhand, pastures in poor condition, might be expected to improve with varying 40-60% use, assuming livestock are removed early enough to allow plant regrowth for improved plant vigor and site protection. The maintenance of vegetative cover provides important habitat conditions for insects during their lifecycle, resulting in prey availability for these bat species. Furthermore, the developement and maintenance of water sources for livestock use may unintentionally provide beneficial effects to foraging bat species in upland habitats.

IIIB2. Cumulative Effects

Because there would be no direct or indirect effects of grazing on bat species of concern or their foraging habitat in riparian and upland pastures that are currently in satisfactory condition, these actions are not cumulative with other past, present or future effects. Beneficial effects of the Proposed Action in riparian and upland foraging habitat currently in poor condition, is cumulative with other past and present management activities across Forest lands that restrict wildlife, livestock and recreational use through fencing, road closures and enforcement of livestock utilization standards.

IIIC. No Grazing

IIIC1. Direct and Indirect Effects

Elimination of grazing would allow riparian areas that are in unsatisfactory condition, due to past heavy use, to improve. Riparian plant composition and vigor would increase and move toward becoming a potential natural community. Over time, the accumulation of plant litter could retard plant production unless wildlife remove the dead material periodically (Clary and Webster 1989). With the accumulation of ground cover for protection, streambank stability would increase and erosion decrease. Eventually, an aggrading channel and rising water table, may increase surface water and allow yearlong flows in potential sites. These improved conditions would provide suitable habitat for foraging bats by attracting a diverse and abundant prey source and provide surface water for drinking.

Elimnation of grazing in the crested wheatgrass reseeds would eventually convert these sites back to a more natural community as native trees, shrubs, forbs and grasses recolonize former pastures. Increased plant diversity and foliage surface area, would increase prey diversity and abundance, and improve the foraging potential for those bats that are foliage gleaners or that forage next to tree canopies.

Upland pastures in poor condition due to past livestock use, would improve over time with the implementation of the No Action Alternative. Increased plant densities and diversity and maintenance of ground cover throughout the year would be expected to increase bat prey diversity and abundance. On the other hand, bats are often attracted to water that has been developed for livestock use. With the implementation of the No Action Alternative, the maintenance of these water sources would probably be eliminated, unless maintenance continued for wildlife purposes.

IIIC2. Cumulative Effects

Implementation of the No Action Alternative would not be cumulative with past and present activities that have reduced the health and vigor of riparian and upland pastures across Forest lands. Activities that have contributed to deteriorating watersheds include livestock/wildlife grazing and trampling and increased recreational use. Elimination of grazing would be cumulative with past and present management activities across Forest land that have restricted the use of these areas through road closures, fencing and utilization standards.

IV. Brian Head Mountainsnail

The Brian Head Mountainsnail (Oreohelix parowanensis) is only known to occur from the type locality, a rock slide near the top of Brian Head Peak (USFWS 1995). This snail probably spends most of its life among rock crevices well below the surface in a large rock slide at an altitude of about 11,200 feet. This area is excluded from grazing as specified in the grazing permit. Therefore, sheep grazing would have no effect on the snail or its habitat.

Elimination of grazing would have no effect on the Brian Head Mountainsnail. There would be no disturbance and to the habitat or the snail.

Cumulative Effects: Because no grazing would occur in or around habitat for this snail and no direct or indirect effects would occur, there would also be no cumulative effects.

EFFECTS OF LIVESTOCK GRAZING ON CULTURAL RESOURCES

Marian Jacklin, Dixie NF Archeologist

In accordance with the National Historic Preservation Act of 1966, the Antiquities Act of 1906, and the Archaeological Resource Act of 1979, the Federal management agency must assure that undertakings on lands under their jurisdiction are conducted with due regard for survey, evaluation amd mitigation of disturbances to cultural resources which includes both Historical, Archaeological and traditional cultural areas of the Native Americans. Those cultural resources found to be eligible for inclusion in the National Register of Historic Places (Historic Properties) will be avoided whenever possible and mitigation will be undertaken to protect and preserve these non-rewneable siginificant resources when they can not be avoided.

Within the lands determinined to be suitable for grazing on the Dixie National Forest a total of 113,165 acres have been intensively surveyed for cultural resources with a total of 1743 sites having been recorded. Of this total, 984
have been evaluated as being eligible for inclusion in the National Register of Historic Places and must be protected from disturbance.

Potential locations of archaeological sites can be predicted by using the information gathered from previous archaeological surveys. The following is a outline of the potential of locating siginificant cultural resources by vegetative zones:

a. Pinyon-Juniper Zone (5000-7000 ft.) At all elevations within this zone, especially along or near perennial water sources sites can be expected to occur. In terms of both quanity and significance of sites this zone is especially sensitive. Types of sites found in this zone include but are not limited to rock shelters, architectural sites, and open camp sites. This last group are thought to exist in siginificant numbers. Open camp sites represent the debris left by groups procuring, and processing natural resources. Features and artifacts likely to be found include wikiup rings, rock walls, cists, hearths, ground stones, projectile points, scrapers, drills, awls, knives and flakes from manufacturing processees. Camps of this nature can date from any time period: Archaic (6500 B.C. - A.D. 400), Formative (A.D. 400 - 1300) and Numic (A.D. 1250- present)

b. Ponderosa Zone (7000-9000 ft). Survey data would suggest that site density begins to decline once the ponderosa pine zone is entered. Sites that are found indicate that hunting and some plant processing is occuring. This would seem to indicate that groups would migrate to these areas to conduct limited activities on a seasonal basis. One such activity is the quarrying of chert nodules from the natural outcrops within the area. Again, people from all time periods of Utah prehistory are expected to have left camp debris beneath the ponderosa canopy.

c. Spruce-Fir-Aspen Zone (+9000 ft). Sites at these elevations and within these vegetative associations, are less common and appear to be small overnight camps or kill/butchering locations left by hunting parties. Sites are generally found along tree and meadow margins and around springs. The identification of sites within this zone is difficult due to heavy carpeting of duff and deadfall common for the zone. In the last two years survey work on the Forest has located very large cultural deposits of lithic material in several high (over 10,000 ft) meadows. It is felt these indicate a long period of occupation on a seasonal basis. The groups were spending time procuring raw materials and game and then traveling to the lower elevations for winter. The most common time period represented at these sites appear to be from the Archaic period. As limited research has been conducted on sites from this time period these sites are extremely significant.

Impacts of Grazing on Cultural Resources.

If archaeological sites can still be identified, their National Register potential assessed and the surface artifact distributions still identifiable after 100 + years of grazing, it can be assumed that grazing in the current trend has had no adverse effect to the characristics that make the sites significant and will continue that way. A archaeoloigcal site is rarely considered eligible for the National Register of Historic Places for it's surface features or artifacts. Most often the decision on eligibilty is based on the site's potential to provide scientific archaeological data, especially from deposits buried below the zone that could be affected by trampling of livestock. There has never been identified a trend of livestock grazing sufficiently injurious to cultural resources such that would necessitatecessation of all grazing within a permit area. There is on the other hand a potential for disturbance from certain livestock activities on individual sites. These appear to be cumulative in nature. These effects occur in areas of livestock concentration for the most part but can been seen also in dispersed areas. These are associated with development projects such as fences, salt grounds, water troughs, and bedding areas. To this end it is imperative that each site specific development project, prior to construction have a survey conducted to locate and evaluate sites on a case by case basis.

EFFECTS OF LIVESTOCK GRAZING TO RECREATION AND THE VISUAL RESOURCE ON THE DIXIE NATIONAL FOREST

Max Molyneux, Dixie NF Landscape Architect

The purpose of this paper is to evaluate the effects of range management on recreation and landscape management on the Dixie National Forest. It will examine what happens to recreation opportunities and the visual landscape when two activities converge on a location equally desirable.

I. What Constitutes Damage to Long-Term Recreation and Visual Resources?

A. Recreation

The USDA Forest Service developed a guide to identify recreation opportunities on National Forest Land. This guide provides a framework which allows administrators to manage for, and users to enjoy, a variety of recreation environments (USDA ROS Book, 1986). The desired setting for recreation opportunities available on forest land is described for six recreation opportunities.

1. Primitive: Unmodified natural or natural appearing environment with very low interaction between users. Minimal evidence of other users with restrictions or controls not evident. No vegetative alterations are permitted.

2. Semi-Primitive Non-Motorized: Natural appearing environment with a low interaction between users. Evidence of other users is evident with minimum of subtle on site controls. Vegetative alterations are small in size and number, widely dispersed and not evident.

3. Semi-Primitive Motorized: Predominantly natural appearing environment with low concentration of users but often contains evidence of others on trails. A minimum of on site controls and restrictions present but subtle. Vegetative alterations very small in size and number, widely dispersed and visually subordinate.

4. Roaded Travel: Mostly natural appearing environment as viewed from sensitive roads and trails. Interaction between users at campsites is of moderate importance. Some obvious on site controls of users. Access and travel is conventional motorized vehicles including sedan, trailers, RVs, and motor homes. Vegetative alterations done to maintain desired visual and recreational characteristics.

5. Rural: Natural environment is culturally modified yet attractive (i.e., pastoral farm lands). Backdrop may range from alterations not obvious to dominating. Interactions between users may be high as is evidence by other users. Obvious and prevalent site controls.

6. Urban: Urbanized environment with dominant structures, traffic lights, and paved streets. May have natural appearing backdrop. Recreation places may be city parks and large resorts. Interaction between large numbers of users is high. Intensive on site controls are numerous. Vegetation is planted and maintained.

B. Landscape Management

The USDA Forest Service developed Agricultural Handbook 462 establishing the process for development of visual quality standards. These standards based on the variety of the landscape features and the sensitivity of the the travel route, use area, or water body from which the areas are seen. The combination of the sensitivity levels and variety class of the landscape establish sensitivity levels. Their definitions are:

1. Preservation: Management activities , except for very low visual impact recreation facilities are prohibited.

2. Retention: Activities may only repeat form, line, color, and texture which are frequently found in the characteristic landscape.

3. Partial Retention: Activities may repeat form, line, color, or texture common to the characteristic landscape but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape. The activities may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but they should remain subordinate to the visual strength of the characteristic landscape.

4. Modification: Activities may visually dominate the original characteristic landscape. However, activities of vegetative and land form alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type. Additional parts of these activities such as structures, roads, slash, rood wads, etc., must remain visually subordinate to the proposed composition.

5. Maximum Modification: Activities with vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground.

The previous information defines Forest Service quality standards and guidelines that have been established to preserve recreation opportunities and landscape characteristic unique to this area. Recreation opportunities exist on the forest which may or may not exist in other location within the region. These opportunities may be forgone due to management practices occurring to enhance or maintain range on the forest. Visual quality objectives established to maintain landscape character types unique to this characteristic landscape have been set. It is the responsibility of the Forest to propose livestock grazing strategies and appropriate mitigation to ensure that the recreation opportunities and visual quality objectives are maintained.

II. What Effects Do Livestock Have on Recreation Opportunities?

According to Mitchell, Wallace, and Wells (1995), visitors in dispersed campsites tended to be more critical of grazing than those in developed sites. The number of visitors indicating that cattle added to their recreation visit and the number stating a negative relationship showed no difference in their study of recreation visitors to the Uncompahgre National Forest. In the same survey, 9% of the respondents listed livestock as the most important source of interference with their enjoyment of the Big Cimarron watershed. Livestock was the highest disrupter of visitors recreation experience with weather (7% in 92 and 2% in 93), insects (5% both years), and other people (6% in 92 and 7% in 93) also interfering with visitor's recreation experience.

Follow up questions asked in the Mitchell et.al. survey (1992-93) queried visitors if they had a desire to have cattle removed from the National Forest. Ten percent of those queried expressed a desire to remove the cattle while 60% felt there was no need for change. Over the two years of the survey, the number of respondents indicating that range livestock added to their stay (35%) was no different than the number stating a negative relationship (33%). The survey found that the proportion of the two groups with extreme views, i.e., adds a lot versus detracts a lot, was higher on the negative side than the positive (19% vs. 11%).

According to Mitchell et. al. (1995), two management implications were evident from the survey completed in 1992-1993. First, if livestock are kept out of developed campground and riparian areas used for fishing and dispersed camping, especially during high recreation demand times, visitors to those areas would be less disturbed by livestock on nearby rangelands than those in dispersed camp sites. Second, interpretive methods used by Federal agencies to explain how livestock grazing can be an integral part of the rangeland ecosystem management should be focused on urban residents and all those visiting dispersed camping sites.

In an unpublished paper by G.N. Wallace, J.E. Mitchell, and M.D. Wells (1995) describing the results of a visitor perception survey done on the Uncompahgre National Forest in 1992-1993, the writers postulated that livestock encounters added to most visitors recreation experience in some situations. The situations most accepted were those associated with rangeland scenes, i.e., cattle in distance, cowboys herding stock, and calves with their mothers. Most visitors were neutral about facilities associated with livestock management on rangelands like corrals, cattle guards, watering tanks, salt blocks, and fences. Fences had significant differences between detracts and adds responses to visitor experience.

The results of the site specific survey done by Wallace et. al. was significantly different than that of nation wide survey done by Brunson and Steel (1994). The nation wide survey indicated one-third of the people surveyed agreed that "grazing should be banned on federal rangelands," only 14% of the visitors to the Big Cimarron found cattle grazing to be a totally unacceptable use of public lands. Wallace et. al. felt the distinction probably was a result of the two sampling populations; i.e., people who actually visit National Forest System lands may be somewhat more likely to identify with a policy that allows grazing than the general public.

Recreational use of rangelands in the United States has accelerated tremendously. Holechek, et. al. (1989) states in his book on Range Management that if present trends of urbanization continue in the 11 western states recreational value will exceed livestock grazing value on most rangelands with the next 15 to 20 years.

In a paper completed by Marcella D. Wells to fulfill the requirements for a degree of Doctor of Philosophy at Colorado State University (1995), four implication for resources managers were presented. These implications were a result of the study completed on the Uncompahgre National Forest, in the Big Cimarron drainage, evaluating public land recreation, and grazing.

1) Manage livestock to keep them away from campsites and trialheads, minimize the time they spend in riparian areas, keep them dispersed, schedule pasture rotation to keep livestock, and recreationists from being together.

2) Plan for better coordination between recreation and allotment management to avoid conflicts. Things to consider (a) time and location of activities (recreation and livestock); (b) location of facilities; (c) social and environmental influences to riparian and other sensitive areas; (d) communication between resource managers, permittees, and visitors; (e) future management actions.

3) Keep the public informed about natural resource issues essential to effective land management. Provide interpretive information to let public know what management is occurring before they arrive in the area.

4) The last implementation is that the public should be kept involved in the planning process.

III. What Effect Does Range Management Have on the Visual Landscape as Perceived by Recreationists?

In a study done by H. Reed Sanderson, Richard A Meganck, and Kenneth C. Gibbs (1978) dispersed recreation users shown photos of landscape scenes were asked to identify their preference. In the survey, 58% of the sample stated that their recreational use would be negatively altered as management intensity increased or became more apparent. Nearly 70% of the fishermen indicated their recreational experience would be altered by negative impacts on the riparian habitat. "Unacceptable" practices noted were grazing near riverbanks, alterations of upstream vegetation resulting in increased siltation, herbicide spraying, and improved river access for recreationists. They found that hunters were generally less aware than campers or fishermen of vegetative manipulation. Hunters were adversely effected by management practices such as closure of areas to vehicles and establishment of more "Wilderness".

In the survey, Sanderson et. al. (1986), it was found that campers felt that cattle were more appropriate in mountain meadows and mountain grassland ecosystems than in the pine forest. Campers frequent comment during the survey was, "I don't mind looking at cows from a distance but wouldn't want to camp with them". It was found that people from outside the area expressed their recreation experience would be altered by range management strategies represented in the photographs they were shown. This might be explained by the fact that 30% of the people sampled associated the purpose of National Forests with preservation.

In the "National Forest Landscape Management", Volume 2, Chapter 3 on Range people have quoted describing changes in the landscape. In the late 1800 and early 1900 when the west was being settled the range land consisted of rolling, open grasslands. As man introduce domestic livestock, overgrazing most of the areas the grass lands were invaded by shrubs and less palatable grasses. The characteristics of the landscape changed from the open slopes to dense stands of brush and trees. This visual change has been slow and unnoticeable to the casual forest visitor.

IV. What Does the Dixie NF do to Ensure that Livestock Grazing does Not Impact Recreation and the Visual Landscape?

It is the responsibility of the Forest to propose livestock grazing strategies and appropriate mitigation to ensure that recreation opportunities and the quality of the visual landscape are maintained. This is accomplished on the Dixie through direction established in the Dixie National Forest Land Management Plan and through the development of Allotment Management Plans.

A. Dixie NF Land and Resource Mnagement Plan (Forest Plan)

The Dixie NF LMP lists a number of standards and guidelines that are designed to protect recreation opportunities and the quality of the visual landscape. Following is a list and description of those standards and guidelines:

General Forest Direct: (Applies to all Management Areas)

1. Management Area Direction:

Plan, design, and locate vegetative manipulation in a scale which retains the color and texture of the characteristic landscape, borrowing directional emphasis of form, and line from natural features. (IV-27)

Close or rehabilitate dispersed sites where unacceptable environmental damage is occurring. (IV-29)

In Wilderness Areas protect spring sources of drinking water near trails from contamination by recreation stock and livestock where culinary sources are scarce or heavily used by recreationists. (IV-31)

In Wilderness Areas restore soil disturbances caused by ... grazing,... to soil loss tolerance levels commensurate with the natural ecological processes for the treatment area. (IV-32)

In Wilderness Areas prohibit new range improvement structures other than corrals, fences no water developments essential to sustain current permitted numbers. (IV-32)

a. Management Area 1A:

1. Management Area Direction: 1) Manage livestock grazing to enhance recreation opportunities in existing and proposed recreation sites (IV-59), 2) Exclude grazing of recreational stock and livestock in developed recreation sites (IV-59).

2. Standards & Guidelines: 1) Maintain vegetation in fair or better range condition (IV-59).

b. Management Area 1B:

1. Management Area Direction: 1) Manage livestock grazing to enhance recreation opportunities in existing and proposed recreation sites (VI-61).

2. Standards & Guidelines: 1) Maintain vegetation in fair or better range condition (IV-61).

c. Management Area 2A:

1. Management Area Direction: 1) Manage site use and occupancy to maintain sites within Frissell Condition Class 3 except for designated sits which may be Class 4. Close and restore Class 5 sites (IV-59), 2) Manage livestock distribution and stocking rates to be compatible with recreation use. Locate structural improvements to meet Visual Quality Objectives (IV-59).

2. Standards & Guidelines: Campsite condition class based on Frissell, SS., Journal of Forestry, May 1978. (IV 59)

d. Management Area 2B:

1. Desired Future Condition: Utilization practices enhance recreation activities. (IV-68)

2. Management Area Direction: Management livestock distribution and stocking rates to be compatible with recreation use. Locate structural improvements to meet visual Quality Objectives. (IV-70)

e. Management Area 8A:

1. Management Area Direction: Manage livestock and herbivorous wildlife forage use in accordance with FSM 2320.3 (36 CFR 293.7).

2. Standards & Guidelines: 1) Follow established utilization standards for areas within grazing allotments, 2) Range management activities must be in accordance with the wilderness designation and in conformance with the Congressional Committee Guidelines outlined in FSM 2323.2.

V. Grazing Impacts to Recreation and Landscape Management Resources

The previous sections of this paper have discussed (1) National Forest guidelines that have been established to protect or enhance recreation opportunities and visual quality standards, (2) the kinds of impacts to the recreation and visual resources that research has found associated with livestock grazing, and (3) what the Dixie National Forest has done through the Forest Land Management Plan direction to ensure recreation opportunities and visual quality objectives are maintained.

Following is a discussion of the impacts to the recreation and visual resources associated with livestock grazing on the Dixie National Forest and how those impacts relate to recreation opportunities and visual quality standards.

A. Effects of Grazing at Proper Use

1. Direct/Indirect Effects of Grazing at Proper Use

a. Preservation: Livestock grazing within Wilderness due to the topography, available water, and vegetation is concentrated in areas common to those popular to recreationists. The allotment management plan establishes utilization standards for the entire allotment but often by the time they are reached the more popular recreation camping and livestock bedding sites are void of vegetation. These areas need more intensive management to reduce the conflict between these two uses. Either cattle should be fenced out of the more popular areas, utilizing alternate water sources, or recreationists should be directed to water sources where cattle are not present.

b. Semi-Primitive Non Motorized and Semi-Primitive Motorized, Listed as Semi Primitive in Forest Plan: Recreation use consists of back country fishing, hiking, horse back riding, or mountain biking. Some use is occurring with ATVs in areas adjacent to summer homes or major recreation attractions. ATVs are also a major means of access to back country lakes. Conflicts have arisen between livestock and recreationists near lake and streams where the water attracts both users as it provides necessities for life and shade for comfort. These areas, like those discussed in preservation, become void of vegetation. Flies are attracted to the areas by cattle and reduce the quality of the recreation experience.

Many of the trails on the Dixie were developed by stockmen to move their stock from area to area. These trails are now the major travel routes for dispersed recreationists. Since stockmen still use the trails, often leaving salt adjacent to or right on the trail major conflicts have arisen due to the loss of vegetation and the smell associated with major concentration of livestock. This also occurs near springs along the trails. The springs or streams are major destination points for livestock and recreationists, so they also become major points of conflict. Allotment Management Plans should address the areas of conflict and develop plans to reduce or eliminate the conflict.

3. Roaded Natural: These areas are located adjacent to major roads accessible by low clearance vehicles. The major campgrounds on the forest are located within these areas. The allotment management plans identify the major campgrounds and require that they be fenced to keep livestock out. Livestock grazing along these roads and stockmen working with the livestock present a desirable recreation experience.

4. Rural: These areas contain major development and are excluded from grazing by livestock.

b. Landscape Management

1. Preservation: Livestock and recreationists congregate around water and in cool shady areas. These areas are evident by their lack of ground vegetation, exposed soil, lack of debris on the ground, and often the trees around are scared by knives or axes. The Dixie NF Land Management Plan, the Allotment Management, and the Wilderness Act of 1964 give specific direction concerning the condition of resources within Wilderness Areas. The objectives for preservation are not met sometimes especially near popular recreation sites.

Grazing of livestock is permitted within wilderness areas but the results of this activity should meet the standard and guidelines outlined. Proper herding techniques would prevent the cattle from continuing to bunch up in the same areas for long periods of time resulting in the loss of vegetation. Recreationists should also be prohibited from continuing to use these same areas causing further damage. Coordination between range and recreation should work together to preserve the more desirable sites prescribed rehabilitation techniques.

Retention: Areas with retention visual quality objectives are located adjacent to highly used recreation areas, trails, roads, streams, and water bodies. These areas are identified in the Dixie NF LMP with appropriate standards and guidelines. The 50-60% utilization standard would insure sufficient ground cover exists to meet the visual quality standard. Critical areas such as along fences where grazing may vary between the two sides and a difference in stubble height would emphasis the management activity would be less visible when the 50% utilization is maintained. New structures would be located or constructed with the type of material to insure the visual quality objective is achieved.

Manipulation of vegetation by mechanical means and natural processes such as fire should be carefully planned in this area. Removal of undesirable vegetation (i.e., sagebrush, pinyon, and juniper) has been done in the past to bring grass back to a historical level. These activities contain strong visual evidence of management which often dominates the landscape. Techniques are available to reduce the evidence of the activity and if they are utilized visual objectives would be met.

Partial Retention: Typically these areas are located adjacent to secondary roads and trails or at distances beyond 1/2 mile from highly used roads, trails, streams, and lakes. Changes in the visual landscape may be evident to the forest visitor while borrowing from the existing character of the landscape to such a degree that the activity does not dominate the landscape. By meeting the utilization standards of 50% on the forage, the existing landscape character would be maintained. Distribution of livestock to prevent them from bunching up around springs and water bodies would prevent degradation of the landscape by preserving the vegetation near recreation attractions.

Structural range improvements would be maintained to promote range utilization. Natural fire and mechanical means would be used to control unwanted plant species. Boundaries between managed and unmanaged areas would be designed to follow lines appearing natural in the landscape, thus helping the project meet visual quality objectives. Spring developments, ponds, guzzlers, and other structures would be located and constructed with the type of material to fit the activity into the existing landscape. The activity may be visible and could dominate natural features.

Modification: These areas are located beyond 1/2 mile from secondary travel routes and water bodies. They are seen most often from a distance. The presence of grazing animals or of herders becomes a part of the landscape enjoyed by the forest visitor. Large vegetative manipulation projects would be visible but if boundaries of the project follow existing features with no straight lines, they would meet the visual objective.

Maximum Modification: These areas are generally not seen by the general public. Activities within these areas may dominate the natural landscape features. The visual quality standards would be achieved.

2. Cumulative Effects of Livestock Grazing at Proper Use

There are many multiple use management actions occurring on the Dixie National Forest. Included in these activities are timber sales; watershed rehabilitation projects; wildlife and fisheries habitat improvement projects; recreation developments such as campgrounds, trails for hiking, biking, ATVs, snowmobiles, etc., ski areas; mining and oil and gas development; utility corridors; roads; etc.

All projects implemented on the Dixie NF are evaluated using a NFMA/NEPA analysis process. All projects are evaluated to determine their impact on recreation and landscape management resources. Mitigation is recommended for all projects to ensure that all recreation opportunities are maintained and visual quality standards are met.

The construction of new roads is the greatest single impact on the recreation resource. With the construction of a single mile of new roads it is estimated that a minimum of 118 acres of forest land is changed from non-motorized to motorized recreation. Since there is a limited land base, the opportunities for non-motorized recreation are disappearing. Timber presently develops the most miles of roads, while range activities rarely change the acres of recreation opportunities. The increasing use of ATVs has changed some of the non-motorized trails into motorized thus changing some opportunities.

Livestock use of the Dixie NF has been occurring since before the National Forest was established. Changes in the visual landscape have resulted due to that use such as the invasion of brush in areas where historic photos show grass once existed. Some vegetative manipulation to reverse this process are evident on the forest. Management of the forest trees has been occurring since man came into the area and began to build dwellings. The development of roads and removal of the trees has impacted the visual landscape over an area much greater than that effected by grazing. Mining, oil, and gas activities have also impact the visual resource in some areas of the forest.

B. Effects of Eliminating Livestock Grazing

1. Direct/Indirect Effects of Eliminating Livestock Grazing

a. Recreation Opportunities:

Preservation: With the removal of livestock from the wilderness areas conflicts between recreationists and livestock would be eliminated. Vegetation would increase in some of the sites used heavily by livestock. However some problems would continue to exist because of recreation livestock. Direction within the standards and guides for wilderness would promote the elimination of the problem.

Semi-Primitive Non-Motorized and Semi Primitive Motorized, Listed as Semi-Primitive in Forest Plan: Livestock use around the popular fishing lakes, springs, and along trails would not exist. Problems with livestock tromping out the vegetation and creating odor problems which attracts flies would not occur. Recreation trail users would be able to hike without continually watching where they step. The areas presently used as salt grounds would revegetate, no longer being a source of odor and flies along the trails. Vegetative manipulation projects would continue to improve wildlife habitat. These would disrupt the recreation opportunities within these areas during the project implementation.

Roaded Natural: Picturesque scenes of cattle grazing in the open meadows would no longer occur on the forest. This part of the recreation experience would be absent from the forest environment.

Rural: Since these areas are excluded from grazing, there would not be a change from the existing condition.

b. Landscape Management

Preservation: Livestock would not be present within the wilderness except for those used by recreationists. The open meadows and areas around water sources would resume natural vegetative conditions typical of the wilderness. Areas void of vegetation around water sources would meet the preservation visual quality standard.

Retention: The presence of livestock would not be evident from the major travel routes, use areas, and water bodies. Visual objectives would be met for the area. Some vegetative manipulation would continue to support wildlife. These areas may be evident; however, many of the areas exist at the present time. The presence of grass would be more predominant and fire would play more of a role in the landscape due to the fuel provided by the grass. Fences would no longer be necessary and the fence line contrast would be absent from the visual landscape. Range structures such as windmills would be removed to reduce their visual impact on the landscape.

Partial Retention: Structural range improvements would not be needed. Fences, wind mills, and watering troughs would be removed from the visual landscape. Fence lines which have created strong unnatural visual features would not be present, the natural features of the landscape would dominate. Range revegetation projects to promote wildlife habitat would remain. These projects would be designed to meet standards and guidelines but may dominate the natural characteristics of the landscape.

Modification: Large vegetative manipulation projects for wildlife would be visible but if standards and guidelines are followed, the visual objective would be met.

Maximum Modification: The visual quality objective would be achieved.

2. Cummulative Effects of Eliminating Livestock Grazing

There would be no adverse cumulative impacts to the recreation and visual resources with a no action alternative.

THE EFFECTS OF LIVESTOCK GRAZING AT PROPER USE ON THE SOCIAL/ECONOMIC ENVIRONMENT OF THE DIXIE NATIONAL FOREST

Ric Rine, Dixie National Forest Economist

AFFECTED ENVIRONMENT

As one of many multiple uses permitted by the LRMP, forage for livestock grazing is permitted and contributes to the economic well being of local communities. The Dixie Land and Resource Management plan (LRMP) Final Environmental Impact Statement (FEIS) describes the Forest-wide range resource history and condition (LRMP FEIS III-22 through 25).

The Affected Environment of the grazing permit issuance analysis is the five county area of southern Utah consisting of Garfield, Iron, Kane, Washington and Wayne Counties. Piute County is also within the Dixie Zone of Influence but includes only an extremely small part of the Dixie National Forest and will not be considered here.

The social and economic structure of southern Utah has its roots in agriculture. Livestock grazing is among the oldest land uses in the region and pre-dates establishment of the Dixie National Forest in 1905--then the Sevier Forest Reserve (Hinton, 1987). Early pioneer uses on the Forest included dairy farming associated with cheese production. Current livestock use on the Dixie is aimed principally at meat and wool production. For several generations, many of the local ranches have been dependent upon the National Forest for summer forage to round out year-long operations. The high percentage of Federal and State land ownership in southern Utah, averaging approximately 74% for the five county area, emphasizes the importance to local ranchers of Federal rangelands in maintaining viable local livestock ranching operations.

Livestock grazing on National Forest System Lands also contributes important cultural and social values to the area. Intertwined with the economic aspects of livestock operations are the lifestyles and culture that have co-evolved with Western ranching. Rural social values and lifestyles, in conjunction with the long heritage of ranching and farming continued to this day from the earliest pioneers in Utah, have shaped the communities and enterprises that make up much of southern Utah. The rural Western lifestyle also contributes to tourism in the area, presenting to travelers a flavor of the West through tourist oriented goods and services, scheduled events, even with tourists photographing sheep bands or cattle in the pastoral setting of the forest.

The following table describes the proportion of each County's income and employment base is contributed by the Agriculture industrial sector (U.S. Dept of Commerce, 1991).

(TABLE 1)

Wayne County derives a relatively large proportion of its income (28%) and employment (27.6%) from agriculture. Garfield County is the second most dependent among the five counties, followed by Iron and Kane Counties. Washington County is the least dependent upon agriculture for income and jobs.

DIRECT AND INDIRECT EFFECTS

NO ACTION

Economic Effects

Livestock growers use National Forest grazing permits to provide feed for their livestock. Some permits are not critical as the source of primary income for the permittee. Many are important and even essential to maintain an ongoing livestock operation and primary income to the permittee. Discontinuing these permits or significantly reducing them could cause social and economic stress to the permittees and local community. Depending on the number of permits, these stresses would be expected to be most deeply experienced in Wayne and Garfield County, whose economies are less diversified and more dependent on agriculture, (27.6% and 14.7% of County employment), including livestock grazing. Iron and Washington Counties would be less affected by termination of one or more permits because their economies, strongly influenced by the Cedar City and St. George municipalities, respectively, are much more diversified and least dependent on agriculture. Kane County is less diversified than Iron and Washington but is not much more dependent on agriculture and related industries than Iron County.

Localized adverse impacts on smaller, outlying rural communities in any county could be much greater, however, should loss of or substantial Animal Unit-Month (AUM) reductions in permits induce family or commercial ranching enterprises to go out of business. Impacts from loss of a substantive component of a rural economy can expand to adversely affect a smaller community's ability to support critical infrastructure, such as medical facilities, school systems, and utilities, because of reductions in customer or tax bases as people leave these communities searching livelihoods elsewhere (5-County, 1991). This attrition can be reversed over time through diversification of rural economies. However, this process can be slow, taking a decade or more, until other economic opportunities--with subsequent investment, infrastructure formation, and workforce development--can be realized. And, no assurance can be made that such a transition will be successful.

Reductions or termination of permits on Forest System lands can directly affect local residents and permittees. Stresses on individuals and families from uncertainty about income, employment and future security can lead to increases in divorce, alcoholism, emotional disorders, and other stress-induced behaviors or symptoms. Local residents can develop concerns that their livelihoods and quality of life will change through Forest Service action on livestock grazing permits.

Effects on Culture and Custom

Depending on the magnitude of a reduction in permitted AUM's under No Action, a phased reduction in the ranching influence on the region's values could occur. As communities diversify, or move from reliance on one primary form of historic commodity-oriented economic activity to another amenity-driven activity, a different value set, generally more diverse and urban, could begin to become more influential in affecting local customs and values. This has been a common phenomenon where urban "outsiders" have "discovered" a rural region with desirable features or amenities. Sun Valley, Idaho, or Jackson Hole, Wyoming are more famous examples of this transformation. In such cases, the original values and symbols which had an authentic stamp of Western lifestyle, values, and customs--deeply rooted on community mores, norms, and behavior--can largely become artifact or cosmetic, supplanted by an increasingly urban affluent value system. Conflict between members of the traditional culture and those of the newly emerging culture often occur.

GRAZING AT PROPER USE LEVELS

Economic Effects

Regional economic impacts from permitted livestock grazing were modeled using a multiplier derived by Nielsen (1991) to determine the induced income dollar benefit per AUM. This value was then multiplied by the permitted AUMs prescribed under each alternative. The value represents the amount of induced economic activity in dollars in the state of Utah, and principally benefits those centers of commerce within the five county area.

It should be emphasized that the costs/benefits are estimates, and are used for comparison purposes only. The values do not represent economic benefits in absolute terms.

The 3.5 multiplier developed by Nielsen (1991) is applied to the net value (permitted AUMs x $8.98/cattle AUM or $13.66/sheep AUM) from livestock grazing, which is dependent on the permitted livestock numbers under the action alternative(s).

The economic effects of implementing an alternative which proposes grazing livestock at proper use levels is displayed in the following table.

(Table 2)

The proposed actions for the allotments in this analysis generate an estimated $1.779 million of direct or induced economic activity in the Utah. Much of this benefit accrues to the five county area in southern Utah. Effects beyond the state of Utah can not meaningfully be discerned and are not essential for this analysis.

Projected reductions in induced income may be compensated for if permittees are able to find substitute purchased or leased forage to replace that lost on National Forest lands. However, costs of such replacement forage may be higher than forage from permitted grazing on National Forest lands, reducing the net benefit to the permittees and the regional economy.

Effects on Custom and Culture

Under the proposed levels of grazing at proper use and in compliance with the Dixie LRMP, the economic benefits of a sustained livestock industry would enhance community stability and provide a less disruptive transition as smaller rural communities attempt to diversify their economies. The GOPB study (1994) projects that job growth in the Agriculture sectors of the southern Utah counties will remain flat or only modestly increase through 2005.

The effects on custom and culture would be expected to be more moderate, if a sustainable livestock industry and rural culture can co-exist with changing values accompanying economic diversification. Conflicts between established and emerging cultures would be expected to be more moderate.

CUMULATIVE EFFECTS

NO ACTION

The grazing permit issuance direct and indirect effects are cumulative with other variables influencing economic activity in the five County area. The maximum extent of cumulative effects considered in this analysis is the entire State of Utah. Effects beyond that point are largely speculative and cannot be measured from the limited actions proposed in this analysis. Most cumulative effects are expected to have the greatest impacts in communities within the five County area, particularly those economies least diversified and most dependent on National Forest outputs. The economic activities considered relevant to this analysis of cumulative effects are the timber, recreation, and tourism industries.

The effects on the five county area from proposed grazing reductions under the No Action alternative when considered in combination with timber harvest activities on the Dixie National Forest could be cumulatively important.

The discussion of the cumulative effects on the five county economy from timber harvest is drawn from information contained in the Supplement to the Final Environmental Impact Statement for the Tippets Valley Timber Harvest (1992). The criteria used to assess cumulative effects contributed by area timber harvest were an estimate of county dependency on the agriculture (livestock grazing) and manufacturing (timber processing) sectors and the magnitude of reductions in either grazing or timber harvest on the National Forest.

There could be an adverse cumulative effect to the area economy from a reduction in permitted grazing if "No Action" alternatives are selected for the proposed timber sales on the Dixie National Forest, or if available timber from Forest sales were substantially reduced or eliminated for other reasons. This would depend on the availability of substitute timber supply from other sources. The No Action alternatives on these projects could contribute to adverse cumulative effects to jobs and income if other timber sales become unavailable, or are offered with substantially reduced volume than presently planned. The adverse cumulative effects would be negligible or avoided completely if other sales substitute for the foregone volume. A sustained flow of future volume from the available sources, while not substituting for the foregone volume under No Action, would limit the adverse cumulative effects to the short term of the next year to two years. The primary adverse effect would be to reduce local income, but this would not likely affect the number of jobs significantly, unless current marginally surviving operators are forced out of business.

A sustained decline of several years in available timber from the area, assuming no substitute volume, would have the expected effect of forcing marginal operators out of business, or to seek employment elsewhere. A substantial decline in available timber would have to occur in the area supply base for the larger mills to be adversely effected by selection of the No Action alternative on any one sale. The same factors of substitute timber from other sales, and the flow of timber from future sales would apply. A 5-year declining trend in timber volume offered by the Dixie increases the risk that these effects are at hand. With a sustained cumulative decline in timber supply, the primary effect would be a short-term loss of income to local mill and woods workers, and secondary enterprises, leading to possible mill closure(s) or transfer of ownership under the most severe circumstances. We have seen evidence of this in recent mill closures in Escalante and Fredonia, plus downsizing of other mills.

There would be a subsequent loss of jobs and income locally as mills and woods workers cease operations. The loss of timber-related jobs, and related loss of business to local support enterprises and erosion of tax base, could create substantial economic dislocations in the five county area. This erosion in the manufacturing base in conjunction with a reduction of grazing forage from permit reductions could coincidentally impact the agricultural base and exacerbate economic decline for a sustained period.

This adverse cumulative effect to jobs and income could be limited if the region's economy were able to diversify from a dependence on Forest commodity outputs and develop other sectors of the economy, such as recreation and tourism. Jobs and income data through 1990 indicate that Services and Trade sectors of the five County area have had robust growth through 1990 (GOPB, 1994). The same study projects that these two sectors will continue to outpace other industrial sectors though 2005. These industrial sectors are assumed to be reasonable surrogates as recreational and tourism economic indicators. As noted, earlier, the transformation of a rural economy can be a long, and highly disruptive, process.

These scenarios representing the degree of economic impacts from the interaction of grazing, timber harvest, and recreation and tourism would differ in relative effects to the five counties. It would be expected that Wayne and Garfield Counties would be most adversely affected by a 'worst case' scenario of declining timber harvest compounded by substantial reductions in permitted grazing, since these counties are most dependent on these resource bases. Kane County, already seriously impacted by the closure of a Fredonia, Arizona, timber mill--which was the major source of local manufacturing jobs--would not be as impacted by reductions in grazing because of a more limited dependence on agriculture but would be expected to remain in serious economic dislocation until replacement industries are developed in the area.

Overall, Iron and Washington Counties would be least impacted by the 'worst case' scenario described above because of their broadly diverse economies and limited dependence on National Forest commodities. However, impacts to smaller rural communities in these counties, such as Enterprise or Pine Valley, could be substantial, proportionate to the magnitude of reductions in permitted grazing. And, impacts to individual permittees and their dependent families would be substantial. These counties would be expected to be the most resilient in rebounding from reductions in permitted grazing, followed by Kane, then Wayne and Garfield counties.

GRAZING AT PROPER USE LEVELS

Under a 'best case' scenario, continued permitted grazing at proposed levels, with a sustainable timber supply and emerging recreation and tourism industries, would foster a less disrupting transition from commodity dependence to more diversified economies. The reverse order of effects would likely occur: Wayne and Garfield benefitting most, possibly more by avoidance of the perturbing effects described above, then Kane County. Iron and Washington Counties, already well diversified and experiencing robust economic growth, would not benefit as much. Economic and demographic forces already acting on these two latter counties would be expected to continue to drive economic development and sustainability.

In the event that permits were issued as proposed, under grazing at proper use numbers, but timber harvest levels continued to decline and recreation-tourism development was slow in replacing manufacturing employment and income, the cumulative effect would be similar but more moderate than those under the 'worst case' scenario, where all three areas of economic activity decline or stagnate. The order of impacts would likely be slightly different.

In this case, Garfield County would likely be most impacted because of its greater dependence on the forest products industry. This would be most true for those private operations that include livestock grazing and forest product consumption from the National Forest for their complete livelihoods. Wayne County would likely be impacted less because livestock grazing at proper use levels would still provide forage for permitted livestock on the National Forest, supporting livestock operations in the Agriculture sector. Forest product enterprises also tend to supplement other primary sources of income in Wayne County. Kane County would not likely see much change from current economic condition and trends. Iron and Washington County, again, would not be expected to experience substantial economic impacts, for the same reasons of diversification described above, and because of a much smaller dependence on forest products. However, smaller ranching communities would be less impacted because livestock operations would still include National Forest forage. The economic benefits of permitted grazing at proper use levels could sustain components of the rural ranching economies in the near term. In this case, changes in the demographic trends toward migration to and urbanization of rural southern Utah would exert stronger influence on the local economies and culture, and the long term sustainability of viable livestock operations, than decisions on permit applications.

Effects on Custom and Culture

For all alternatives, cumulative impacts on custom and culture would approximate those direct and indirect impacts of changing rural economies and cultures described earlier. To summarize, as economies shift from commodity-dependent economic activity, with more cohesive uniform customs and values, to more urban-influenced diversified economic activities, with correspondingly more diverse customs and values, the same set of effects described earlier would be expected to occur. The rate and circumstance of the change could exacerbate the degree of conflict or tension in rural communities undergoing such changes.