National Park Service
U.S. Department of the Interior

Capitol Reef National Park
July 2018

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan and Environmental Assessment

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CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

When the decision-making process for this draft plan and environmental assessment is concluded, the alternative selected for implementation will become the Livestock Grazing and Trailing Management Plan at Capitol Reef National Park.

The National Park Service is preparing this Draft Livestock Grazing and Trailing Management Plan (LGTMP) and Environmental Assessment (Draft Plan/EA) for Capitol Reef National Park (also referred to as Capitol Reef or the park) in Utah. The Draft Plan/EA assesses the impacts that could result from continuing current management (the No-Action Alternative) or implementing the proposed LGTMP. At the conclusion of the National Environmental Policy Act of 1969 (NEPA)-required analysis and the decision-making process, the alternative selected for implementation will become the LGTMP for the park.

This purpose of and need for action chapter identifies what the National Park Service hopes to accomplish and why it is taking action at this time. It provides background on grazing and trailing in the park and introduces the environmental issues that have been analyzed in the EA.

PURPOSE AND NEED

The purpose of developing an LGTMP is to promote the shared conservation and stewardship of the natural resources, ecological processes, and cultural resources of Capitol Reef National Park by providing guidance and tools to the National Park Service and permit holders for the long-term management of livestock grazing and trailing at the park.

An LGTMP is needed because, as of 2010, the National Park Service assumed sole responsibility for managing livestock grazing and trailing in Capitol Reef, and the park lacks a comprehensive, collaborative approach to address potential impacts on the following:

- Soils, vegetation (upland and riparian, including native forage used by livestock), aquatic systems, and wildlife and its habitat
- Habitat for and populations of species of concern, including plants and animals listed under the Endangered Species Act (ESA)
- Cultural resources, such as archeological sites and historic properties, including those protected under the National Historic Preservation Act (NHPA)

In addition, as explained below, one grazing permittee recently relinquished their right to graze livestock in Capitol Reef, and has since requested permits to trail their livestock through the park. As such, the National Park Service (NPS) also needs to consider issuing two permits to trail livestock along two routes through the retired allotment (see the next section and *Planning Area* section that follow for more details).

LIVESTOCK GRAZING AND TRAILING IN CAPITOL REEF

Capitol Reef National Park lies in south-central Utah in the southern part of the Northern Colorado Plateau (see Figure 1.1). The park is approximately 70 miles long and just 13.5 miles wide at its widest point and encompasses almost 242,000 acres. Utah State Highway 24 traverses the park from east to west, generally dividing the park in half. Although some private land lies next to and near the park, it is

bounded primarily by public lands managed by the NPS, Bureau of Land Management (BLM), and the US Forest Service (USFS). Some State of Utah lands also bound the park.

Livestock management, including grazing and trailing, has a long history in southern Utah, including on the lands that are now part of Capitol Reef. Domestic grazing in Utah began with the arrival of Mormon settlers in the 1840s around the Salt Lake Valley (Frye 1998). In the late 1870s Mormon settlements were established near the lands that later became the park (Frye 1998). Livestock grazing and trailing became established on these lands and later were authorized and managed by the BLM and the USFS.

President Franklin Roosevelt established Capitol Reef National Monument by proclamation on August 2, 1937, setting aside 37,700 acres. President Lyndon Johnson issued a presidential proclamation in January 1969 that increased its size by about 215,000 acres, adding thousands of acres of public land that were managed previously by other federal land management agencies. These lands included many active grazing allotments, whose permit holders were allowed to continue operations on the monument.

Congress established Capitol Reef National Park in Public Law 92-207, signed into law in December 1971. The park-enabling legislation recognized that grazing and trailing were existing valid uses for those who traditionally grazed or trailed livestock through the park. The legislation provided for livestock grazing and trailing to continue on park lands; however, grazing would be phased out by allowing a one-time only renewal of permits for the 19 allotments in the park. These privileges were granted to existing permit holders, subject to appropriate management by the National Park Service. Public Law 97-341, enacted in October 1982, extended grazing until December 31, 1994. Public Law 100-446, passed in September 1988, repealed Public Law 97-341 and extended grazing privileges for the lifetime of the 1971 permit holders and their children born on or before December 18, 1971. Public Law 100-446 is still in effect, and livestock grazing is anticipated to be discontinued after the current generation of permit holders ceases operations in Capitol Reef.

Before the park was established and for several decades thereafter, the Bureau of Land Management permitted and managed livestock grazing in the active allotments on lands that are now located in Capitol Reef National Park. The National Park Service relied on the Bureau of Land Management to manage livestock grazing in the park; however, between 2000 and 2010, Capitol Reef assumed responsibility for permitting and managing the active allotments in the park.

While there were 19 grazing allotments in the park when it was established in 1971, when the LGTMP process began, only two allotments were still grazed: the Hartnet allotment and the Sandy 3 allotment (Figure 1.2). Since 2010, the Hartnet allotment, which encompassed lands managed by both Capitol Reef and the Bureau of Land Management, has been managed as two separate allotments that were permitted to the same ranching operation. Capitol Reef National Park and the Bureau of Land Management managed their respective Hartnet allotments independently, coordinating as necessary. In March 2018, however, the Hartnet allotment permit holder willingly sold the permit to graze on the NPS Hartnet allotment to a nonprofit, and in the process relinquished the right to graze livestock in Capitol Reef. As a result, today, there is only one active grazing allotment in the park, the Sandy 3 allotment.

The enabling legislation of Capitol Reef National Park continues stock trailing along traditional routes crossing the park, without any phase out. Currently, eight traditional livestock trailing routes are used by current permit holders in the park (Figure 1.2), six of which are used once or twice per year. The remaining traditional trailing routes are used only occasionally. In addition, requests for new trailing permits will be evaluated by the National Park Service through the appropriate review process on a case-by-case-basis.

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA

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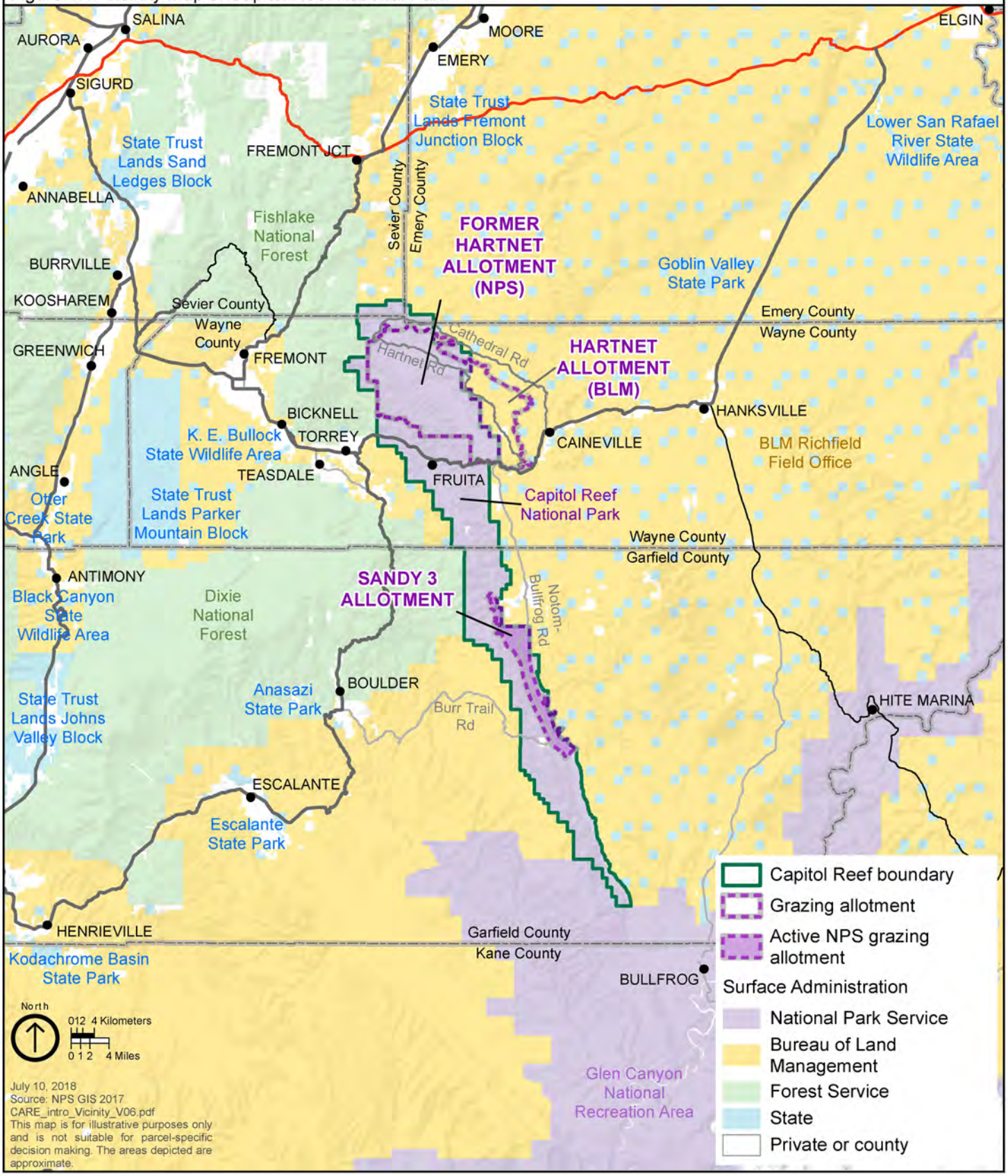
Figure 1.1: Vicinity Map of Capitol Reef National Park



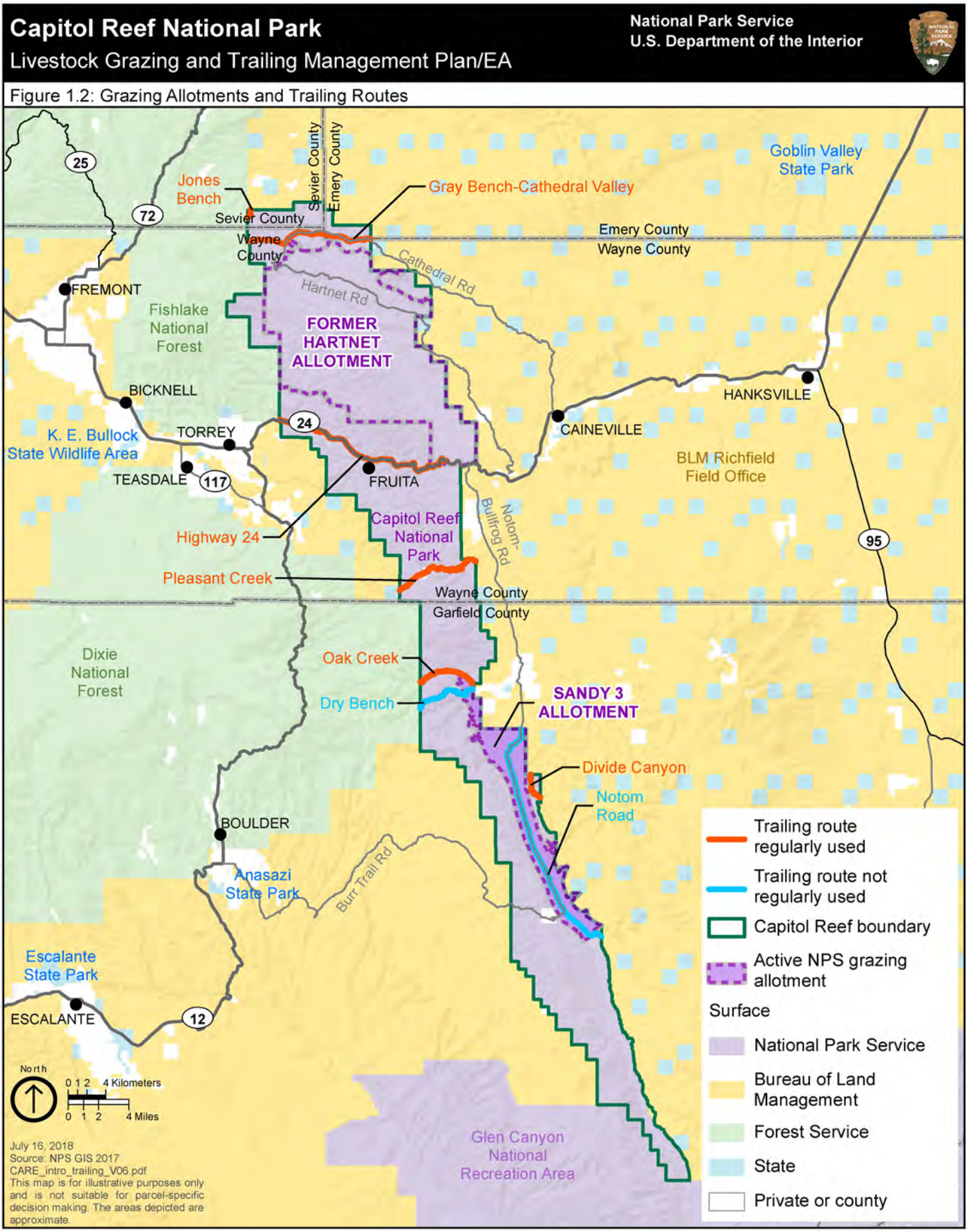

Capitol Reef National Park
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Figure 1.2: Grazing Allotments and Trailing Routes
Goblin Valley State Park
Jones Bench
Sevier County
Emery County
Gray Bench-Cathedral Valley
Emery County
Wayne County
Wayne County
Cathedral Rd
Hartnet Rd
FREMONT
Fishlake National Forest
FORMER HARTNET ALLOTMENT
BICKNELL
HANKSVILLE
CAINEVILLE
K. E. Bullock State Wildlife Area
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Notom-Bullfrog Rd
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Pleasant Creek
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Dixie National Forest
Oak Creek
Dry Bench
SANDY 3 ALLOTMENT
Divide Canyon
Notom Road
BOULDER
Anasazi State Park
Burr Trail Rd
Escalante State Park
ESCALANTE
Glen Canyon National Recreation Area
Trailing route regularly used
Trailing route not regularly used
Capitol Reef boundary
Active NPS grazing allotment
Surface
National Park Service
Bureau of Land Management
Forest Service
State
Private or county
North
0 1 2 4 Kilometers
0 1 2 4 Miles
July 16, 2018
Source: NPS GIS 2017
CARE_intro_trailing_V06.pdf
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate.

PLANNING AREA

The planning area for the Draft Plan/EA includes the Sandy 3 allotment that lies to the east of the Waterpocket Fold, the principal feature of the park, and the eight livestock trailing routes that currently cross the park (Figure 1.2). In addition, the National Park Service has recently received a request to for trailing permits on two additional routes through the recently retired Hartnet allotment from the permit holder that relinquished the rights to grazing on Capitol Reef. Both permits would be issued along traditional trails and are referred to as the Hartnet trail and the Lower South Desert trail. The former permittee has requested the permits to facilitate moving their livestock in the fall and, in some cases, spring (see Table 2.3 in Chapter 2) from USFS allotments west of the park to BLM allotments east of the park; therefore, the planning area also includes areas that could be affected by issuing these new trailing permits (see Figure 2.4 in Chapter 2).

It is important to note that of the nearly 15,000 acres in the Sandy 3 allotment, about 10,200 acres are grazed each year, and the rest of the allotment are inaccessible to livestock or have little to no livestock use; therefore, hereafter in this EA, unless specifically noted, the discussion of acres available for grazing and forage production will be based on this grazed portion of the Sandy 3 allotment. While the plan/EA focuses on the grazable acres, the National Park Service recognizes that livestock, from time to time, may graze outside of the grazable acres. These livestock are not considered to be trespassing. Such occurrences would be infrequent and by few livestock, so the impacts of this occurring are not measurable.

RANGELAND CONDITION ASSESSMENTS

Capitol Reef needed site-specific data documenting the current condition of active grazing allotments to inform the planning and NEPA process, and to have scientifically valid and defensible data with which to make range management decisions. In 2015, therefore, Capitol Reef applied Interpreting Indicators of Rangeland Health v. 4 (IIRH; Pyke et al. 2002; Pellant et al. 2005) to assess rangeland condition. Appendix B, Rangeland Condition Assessment, contains detailed information on the assessment methodology and its results, which indicate that for the Sandy 3 allotment, 59% to 69% of assessment plots in the allotment are in a state of *moderate* or *moderate to extreme* departure from reference conditions. Furthermore, 13% to 23% of the plots are in a state of *moderate to extreme* departure from reference conditions. Although not a component of the rangeland health assessment, scat count data collected in the Sandy 3 allotment showed that as the frequency of livestock dung observation increases, there is a greater departure from reference conditions.

In addition to providing an overview, the rangeland condition assessments also inform the affected environment for specific resources, such as soils and vegetation; therefore, Chapter 3 provides additional details regarding the results of the rangeland condition assessment for specific impact topics analyzed in detail.

DESIRED CONDITIONS

NPS management policies define desired conditions as a park's natural and cultural resource conditions that the National Park Service aspires to achieve and maintain over time (NPS 2006). Goals and desired conditions are value based. Natural resources on NPS lands are not managed to the threshold of being impaired; on the contrary, they are managed with the intent of being within the range of ecological integrity. This means that ecosystem processes are supported, and diverse plant and animal communities

are maintained; however, desired conditions for natural resources must be developed within the context of relevant laws or policies and human dimensions.

Where possible, the National Park Service seeks to represent desired conditions using quantified metrics that provide indicators that can be monitored, that reflect the type and scale of information that supports adaptive management, and that provide a framework for selecting among possible responses to unforeseen resource response. If there is a lack of site-specific information, the National Park Service may use the best available knowledge pertaining to that resource to develop desired conditions.

With this in mind, the National Park Service developed desired condition statements for Capitol Reef rangelands, riparian areas, and federally listed species and, where available, quantitative indicators for those desired conditions. These are presented in Appendix C.

Also, the park has worked with the US Fish and Wildlife Service (USFWS) to develop monitoring protocols and thresholds of damage and disturbance to listed plants along livestock trails that would trigger adaptive management actions (Appendix C). Staying below these thresholds is expected to assist the National Park Service in meeting these desired conditions.

IMPACT TOPICS IDENTIFIED THROUGH SCOPING

The National Park Service used internal, agency, and public scoping, as well as guidance in the 2015 NPS NEPA Handbook to identify those issues that would be carried forward for detailed analysis, versus those that would not be carried forward, in the Draft Plan/EA. The impact topics related to the issues carried forward for detailed analysis and additional discussion in Chapters 3 and 4 are listed below:

- Special status plants
- Upland and riparian vegetation associations
- Migratory birds and resident birds
- Soils
- Water resources (springs and creeks in the allotments and along trails)
- Mexican spotted owl (MSO), habitat, prey base
- Permittee traditional uses and socioeconomics
- Wilderness qualities

The level of detail in the description of each impact topic and the effects from implementing any of the alternatives also are described in Chapters 3 and 4, in proportion to their importance. Additional information on the issues and impact topics identified through scoping, including those not carried forward in the EA, is available in Appendix D; however, as required by Environmental Compliance Memorandum No. ECM95-3 (DOI 1995) and ECM97-2 (DOI 1997), information regarding environmental justice and Indian Trust Resources is presented below.

Environmental Justice. Presidential Executive Order 12898, General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1998), requires all federal agencies to incorporate environmental justice into their missions. They do this by identifying and addressing the disproportionately high or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities.

According to the Environmental Protection Agency's (EPA) website, "environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goals of "fair treatment" are not to shift risks among populations, but to identify potentially disproportionately high and adverse environmental effects and to identify alternatives that may mitigate these impacts.

Evaluating whether a proposed action could have disproportionately high and adverse impacts on minority or low-income populations typically involves the following:

- Identifying any potential high and adverse environmental or human health impacts
- Identifying any minority or low-income communities in the potentially high and adverse impact areas
- Determining whether these communities would be disproportionately affected by these impacts

Wayne and Garfield Counties contain both minority and low-income populations; however, environmental justice was dismissed as an impact topic for the following reasons:

- The park staff and planning team solicited public participation as part of the planning process and gave equal consideration to all input from persons, regardless of age, race, income status, or other socioeconomic or demographic factors.
- Implementing any of the alternatives would not result in any identifiable adverse human health effects; therefore, there would be no direct or indirect adverse effects on any minority or low-income population.
- The environmental impacts associated with implementing any alternatives would not disproportionately affect any minority or low-income population or community.
- Implementing any alternatives would not result in any identified environmental effects that would be specific to any minority or low-income community.
- The economic impacts from implementing any of the alternatives may be adverse, but they would not disproportionately affect minority or low-income populations. In addition, the park staff and planning team do not anticipate that the impacts on the socioeconomic environment would alter the physical and social structure of nearby communities.

Based on this rationale, environmental justice was dismissed and is not carried forward for analyses in this Draft Plan/EA.

Indian Trust Resources (including sacred sites).

NPS staff consulted with the affiliated Native American tribes to determine whether any trust resources, including sacred sites, could be affected by implementing an LGTMP at Capitol Reef National Park. Following consultation, the National Park Service determined that there are no Indian trust resources that would be affected by livestock grazing and trailing; therefore, Indian trust resources was dismissed as an impact topic and is not carried forward for analysis in this Draft Plan/EA.

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CHAPTER 2: ALTERNATIVES

The range of alternatives is the set of reasonable alternatives and those that were considered but were eliminated from detailed analysis.

This chapter describes the actions that the National Park Service would implement to manage livestock grazing and trailing in Capitol Reef National Park. This Draft Plan/EA analyzes in detail the No-Action Alternative (Alternative 1) and one action alternative (Alternative 2), which was developed to meet the purpose and need for the plan. In addition to Alternatives 1 and 2, this chapter describes three alternatives that were not analyzed in detail; these include eliminating grazing on the Sandy 3 allotment or trailing on traditional routes across Capitol Reef, as described later in this chapter.

ALTERNATIVE 1 (NO ACTION)

Sandy 3 Allotment Grazing

The Sandy 3 allotment includes 15,000 acres in Capitol Reef (Figure 2.1). Portions of the Sandy 3 allotment are not accessible to livestock or have little to no livestock use; therefore, the grazed portion of the allotment is approximately 10,200 acres. The No-Action Alternative in this Draft Plan/EA would continue partial-year continuous grazing in the absence of a management plan (i.e., livestock would have unrestricted and uninterrupted access to an allotment during the season of use).

Season of use and animal unit months (AUMs). The season of use for Alternative 1 is from November 1 through March 31 each year, unless weather or forage conditions are such that the National Park Service and permit holder agree to an alternate schedule. Under normal conditions, the stocking rate is 82 livestock, which graze for 152 days, equivalent to 410 AUMs. During years of abundant forage or years of minimal forage, stocking rates and AUMs are adjusted to match forage and overall range conditions, to a maximum of 410 AUMs. Public Law 100-446 (September 1988) states that grazing would be based on the active preference that existed when the law was passed, with no increase in AUMs allowed on park lands. The active preference in September 1988 for the Sandy 3 allotment was 410 AUMs; therefore, that is the maximum number of AUMs permitted by congressional legislation.

Grazing management infrastructure. Boundary fences would continue to be maintained to ensure they are functional. No new stock ponds would be constructed, and select stock ponds would only be refurbished, when possible.

Sensitive resource fencing. Under the No-Action Alternative, there are no plans for fencing sensitive resource areas. They would be fenced only when warranted because of severe resource degradation or other need.

Pastures and herding. The permit holder would continue to herd livestock on the allotment, when livestock are initially distributed in early November. Pastures would not be delineated, and livestock would range freely during the grazing season until their removal on March 31.

Invasive plant management. Invasive plants would be treated on an ad hoc basis, under separate compliance.

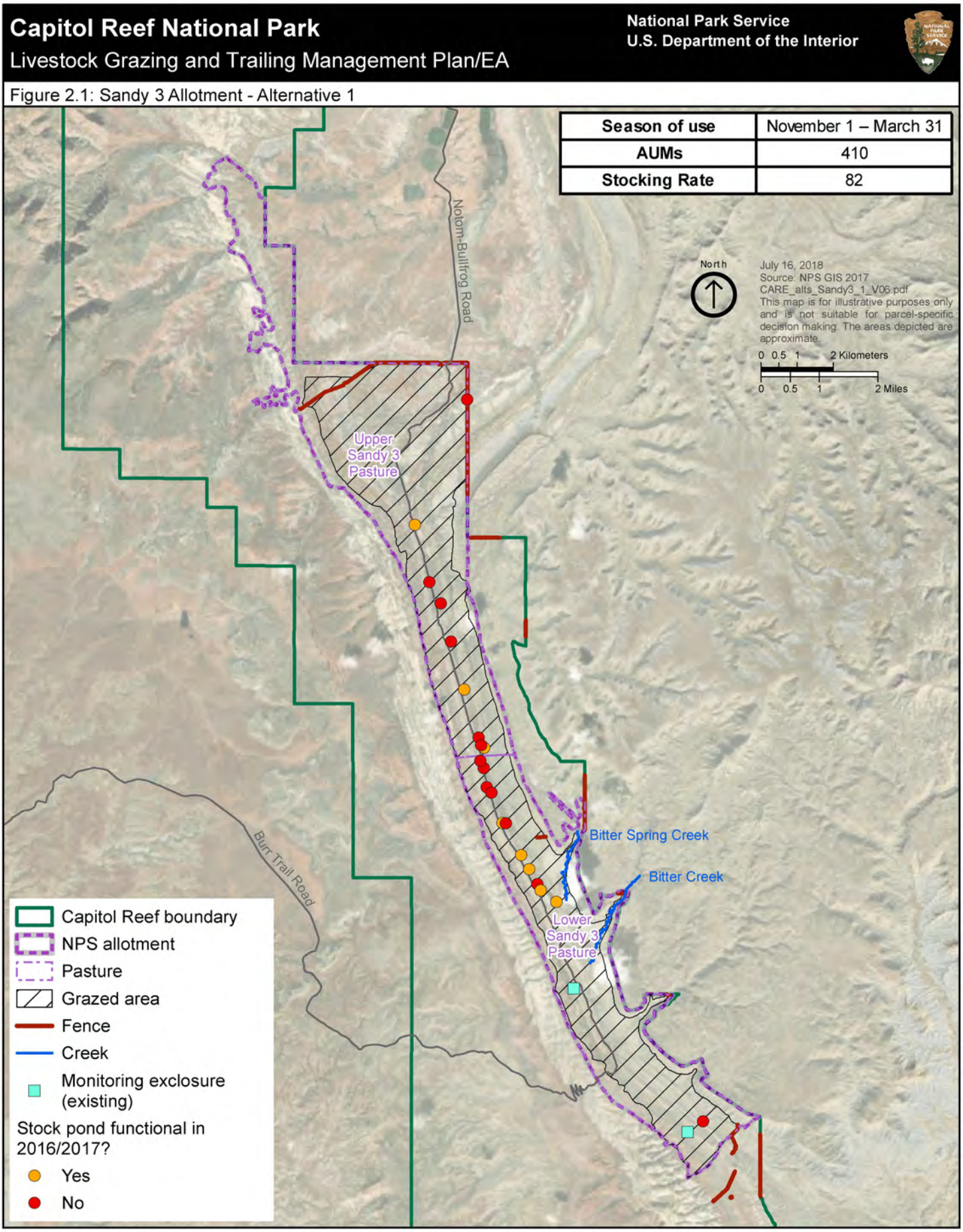
Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA
National Park Service
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Figure 2.1: Sandy 3 Allotment - Alternative 1
Season of use | November 1 – March 31
AUMs | 410
Stocking Rate | 82
North
July 16, 2018
Source: NPS GIS 2017
CARE_alts_Sandy3_1_V06.pdf
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate.
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles
Notom-Bullfrog Road
Upper Sandy 3 Pasture
Bitter Spring Creek
Bitter Creek
Lower Sandy 3 Pasture
Burr Trail Road
Capitol Reef boundary
NPS allotment
Pasture
Grazed area
Fence
Creek
Monitoring exclosure (existing)
Stock pond functional in 2016/2017?
Yes
No

Livestock Trailing

Currently permitted routes. Under Alternative 1, the National Park Service assumes that current trailing permit holders would continue to use the routes they are permitted for, and they would trail similar numbers of livestock as authorized by their current permits. Listed from north to south, the traditional routes for which the National Park Service currently issues permits include Jones Bench, Gray Bench-Cathedral Valley, Highway 24, Pleasant Creek, Oak Creek, Dry Bench, Notom Road, and Divide Canyon. These trailing routes are shown in Figure 2.2, and data for each trail are presented in Table 2.1.

TABLE 2.1. CURRENTLY USED LIVESTOCK TRAILING ROUTES IN CAPITOL REEF NATIONAL PARK

Trailing Route	Number of Stock	Season	Duration per Event	Distance (Miles)
Jones Bench	100–500	Spring and fall	~ 2 days	0.7
Gray Bench-Cathedral Valley	140–180	Fall only	< 24 hours	8.9
Highway 24	100–125	Fall only	< 24 hours	13.6
Pleasant Creek	~ 250	Fall only	~ 24 hours	7.0
Oak Creek	~ 1,100	Spring and fall	~ 6 days	4.6
Dry Bench*	Not regularly used	variable	N/A	4.8
Notom Road	120–140, occasional use	Spring and fall	~ 2 days	16.6
Divide Canyon	180	Spring and fall	1 day	2.1

*Unlike the other routes, the Bureau of Land Management constructed the Dry Bench trailing route in 1963 specifically as a trailing route; however, it is rarely used, and portions would require repair for the trail to be considered a reliable trailing route.
< = less than
~ = approximately

Trailing would continue to be managed with limited oversight by staff at Capitol Reef National Park. Assuming the number of livestock trailed is similar in the future to recent use, the park staff would work with current permit holders to identify best management practices appropriate for specific trails on an ad hoc basis. Examples of these practices are the number of livestock to be trailed on a given day, the total number of trailing days and whether they are consecutive or spaced apart, and modifications to the route. Best management practices would be focused on an efficient and optimal livestock trailing process for the permit holder and to minimize potential impacts on park resources.

Applications for new permits/transferring existing permits. Any new applications for trailing permits on traditional and/or other trails, to transfer existing trailing permits, and to change season of use or the number of livestock trailed would be considered on a case-by-case basis. New permits would include mitigation measures to prevent additional impacts on natural and cultural resources, particularly for trails that traverse riparian areas and areas with sensitive species. If needed, compliance for future actions involving new impacts, such as a new trailing route, would be conducted at the time the action is evaluated. Best management practices would be focused on an efficient and optimal livestock trailing process for the permit holder and to minimize potential impacts on park resources.

Additional permits would not be issued for the Oak Creek trailing route until the Oak Creek riparian corridor in the park is in proper functioning condition. Also, despite having the ability to do so, the National Park Service would not issue permits for trailing on the Hartnet trail or through the Lower South Desert under the No-Action Alternative, because the park has not issued these permits in the past.

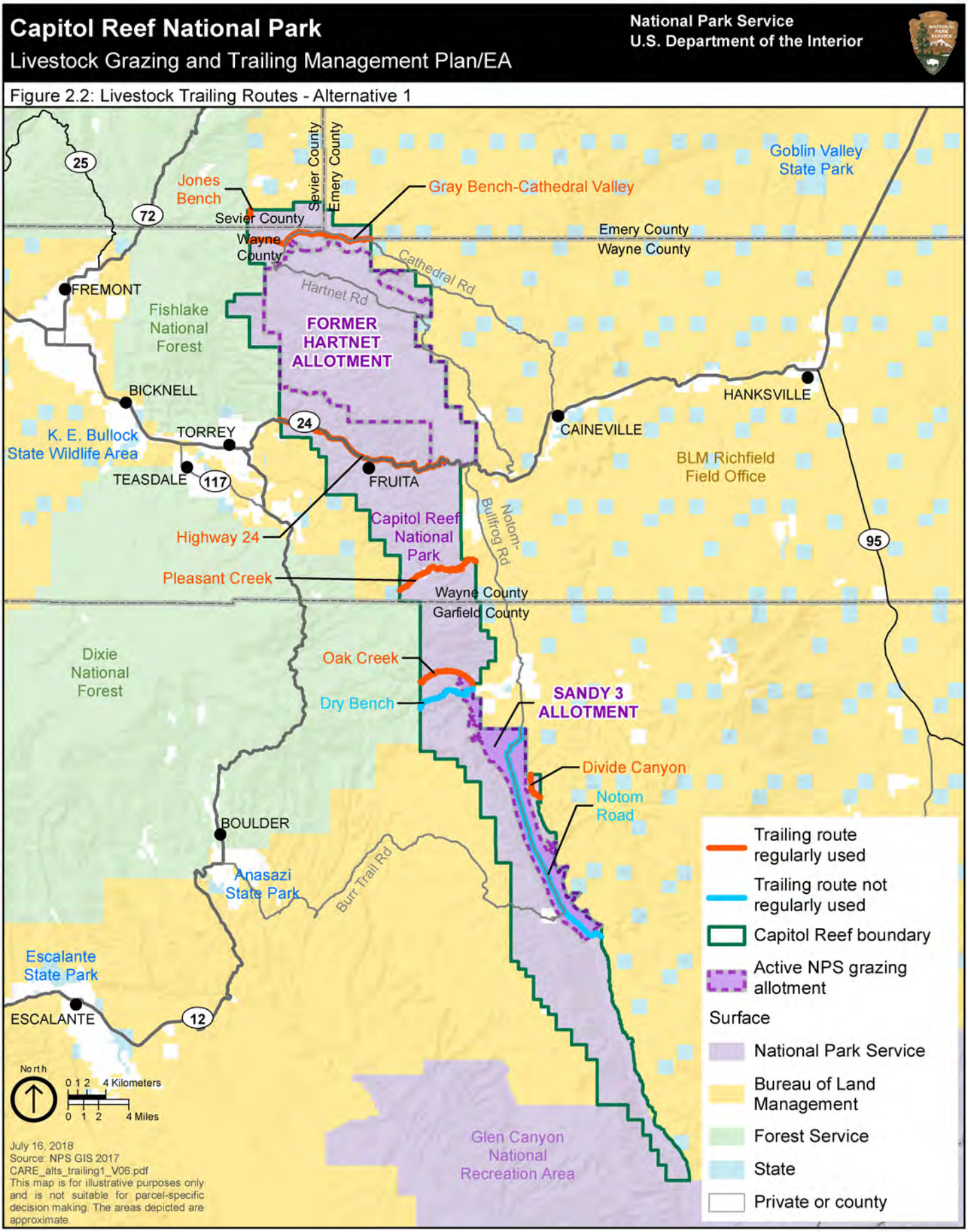
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Figure 2.2: Livestock Trailing Routes - Alternative 1
Goblin Valley State Park
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Active NPS grazing allotment
Surface
National Park Service
Bureau of Land Management
Forest Service
State
Private or county
North
0 1 2 4 Kilometers
0 1 2 4 Miles
July 16, 2018
Source: NPS GIS 2017
CARE_alts_trailing1_V06.pdf
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate.

Invasive plant management. Capitol Reef staff would continue to work with the National Park Service Northern Colorado Plateau Network (NCPN) and the Lake Mead National Recreation Area Exotic Plant Management Team to monitor and control weeds along some of the Highway 24, Pleasant Creek, Oak Creek, and Gray Bench-Cathedral Valley livestock trailing routes. The park staff would continue to participate in the South Central Utah Cooperative Weed Management Area meetings when the opportunity arises.

Monitoring and Adaptive Management

Range and Trail Monitoring and Assessment. There would continue to be limited monitoring of rangeland conditions. The recently retired Hartnet allotment has two small exclosures that would be maintained, and there are two exclosures in the Sandy 3 allotment that also would be maintained. New exclosures would be established in the Sandy 3 allotment, as funding becomes available.

The following actions would continue to be considered for periodic or occasional use in monitoring rangeland conditions:

- Assessing rangeland conditions at plots established in 2015, using the multiple-agency IIRH assessment protocols
- Assessing riparian conditions using proper functioning condition (PFC) assessment protocols, applied in the Sandy 3 allotment as well as in Oak Creek and Pleasant Creek to assess the condition of MSO foraging habitat along the trails
- Monitoring, using photos, at trend monitoring sites

Adaptive management. No formal adaptive management program would be developed. Minor adjustments could be made to grazing permits, based on monitoring results and observed conditions. For example, the numbers of permitted livestock, the duration of the grazing season, and/or the trailing routes could be adjusted in response to forage and range conditions, or impacts on listed plant species.

General Administration of Livestock Grazing and Trailing

Under the No-Action Alternative, the National Park Service would administer a grazing and trailing management program in the absence of a comprehensive management plan. Coordination with adjacent land management agencies and grazing and trailing permit holders, efforts to address unauthorized livestock use, grazing and range management activities, development of range infrastructure project design criteria (e.g., guidelines for construction and maintenance of range infrastructure such as fences and stock ponds), and education/interpretation would continue on an ad hoc basis.

ALTERNATIVE 2 (NPS PREFERRED ALTERNATIVE)

Sandy 3 Allotment Grazing

This alternative includes implementation of a pasture rotation system in the actively grazed areas of the Sandy 3 allotment, which is a standard practice to improve the three fundamental principles of grazing management: duration, timing, and intensity (Straube and Melton 2012). Addressing these principles together is intended to provide the foundation for improving the ecological, social, and economic sustainability of grazing at the park (Straube and Melton 2012). Alternative 2 was also developed with

recognition of the Bureau of Land Management's Utah Standards for Rangeland Health (BLM 1997) related to upland soils and vegetation, riparian and wetland areas, desired species (including native, threatened, endangered, and special status species), and water quality.

The National Park Service recognizes that there is uncertainty in the management of rangelands, which are inherently complex and variable ecosystems, such as those at the park; therefore, grazing management actions are intended to be flexible and responsive to variation in precipitation, forage, and rangeland conditions. To accomplish this, the National Park Service proposes a robust monitoring and adaptive management process to meet desired conditions as described in Appendix C.

Season of use and animal unit months. Same as Alternative 1.

Pastures and herding. Alternative 2 would implement a pasture rotation system using the two active pastures, Upper and Lower Sandy 3 (see Figure 2.3). The total acreage of the Sandy 3 allotment for Alternative 2 is shown in Figure 2.3. The total acreage available for active grazing under Alternative 2 is approximately 10,200 acres. Approximately 6,000 acres are accessible for grazing in the Upper Sandy 3 pasture, and approximately 4,200 acres are accessible in the Lower Sandy 3 pasture.

Pastures would be grazed using a two-pasture rotation system, repeating the pattern every 2 years, as presented in Table 2.2, below. All livestock would graze on each pasture successively. Capitol Reef would work with the permit holder during the grazing season to determine specific dates for moving livestock from one pasture to another. Evaluation criteria would include forage condition and forage consumed in each pasture, weather and access conditions, and calving schedules. Forage condition and consumption evaluation criteria and triggers are discussed briefly under *Monitoring and Adaptive Management*, below, and in greater detail in Appendix C.

TABLE 2.2. ALTERNATIVE 2 SANDY 3 ALLOTMENT PASTURE ROTATION SCHEDULE, NORMAL YEAR

Season	Year 1	Year 2
Fall/winter	Upper Sandy 3 ~76 days November 1 to January 15	Lower Sandy 3 ~76 days November 1 to January 15
Winter/spring	Lower Sandy 3 ~76 days January 16 to March 31	Upper Sandy 3 ~76 days January 16 to March 31

~ = approximately (The number of days grazed on each pasture and the corresponding dates are approximate)

Much of the grazing season is during the winter, when roads are sometimes impassable; therefore, access to the Sandy 3 allotment is not always possible on any given day. Calves need several days to mature after they are born; therefore, moving livestock from one pasture to another or trailing from the allotment may need to be adjusted, based on when calves are born and when access is available.

Water for livestock in the Upper Sandy 3 pasture would be provided by stock ponds, snow, and runoff from snowmelt; in the Lower Sandy 3, water for livestock would be available from Bitter Spring Creek, Bitter Creek, stock ponds, snow, and runoff from snowmelt.

Grazing management infrastructure. Under Alternative 2, Capitol Reef would plan for new fencing, refurbishing stock ponds for water supply (to improve livestock distribution), and installing a cattle guard. Fences would be used to delineate pastures and provide range monitoring exclosures.

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA

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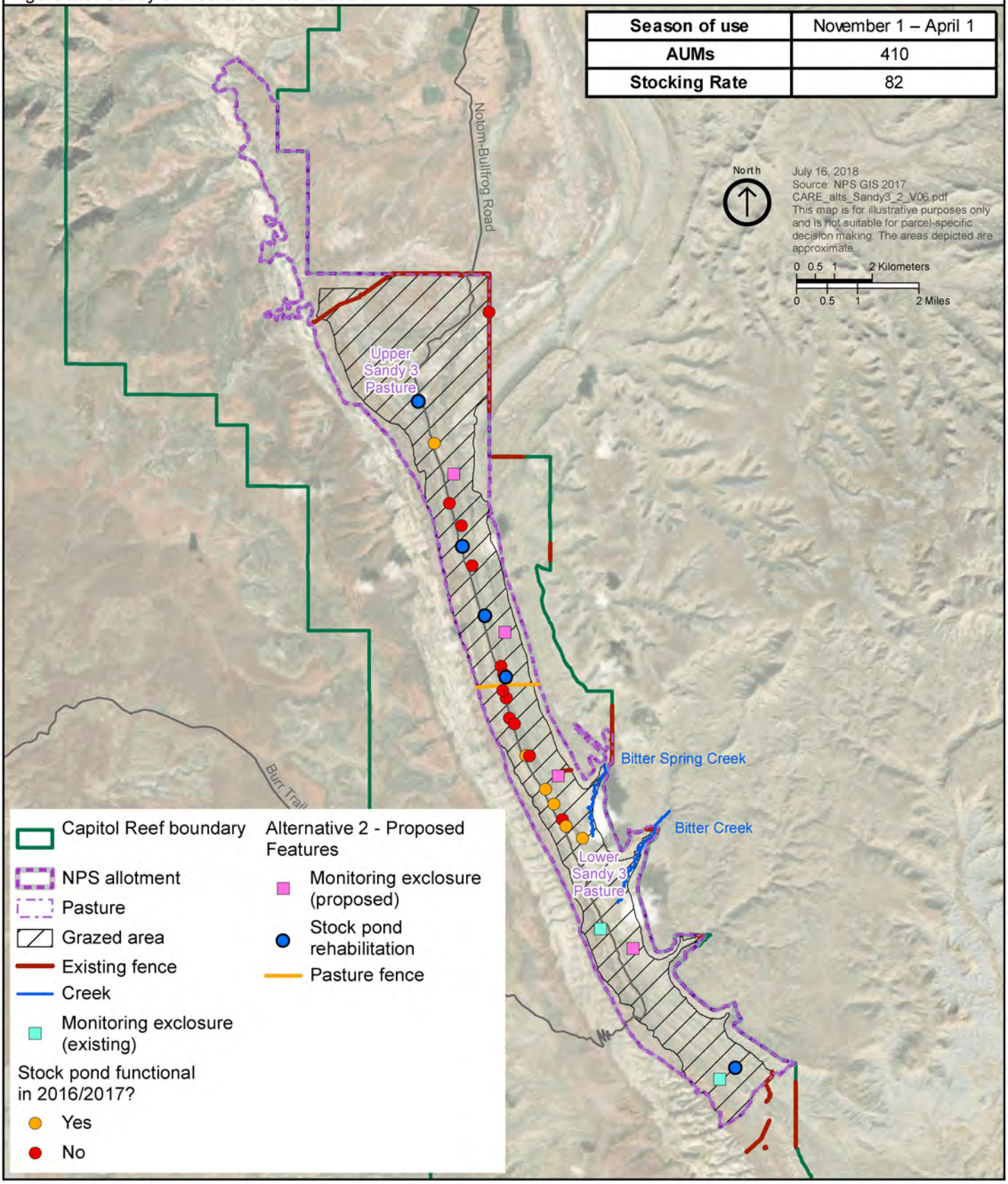
Figure 2.3: Sandy 3 Allotment - Alternative 2



Range Construction Project Design Criteria described in Appendix C provide details on fence construction and stock pond rehabilitation.

Pasture delineation fencing — A fence aligned approximately east to west would be constructed south of the Bitter Creek Divide to separate the two Sandy 3 pastures.

Range monitoring exclosures — Four new monitoring exclosures would be constructed in the Sandy 3 allotment: two each in the Upper Sandy 3 and Lower Sandy 3 pastures. The monitoring exclosures would be in appropriate key areas of each pasture and would encompass approximately 2 acres each (300 feet on a side). The exclosures would be used to evaluate vegetation, biological soil crust, soil stability, and the effects of weather and climate change.

Stock ponds — Five existing earth-berm stock ponds would be refurbished and maintained to catch and hold runoff from precipitation and snowmelt. All of the stock ponds that would be refurbished are next to the Notom Road (Figure 2.3), and all but one are within proposed wilderness. The stock ponds would be developed to provide for a better distribution of livestock in the pasture and a more efficient use of forage in the pasture. If the permit holder, in collaboration with the NPS, identifies other stock ponds not analyzed in the EA that need to be refurbished, environmental review could tier from this EA, as appropriate.

Cattle guard — A cattle guard would be required where the Notom Road intersects the planned pasture delineation fence.

Livestock Trailing

Currently used trailing routes. Alternative 2 provides for the continued use of currently permitted livestock trailing routes used by current permit holders, as described under Alternative 1 (see Figure 2.2 and Table 2.1). Based upon recent discussions with permit holders, the number of livestock trailed could increase to 300 on the Pleasant Creek trail, 200 on the Highway 24 trail, and 400 on the Divide Canyon trail. These increased numbers are analyzed under Alternative 2.

Capitol Reef staff would work with current permit holders to identify best management practices appropriate for specific trails (for example, the number of livestock to be trailed on a given day, the total number of trailing days and whether they are consecutive or spaced apart, and modifications to the route).

Permit holders would be required to use riders to move livestock at a deliberate pace. Permit holders would be encouraged to trail livestock through the park in an efficient manner that balances placing undue stress on the livestock while minimizing the impacts of grazing on park resources. This may mean keeping livestock on defined trails, rather than allowing them to stray and graze during trailing.

Capitol Reef staff would also coordinate with the permit holder using the Pleasant Creek route trail to develop adequate control for livestock that spend the night at the park's eastern boundary. The purpose of the control is to minimize grazing and trampling impacts on natural and cultural resources along the Pleasant Creek corridor.

The park staff would continue invasive plant management efforts described for Alternative 1.

Applications for new permits/transferring existing permits. Under this alternative, in response to recent requests, the National Park Service would issue two new trailing permits in the recently retired

Hartnet allotment (see Figure 2.4 and Table 2.3). Both trails would be used by the permit holder to access their BLM grazing allotment east of the park.

TABLE 2.3. NEW TRAILING PERMITS CONSIDERED IN CAPITOL REEF NATIONAL PARK

Trailing Route	Number of Stock	Season	Duration (Total)	Distance (Miles)
Hartnet Trail	Typically 30 to 50 but up to 150	Each fall, and spring in some years	1 day[a]	12.1
Lower South Desert	Typically 100 to 125 but up to 200	Fall	1-2 days	11.8

[a] To minimize impacts on the three listed plant species along this route, livestock would be trailed through the park in 1 day. Requests for 2 days to trail along this route would be considered on a case-by-case basis.

In the past the permit holders of the recently retired Hartnet allotment have used the Highway 24 livestock trail each fall to move livestock from Torrey to the Lower South Desert portion of the allotment. They would continue to do this in a day with the livestock staying overnight in the Lower South Desert. During the overnight period, livestock may make their way up the Lower South Desert on their own as far as Deep Creek (~ 4 miles) or Baker Post Seep (~ 8 miles; see Figure 3.2 in Chapter 3). The following day riders would be used to move livestock up the Lower South Desert to Jailhouse Rock and then east up the trail to the Lower South Desert Overlook parking area and beyond to BLM lands. To protect sensitive resources, livestock would be trailed through a designated corridor just south of Jailhouse Rock to just beyond the Lower South Desert Overlook parking area (approximately 1.5 miles long and 100 feet wide). It is proposed that the permit holder and possibly Capitol Reef employees would escort livestock through the corridor when they are trailed through the area. Livestock would need to be moved through this area quickly to avoid impacts on sensitive resources.

Any other new applications for trailing permits on traditional and/or other trails, and applications to transfer existing trailing permits, to change season of use, or to change the number of livestock trailed would be considered on a case-by-case basis, as described for Alternative 1.

Monitoring and Adaptive Management

Sandy 3 allotment range monitoring and assessment. Monitoring and adaptive management in the Sandy 3 allotment would address the relationships between duration, timing, and intensity of grazing and rangeland conditions. Monitoring and evaluation of grazing impacts would be based on desired conditions described in Appendix C, including appropriate indicators for rangelands, riparian areas, and federally listed species.

Both short- and long-term monitoring programs would be developed to collect a variety of rangeland data. Monitoring data would be used to determine if range conditions are moving toward or away from desired conditions. Conditions would be evaluated to determine the reasons for the observed deviation. The results of monitoring, particularly during the first 3 to 5 years after implementation of this alternative, would enable the park and permit holders to evaluate the effectiveness of management actions in moving park resources toward desired conditions, and adjust actions as needed.

The monitoring program would consist of short- and long-term monitoring, as shown in Table 2.4, below. See Appendix C for details on how monitoring would occur.

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA

National Park Service
U.S. Department of the Interior

Figure 2.4: Livestock Trailing Routes - Alternative 2

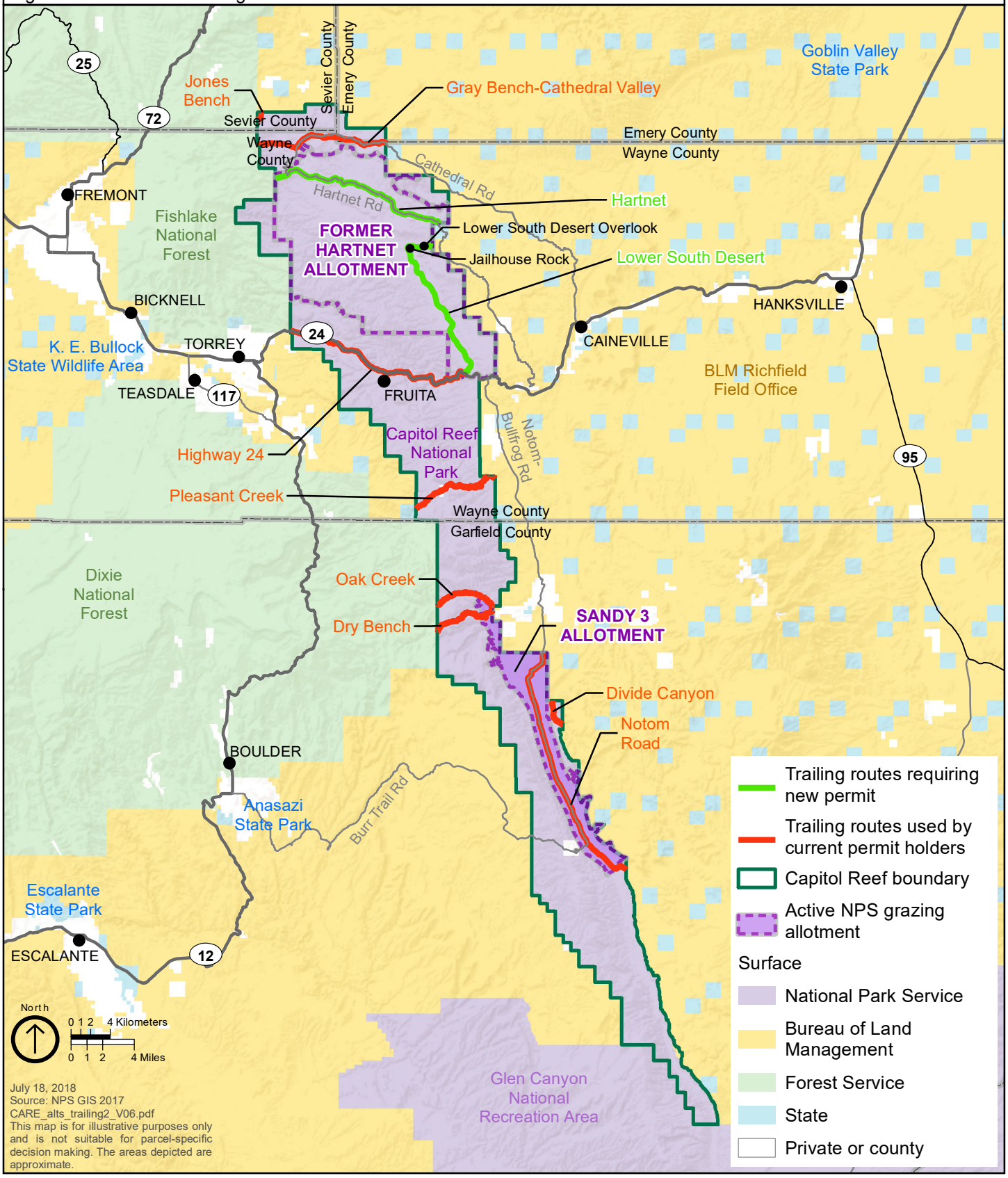


TABLE 2.4. SANDY 3 RANGELAND MONITORING SCHEDULE

Monitoring Type	Annual	Every Second Year	Every Third Year	Every Fifth Year	Every 7 to 10 Years
Weather conditions	X				
Forage production	X				
Forage utilization	X				
Photo points	X				
Livestock days grazing	X				
Breeding birds	X				
Threatened and endangered plant species	X				
Stocking rate		X			
Riparian condition		Possible	X		
Range infrastructure maintenance			X		
Cultural resources				X	
Long-term vegetation and soil trends				X	
IIRH condition assessments					X

Sandy 3 allotment adaptive management actions. Adaptive management actions would be implemented if monitoring indicates that desired conditions are not being achieved, or if range conditions are such that additional livestock or season of use could be tolerated to the maximum AUMs established for each allotment. Monitoring and adaptive management actions, particularly those that do not involve actions with impacts on the human environment, are discussed more fully in Appendix C.

Forage availability or changing range conditions — Adjust the stocking rate and duration of the grazing season in response to abundant forage, insufficient forage, or changing range conditions. Abundant or minimal forage would be determined based on clipping and weighing of representative forage in the allotment, other monitoring data, and a comparison of forage conditions with Natural Resources Conservation Service (NRCS) forage production values (NRCS 2013).

Season of use — Season of use could be adjusted based on the overall condition of range vegetation and weather. In the Sandy 3 allotment, the season of use could also be adjusted to allow livestock on the allotment in mid-October instead of November 1 to help control cheatgrass.

Distribution of livestock — Develop and implement mechanisms to provide for better distribution of livestock in the pastures, to enhance efficient forage utilization, and to minimize the effects of livestock congregating in small areas. Concepts could include the following:

- Place supplements in strategic locations to achieve desired distribution; if supplements are used, buffers (between 0.25 and 1.0 mile) would be established between areas where supplements are placed and populations of sensitive species or water sources that could be negatively affected
- Place supplements to increase utilization of cheatgrass- and Russian thistle-dominated areas in the Sandy 3 allotment
- Use riders on horseback and move livestock within pastures to improve distribution, in response to weather, water, and forage availability

Improve overall range and natural resource conditions — Specific adaptive management actions have not been developed for this broad topic; however, potential actions could include the following:

- Inhibiting active erosion (gullies and head-cutting)
- Improving native forage, riparian zone, and woody species ecological function
- Treating widespread invasive plant species
- Reseeding native grasses and shrubs

Such actions would generally contribute to the ability of the National Park Service to meet desired conditions. This would improve resource conditions relative to the current condition; however, such actions may require additional planning and compliance.

Trail monitoring and assessment. The park would monitor trailing along routes with sensitive resources, particularly the Oak Creek, Pleasant Creek, Gray Bench-Cathedral Valley, Hartnet, and Lower South Desert trailing routes. Monitoring and adaptive management actions, particularly those that do not involve actions with impacts on the human environment, are discussed more fully in Appendix C. The National Park Service would coordinate with the permit holders and only use park staff with experience trailing livestock so that observation, monitoring, and assistance does not interfere with operations.

Riparian assessments: The condition of the following riparian areas, which occur along permitted trailing routes, would be monitored as described in Appendix C:

- Oak Creek (also informs condition of foraging habitat for MSO)
- Pleasant Creek (also informs condition of foraging habitat for MSO)
- Ackland Springs (Hartnet Draw)
- Deep Creek Spring (Lower South Desert)
- Notch Water Spring (Lower South Desert)

Threatened and endangered species — As described in Appendix C, select localities of listed plant species along the Hartnet, Lower South Desert, and Gray Bench-Cathedral Valley trailing routes would be surveyed within a week of each trailing event to quantify the percentage of plants damaged or disturbed by livestock. If the percentage of plants damaged or disturbed at a locality (i.e. a systematically surveyed area with one or more individuals) is greater than or equal to 5% or 15%, respectively, the US Fish and Wildlife Service (USFWS) would be contacted to discuss potential adaptive management actions. For fall trailing events when Winkler cacti may be retracted underground, a habitat disturbance index would be used to predict the probability of cactus disturbance (Clark 2016).

Trailing Adaptive Management Actions

General — Adaptive management actions would be implemented if monitoring indicates that the percentage of listed plant species damaged or disturbed by livestock at select localities exceeds the established threshold or if riparian corridors used as livestock trails are not in proper functioning condition due to livestock activities. The following are potential adaptive management actions that could be used:

- Temporarily fence sensitive resources, including threatened and endangered species and cultural resources, while trailing occurs
- Enlist more riders or staff during trailing events to ensure livestock stay out of areas with listed plants

- Identify alternative trailing route alignments to avoid listed species
- Move livestock through sensitive resource areas more quickly
- For the Lower South Desert trail, contain livestock overnight rather than allowing them to drift up the Lower South Desert
- If stock ponds in the Upper Sandy 3 pasture do not retain water, the National Park Service will leave the cross fence between the upper and lower Sandy 3 pastures open so anmials can reach perennial water sources in the lower Sandy 3 pasture.

Oak Creek — If Oak Creek becomes nonviable for any reason (e.g., due to continued "nonfunctional" PFC assessment ratings that affect the MSO foraging habitat, or a natural event that prevents its use), the Dry Bench trailing route would continue to be available for use, and as needed, the park would use a trail crew to repair sections of the trail that are unsafe for livestock and riders (see Appendix C for details).

Deep Creek Spring — Deep Creek Spring is located in the Lower South Desert and could be affected by issuing permits for trailing through this part of the recently retired Hartnet allotment. If this riparian area continues to be affected by livestock during trailing (i.e., if PFC assessment ratings continue to be nonfunctional), approximately 1 to 2 acres could be fenced to protect Deep Creek Spring riparian resources. Water would not need to be piped out of the fenced area because the spring discharge is sufficient for water to flow outside the proposed fenced area. This fencing would be constructed in accordance with Range Construction Project Design Criteria noted below, and described in detail in Appendix C.

General Administration of Livestock Grazing and Trailing

Under Alternative 2, the National Park Service would implement a plan for grazing and trailing management that would provide comprehensive guidance for the general administration of grazing and trailing related to coordination with other agencies and permit holders, unauthorized livestock or other livestock use, staffing/range management activities, range construction project design criteria (for stock ponds, fences, and water delivery systems), and education/interpretation**.** Details of this guidance for general administration of grazing and trailing can be found in **Appendix C**.

Invasive Vegetation Management

Eliminating or controlling invasive plant species and restoring native plant communities throughout all ecosystems, including developed areas, is a goal of Capitol Reef. Some invasive plant species can be treated through mowing and string trimming or by hand pulling; some species can be managed through intensive livestock grazing programs; other species are most effectively treated using herbicides. Use of herbicides in the park is minimized; however, its use is necessary in some instances to effectively control highly invasive species. Species targeted for control with herbicides include salt cedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), tree of heaven (*Ailanthus altissima*), Russian thistle (*Salsola tragus*), cheatgrass (*Bromus tectorum*), and halogeton (*Halogeton glomeratus*). All of these species are found either in the Sandy 3 allotment, along traditional trailing routes used by current permit holders, and along routes for which new trailing permits have been requested. Details regarding invasive plant management, including the potential for treating 5 to 8 acres of tamarisk at Little Lake Mead in the Sandy 3 allotment, are provided in Appendix C. However, herbicide use at the park is evaluated under separate compliance and is, therefore, not analyzed in detail in this Draft Plan/EA.

ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

Discontinue Grazing or Trailing

As noted in Chapter 1, when Congress established Capitol Reef National Park in 1971, the enabling legislation (Public Law 92-207) provided for continuation of livestock grazing and trailing, subject to appropriate management by the National Park Service. Grazing was expected to be phased out within 10 to 20 years under the 1971 legislation, but congressional action in 1982 (Public Law 97-341) and 1988 (Public Law 100-446) extended the length of time in which grazing would be allowed in Capitol Reef. These statutes collectively preclude the National Park Service from discontinuing existing grazing and trailing privileges at this time.

While in some situations it may be appropriate for agencies to consider alternatives that are outside of their jurisdiction, discontinuing grazing and trailing would be directly contrary to the intention of Congress, as demonstrated by the 1982 and 1988 legislation. Furthermore, the purpose of this Draft Plan/EA is to provide guidance and tools for the long-term management of these statutorily authorized uses, in a manner that promotes the shared conservation and stewardship of the natural resources, ecological processes, and cultural resources of the park; therefore, an alternative that discontinues grazing or trailing in the park would not meet the purpose for this Draft Plan/EA and is not reasonable; thus, it was dismissed from further consideration.

Alternative Grazing Locations

This alternative would have required the National Park Service to work with permit holders to find other locations on federal and/or private land to graze their livestock. During scoping with other agencies, Capitol Reef determined that federal land in the area where grazing is allowed is already encumbered by valid grazing permits issued to other operations. In addition, no clear funding or authority exists to purchase alternative grazing sites on private lands to replace forage that would no longer be available on the park; therefore, this alternative is not feasible and was dismissed from further consideration.

Grand Canyon Trust and Great Old Broads for Wilderness Alternative

The Grand Canyon Trust and Great Old Broads for Wilderness submitted an alternative for consideration during public scoping for this project, which they called the Sustainable Multiple Use Grazing Alternative. It centered on six general goals, as follows:

- Watershed condition
- Healthy and diverse native plant communities
- Maintenance of ecological processes
- Healthy riparian areas and wetlands
- Productive soils
- Healthy habitats that support native species and provide for recovery of federally listed or proposed species

The alternative submitted by Grand Canyon Trust and Great Old Broads for Wilderness proposed management activities to meet five sets of objectives for native plant communities, riparian areas and wetlands, soils, water quality standards, and habitats for species of concern.

There are many similarities and overlap between these goals and objectives, and the purpose and need and objectives that the National Park Service has developed for the project.

The proposed alternative explains its goals and objectives well and explains the rationale behind them; however, as submitted, the alternative does not include detailed information or specifics on how and where its suggestions would be implemented in Capitol Reef.

In addition, Alternative 2 addresses the framework proposed under this alternative and is analyzed in detail. For example, Alternative 2 includes some public involvement as part of the grazing program management. Alternative 2 provides specific grazing management details for the allotment. It addresses timing and intensity of grazing, vegetation management, maintenance of infrastructure, and any new infrastructure. It also includes monitoring requirements and adaptive management strategies.

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CHAPTER 3: AFFECTED ENVIRONMENT

The affected environment describes the existing condition of the resources that could be affected by implementing any of the alternatives.

This chapter describes the existing condition of resources that could be affected by implementing the alternatives analyzed in detail. Only the impact topics related to issues carried forward for detailed analysis are included in the affected environment.

The affected environment serves as the baseline for predicting changes that could occur if any of the alternatives under consideration, including the No-Action Alternative, are implemented. The affected environment is separate and distinct from the No-Action Alternative, which describes current management that would continue into the future rather than the current state of affected resources.

SOILS

Most of the available information on soils in Capitol Reef National Park is from a soil survey by the Natural Resources Conservation Service between 2010 and 2014. Fieldwork for the soil survey was completed in 2011, and the two-volume report was published in 2014 (NRCS 2014).

Every soil component mapped in Capitol Reef National Park is correlated to an upland, or riparian ecological site description (ESD) developed by the Natural Resources Conservation Service (NRCS 2014). Ecological sites are the fundamental unit of a potential-based land classification system. Their purpose is to classify similar types of land, based on the land's ability to produce particular plant communities that respond similarly. For uplands, ecological sites are correlated to soil components based on the potential of the soil component to produce a particular kind and amount of vegetation that responds in a certain way to disturbance and management. For riparian areas, ecological sites are also correlated to soil components; however, the correlation is based on associated valley types and stream types that produce a distinctive complex of riparian plant communities that respond in a certain way to disturbance and management. Ecological sites may be correlated to more than one soil component, as long as the potential vegetation and response to disturbance are similar among soil components (NRCS 2014). Ecological sites and soil map units (SMUs) present in the Sandy 3 allotment are presented in Table 3.1.

Biological soil crusts are associated with almost all soils in the Sandy 3 allotment and along the trailing routes evaluated in this EA. In the Colorado Plateau region, they comprise over 70% of the living ground cover and play a key role in reducing erosion and increasing water retention and soil fertility (USGS 2001). Crusts are dominated by cyanobacteria, but fully developed communities of soil crusts also include lichens, mosses, microfungi, other bacteria, and green algae (USGS 2001). These living organisms and their by-products create a continuous crust on the soil surface.

Biological soil crusts serve many ecosystem functions, including reducing wind and water erosion, fixing atmospheric carbon dioxide and nitrogen, functioning as living mulch to retain soil moisture and discourage weed growth, and contributing to soil organic matter and nutrient retention (Evans and Belnap 1999, 2006; Belnap and Gillette 1997; Darby et al. 2006; Neff et al. 2005). Because plant cover is sparse, crusts are an important source of organic matter for desert soils. Cyanobacteria and cyanolichens contribute nitrogen to soils, which is especially important in desert ecosystems, where nitrogen often limits plant growth. One additional benefit of crusts is that cyanobacteria secrete compounds that stimulate plant growth (USGS Up 2001).

Biological soil crusts in the park have been disturbed, to varying degrees, by livestock grazing and trailing. Disturbance can lead to reductions or elimination of ecosystem functions, such as carbon and nitrogen fixation or soil moisture retention, by altering species composition of the crusts or destroying the living crust altogether (Binkley and Hart 1989; Evans and Belnap 1999; Matson et al. 1991; Peterjohn and Schlesinger 1991; Virginia et al. 1982). Studies have shown that livestock grazing may negatively affect biological soil crusts by reducing cover and species richness because of direct disturbance (Anderson et al. 1982; Belnap et al. 1994; Harris and Asner 2003; Hiernaux et al. 1999; Johansen and St. Clair 1986; Kleiner and Harper 1972; Marble and Harper 1989; Memmott et al. 1998; Neff et al. 2005; Terry and Burns 1987).

Sandy 3 allotment. Table 3.1 presents the ecological sites and respective SMUs in the grazed area of the Sandy 3 allotment. These ecological sites were confirmed with soil pits and vegetation analysis during the rangeland health assessments (see Appendix B).

TABLE 3.1. ECOLOGICAL SITES AND SOIL MAP UNITS: SANDY 3 ALLOTMENT GRAZED AREA

Ecological Site ID	Ecological Site Name	SMU	SMU Name
R035XY003UT	Alkali Bottom (Greasewood)	16	Calladito-Yarts complex
R035XY009UT	Alkali Flat (Greasewood)	10	Begay, saline-Querencia, saline-sodic complex
		16	Calladito-Yarts complex
R035XY011UT	Loamy Bottom (Basin Big Sagebrush)	16	Calladito-Yarts complex
		96	Sandyranch-Mido-Mident complex
R035XY109UT	Desert Loam (Shadscale)	8	Begay sandy loam
		10	Begay, saline-Querencia, saline-sodic complex
		16	Calladito-Yarts complex
R035XY124UT	Desert Shallow Clay (Mat Saltbush)	65	Querencia-Lybrook complex
R035XY209UT	Semidesert Loam (Wyoming Big Sagebrush)	8	Begay sandy loam
R035XY212UT	Semidesert Sand (Fourwing Saltbush)	96	Sandyranch-Mido-Mident complex
R035XY215UT	Semidesert Sandy Loam (Fourwing Saltbush)	8	Begay sandy loam
		10	Begay, saline-Querencia, saline-sodic complex
		12	Begay-Ignacio-Retsabal complex
		96	Sandyranch-Mido-Mident complex
R035XY242UT	Semidesert Stony Loam (Shadscale)	8	Begay sandy loam
		10	Begay, saline-Querencia, saline-sodic complex

Source: NRCS 2014

Based on rangeland health assessments conducted per the protocol described in Interpreting Indicators of Rangeland Health, version 4 (Pellant et al. 2005), substantial portions of the Sandy 3 allotment are in a state of departure from reference conditions with regard to soil and site stability (Table 3.2; see Appendix B for details).

TABLE 3.2. DEPARTURE FROM REFERENCE CONDITIONS FOR SOIL AND SITE STABILITY ATTRIBUTE, SANDY 3 ALLOTMENT

Rangeland Health Assessment, Soil and Site Stability Attribute		
Departure from Reference Conditions Category	**Plots in Each Category**	**Extrapolated Area in Each Category**
None-to-slight	17.9%	1,800 acres
Slight-to-moderate	23.1%	2,400 acres
Moderate	46.2%	4,700 acres
Moderate-to-extreme	12.8%	1,300 acres

The current condition of soil in areas with slight-to-moderate, moderate, and moderate-to-extreme departures from reference condition is a product of the following, based on the rangeland health assessments (the indicators in parentheses correspond to the list of indicators found in Appendix B):

- Increased bare ground (Indicator 4)—Bare ground extent is greater than reference conditions in ecological sites representing approximately 56% of the area.
- Loss of biological soil crust (Indicator 12)—Biological soil crust extent is less than or toward the low range of reference conditions in ecological sites representing approximately 56% of the area of the allotment.
    - In the Sandy 3 allotment, many SMUs and associated vegetation communities are largely devoid of biological soil crusts because of disturbance by cattle. Additional locations in the allotment exhibit biological soil crusts only under plant bases, plant canopies, and on steep slopes marginal to more accessible ground. Many vegetation monitoring plots have experienced a complete shift of biological soil crust species, from lichenous-moss pedestals to less productive cyanobacterial crusts.
- Soil loss through sheet flow, channel runoff, and wind scour (Indicators 1, 2, 3, 5, and 6)—The rangeland health data indicate that 36.5% of the plots evaluated exhibit a moderate, moderate-to-extreme, or extreme-to-total departure from reference conditions.
- Deposition of windblown sediments in dunes and on lee faces (Indicators 6, 7, and 9)—The rangeland health data indicate that 39% of the plots evaluated exhibit a moderate, moderate-to-extreme, or extreme-to-total departure from reference conditions.
- Alteration and loss of vegetation (Indicators 10, 12, 13, 15, 16, and 17)—The rangeland health data indicate that 45.5% of the plots evaluated exhibit a moderate, moderate-to-extreme, or extreme-to-total departure from reference conditions.
- Decreased infiltration of precipitation (Indicators 5, 8, 10, and 11)—The rangeland health data indicate that 39% of the plots evaluated exhibit a moderate, moderate-to-extreme, or extreme-to-total departure from reference conditions.

Livestock trailing routes. For the purposes of this EA, the National Park Service identified the analysis area as a 200-foot corridor (100-foot buffer) along trailing routes; this corridor was chosen because it represents the extent of the area affected by cattle as observed by park staff. The estimated area of impact for the proposed Lower South Desert trailing route includes a quarter-mile of disturbance around water sources since cattle may concentrate in these areas overnight.

Rangeland health assessments conducted for the recently retired Hartnet allotment provide insights into current soil conditions in areas where new trailing permits may be issued (e.g., the Hartnet and Lower South Desert routes). These assessments indicated that over 80% of the soils in the grazed areas of the

recently retired Hartnet allotment were in slight-to-moderate, moderate, and moderate-to-extreme departure from reference condition because of increased bare ground (Indicator 4); loss of biological soil crust (Indicator 12), including issues described above for the Sandy 3 allotment; soil loss through sheet flow, channel runoff, and wind scour (Indicators 1, 2, 3, 5, and 6); deposition of windblown sediments in dunes and on lee faces (Indicators 6, 7, and 9); alteration and loss of vegetation (Indicators 10, 12, 13, 15, 16, and 17); and decreased infiltration of precipitation (Indicators 5, 8, 10, and 11).

Rangeland health assessments do not provide information about the current condition of soils along the currently permitted trailing routes; however, based on park staff observations, many of the same factors affecting soil conditions in the Sandy 3 allotment and recently retired Hartnet allotment are occurring along currently permitted trailing routes, including increased bare ground; loss of biological soil crusts; soil loss through sheet flow, channel runoff, and wind scour; deposition of windblown sediments in dunes and on lee faces; alteration and loss of vegetation; and decreased infiltration of precipitation.

UPLAND AND RIPARIAN VEGETATION COMMUNITIES

Capitol Reef National Park is part of the Canyonlands section of the Colorado Plateau Division of the Intermountain Flora (Cronquist et al. 1972; The Nature Conservancy 2009). The park protects much of the Waterpocket Fold, a monocline, or giant wrinkle, in the earth's crust that extends for almost 100 miles. This uplift has resulted in 17 different geologic formations being exposed within the park, along with unique topographic features, including monoliths, slot canyons, cliffs, arches, and bridges. The varied geology and topography, in combination with the wide range in elevation (1,200–2,700 meters [m]; 3,900–8,800 feet) and precipitation (13–25 centimeters; 5–10 inches), have resulted in diverse vegetation communities (Welsh and Chatterley 1985). Nine hundred and nine plant species have been documented in the park, including 40 endemic species with very restricted distributions, occurring on specific geologic formations, soils, slopes, aspects, elevations, or precipitation ranges (Fertig 2007; Fertig et al. 2012).

Coles et al. (2009) conducted US Geological Survey (USGS)-NPS Classification and Vegetation Mapping in Capitol Reef National Park between 2002 and 2005, with a report and vegetation map completed in 2009. Throughout the park, they mapped 175 vegetation associations, which describe repeatable vegetation assemblages in terms of general appearance, distribution, and other environmental factors (Barbour 1987). Due to the difficulty of distinguishing the associations at the scale used in the project, similar associations were combined into complexes.

The dominant upland vegetation associations and complexes in the planning area have been grouped into four broad community types. Table 3.3 identifies the extent of these upland vegetation community types, as well as riparian and wetland communities, in the Sandy 3 allotment. Using the same 100-foot buffer on each side of the trail, described in the *Soils* section, with an additional quarter-mile of impact around springs along the Lower South Desert trail, as detailed in Table 4.2, Table 3.4 identifies the extent to which trailing routes analyzed in this EA pass through these upland, riparian, and wetland vegetation community types.

The following sections identify the complexes that make up the upland, riparian, and wetland community types in the planning area. The information is summarized from Coles et al 2009, which is hereby incorporated by reference (Coles et al. 2009 is available on http://parkplanning.nps.gov/care_lgtmp). Other vegetation associations, such as unvegetated slickrock slopes, mudstone cliffs, bare talus slopes, or barren wash bottoms, that make up much smaller amounts of the planning area are not typically accessible to or grazed by cattle; therefore, they are not discussed further.

TABLE 3.3. DOMINANT VEGETATION COMMUNITY TYPES IN THE SANDY 3 ALLOTMENT

Community Type	Grazed Acres	Percentage of Grazed Acres
Upland Shrublands	5,394	53
Upland Forest and Woodlands	3,371	33
Sparsely Vegetated Badlands	1,210	12
Upland Herbaceous	280	3
Riparian and Wetlands	65	0.6

Source: Coles et al. 2009

TABLE 3.4. DOMINANT VEGETATION COMMUNITY TYPES ASSOCIATED WITH TRAILING ROUTES

Community Type	Acres (Percentage of Total) of Trail									
	Jones Bench	Gray Bench-Cathedral Valley	Highway 24	Pleasant Creek	Oak Creek	Dry Bench	Notom Road	Divide Canyon	Hartnet Trail	Lower South Desert
Upland Shrublands	0	122 (56)	158 (48)	102 (60)	43 (39)	8 (7)	179 (44)	27 (54)	182 (62)	357 (70)
Upland Forest and Woodlands	17 (100)	47 (22)	6 (2)	31 (19)	49 (44)	102 (88)	103 (26)	23 (46)	59 (20)	0
Upland Herbaceous	0	31 (14)	3 (1)	2 (1)	0	0	40 (10)	0	13 (4)	95 (19)
Sparsely Vegetated Badlands	0	0	12 (4)	0	0	0	19 (5)	0	7 (2)	20 (4)
Riparian and Wetlands	0	2 (1)	70 (21)	9 (5)	7 (6)	0	0	0	1 (<1)	18 (4)

Upland Vegetation

Sandy 3 allotment. Table 3.5 identifies the dominant complexes that make up the upland vegetation community types in the Sandy 3 allotment (see Figure 3.1).

Changes in upland vegetation communities over time in Capitol Reef National Park, including the Sandy 3 allotment, can be generally characterized as a shift in community composition from cool-season grass dominated grasslands to warm-season grasses and an increased abundance of invasive species (see below for more on invasive plant species). Fisher et al. (1991) analyzed phytoliths[1] and found that 200 to 800 years ago, the plant communities in grazed sites were dominated by cool-season grasses and had more forbs and shrubs. Highly palatable species, such as winterfat and Indian ricegrass, were historically common but have declined or become locally extirpated since the introduction of nonnative ungulates (Heil et al. 1993; Cole et al. 1997).

[1]Mineralized, microscopic plant structures that persist in the soil profile

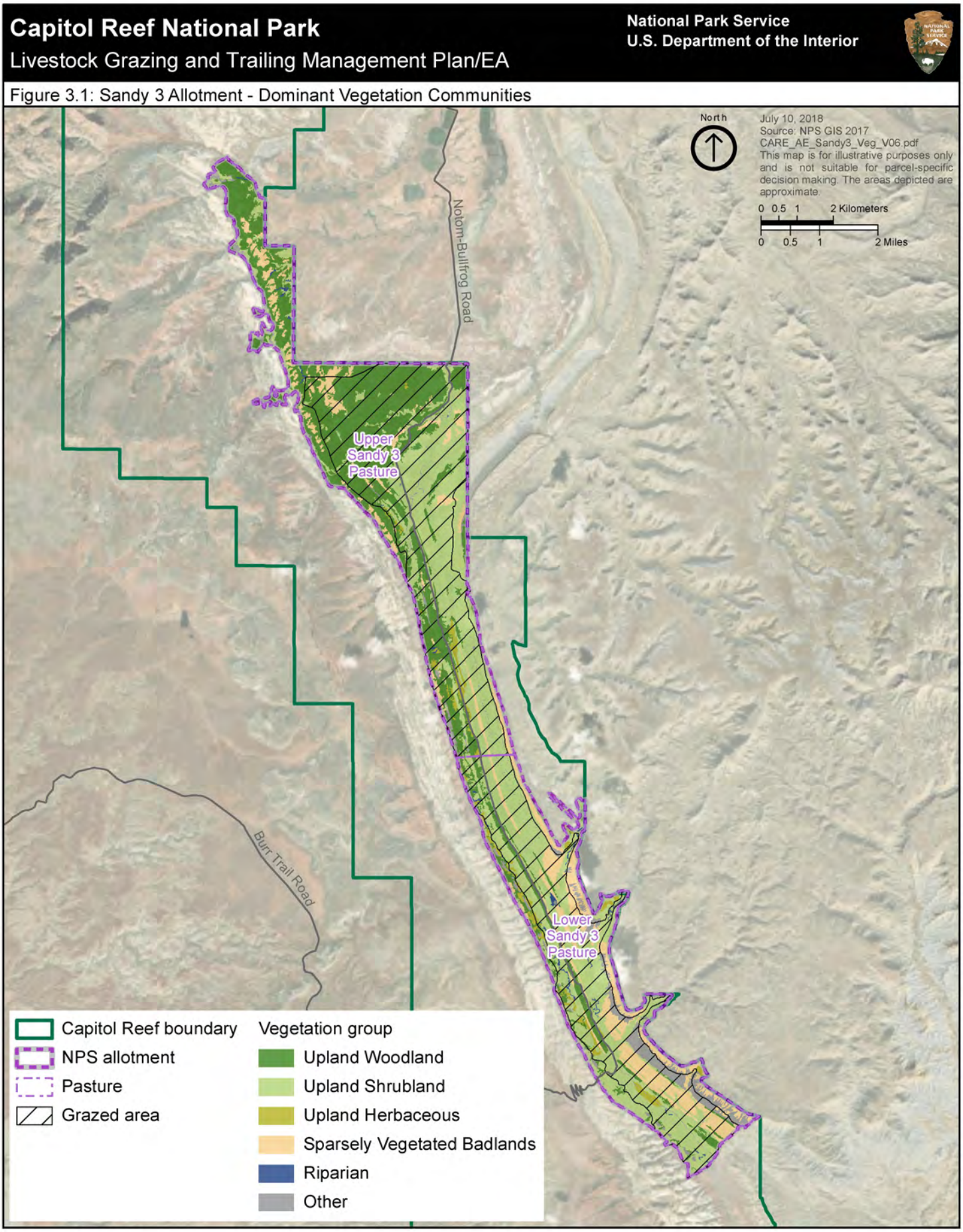

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA
National Park Service
U.S. Department of the Interior
Figure 3.1: Sandy 3 Allotment - Dominant Vegetation Communities
North
July 10, 2018
Source: NPS GIS 2017
CARE_AE_Sandy3_Veg_V06.pdf
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate.
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles
Notom-Bullfrog Road
Upper Sandy 3 Pasture
Lower Sandy 3 Pasture
Burr Trail Road
Capitol Reef boundary
NPS allotment
Pasture
Grazed area
Vegetation group
Upland Woodland
Upland Shrubland
Upland Herbaceous
Sparsely Vegetated Badlands
Riparian
Other

TABLE 3.5. DOMINANT UPLAND VEGETATION COMPLEXES IN THE SANDY 3 ALLOTMENT

Community Type	Grazed Acres	Percentage of Grazed Acres
Upland Shrublands		
Shadscale Shrublands	2928	27
Black Greasewood Shrublands	1075	10
Big Sagebrush Shrubland	531	5
Desert Wash Shrubland Mosaic	192	2
Mixed Desert Shrublands	303	3
Upland Forest and Woodlands		
Pinyon-Juniper/Mesic Shrubs Woodlands	1806	17
Pinyon-Juniper/Xeric Shrubs Woodland	919	9
Pinyon-Juniper/Mixed Grass Woodland	217	2
Pinyon-Juniper/Sparse Understory Woodland	226	2
Sparsely Vegetated Badlands		
Saltbush Badlands Shrubland Complex	917	8
Gypsum Badland Sparse Vegetation Complex	167	2
Bentonite Badlands	126	1
Upland Herbaceous		
Mixed Grassland Complex	280	3

Note: Unvegetated land cover (e.g., roads) and associations with less than 1% cover are excluded.

Rangeland health assessments support these observations, showing that large areas of the Sandy 3 allotment have departed from reference conditions with respect to biotic integrity (Table 3.6; see Appendix B for details).

TABLE 3.6. DEPARTURE FROM REFERENCE CONDITIONS FOR BIOTIC INTEGRITY ATTRIBUTE, SANDY 3 ALLOTMENT

Rangeland Health Assessment, Biotic Integrity Attribute		
Departure from Reference Conditions Category	**Plots in Each Category**	**Extrapolated Area in Each Category**
None-to-slight	15.4%	1,600 acres
Slight-to-moderate	15.4%	1,600 acres
Moderate	46.2%	4,700 acres
Moderate-to-extreme	23.1%	2,300 acres

The current condition of vegetation in areas with moderate, moderate-to-extreme, and extreme-to-toal departure from reference condition is a product of the following indicators, based on rangeland health assessments (the indicators in parentheses correspond to the list of indicators found in Appendix B).

- Change in plant functional/structural groups (Indicator 12)—Departure from reference conditions occurred in 63% of plots, often due to loss of cool-season grasses.
- Plant mortality (Indicator 13)—Higher than expected proportions of dead plant material indicated that plant recruitment is not occurring in 45% of plots.

- Annual production (Indicator 15)—Reduced annual production resulted in departure from reference conditions for 32% of plots. This can occur due to hedging of shrubs (e.g., saltbush) or grasses (e.g., blue grama).
- Invasive plants (Indicator 16)—Departure from reference conditions occurred in 74% of plots. The Sandy 3 allotment has been widely invaded by cheatgrass.
- Plant reproductive capability (Indicator 17)—Seed production on native plants, including grasses, was lower than in reference areas in 32% of plots.

Livestock trailing routes. Table 3.7 identifies the dominant upland vegetation complexes that make up the community types shown in Table 3.4. As described above, the area of impact is assumed to be a 100-foot buffer along trails, with an additional quarter-mile area of impact around springs on the Lower South Desert trail (Table 4.2).

Rangeland health assessments do not provide current conditions specifically for routes used by current permit holders (see Table 3.4); however, the Notom Road route trails through the Sandy 3 allotment and based on staff observations, the same factors contributing to departure from reference conditions for the allotment (as described above) are occurring along the trailing route, particularly the presence of invasive species.

Rangeland health assessments for the recently retired Hartnet allotment provide insight into conditions along the Hartnet and Lower South Desert routes. Reduced reproductive capability of perennial plants (Indicator 17), change in plant functional/structural groups (Indicator 12), increased invasive plants (Indicator 16), increased plant mortality (Indicator 13), and reduced annual production (Indicator 15) all contributed to departure from reference conditions in these areas.

Riparian and Wetland Vegetation

Although riparian and wetland vegetation complexes cover little area, they are disproportionately important due to their hydrologic functions and unique vegetation, which create important habitat for birds and other wildlife. They are also highly vulnerable and altered in the western United States, due to water withdrawal and management projects, invasive species, and livestock grazing (Belsky et al. 1999; Fleischner 1994). Water sources are important for livestock, and the distribution of water sources can play an important role in encouraging livestock distribution to the benefit of rangeland health (NRCS 2003; Vallentine 2001).

The current condition of riparian vegetation in the Sandy 3 allotment, and along or near many of the trailing routes analyzed in this EA, has been described based on proper functioning condition assessments. These details are described in the *Water Resources* section later in this chapter.

Sandy 3 allotment. Table 3.8 identifies the dominant riparian complexes in the Sandy 3 allotment.

Livestock trailing routes. Table 3.9 identifies the dominant riparian complexes that occur within 100 feet on each side of trails analyzed in this EA. Note that there are no riparian areas along Divide Canyon, Dry Bench, Jones Bench, or Notom Road, so they are not included in the table.

TABLE 3.7. ACRES (PERCENTAGE OF TOTAL) OF UPLAND VEGETATION COMPLEXES ASSOCIATED WITH TRAILING ROUTES*

Community Type	Acres (Percentage of Trail)									
	Gray Bench-Cathedral Valley	Divide Canyon	Dry Bench	Hartnet	Highway 24	Jones Bench	Lower South Desert	Notom Road	Oak Creek	Pleasant Creek
Upland Shrublands										
Big Sagebrush Shrubland Complex	10 (5)	0	0	11 (4)	1 (<1)	0	0	5 (1)	27 (24)	9 (5)
Black Greasewood Shrubland Complex	68 (32)	0	0	101 (34)	0	0	62 (12)	78 (19)	0	0
Desert Wash Shrubland Mosaic	10 (5)	19 (37)	0	4 (1)	29 (9)	0	7 (1)	14 (3)	10 (9)	79 (46)
Little-leaf Mountain Mahogany Slickrock Sparse Vegetation	0	0	2 (2)	0	8 (2)	0	0	0	6 (6)	10 (6)
Mixed Desert Shrubland Complex	32 (15)	2 (4)	0	20 (7)	75 (23)	0	161 (32)	19 (5)	0	0
Sand Sage Shrubland Complex	0	0	0	0	0	0	25 (5)	0	0	0
Shadscale Shrubland Complex	2 (1)	6 (13)	0	46 (15)	43 (13)	0	33 (6)	62 (15)	0	0
Talus Mixed Shrubland Complex	0	0	0	0	2 (1)	0	0	0	0	0
Torrey Mormon Tea Shrubland Complex	0	0	0	0	0	0	67 (13)	0	0	5 (3)
Wyoming Sagebrush/Blue Grama Shrubland	0	0	6 (5)	0	0	0	0	0	0	0
Upland Forest and Woodlands										
Pinyon-Juniper/Cheatgrass Semi-natural Woodland	0	0	0	0	0	0	0	2 (1)	0	0
Pinyon-Juniper/Mesic Shrubs Woodland Complex	0	23 (46)	41 (36)	4 (1)	0	17 (97)	0	16 (4)	24 (22)	23 (14)
Pinyon-Juniper/Mixed Grass Woodland Complex	9 (4)	0	2 (2)	24 (8)	0	0	0	19 (5)	5 (5)	2 (1)
Pinyon-Juniper/Mountain Mahogany and Gambel Oak Woodland	0	0	40 (35)	0	0	0	0	0	0	0

TABLE 3.7. ACRES (PERCENTAGE OF TOTAL) OF UPLAND VEGETATION COMPLEXES ASSOCIATED WITH TRAILING ROUTES*

Community Type	Acres (Percentage of Trail)									
	Gray Bench-Cathedral Valley	Divide Canyon	Dry Bench	Hartnet	Highway 24	Jones Bench	Lower South Desert	Notom Road	Oak Creek	Pleasant Creek
Pinyon-Juniper/Sagebrush Woodland Complex	0	0	9 (8)	0	0	0	0	0	9 (8)	0
Pinyon-Juniper/Sparse Understory Woodland	12 (6)	0	2 (2)	14 (5)	0	<1 (3)	0	17 (4)	9 (8)	3 (2)
Pinyon-Juniper/Xeric Shrubs Woodland Complex	27 (12)	0	0	18 (6)	6 (2)	0	0	49 (12)	1 (1)	4 (2)
Ponderosa Pine/Greenleaf Manzanita Woodland	0	0	7 (6)	0	0	0	0	0	0	0
Sparsely Vegetated Badlands										
Bentonite Badlands	0	0	0	0	0	0	0	8 (2)	0	0
Saltbush Badlands Shrubland Complex	0	0	0	7 (2)	12 (4)	0	20 (4)	11 (3)	0	0
Upland Herbaceous										
Mixed Grasslands Complex	31 (14)	0	0	13 (4)	3 (1)	0	95 (19)	40 (10)	0	2 (1)

*Unvegetated land cover (e.g., roads) and associations with less than 1% cover are excluded.

TABLE 3.8. DOMINANT RIPARIAN VEGETATION COMPLEXES IN THE SANDY 3 ALLOTMENT

Community Type	Percentage of Grazed Acres	Location
Tamarisk temporarily flooded shrubland	<1%	Scattered along Halls Creek, Bitter Creek, and Bitter Spring Creek and around most stock ponds
Fremont cottonwood woodlands	<1%	Halls Creek, Bitter Spring Creek
Willow shrublands	<1%	Along Bitter Spring and Bitter Spring Creek

TABLE 3.9. DOMINANT RIPARIAN VEGETATION COMPLEXES ALONG TRAILING ROUTES

Community Type	Acres (Percentage of Trail)					
	Gray Bench-Cathedral Valley	Hartnet	Highway 24	Lower South Desert	Oak Creek	Pleasant Creek
Tamarisk temporarily flooded shrubland	2 (1)	0	4 (1)	18 (3)	0	0
Fremont cottonwood woodlands	0	0	65 (20)	1 (<1)	6 (6)	9 (5)
Willow shrublands	0	0	2 (1)	0	1 (1)	0
Springs and seeps mosaic	0	1 (<1)	0	0	0	0

Invasive Plant Species

Of the 909 plant species in Capitol Reef National Park, 13% are invasive (Fertig 2007). Four of the five routes in the park established to monitor invasive plant species occur along livestock trailing routes: Highway 24, Pleasant Creek, Oak Creek, and Gray Bench-Cathedral Valley. Invasive plant species detected during monitoring along these routes from 2003 to 2015 are summarized in Table 3.10 (Perkins 2016). Low-priority species are those that have become naturalized, are impossible to eradicate and control on a large scale, and are ubiquitous across some habitat types. Attempts may be made to control these low-priority species at a local level. High-priority species are targeted for management by the park, and there is a high likelihood of them being eradicated or contained.

Sandy 3 allotment. Invasive annual forbs are common on disturbed upland sites in the Sandy 3 allotment (e.g., around stock ponds) and include halogeton, Russian thistle, and African mustard (*Malcolmia africana*). Black greasewood shrublands (10% of grazed area in the Sandy 3 allotment; Table 3.5) are prone to invasion by *Chenopodium* forbs and halogeton. Large, continuous stands of cheatgrass are common. Tamarisk is present at stock ponds and in Bitter Creek and Bitter Spring Creek.

Livestock trailing routes. Percent cover of invasive plants along the Oak Creek livestock trailing route is low and is comprised of tamarisk, Russian olive, and cheatgrass. The Gray Bench-Cathedral Valley livestock trailing route has tamarisk and Russian thistle, which was found at 58% of transects run in 2015. Tamarisk and Russian olive occur along Pleasant Creek; tree-of-heaven has been eradicated.

TABLE 3.10. INVASIVE SPECIES DETECTED IN CAPITOL REEF NATIONAL PARK FROM 2003 TO 2015

Scientific Name	Common Name	Priority
Ailanthus altissima	Tree-of-heaven	High
Asparagus officinalis	Asparagus	High
Centaurea repens	Russian knapweed	High
Cirsium vulgare	Bull thistle	High
Convolvulus arvensis	Field bindweed	High
Elaeagnus angustifolia	Russian olive	High
Malcolmia africana	African mustard	High
Medicago sativa	Alfalfa	High
Tamarix spp.	Tamarisk	High
Verbascum thapsus	Woolly mullein	High
Agropyron cristatum	Crested wheatgrass	Low
Bromus tectorum	Cheatgrass	Low
Halogeton glomeratus	Halogeton	Low
Melilotus officinalis	Yellow sweetclover	Low
Portulaca oleracea	Common purslane	Low
Salsola tragus	Russian thistle	Low
Tribulis terrestris	Goathead	Low

Source: Perkins 2016

The Highway 24 route has the greatest number of invasive species of the four monitoring routes. Being near the Fremont River, the route has extensive stands of tamarisk and Russian olive. Other species found along the Highway 24 route are asparagus *(Asparagus officinalis)*, bull thistle *(Cirsium vulgare)*, field bindweed *(Convolvulus arvensis)*, and woolly mullein *(Verbascum thapsus)*. Tree-of-heaven, which historically occurred along this route, was eradicated by 2013.

The other trailing routes evaluated in this EA have not been specifically surveyed for invasive species; however, many of the mixed grasslands along the Notom Road have been heavily invaded by cheatgrass. Cheatgrass, Russian thistle, halogeton, and African mustard are found within the recently retired Hartnet allotment, which includes the Hartnet and Lower South Desert trailing routes. Cheatgrass is uncommon, however, in the Lower South Desert.

Vegetation Communities and Climate Change Predictions

Although uncertain, the climate of the southwestern region of the United States is predicted to undergo substantial changes this century, with temperatures projected to increase by 3.5°C–4°C and precipitation to decrease by at least 5%–20% (Bagne and Finch 2013; Hatten et al. 2016; Seager et al. 2007). These conditions are expected to contribute to a high risk of severe drought over the region in the latter half of the twenty-first century (Cook et al. 2015). In the Colorado Plateau, a 0.2°C–0.5°C temperature rise occurred from 1988 to 2008, primarily during winter. Similar to the larger region, increasing temperatures, coupled with prolonged and severe drought patterns, are anticipated to continue in the Colorado Plateau (Schwinning et al. 2008).

Some vegetation communities in the park are vulnerable to climate change. An assessment conducted by Decker and Fink (2014) for southwestern Colorado looked at the vulnerability of multiple ecosystems to climate change. Vulnerable plant communities common in the park and discussed in the

review are pinyon pine, sagebrush, and riparian/wetlands. Warmer conditions may allow for expansion of pinyon-juniper communities, which can persist in a wide range of ecological conditions (Decker and Fink 2014); however, pinyon pine may be more susceptible to drought than juniper and is likely to decline at the lower end of its elevation range (Breshears et al. 2005; Munson et al. 2011). In general, forest and woodland communities are expected to shift upward in elevation with warming temperatures (Lenoir et al. 2008). Riparian areas are not restricted by elevation or range but may experience more frequent drought stress during low summer stream flows (Decker and Fink 2014).

Warmer temperatures in perennial grasslands will likely favor warm-season grasses, such as galleta grass and blue grama, over cool-season grasses, such as Indian ricegrass and needle-and-thread grass (Munson et al. 2011; Esser 1992); however, increased drought might affect even warm-season grasses, and fire could encourage encroachment of invasive species, such as cheatgrass. Shrubs may benefit from an increase in carbon dioxide (CO_2). They may remain dominant where established or encroach into grasslands (Archer et al. 1995).

Changes in precipitation regimes, which are difficult to predict, will influence species-specific responses to climate change and may shift the balance between grasslands and shrublands (Brown et al. 1997). A shift to less frequent but greater magnitude rainfalls will likely favor more deeply rooted species (Fay et al. 2008; Munson et al. 2011). Also, grasses tend to respond to summer rains and shrubs to winter rains (Ehleringer et al. 1991), and grasses recover more quickly following disturbances than shrubs (Bagne and Finch 2013). This could mean periodic shrub die-offs in sparsely vegetated shrublands during droughts (Bagne and Finch 2013). More frequent drought conditions, encroachment of shrubs, and loss of cool-season grasses will result in loss of valuable forage for wildlife and livestock.

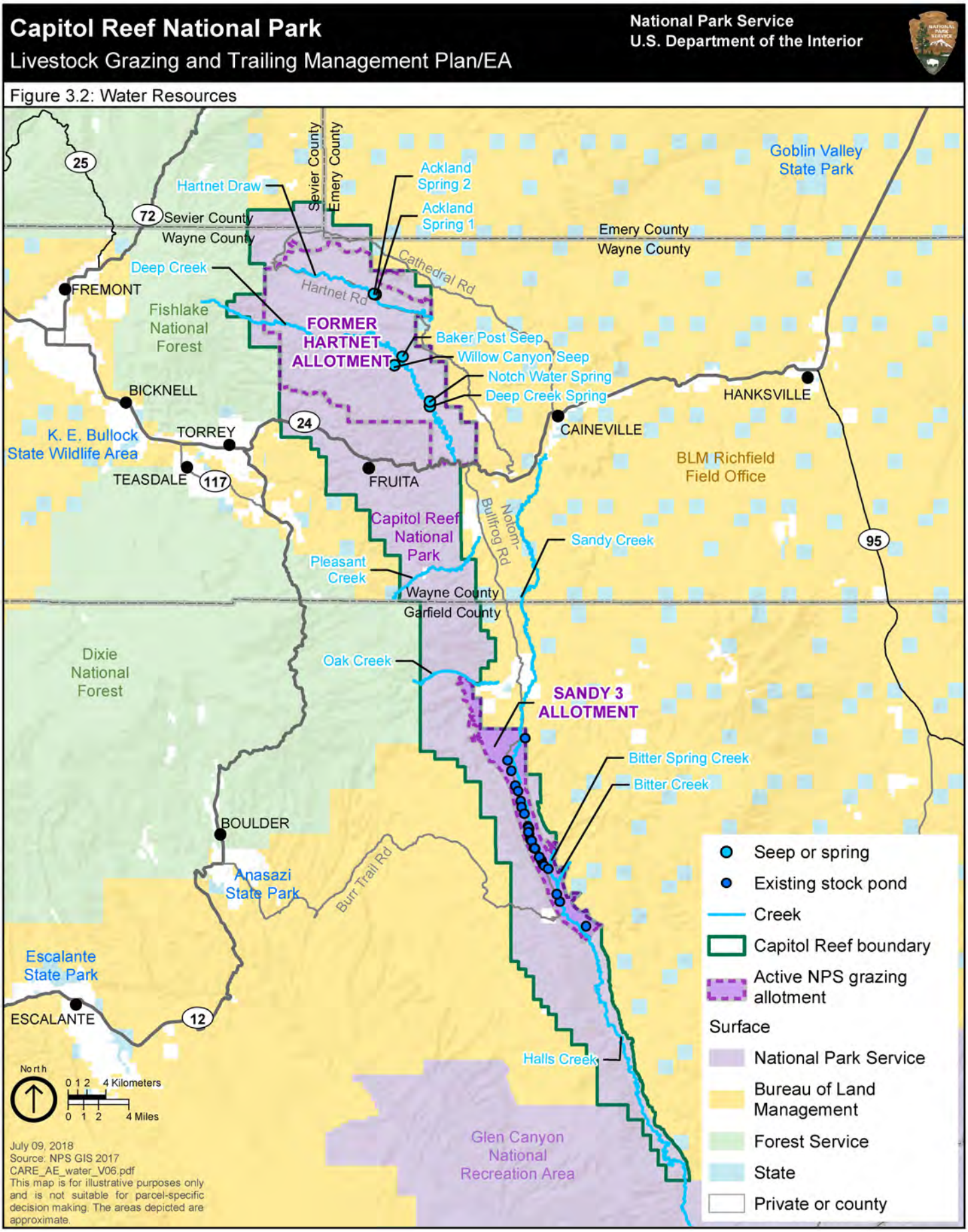
WATER RESOURCES

Water resources in Capitol Reef National Park are perennial (flow continuously all year), intermittent (flow discontinuously, mostly during wet seasons, supported by groundwater discharge), and ephemeral streams (flow in direct response to precipitation, and the channel is above the water table). Other sources are springs, tinajas, ponds fed by precipitation, and groundwater in alluvial, basalt, and sedimentary aquifers (Christina 1991).

Streams in the northern two-thirds of the park generally flow east and are tributary to the Fremont River, with the largest being Pleasant Creek, Oak Creek,[2] and Sulphur Creek (see Figure 3.2). Streams in the southern portion of the park flow generally south and are tributary to the Colorado River and Lake Powell, with the largest being Halls Creek.

Generally, cattle contribute directly to the degradation of wetland and riparian resources in many of the streams and springs in the Sandy 3 allotment and along Oak Creek and other trails, including along trails analyzed in this EA. Field observations indicate cattle spend a disproportionate amount of time in wetlands and riparian areas, degrading vegetation, bank stability and channel morphology, and aquatic system ecology. These combined impacts alter the chemical, physical, and bacteriological characteristics of the water column (Alexander et al. 2008; Belsky et al. 1999; Kauffman et al. 1983; Platts 1986; Platts and Nelson 1989; Zaimes et al. 2004, 2008).

[2] Reservoirs created as range improvements west of the park have altered the natural hydrology of Oak Creek (and Pleasant Creek) and have allowed water derived from Boulder Mountain to be diverted to either Oak Creek or Pleasant Creek. While this human-made diversion has allowed for increased flows in Oak Creek over natural flow regimes, Oak Creek is defined as a Water of the United States, based on the Clean Water Act of 1977. It meets the act's legal definition of being a tributary to a traditional navigable Water of the United States, which is the Fremont River.


Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA
National Park Service
U.S. Department of the Interior
Figure 3.2: Water Resources
Goblin Valley State Park
Hartnet Draw
Sevier County
Emery County
Ackland Spring 2
Ackland Spring 1
Sevier County
Wayne County
Emery County
Wayne County
Deep Creek
Cathedral Rd
Hartnet Rd
FREMONT
Fishlake National Forest
FORMER HARTNET ALLOTMENT
Baker Post Seep
Willow Canyon Seep
Notch Water Spring
Deep Creek Spring
BICKNELL
HANKSVILLE
CAINEVILLE
K. E. Bullock State Wildlife Area
TORREY
TEASDALE
FRUITA
BLM Richfield Field Office
Capitol Reef National Park
Bullfrog Rd
Notom-
Sandy Creek
Pleasant Creek
Wayne County
Garfield County
Dixie National Forest
Oak Creek
SANDY 3 ALLOTMENT
Bitter Spring Creek
Bitter Creek
BOULDER
Anasazi State Park
Burr Trail Rd
Escalante State Park
ESCALANTE
Halls Creek
Glen Canyon National Recreation Area
North
0 1 2 4 Kilometers
0 1 2 4 Miles
July 09, 2018
Source: NPS GIS 2017
CARE_AE_water_V06.pdf
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate.
Seep or spring
Existing stock pond
Creek
Capitol Reef boundary
Active NPS grazing allotment
Surface
National Park Service
Bureau of Land Management
Forest Service
State
Private or county

The functional condition of several streams, springs, and associated riparian areas in the Sandy 3 allotment and along trails analyzed in this EA, have been assessed periodically by the Bureau of Land Management and National Park Service using the PFC assessment method (US Department of the Interior, Technical Reference 1737-15 1998) and the Rapid Stream Riparian Assessment (Stacey et al. 2006).

The Bureau of Land Management assessed select springs and stream reaches in the recently retired Hartnet allotment between 2000 and 2008. In 2014 and 2015 a team of NPS (one hydrologist and one wetland scientist) and NRCS (a revegetation technical advisor) scientists conducted PFC assessments on Pleasant and Oak Creeks and on four springs in the recently retired Hartnet allotment and the Sandy 3 allotment. Capitol Reef National Park scientists conducted less formal assessments of Pleasant and Oak Creeks and two springs in the recently retired Hartnet allotment in 2016.

The PFC assessment evaluates hydrology, vegetation, and geomorphologic elements for each assessment reach. Each reach is assigned one of three ratings—PFC, functional at risk, or nonfunctional—based on the assessment. Streams and springs determined to be at risk can be further subdivided by trend (upward, stable, or downward) and contributing factors (disturbances contributing to a rating). The results of this assessment are summarized below for each of the water resources that could be affected by grazing in the Sandy 3 allotment, and trailing along existing or proposed trails.

Sandy 3 allotment. The streams in the Sandy 3 allotment are Sandy Creek, Bitter Spring Creek, Bitter Creek, and Halls Creek (see Figure 3.2). Sandy Creek and Halls Creek are strictly ephemeral in the allotment and do not have associated springs. Bitter Spring Creek and Bitter Creek each have perennial springs (called by the name of the respective creeks) that support riparian habitat. The streams created by these springs are perennial, and the lengths of the perennial reaches vary, depending on season.

A summary of PFC assessments conducted in the Sandy 3 allotment is presented in Table 3.11. Narrative descriptions for each water resource are presented following the table.

TABLE 3.11. PROPER FUNCTIONING CONDITION RATINGS, SANDY 3 ALLOTMENT

Water Resource	Date	Functional Status	Trend	Area or Miles Evaluated	Affected by Cattle	
					Direct	Indirect
Evaluations Conducted by the National Park Service and Natural Resources Conservation Service in 2014 and 2015						
Bitter Creek	June 2015	Functional at risk	Not apparent	1 mile	Unknown	X
Bitter Spring Creek	June 2015	Functional at risk	Not apparent	0.65 miles	Unknown	X

Bitter Creek and Bitter Spring Creek—Both creeks are in the Lower Sandy 3 pasture. In its 2015 PFC assessment, the National Park Service determined that the creeks are functional at risk, with no identifiable trend. Bitter Creek and Bitter Spring Creek are functional riparian habitats. This is based on vegetation conditions, the ability of most sub-reaches to dissipate the energy of moderately large flows without excessive erosion, and the vertical stability of these two intermittent reaches; however, large pulses of sediment moving through both systems create some channel segments, with substantial aggradation and braided forms that are not in balance with the landscape setting.

Destabilizing factors, such as intense rainstorms and past land uses that may have reduced upland vegetation, may have increased sediment delivery to the channels. Within the park, upland grasses on the adjacent floodplains and terraces are very sparse, and there is ample opportunity for sediment to

move from uplands into the channel by overland flow. There is a substantial risk that continued sedimentation and channel aggradation could cause the shallow water tables to become deep enough that riparian-wetland vegetation can no longer be established or sustained (i.e., movement toward a nonfunctional condition).

Also, there are more than 25 constructed stock ponds in the Sandy 3 allotment to provide water for cattle. Many no longer retain water, and Capitol Reef National Park staff evaluated their functionality in 2016 to identify ponds that are viable and those that could be refurbished. Staff determined that eight stock ponds are functional and five to six are potentially viable for refurbishment. Stock pond locations are shown in Figure 3.2.

Livestock trailing routes. The creeks, streams, and springs found along livestock trails analyzed in this EA include Pleasant Creek and Oak Creek, which are perennial water resources; Hartnet Draw and Ackland Springs along the Hartnet trail; and Deep Creek, Deep Creek Spring, and Notch Water Spring along the Lower South Desert trail. Two additional seeps occur in the Lower South Desert, Willow Canyon Seep, and Baker Post Seep. Both are known to be used by livestock but have not been assessed, and their current condition is unknown. Of the two, Baker Post Seep is more accessible (see Figure 3.2).

A summary of PFC assessments conducted on these creeks, streams, and/or springs is provided in Table 3.12. Narrative descriptions for each water resource are presented following the table.

TABLE 3.12. PROPER FUNCTIONING CONDITION RATINGS FOR WATER RESOURCES ASSOCIATED WITH TRAILING ROUTES

Water Resource	Date	Functional Status	Trend	Area or Miles Evaluated	Affected by Cattle	
					Direct	Indirect
Evaluations Conducted by the Bureau of Land Management between 2000 and 2008						
Ackland Spring No. 2	July 2000	PFC	N/A	1.5 acres	Unknown	Unknown
Ackland Spring No. 1	July 2001	Functional at risk	Stable	1.5 acres	Unknown	Unknown
Deep Creek Spring	July 2005	PFC	N/A	1 acre	Unknown	Unknown
Notch Water Spring	November 2007	Functional at risk	Stable	0.5 acres	Unknown	Unknown
Evaluations Conducted by the National Park Service and Natural Resources Conservation Service in 2014 and 2015						
Oak Creek	July 2014	Nonfunctional	N/A	3.9 miles	X	X
Pleasant Creek	July 2014	PFC	N/A	7.25 miles	Unknown	Unknown
Ackland Springs	June 2015	Nonfunctional	N/A	0.65 miles	X	X
Deep Creek Spring	June 2015	Nonfunctional	N/A	0.23 miles	X	X
Evaluations Conducted by the National Park Service in 2016						
Oak Creek	July 2016	Nonfunctional	N/A	4 miles	X	X
Pleasant Creek	July 2016	PFC	N/A	7 miles	X	X

Sulphur Creek and the Fremont River are next to the Highway 24 livestock trailing route; however, there are no potentially significant issues for Sulphur Creek and the Fremont River, and they have been dismissed from detailed analysis as described in Appendix D.

Oak Creek. Oak Creek flows west to east through Capitol Reef National Park in the central portion of the park and is tributary to Sandy Creek. The 2014 and 2016 assessments determined that Oak Creek is nonfunctional because of cattle impacts and invasive plant species. The extremely poor condition of riparian-wetland vegetation on the streambanks, point bars, and other channels and low floodplains contribute strongly to a lack of channel stability, loss of bank structure, channel sedimentation, conversion to a braided channel form in many portions of the creek, and loss of most natural riparian functions. Several of the riparian plant community components were in accordance with expectations. The introduction of invasive species and cattle has caused divergences from the reference plant communities. Unmanaged herbivory from trespassing cattle is the most likely cause of the highly degraded vegetation conditions in the Oak Creek riparian system. Cattle trailing is the most likely source of invasive vegetation.

Pleasant Creek. Pleasant Creek flows west to east through Capitol Reef National Park in the north-central portion of the park (between Highway 24 and Oak Creek). It is tributary to the Fremont River. The 2014 and 2016 assessments determined that Pleasant Creek is in PFC. Point bars and floodplains show ample evidence of recent sediment deposition, and the channel is not showing signs of being incised throughout most of the reach. Overall, the sinuosity and width-to-depth ratios are in balance with the landscape. The gradient of the reach is determined primarily by numerous bedrock outcrops; however, in the lower reaches of Pleasant Creek the channel form is influenced by alluvial processes, resulting in meandering alluvial channels, with opposing cutback and point bar channel forms.

There is no obvious channel destabilization or lateral instability. Channel/floodplain morphology shows stabilization, with vegetated point bars and side- and mid-channel bars having substantial vegetation to dissipate energy during high flows and floods. Riparian vegetation is not being invaded by upland species, and many age classes of several riparian species were observed. Cattle trailing appears to be the dominant source of invasive vegetation in riparian areas.

Ackland Springs. The 2015 PFC assessment determined that the springs are nonfunctional because of road and cattle impacts. The riparian area and Hartnet Draw channel are severely affected by Hartnet Road, which enters and exits the channel several times in this reach. The road results in channel widening and associated narrowing and loss of the riparian zone. Cattle that are grazing and congregating in the riparian area and adjacent uplands contribute to loss of riparian vegetation and to channel widening. Grazing on adjacent uplands has reduced vegetation, caused a loss of biological soil crust, and increased the amount of bare ground, all of which have contributed to increased sediment loads to Hartnet Draw and the riparian zone.

Invading tamarisk will increase soil salinity levels, making it difficult for other native plant species to propagate. In areas affected by roads and livestock grazing, riparian vegetation is heavily damaged or completely void, leaving stream banks unprotected from erosion; therefore, stream energy is dissipated by eroding unprotected channel banks and low terraces. Photos of Ackland Spring are presented in Figure 3.3 through Figure 3.5.

Deep Creek Spring. Deep Creek Spring is along Deep Creek and could be affected by new trailing permits issued in the Lower South Desert. In its 2015 PFC assessment, the National Park Service determined that the spring is nonfunctional, because of channel incision and alteration of vegetation and geomorphologic characteristics. Moderate incision along most of the assessment reach reduces the frequency of overbank flow and results in a loss of floodplain connectivity. Channel incision has reduced sinuosity and produced a lower width-to-depth ratio than would be expected for the landscape setting. Energy-dissipating channel features are absent.

Figure 3.3. Ackland Springs, April 2012

Figure 3.4. Ackland Springs, August 2012

Figure 3.5. Ackland Springs, April 2014

Incision exacerbates channel widening and erosion, with subsequent narrowing of the riparian area. Vegetation is adequately diverse for maintenance and recovery in some sub-reaches; however, the woody component is not adequately diverse, because tamarisk is the only woody species present. Upland plant species are encroaching on the incised banks. Substantial areas of the streambank are bare or poorly vegetated.

Notch Water Spring. Notch Water Spring is along Deep Creek, and could be affected by new trailing permits issued in the Lower South Desert. In its 2007 assessment, the Bureau of Land Management determined that the spring was functional at risk, with a stable trend. This was primarily because tamarisk had replaced much of the native riparian vegetation and caused excessive accumulation of salts. Tamarisk establishment and dominance displaced native tree species and overall vegetation; therefore, the riparian system's capability to protect the soil surface and dissipate energy during high water flows was diminished.

SPECIAL STATUS SPECIES

This section addresses federally listed threatened and endangered plant and animal species in the planning area. Under the ESA, the National Park Service is required to ensure that its actions do not jeopardize the continued existence of listed species. Further, it must ensure the species' survival and use its authorities to recover listed species. Additionally, the National Park Service is mandated under the ESA to not destroy or adversely modify designated critical habitats. NPS Management Policies (2006) state that the National Park Service "will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act."

The following narrative focuses on three federally listed plant species: Wright fishhook cactus, Winkler cactus, and Last Chance townsendia.

Wright fishhook cactus was listed as endangered in 1979, Winkler cactus was listed as threatened in 1998, Last Chance townsendia was listed as threatened in 1985, and the MSO was listed as threatened in 1993. All three listed plant species have highly restricted distributions, occurring in Sevier, Emery, and Wayne Counties in south-central Utah only, primarily on National Park Service, Bureau of Land Management, Forest Service and State lands. All three occur in areas of the recently retired Hartnet

allotment where new trailing permits are being considered. Wright fishhook cactus also occurs along the Grey Bench-Cathedral Valley cattle trail (Table 3.14). Critical habitat has not been designated for any of the plant species.

Livestock have altered the habitat of all three listed plant species in the planning area over the past 150 years, as described in the previous sections on *Soils and Upland and Riparian Vegetation* (Barth and McCullough 1988; Cole et al. 1997). These alterations include soil loss and erosion, and increased cover of shrubs in vegetation communities. Because the number of ungulates inhabiting the Colorado Plateau was low until the introduction of domestic livestock by the late 1800s, the listed plant species in Capitol Reef National Park most likely did not evolve to tolerate impacts from livestock (Spector 2013).

The MSO has a much wider distribution, occurring throughout the southwestern United States. The National Park Service, in consultation with the US Fish and Wildlife Service, has designated MSO protected activity centers (PACs); these occur near the grazing allotment and some of the trailing routes. While livestock grazing and trailing does not occur in the PACs, trailing does occur in foraging habitat near the PACs. Spotted owl critical habitat encompasses the Sandy 3 allotment and several of the livestock trailing routes.

Wright Fishhook Cactus

Wright fishhook cactus is a round to barrel-shaped cactus, 1 to 18 centimeters (cm) tall and 4 to 10 cm in diameter. It typically grows as a single stem, but if damaged it may form multiple stems. Plants typically bloom from late April through May and set fruit in June. Short, round spines, early flowering time, small flower size, and magenta filaments help distinguish this species from other similar cacti (Heil and Porter 1994; Benson 1982).

Wright fishhook cactus is a long-lived species that is slow to reach reproductive maturity with the highest reproductive rates associated with larger, older adult plants (over 9.0 cm in diameter; Kass 2001a; Clark and Clark 2007; Capitol Reef National Park 2011–2013, unpublished data). Juveniles are numerous in the population, but they flower only occasionally and seldom set fruit (Kass 2001a). The low frequency of cacti in the smallest size classes usually indicates that recruitment is rare and episodic (Kass 2001a). Demographic monitoring has demonstrated low recruitment and high mortality rates of Wright fishhook cacti, especially in the largest size classes. Kass (2001a) concluded that Wright fishhook cacti have an overall natural mortality-to-recruitment ratio of approximately 2.5 to 1. This mortality rate indicates a slow population decline (Kass 2001a). This is supported by a long-term demographic monitoring study of Wright fishhook cactus in the park started in 2013. Analysis of data collected through 2016 showed that mortality exceeded survival for Wright fishhook cactus, resulting in a downward population trend (Hornbeck 2017). This analysis shows that survival is the most important contributor to population growth rates for the species.

Cattle grazing, predation by insects and rodents, native ungulate disturbance, illegal collecting, and climate change have been identified as threats to Wright fishhook cacti in the park. The cactus borer beetle (*Moneilema semipunctatum*) and the larva of a *Rhagea* moth species can cause substantial mortality of Wright fishhook cactus (Clark 1998, 2006, 2008a; Kass 2001a, b; BLM 2015b; NPS 2014b; Borthwick 2016b; Borthwick and Livensperger 2017b). Small mammals have been documented as a substantial cause of mortality or damage to Wright fishhook and Winkler cacti (Kass 2001a; BLM 2015a, b; Clark 2009) as well. Black-tailed jackrabbits (*Lepus californicus*), which occur in the planning area, have also been known to feed on cacti (Vorhies and Taylor 1933). Additionally, Wright fishhook cactus requires cross pollination to produce viable seeds. Tepedino (2000) cited ground-nesting bees, with a maximum foraging distance of approximately 400 meters, as pollinators of Wright fishhook

cactus (Tepedino 2000). Because Wright fishhook cactus sites are widely scattered, pollinators may not find cactus sites, resulting in reduced production of viable seeds and therefore low recruitment rates.

The rangewide distribution of Wright fishhook cactus consists of 696,100 acres, 63,800 acres of which are in Capitol Reef National Park (9% of total range; Spector 2013). The total number of live Wright fishhook cacti documented in the park between 2011 and 2018 was 3,951. This is a conservative number, based on 4 person-hour surveys. Based on BLM surveys and surveys conducted by Capitol Reef National Park staff, the known number of Wright fishhook cactus rangewide is 14,761 (Capitol Reef National Park data 2018; BLM Botanist Dustin Rooks, email message to NPS Biologist Sandy Borthwick, August 9, 2017).

Within the planning area, Wright fishhook cactus rangewide habitat and individuals occur along three routes where trailing permits could be issued: Grey Bench-Cathedral Valley, Hartnet, and Lower South Desert. The approximate acres of Wright fishhook cactus rangewide habitat that occurs along each livestock trail are shown in Table 3.13. The known number of individuals occurring on level terrain within 300 feet of the trails is shown in Table 3.14. The 300 feet is from guidelines developed by the US Fish and Wildlife Service regarding the standard buffer for surveys from a project that involves surface disturbance (USFWS 2011). Because the exact trailing route up the southern part of the Lower South Desert trail is unknown, all known Wright fishhook cactus in that area are included in the tabulation. The total number of known Wright fishhook cacti near these trails (n=402) represents 10.0% of the known number in the park (3,951) and 2.7% of the known number rangewide (14,761).

TABLE 3.13. APPROXIMATE ACRES OF LISTED SPECIES HABITAT ALONG EACH OF THE TRAILING ROUTES[a]

Species	Gray Bench-Cathedral Valley	Hartnet	Lower South Desert[b]	Total
Wright fishhook cactus	647	880	1,027	2,554
Winkler cactus	451	676	153	1,280
Last Chance townsendia	647	756	0	1,404

[a] Based upon a buffer of 300 feet along each side of the trail

[b] Because cattle will be unrestrained overnight in the Lower South Desert before being pushed out the following day, the acres include a 0.25-mile buffer around spring sources where cattle may concentrate overnight.

TABLE 3.14. KNOWN NUMBER OF INDIVIDUALS OF EACH FEDERALLY LISTED PLANT SPECIES ALONG TRAILING ROUTES[a]

Species	Gray Bench-Cathedral Valley	Hartnet	Lower South Desert	Total
Wright fishhook cactus	113	49	240[b]	402
Winkler cactus	0	78	180	258
Last Chance townsendia	0	86	0	86

Source: 2011–2018 NPS Data

[a] Not all habitat along the trails has been surveyed, and the number of individuals is expected to increase with future surveys.

[b] Livestock trailing up the southern part of the Lower South Desert are expected to stay within the Deep Creek valley; however, because the exact trailing route is unknown, the number of Wright fishhook cactus includes all individuals within the Lower South Desert area. Beyond that point to BLM-administered lands, cattle will be herded along a designated route.

Additionally, Wright fishhook cactus monitoring has been conducted by the National Park Service and Bureau of Land Management (NPS 2012b, 2013c, 2014b; BLM 2015b, 2016b). This monitoring

showed that in areas grazed by livestock, 5.6% to 9% of cacti were dead, 3.6% to 6.9% of cacti were damaged, and 29% to 33% of live cacti were disturbed by cattle (i.e., had a cattle track within 15 cm of the plant). Cause of death could be discerned for limited numbers of cacti and was attributed to (in order of decreasing numbers) impacts from cactus borer beetle, livestock, rodents, insects, and other ungulates. Damage to live cacti (in order of decreasing numbers) was a result of impacts from small mammals, cattle, native ungulates, insects, or unknown causes. While most disturbance was from cattle, 1%–2% of live cacti were also disturbed by native ungulates (an elk or other native ungulate track was found within 15 cm of the cacti).

Only recent damage and disturbances were discernible, so these are considered conservative numbers. Some BLM monitoring (BLM 2016b) did find that two plots with livestock grazing continued to have cactus while a third plot, which is not grazed, had few cacti. Because the plots had not been consistently monitored, the influence from factors that could contribute to changes in the number of cacti in the three plots (e.g., degree of livestock use, rodents, insects, and climate) was unknown.

Specific to the Gray Bench-Cathedral Valley trailing route, Capitol Reef National Park staff monitored impacts on 140 tagged Wright fishhook cacti along the trail from 2011 to 2016. Damage and disturbance to tagged cacti were low, with only 5 tagged (0.6%; n=840 [140 cacti times 6 years]) cacti damaged and 29 (3.4%) disturbed. Staff conducting the monitoring discovered that most cattle actually trailed down a wash farther south, avoiding the large concentrations of cacti.

A 1994 report (San Juan College 1994) provides insights into the impacts of cattle on Wright fishhook cacti along the Hartnet and Lower South Desert trails where permits could be issued. This study showed an estimated 25% of the population of Wright fishhook cacti were trampled near water sources and 5%–10% were trampled in other regions of the allotment. Trampling often destroys the apical meristem (growing tip); as a result, the plant produces no flowers, fruits, or seeds (San Juan College 1994). Cattle grazing and trailing also reduced suitable habitat due to soil compaction and subsequent loss of native vegetation.

Winkler Cactus

Winkler cactus is a small cactus that typically grows as a solitary stem (Welsh et al. 2003). It ranges in size from 0.5 to 7 cm tall and 0.5 to 8 cm in diameter. It typically flowers from April through mid-May, and produces seeds in May and June. During the summer heat, the cacti shrink back to ground surface or below and typically remain there through winter until temperatures begin to increase again the following spring, triggering the cacti to resurface, provided that rainfall has been adequate (Clark 2008d). In cases of drought or after being damaged or disturbed, Winkler cacti may survive underground for up to 2 years (Clark and Clark 2008a; Clark et al. 2015). Dormancy in Winkler cacti may be a strategy to allow plants to escape environmental stress, such as drought or herbivory, or to conserve resources for future reproduction (Lesica and Crone 2007).

Threats to the species rangewide are off-highway vehicles; illegal collecting; mineral, road, and utility corridor development; livestock and native ungulate trampling and disturbance; small mammal and insect predation; and climate change (Spector 2013; USFWS 2015b). In Capitol Reef National Park, cattle and native ungulate trampling and disturbance, illegal collecting, and climate change have been identified as primary threats to the species (Clark et al. 2015). Additionally, across its range, Winkler cacti occur in low numbers and in small, isolated populations, many with less than 100 individual plants (Clark et al. 2015; BLM 2015a; NPS 2012a, 2013b, 2014a). The small size and scattered distribution of Winkler cactus populations may limit pollinator visits and therefore reproductive success (USFWS 2015b).

Except for one small population in Sevier County, all known Winkler cacti occur in northern Wayne County, Utah, primarily on Capitol Reef National Park and BLM-administered lands. The Winkler cactus range consists of approximately 189,000 acres (USFWS 2015b), with 75,600 to 94,500 acres in Capitol Reef National Park, 40%–50% of the total range (Tracy Switek, USFWS contractor, personal communication, August 13, 2014).

A 20-year demographic study of Winkler cactus conducted in the recently retired Hartnet allotment in Capitol Reef National Park (Clark et al. 2015) showed that Winkler cacti exhibit low overall fecundity, and reproductive output was positively correlated with size and age, with the older, larger cacti flowering much more frequently than smaller cacti. Recruitment was low and sporadic and was correlated with warmer minimum temperatures in February and March. Clark et al. (2015) also found that the large, most productive cacti grew beneath shrubs or between rocks, which protected them from disturbance. This suggests that a lack of disturbance may be vital for the development and protection of the largest, most reproductive cacti required to maintain the population (USFWS 2015b). They also found a positive relationship between cacti survival and higher precipitation. Drought was found to play a substantial role in the overall population dynamics of Winkler cactus contributing to adult mortality, low recruitment rates, and subsequent population declines (Wilkowske et al. 2003; Clark et al. 2015).

In 2013, Capitol Reef National Park initiated a long-term demographic monitoring study of Winkler cactus. Analysis of data collected through 2016 showed that mortality exceeded survival, resulting in a downward population trend (Hornbeck 2017). This analysis shows that survival is the most important contributor to population growth rates for the species.

Based on surveys conducted by the Bureau of Land Management and Capitol Reef National Park from 2011 through 2017, the known number of Winkler cacti is approximately 5,944 individuals (USFWS 2017) with approximately 46% (2,758) of the recorded individuals occurring in the park. Within the planning area, Winkler cactus rangewide habitat occurs along three routes where trailing permits may be issued: Grey Bench-Cathedral Valley, Hartnet, and Lower South Desert. The approximate acres of Winkler cactus rangewide habitat that occurs along each livestock trail is shown in Table 3.13. The known number of Winkler cacti occurring on level terrain within 300 feet of these trails is shown in Table 3.14. The total number of cacti found along these trails (258) represents 9.4% of the known Winkler cacti in the park (2,758) and 4.3% of the known number rangewide (5,944).

The 20-year study (Clark et al. 2015) and other BLM monitoring efforts (BLM 2017) show a decline in Winkler cacti numbers that were attributed to precipitation and temperatures, which affected flowering, mortality, and recruitment, and large ungulate disturbances, namely by livestock, which increased mortality and reduced the probability of flowering. For the BLM efforts, more information is needed on other factors that contribute to Winkler cactus population dynamics, such as climate and the presence of predators (e.g., insects and rodents) and cactus poachers, which was an issue in the past (Clark 2008).

Additional data collected by the National Park Service and Bureau of Land Management (NPS 2012a, 2013b, 2014a; BLM 2015a) showed less than 1% of Winkler cacti in grazed areas were dead, approximately 7% were damaged, and approximately 12 to 27% were disturbed by livestock (i.e., had cattle tracks within 15 cm). Although dead Winkler cacti are seldom found in the field, perhaps because they quickly degrade or die underground, livestock activity was documented for only one of the four dead cacti recorded in these surveys. Damage to live cacti (in order of decreasing numbers) was a result of impacts from cattle, native ungulates, small mammals and rodents, insects, or humans. While most disturbance was from cattle, 3 to 6% of live cacti were also disturbed by native ungulates (an elk or other native ungulate track was found within 15 cm of the cacti).

A 1994 report (San Juan College 1994) provides insights into the impacts of cattle on Winkler cacti along the Hartnet and Lower South Desert trails where permits could be issued. An estimated 2%–5% of the Winkler cacti were trampled near water sources. Trampling often destroys the meristem of a cactus and, as a result, the plant produces no flowers, fruits, or seeds. Cattle grazing and trailing also reduced suitable habitat for the Winkler cactus due to soil compaction and subsequent loss of native vegetation. An estimated 5%–10% of suitable habitat was lost in the recently retired Hartnet allotment.

Last Chance Townsendia

Last Chance townsendia is a small, stemless, mound-forming perennial plant in the sunflower family. Plants are 1.5 cm–2.5 cm tall with tiny leaves that grow in small, circular basal rosettes. It flowers in early spring, from late March through early June.

Last Chance townsendia is endemic to south-central Utah, occurring in Wayne, Sevier, and Emery Counties. Its range covers over a million acres (USFWS 2018) although only approximately 9,000 acres are occupied habitat (USFWS 2013a). Most of the occupied habitat occurs on BLM-administered lands (53%), followed by Capitol Reef National Park (25%), National Forest lands (21%), and State lands (1%; USFWS 2013a). It occurs in some of the same habitat as Winkler and Wright fishhook cacti. Based upon surveys conducted in Capitol Reef National Park between 1998 and 2016, there are approximately 1,911 Last Chance townsendia in the park. The total number of Last Chance townsendia rangewide reported in a 5-year review of the species is 6,848 (USFWS 2013a).

There is little information on Last Chance townsendia life history, pollination ecology, demographics, or predation (USFWS 2013a). Plants do not reach reproductive maturity until their second year of life, when they achieve a size of approximately 15 mm–20 mm in diameter (Tepedino et al. 2004). Reproduction is positively correlated with size, so large plants produce more flowers than small plants (Clark 2008b; USFWS 2013a). Last Chance townsendia can reproduce either sexually or asexually; however, most reproduce sexually using insects (e.g., bees) or wind for cross pollination (Tepedino et al. 2004). Low seed production was mentioned in the species recovery plan (USFWS 1993). Factors limiting seed production could include low pollinator numbers; inclement weather, which might affect pollinator activity; or small population size (Tepedino et al. 2004; USFWS 1993).

Mineral and energy development, road construction, livestock trampling, and off-road vehicle use have been identified as primary threats to the species rangewide (USFWS 1993). The 5-year review of Last Chance townsendia identified livestock grazing as a high threat to the species; other activities outside the planning area were identified as being moderate (energy and mineral development, and wild horses and burros) or low (range improvements and off-highway vehicle travel) threats (USFWS 2013a). Cattle, and more recently elk, trampling of suitable habitat has been identified as a threat to Last Chance townsendia in the park (San Juan College 1994; Borthwick 2017).

Within the planning area, Last Chance townsendia rangewide habitat exists along the Gray Bench-Cathedral Valley trail. Rangewide habitat also exists along the Hartnet trail, which is in the recently retired Hartnet allotment. The approximate acres of Last Chance townsendia habitat along each of these trails is shown in Table 3.13. The approximate number of Last Chance townsendia occurring on level terrain within 300 feet of these trails is 86 (Table 3.14). This represents 4.5% of the known Last Chance townsendia in the park (1,911) and 1.3% of the known number rangewide (6,848).

Clark (2008b) summarized results from data collected between 1996 and 2008 during a demographic study of Last Chance townsendia on BLM-administered land outside the planning area for this project. Although cattle contributed to Last Chance townsendia mortality (6 of 13 trampled plants died), cattle

use of this area was low, and impacts from cattle were not a substantial mortality factor (Clark 2008b; USFWS 2013a). At this plot, climate factors (low precipitation and colder winters) were thought to be the greatest cause of Last Chance townsendia decline.

A 1994 report (San Juan College 1994) provides insights into the impacts of cattle on Last Chance townsendia along the Hartnet trail where permits could be issued. The study documented 0%–2% of the Last Chance townsendia plants were damaged by cattle. Although trampling was found to affect a low percentage of the population, cattle grazing and trailing were cited as reducing suitable habitat for the species in portions of the allotment. This was due to soil compaction and subsequent losses in native vegetation. Ungulate impacts compound other threats, such as climate change (Schwinning et al. 2008; Krause et al. 2015).

Threatened and Endangered Plants and Climate Change

As described under Upland and Riparian Vegetation, although there is some uncertainty, the climate of the southwestern region of the United States is predicted to undergo substantial changes this century, and increasing temperatures, coupled with prolonged and severe drought patterns, are anticipated to continue in the Colorado Plateau (Schwinning et al. 2008).

Grazing-induced disturbance of vegetation and soil negatively affects biological soil crusts, reduces soil carbon and nitrogen stocks, and increases rates of soil erosion. All of these factors weaken an ecosystem's ability to respond to drought and to a warmer, drier climate that it is not adapted to (Schwinning et al. 2008).

Increasing temperatures, coupled with prolonged and severe drought patterns, may affect the federally listed plant species analyzed in this EA. Further, wider fluctuations in temperature and precipitation are expected in the future. Endemic plant species, such as Winkler cactus, Wright fishhook cactus, and Last Chance townsendia, and many of the NPS sensitive species may be particularly vulnerable to climate change because of their limited range distribution. As previously noted, all three listed plant species at Capitol Reef National Park have highly restricted distributions. Shifts in species' ranges in response to climate change have already been observed (Parmesan 2006), but endemic species may have difficulty in dispersing to new areas (Comstock and Ehleringer 1992). Krause et al. (2015) found that many Colorado Plateau endemic species will experience major range reductions, due to current habitats becoming unsuitable and the species' inability to disperse to new areas.

Although little is generally known about the dispersal ability of listed species at Capitol Reef National Park, Kass (2001a) notes an apparent lack of long-distance seed dispersal for Wright fishhook cactus. Additionally, Winkler cactus was found to have overall low fecundity (its ability to reproduce in abundance; Clark et al. 2015), which suggests that this long-lived species would have difficulty in adapting to relatively rapid climate change.

Studies of the effect of climate change on individual species are few, and they focus mainly on temperature and life cycle changes with respect to changes in phenology (flowering times) and the effects of climate change on pollinators. Parmesan and Yohe (2003) found plant reproductive potential to be disrupted when the presence of pollinators and a species' flowering time differ; as a consequence, this promotes changes in competition between plants and pollinators.

Plant vulnerability to climate change can be assessed using vulnerability indices[3] or habitat distribution models that predict current and future areas of suitable habitat (Still et al. 2015). Lack of information on life history traits and current distribution of rare plants often makes these methods difficult to implement; however, Wright fishhook and Winkler cacti were among 34 species that Still et al. (2015) assessed, using two vulnerability assessment methods. In Still et al.'s evaluation, Winkler cactus was found to be highly vulnerable to climate change. Wright fishhook cactus was found to be extremely vulnerable, with no predicted overlap between current and future suitable habitat area.

Desert plants, being uniquely adapted to hot and dry conditions, have a number of mechanisms that may help populations persist under climate change scenarios (Salguero-Gomez et al. 2012). Winkler cactus demonstrates one such mechanism, with its ability to contract underground during droughts and to emerge in subsequent years; however, demographic information from long-term monitoring is needed to understand whether such mechanisms will allow any of the rare plants in Capitol Reef National Park to persist in a warmer and drier future.

Mexican Spotted Owls and Designated Critical Habitat

The MSO, a subspecies of the spotted owl, was listed in 1993 as a federally threatened species under the ESA. This owl species inhabits forested mountains and canyon lands throughout the southwestern United States, including Arizona, Colorado, New Mexico, Utah, and the western portions of Texas; it also ranges south into several states of Mexico (USFWS 2012a). Capitol Reef National Park is in the Colorado Plateau Mexican Spotted Owl Ecological Management Unit, which includes steep-walled rocky canyon habitats supportive of the owl (USFWS 2012a). MSOs inhabit Capitol Reef National Park only in these rocky-canyon habitats.

In the Colorado Plateau, MSOs use rocky-canyon habitats for nesting, roosting, and foraging. This habitat is characterized by vertical, rocky cliffs in complex watersheds, including many tributary side canyons (USFWS 2012a). Canyon walls with caves, ledges, and fracture zones provide nesting and roosting sites. Owls nest and roost in protected caves and on rocky ledges, as well as in trees (Willey 1998a).

MSOs use a greater diversity of habitats for foraging than for nesting or roosting (USFWS 2012a). Their specific prey is woodrats (*Neotoma spp.*), mice, voles, rabbits, gophers, bats, birds, reptiles, and arthropods (insects). In Colorado Plateau canyon habitat, spotted owls prey on more woodrats and fewer birds than do spotted owls from other areas (Ward and Block 1995; Willey and Willey 2010).

The MSO Recovery Plan considers riparian habitats important to owl recovery, because they are productive foraging habitats for MSOs and can act as refuges for small mammals, the primary prey of owls, during drought periods (USFWS 2012a). In dry, rocky-canyon habitats in the Grand Staircase Escalante National Monument in southern Utah, the amount of precipitation influenced abundance and species richness of rodent populations, which in turn influenced site occupancy and reproductive rates of MSOs (Willey and Willey 2010). Diet composition of MSOs in this study were dominated by woodrats (over 80% of biomass consumed), which responded positively to increased herbaceous cover and seed production resulting from increased precipitation.

MSOs breed sporadically and do not nest every year (Ganey 1988, in USFWS 2012a). Females lay one to three eggs, with two being the most common. Courtship begins in March, and eggs are usually laid in

[3] A qualitative framework that incorporates information on species exposure, sensitivity, and adaptive capacity to climate change

early April. Eggs typically hatch in early May, and nestlings leave the nests, often before they can fly, from 4 to 5 weeks after hatching in early to mid-June. Parents provide young with food throughout the summer, and young leave the nesting area in the fall (Ganey 1988, in USFWS 2012a).

In coordination with the US Fish and Wildlife Service, Capitol Reef National Park staff has identified and designated nine MSO PACs. These PACs are intended to protect the activity center of a single owl territory and to sustain or enhance areas that are presently, recently, or historically occupied by breeding MSOs (USFWS 2012a). PACs encompass a minimum of 600 acres surrounding known nest or roost sites (USFWS 2012a).

Seven of the PACs are within 2 miles or less of the Sandy 3 allotment or a currently permitted trailing route. The Hartnet trail and the proposed Lower South Desert trail are both more than 4.5 miles from a PAC. Since 2008, the seven PACs have been regularly monitored, although not every PAC has been surveyed each year. Results from MSO surveys conducted from 2008 to 2016 revealed that, over those 9 years, an MSO pair was observed at four of the PACs, juveniles were observed at three, single owls were observed at three, and no owls were detected at two of the PACs (Capitol Reef National Park, unpublished data).

There are no PACs in the Sandy 3 allotment, but there is one within 0.25 miles and another within 0.75 miles of the allotment. During surveys conducted annually between 2008 and 2016, one of the PACs was occupied by an MSO pair, with two to three juveniles in 3 of the 9 survey years; in three other years, single owls were detected. No MSOs were detected at the other PAC, which was surveyed in 6 of the 9 years, between 2008 and 2016 (unpublished Capitol Reef National Park data).

Approximately 8.6 million acres of critical habitat were designated for the MSOs in Arizona, Colorado, New Mexico, and Utah. More than half of Capitol Reef National Park is included in critical habitat unit CP-13. All of the Sandy 3 allotment is in designated critical habitat; however, critical habitat polygons are large areas that include habitat that is unsuitable for the species. Willey and Zambon (2014) developed a GIS-based habitat suitability model to delineate suitable habitat within the critical habitat polygons. Based on their model, only the western Waterpocket Fold area in the southern part of the allotment contains suitable habitat. This suitable habitat is more than 3 miles from the nearest PAC and has little cattle use.

The critical habitat final rule (69 *Federal Register* 53181) included primary constituent elements of critical habitat for forested habitats, canyon habitats, and prey species. These primary constituent elements provide a qualitative description of physical and biological features that critical habitat is based on and that are essential to the conservation of the MSO (USFWS 2012a).

None of the trails pass through MSO PACs and none of the PACs are located in the Sandy 3 allotment. As PACs themselves are not affected by grazing and trailing in the park, they are not described/analyzed further in this EA.

While MSO PACs are not directly affected by grazing and trailing, the Sandy 3 allotment and two currently permitted trailing routes (Oak Creek and Pleasant Creek) provide potentially important foraging habitat located in proximity to PACs which have been surveyed regularly since 2008; and which have been periodically occupied by breeding, juvenile, and/or single MSOs (Capitol Reef National Park, unpublished data). In addition, all of the Sandy 3 allotment is in designated critical habitat for MSOs, as are six of the ten livestock trailing routes analyzed in this EA (Figure 3.6). The critical habitat final rule (69 *Federal Register* 53181) included primary constituent elements of critical

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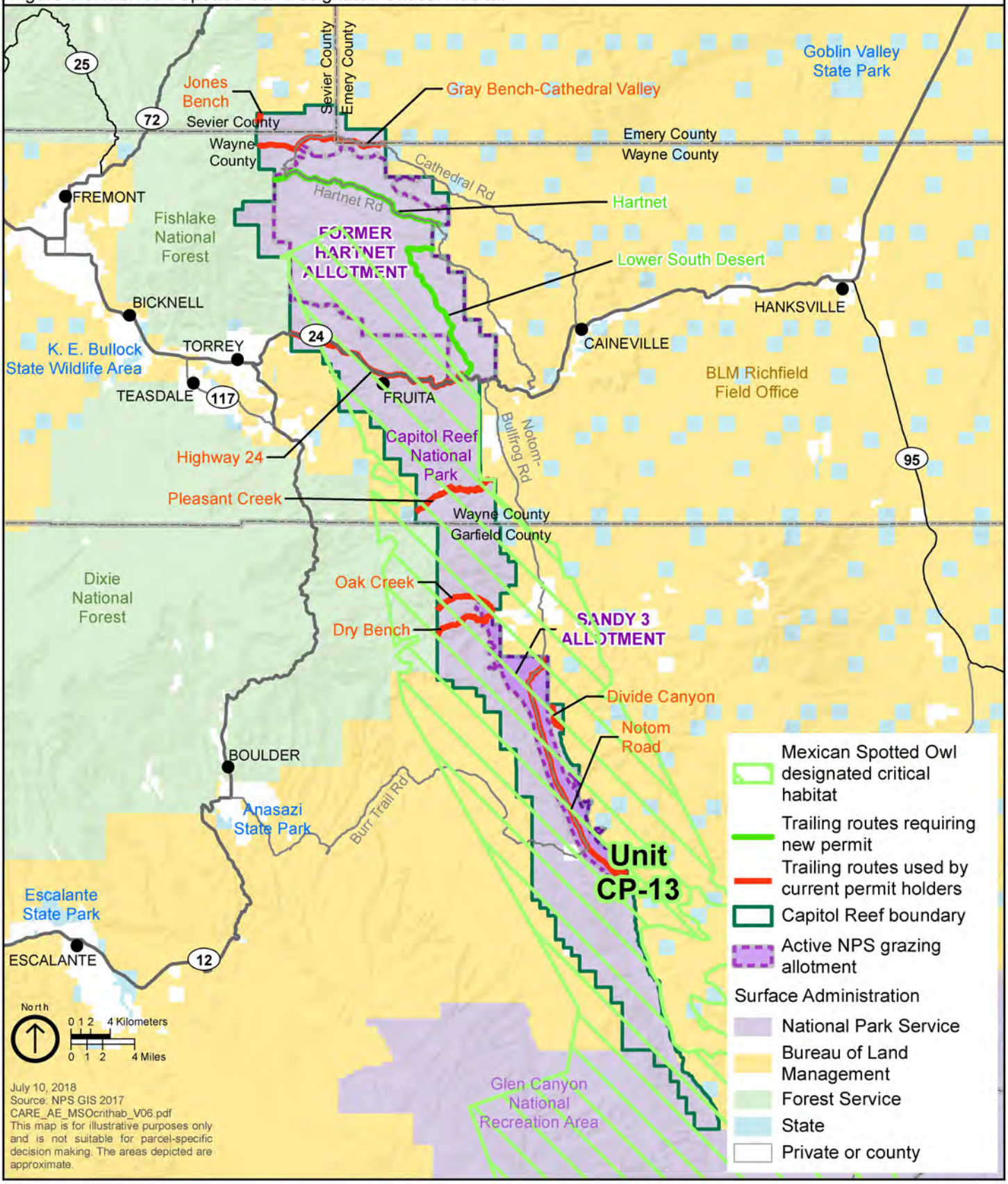
Figure 3.6: Mexican Spotted Owl Designated Critical Habitat



habitat for forested habitats, canyon habitats, and prey species. These primary constituent elements provide a qualitative description of physical and biological features that critical habitat is based on and that are essential to the conservation and recovery of the MSO (USFWS 2012a).

The primary constituent elements related to canyon habitat are as follows:

- Presence of water (often providing cooler and often higher humidity than the surrounding areas)
- Clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, or riparian vegetation
- Canyon walls containing crevices, ledges, or caves
- High percentage of ground litter and woody debris

Primary constituent elements were also identified for spotted owl prey species, as follows:

- High volumes of fallen trees and other woody debris
- A wide range of tree and plant species, including hardwoods
- Adequate levels of residual plant cover to maintain fruits and seeds and to allow plant regeneration

However, critical habitat polygons are large areas that include habitat that is unsuitable for the species. Willey and Zambon (2014) developed a GIS-based habitat suitability model to delineate suitable habitat within the critical habitat polygons.

Based on their model, only the western Waterpocket Fold area in the southern part of the Sandy 3 allotment contains suitable habitat for MSOs. This suitable habitat is more than 3 miles from the nearest PAC and has little cattle use. Also, the riparian corridors and canyon bottoms which provide the best foraging habitat for MSOs in the Sandy 3 Allotment are outside of MSO suitable habitat and are 4.8 and 6.2 miles from the nearest PAC. It is therefore unlikely that owls use these areas in the Sandy 3 allotment for foraging or nesting (USFWS 2015a), and as a result, these areas not considered further in this EA.

Of the six trailing routes within designated critical habitat, only Oak and Pleasant Creeks support suitable MSO habitat (Willey and Zambon 2014). They have been identified as important foraging areas for owls, due to habitat content and their proximity (2 miles or less) to a PAC (USFWS 2015b). As a result, the MSO habitat along the Oak and Pleasant Creek trails is considered in detail in the EA.

Riparian assessments conducted along both creeks in 2014 and 2016 found Pleasant Creek to be functional, indicating it supports the riparian conditions necessary for suitable MSO foraging habitat.. However, Oak Creek was rated not functional, due to cattle trailing and use by unauthorized cattle (Martin and Wagner 2015; Capitol Reef National Park 2016). The riparian assessment of Oak Creek found 20% to 25% of the reach used for cattle trailing supported some riparian vegetation, with only about 10% supporting herbaceous riparian vegetation (Martin and Wagner 2015). A nonfunctioning rating indicates that the habitat quality is poor and therefore affects suitable habitat for owls; examples are the cool, humid conditions found in riparian canyons (USFWS 2012a) and the reduction in prey population available for owls (Willey and van Riper 2014).

The nonfunctioning condition of Oak Creek also indicates that the MSO's designated critical habitat primary constituent element to maintain an adequate prey base is degraded. This specifically refers to the adequate levels of residual plant cover to maintain fruits and seeds and to allow plant regeneration.

Mexican spotted owls in Capitol Reef National Park and impacts from climate change. As described previously in this chapter, although uncertain, the climate of the southwestern region of the United States is predicted to undergo substantial changes this century, and the rise in temperature, coupled with prolonged and severed drought patterns, is anticipated to continue on the Colorado Plateau (Schwinning et al. 2008; Bagne and Finch 2013; Hatten et al. 2016; Seager et al. 2007).

With increasing temperatures and substantial changes to precipitation patterns in an already arid environment, the distributions and viability of animal populations will be affected (Hatten et al. 2016; van Riper et al. 2014).

MSOs are vulnerable to the effects of climate change in several ways (Greenlee et al. 2016). They are adapted for cool to cold temperatures; their plumage is thicker than other owl species. This protects them from the cold but inhibits their ability to release heat during periods with warmer temperatures (Barrows 1981). MSOs, like many other animal species, live at a physiological thermal limit (Weathers et al. 2001). As temperatures rise, they are likely to experience heat stress, which could have broad implications for their survival in the park and throughout their range.

Predicted changes in climate will result in prolonged droughts, heat waves, shifts in timing of peak seasonal rainfall, snowpack depth, and spring runoff. A change in precipitation, duration of drought, and duration and intensity of heat waves could alter the phenology and distribution of plants in owl habitat. This could result in crashes in small mammal prey base (Seamans 2002) and reductions in suitable vegetation and nesting/roosting sites (van Riper et al. 2014).

Precipitation influences primary productivity and prey population dynamics. Long-term drought may reduce forage, leading to owl starvation (Seamans 2002). A large study evaluating the impacts of climate change on North American birds indicated that the current MSO range in southwestern Colorado will decrease by 20% to 30% by 2050 and upward of 50% to 60% by 2080 (Langham et al. 2015).

Other effects of climate change on MSOs have been assessed by Willey and Willey (2010) in the Grand Staircase-Escalante National Monument, west of Capitol Reef National Park. They reported that drought had a negative effect on owl occupancy, pair status, and offspring. Climate, particularly precipitation, was found to be a major factor affecting desert rodent population dynamics, including MSO prey species. It is likely that populations of MSOs and their prey species in the park will be similarly affected by climate change.

MIGRATORY AND RESIDENT BIRDS

The Migratory Bird Treaty Act (MBTA; 16 USC 703–712) was passed in 1918 to regulate the taking of native birds. Of the 241 resident, breeding, or migrating bird species in Capitol Reef National Park, 235 native species are protected under the Migratory Bird Treaty Act, regardless of their migratory behavior. Most of the species documented in the park are seasonal visitors or neotropical migrants;[4] however, some are year-round residents. Of the 241 species in the park, 161 (67%) are resident or seasonal breeding species; 78 (33%) are migrants that use Capitol Reef National Park as a stopover during their migration to breeding or wintering grounds.

[4] Neotropical migrants are species that breed in the United States or Canada and winter in Mexico, Central America, South America, or the Caribbean Islands.

Many of the bird species inhabiting Capitol Reef National Park are native songbirds that could be affected by livestock grazing and trailing. Studies evaluating the effect of livestock grazing on avian species have shown those most susceptible to livestock activities are ground-, near-ground-, and shrub-nesting species (Earnst et al. 2005; Saab et al. 1995). Ground- and shrub-nesting bird species in the Sandy 3 allotment or livestock trailing routes in the park are listed in Table 3.15.

In addition, raptors can be affected by livestock grazing and its management. Raptors that occur in the planning area include hawks, eagles, vultures (family Accipitridae), falcons (family Falconidae), and owls (order Strigiformes).

TABLE 3.15. GROUND-TO-SHRUB-LEVEL NESTING BIRD SPECIES THAT OCCUR IN THE PLANNING AREA IN CAPITOL REEF NATIONAL PARK

Common Name	Scientific Name	Nesting Level	Breeding Habitat	Winter Habitat[a]
Black-throated sparrow	*Amphispiza bilineata*	Shrub	Upland Shrub	Upland Shrub
Brewer's sparrow	*Spizella breweri*	Shrub	Upland Shrub	N/A
Chipping sparrow	*S. passerina*	Shrub	Upland Shrub/Riparian	N/A
Common nighthawk	*Chordeiles minor*	Ground	Upland Shrub/Grassland	N/A
Horned lark	*Eremophila alpestris*	Ground	Mixed Grassland	Mixed Grassland
Indigo bunting	*Passerina cyanea*	Shrub	Riparian	N/A
Lark sparrow	*Chondestes grammacus*	Ground/ Shrub	Upland Shrub	N/A
Lazuli bunting	*Passerina amoena*	Shrub	Riparian	N/A
Loggerhead shrike	*Lanius ludovicianus*	Shrub	Pinyon-Juniper Woodland/Upland Shrub	Upland Shrub
Rock wren	*Salpinctes obsoletus*	Ground	Rock Outcrop	Rock Outcrop
Sagebrush sparrow	*Artemisiospiza nevadensis*	Ground/ Shrub	Upland Shrub	N/A
Spotted towhee	*Pipilo maculatus*	Ground/ Shrub	Riparian	N/A
Virginia's warbler	*Oreothlypis virginiae*	Ground	Oak/Pinyon-Juniper	N/A
Western meadowlark	*Sturnella neglecta*	Ground	Upland Shrub/Grassland	Pastures
Yellow warbler	*Setophaga petechia*	Shrub	Riparian	N/A
Yellow-breasted chat	*Icteria virens*	Shrub	Riparian	N/A

[a] N/A: Breeding or migratory species that are not present in Capitol Reef National Park during winter.

Two primary efforts to monitor bird populations in Capitol Reef National Park are ongoing. Beginning in 1987, surveys have been conducted by park or BLM staff using the North American Breeding Bird Survey protocols at the Desert View route and the Notom Road route. Both routes have been run for 19 of 29 years between 1987 and 2016.

The Desert View route provides information regarding birds that could be affected by issuing a new trailing permit for the Hartnet route. It follows Hartnet Road, from the northwest boundary of the recently retired Hartnet allotment, onto BLM-administered land, terminating above the Fremont River Valley. The most abundant species detected along the Desert View route are rock wren (*Salpinctes obsoletus*), black-throated sparrow (*Amphispiza bilineata*), lark sparrow (*Chondestes grammacus*), horned lark (*Eremophila alpestris*), pinyon jay (*Gymnorhinus cyanocephalus*), and mourning dove (*Zenaida macroura*; Pardieck et al. 2016).

The Notom Road route starts at the junction of Notom Road and Highway 24 and continues south through BLM-administered lands and into Capitol Reef National Park. It extends approximately 6 miles into the Sandy 3 allotment and along the Notom Road trailing route. The most abundant species detected along this survey route are black-throated sparrow, lark sparrow, mourning dove, rock wren, common raven (*Corvus corax*), and house finch (*Carpodacus mexicanus*; Pardieck et al. 2016).

In addition to the North American Breeding Bird Survey, data on breeding birds have been collected as part of the National Park Service NCPN's Land Bird Monitoring Program. Two transects in Capitol Reef National Park have been surveyed from 2005 to 2015 (McLaren and Hanni 2015). Transect LR08 surveys riparian habitat along Pleasant Creek corresponding with nearly half of the Pleasant Creek trailing route. Transect PJ04 surveys pinyon-juniper woodland habitat at the north end of the Sandy 3 allotment. In general, the riparian LR08 route shows greater species diversity than the pinyon-juniper PJ04 route. This result is to be expected, because riparian habitats in the arid west typically have greater bird species richness and abundance than upland habitats (Soykan et al. 2012).

The long-term trend in total number of bird species detected (bird species richness) during this monitoring indicates a general decline in bird species richness for both routes; however, this decline is not statistically significant (Figure 3.7; NPS land bird monitoring data 2005–2015). Some year-to-year variation in bird species richness is expected and may be due to the observer, timing of surveys, or variation in environmental conditions for a specific year.

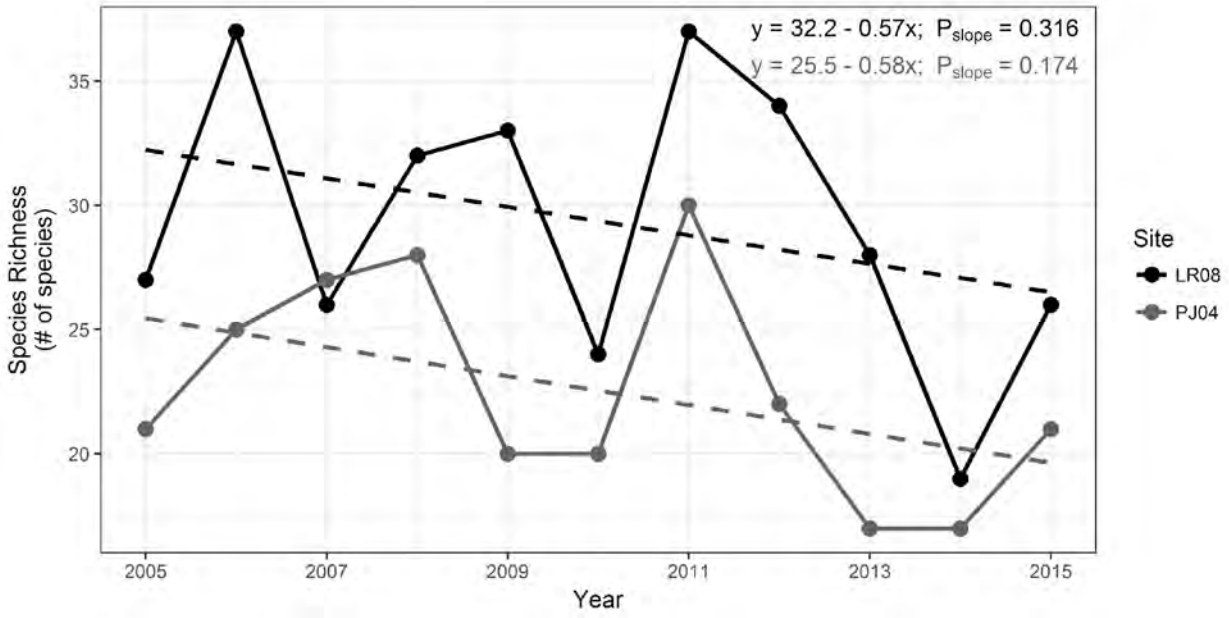


Figure 3.7. Bird Species Richness from 2005 to 2015
Measured During the Summer Breeding Season Through Riparian Habitat Along Pleasant Creek (LR08) and Through Pinyon-Juniper Woodlands in the Sandy 3 allotment (PJ04)

In the Sandy 3 allotment grazed areas, Bitter Spring Creek and Bitter Creek provide the most important riparian habitat for birds. There is additional riparian habitat in the planning area along and in the vicinity of several of the trailing routes analyzed in this EA (Oak Creek; Pleasant Creek; Highway 24, which follows the Fremont River; Hartnet; and Lower South Desert). The Fremont River within the Fruita Historic District of the park is a State priority, Audubon Society-designated Important Bird Area (National Audubon Society 2017). Of the 241 species of birds confirmed in Capitol Reef National Park (NPS 2017a), 165 have been recorded in this Important Bird Area.

Migratory Bird Species of Concern

In 2001, President Clinton signed Executive Order 13186 (66 FR 3853), which outlines actions intended to ensure that federal agencies adequately implement the Migratory Bird Treaty Act to protect birds and their habitats. In accordance with this executive order, the National Park Service and the US Fish and Wildlife Service developed a memorandum of understanding, signed in 2010, to cooperate in protecting migratory birds and to evaluate NPS actions and plans that may affect migratory bird species of concern.

When evaluating the effects of its projects or actions on migratory birds, Capitol Reef National Park focuses on the following lists: Birds of Conservation Concern for the Southern Rockies/Colorado Plateau Region (USFWS 2008a), the Utah Partners in Flight priority species (Parrish et al. 2002), and the National Park Service's sensitive species list. Based on these lists, 15 bird species in the Sandy 3 allotment or along trailing routes in the park are bird species of concern (Table 3.16). The three species that nest on the ground or in shrubs—Brewer's sparrow (*Spizella breweri*), sagebrush sparrow (*Artemisiospiza nevadensis*), and Virginia's warbler (*Oreothlypis virginiae*)—are especially vulnerable to livestock grazing and trailing. This is because livestock can directly trample or disturb nests or remove vegetation needed for construction and concealment of nests (Bock et al. 1993).

TABLE 3.16. BIRD SPECIES OF CONCERN THAT OCCUR IN THE PLANNING AREA IN CAPITOL REEF NATIONAL PARK

Common Name	Scientific Name	Breeding Habitat	Winter Habitat[4]
Black-throated gray warbler[1]	*Setophaga nigrescens*	Pinyon-Juniper	N/A
Blue grosbeak[2]	*Passerina caerulea*	Riparian	N/A
Brewer's sparrow[1, 2]	*Spizella breweri*	Upland Shrubland	N/A
Broad-tailed hummingbird[1]	*Selasphorus platycercus*	Riparian	N/A
Common yellowthroat[2]	*Geothlypis trichas*	Riparian	N/A
Golden eagle[2, 3]	*Aquila chrysaetos*	Cliffs/Upland Shrubland	Upland Shrubland
Gray flycatcher[1]	*Empidonax wrightii*	Upland Shrubland	N/A
Gray vireo[1, 2]	*Vireo vicinior*	Pinyon-Juniper	N/A
Juniper titmouse[2]	*Baeolophus ridgwayi*	Pinyon-Juniper	Pinyon-Juniper
Olive-sided flycatcher[2]	*Contopus cooperi*	Ponderosa Woodland/ Riparian	N/A
Peregrine falcon[2, 3]	*Falco peregrinus*	Cliffs/Riparian	N/A
Prairie falcon[2]	*F. mexicanus*	Cliff/Upland Shrubland	Upland Shrubland
Pinyon jay[2]	*Gymnorhinus cyanocephalus*	Pinyon-Juniper	Pinyon-Juniper
Sagebrush sparrow[1]	*Artemisiospiza nevadensis*	Upland Shrubland	N/A
Virginia's warbler[1, 2]	*Oreothlypis virginiae*	Oak/Pinyon-juniper	N/A

[1] Denotes priority species identified by Utah Partners in Flight (Parrish et al. 2002)
[2] Denotes species identified by the US Fish and Wildlife Service as birds of conservation concern (2008)
[3] Denotes species on Capitol Reef National Park's sensitive species list
[4] N/A: Migratory species that are not present in the park during winter

The Fremont River Important Bird Area includes a portion of the currently permitted Highway 24 trailing route. It is host to several bird species of concern, namely common yellowthroat (*Geothlypis trichas*), Virginia's warbler, and black-throated gray warbler (*Setophaga nigrescens*). Additionally, a Mexican spotted owl has been recorded there (National Audubon Society 2017).

Numerous bird species of concern have been detected along the two North American breeding bird survey routes, discussed previously. The most commonly detected species of concern along the Desert View route are pinyon jay, Brewer's sparrow, gray flycatcher (*Empidonax wrightii*), and juniper

titmouse (*Baeolophus ridgwayi*; Pardieck et al. 2016). The most commonly detected species of concern along the Notom Road route are Brewer's sparrow, gray vireo (*Vireo vicinior*), and blue grosbeak (*Passerina caerulea*; Pardieck et al. 2016).

Finally, bird species of concern were detected during the Land Bird Monitoring Program surveys, described previously. Along LR08, the riparian survey route, black-throated gray warbler, broad-tailed hummingbird (*Selasphorus platycercus*), and Virginia's warbler were recorded. Species of concern recorded along the PJ04 route, which traverses pinyon-juniper habitat, were black-throated gray warbler, gray flycatcher, and pinyon jay.

Birds in Capitol Reef National Park and Climate Change

As described previously in this chapter, although uncertain, the climate of the southwestern region of the United States is predicted to undergo substantial changes this century, and the rise in temperature, coupled with prolonged and severe drought patterns, is anticipated to continue on the Colorado Plateau (Schwinning et al. 2008; Bagne and Finch 2013; Hatten et al. 2016; Seager et al. 2007). With increasing temperatures and substantial changes in precipitation patterns in an already arid environment, the distributions and viability of animal populations will be affected (Hatten et al. 2016; van Riper et al. 2014).

The changing climate will likely have species-specific impacts on birds (Hatten et al. 2016; van Riper et al. 2014; Gardali et al. 2012). Exposure to climate change and climatic variability, sensitivity (such as physiological tolerance to changes in temperature or moisture), and adaptive capacity are variables that can influence a species' vulnerability to climate change (Greenlee et al. 2016). Some species will likely gain suitable habitat and may experience increasing populations, while others will experience distribution contractions and likely shrinking populations (Hatten et al. 2016; van Riper et al. 2014).

Hatten et al. (2016) found that, for bird species with distribution ranges in the Colorado Plateau, patch isolation was a major driver of projected bird ranges under climate change. Habitat fragmentation was a major driver for most bird species evaluated in the study, whereby the degree of contemporary habitat fragmentation was strongly correlated with range contractions under future climate scenarios (Hatten et al. 2016). The study combined climatic variables, level of habitat fragmentation, and biological attributes into mathematical models used to predict species responses to climate change. The collective results of the study indicated that the most vulnerable bird species in the southwestern United States are forest and woodland birds, followed by most sagebrush associates (Hatten et al. 2016).

Three sagebrush associate species evaluated in the study that also occur within the park were predicted to lose 34% to 80% of their range: Brewer's sparrow, gray flycatcher, and sage thrasher (*Oreoscoptes montanus*). Two inhabitants of pinyon-juniper woodlands in the park, juniper titmouse and pinyon jay, are predicted to have range contractions, as is the Virginia's warbler, associated with Gambel oak (*Quercus gambelii*). Species in the park predicted to experience range expansions under climate change are sagebrush sparrow, black-throated sparrow, gray vireo, and black-throated gray warbler (Hatten et al. 2016).

WILDERNESS

In accordance with the Wilderness Act of 1964, a wilderness suitability study for Capitol Reef National Park was completed in 1974. The study was conducted for all roadless areas within Capitol Reef National Park, ultimately resulting in a recommendation that 179,800 acres be designated as wilderness,

along with 4,100 acres that showed wilderness potential. On May 23, 1977, President Carter officially submitted the wilderness recommendation to Congress, which never acted on it.

In 1999, park managers reviewed the 1974 recommended wilderness boundaries and redrew wilderness maps to reflect newly acquired lands that were once inholdings. They also expanded the area of recommended wilderness, most notably into the Hartnet/Cathedral Valley area. While the boundaries outlined in 1999 were decided on and approved by the National Park Service, this recommendation has never been submitted to Congress. Until the 1999 revised boundaries (or any other revised boundaries) are submitted to Congress by a president, the 1974 wilderness recommendation is the only official document with the legal authority to determine the boundaries and acreage for the Capitol Reef National Park wilderness. The National Park Service manages recommended wilderness as wilderness.

Wilderness character encompasses the five qualities that are described in the definition of wilderness from Section 2(c) of the Wilderness Act (16 USC Sections 1131–1136): untrammeled, natural, undeveloped, solitude or primitive and unconfined recreation, and other features of value. Together, these five qualities are used to monitor how stewardship actions, impacts from modernization, and other changes occurring outside of a given wilderness area affect it over time.

Grazing is a traditional practice that has been present on lands now in the park and its wilderness for over a century. While grazing has impacts on a number of wilderness qualities, it is written into the Wilderness Act of 1964 as an allowable use. Grazing is allowed in Capitol Reef National Park's recommended wilderness by the Wilderness Act of 1964 and the park's enabling legislation.

While grazing is a traditional practice at Capitol Reef National Park and is permitted by US law and NPS policy, this activity has had widespread influence on many qualities of wilderness character in the park. Currently, livestock grazing is authorized on nearly 15,000 acres in the park, most of which are in recommended wilderness; this includes 8,000 acres in the grazed portion of the Sandy 3 allotment (see Figure 3.8 for acreages). In these areas, impacts from cattle grazing and trailing can be seen. These impacts include bare ground; loss of biological soil crust; cattle trails; vegetation that is noticeably different from non-grazed areas, affecting the current condition of natural character; and fences.

Cattle grazing and its associated infrastructure have widespread impacts on wilderness character, including the alteration of the natural biophysical environment; therefore, grazing is considered a trammeling action. As described in Appendix B, rangeland health assessments indicate that substantial portions of the Sandy 3 allotment have experienced a moderate-to-extreme or extreme-to-total departure from reference conditions, affecting the untrammeled, natural, and other features of value aspects of wilderness. Similarly, grazing has affected the untrammeled, natural, and other features of value aspects of wilderness, where riparian systems are nonfunctional or functional at risk because of grazing.

As shown in Table 3.17, portions of five trailing routes analyzed in this EA traverse recommended wilderness, for a total distance of 21.8 miles.

Trailing routes through Capitol Reef National Park provide essential driveways for local ranchers, allowing cattle to move between summer and winter ranges on surrounding BLM-administered and National Forest Service lands. Although livestock trailing is recognized as a valid use in wilderness, it still can have adverse environmental impacts, such as plant trampling, soil erosion, water pollution, and introduction of invasive plants and pathogens. As described earlier in this chapter, the Oak Creek riparian corridor is nonfunctional because of cattle trailing and trespassing. Similar to grazing, cattle trailing also affects visitor experiences.

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Figure 3.8: Recommended Wilderness

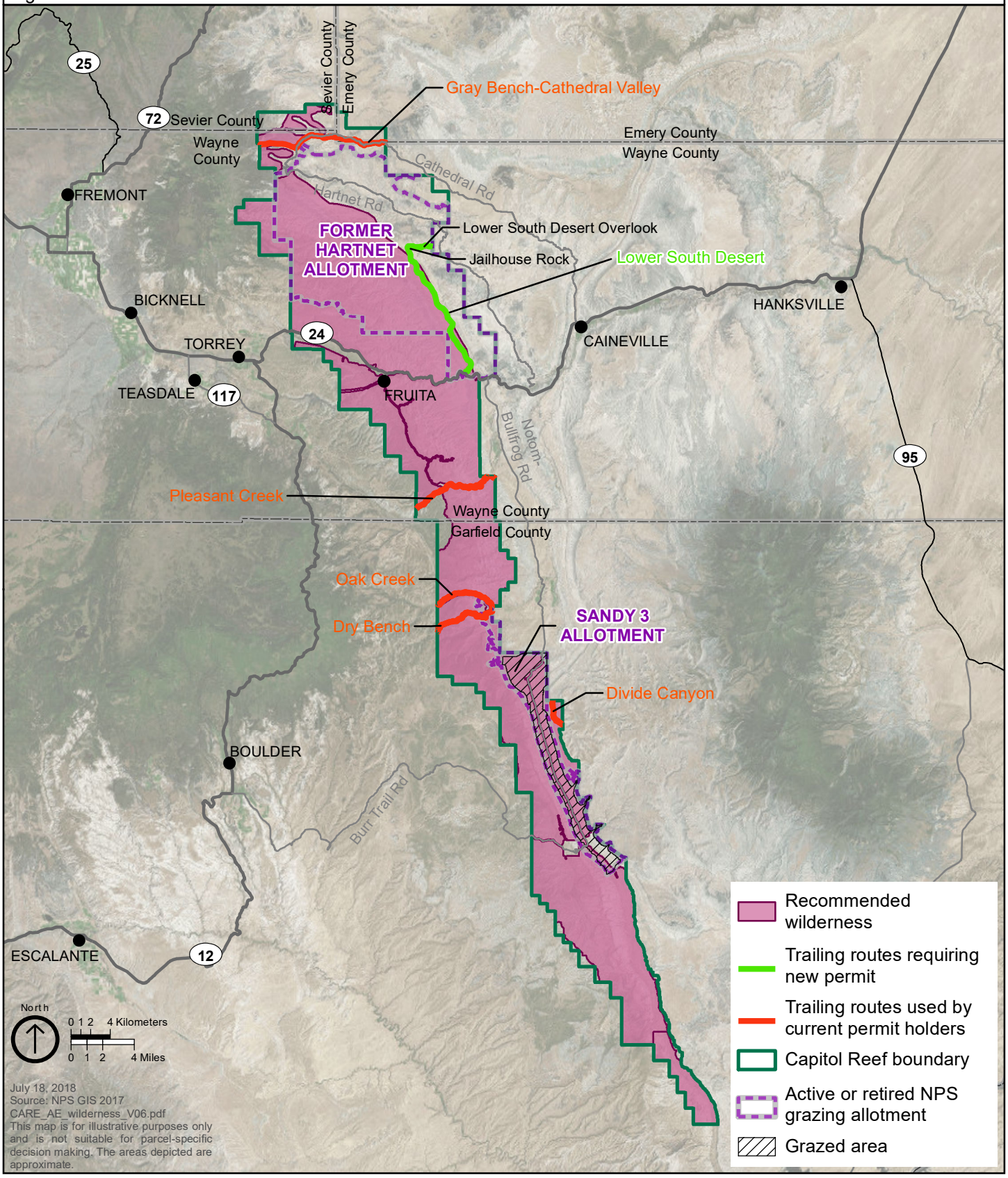

TABLE 3.17. LIVESTOCK TRAILING ROUTES IN RECOMMENDED WILDERNESS IN CAPITOL REEF NATIONAL PARK

Trailing Route[a]	Number of Stock	Season	Miles of Trail in Recommended Wilderness	Stock Miles
Gray Bench	160	Fall only	1.5	240
Oak Creek	250 (x2), operator 1	Spring and fall	0.75	375
Oak Creek	850 (x2), operator 2	Spring and fall	0.75	1,275
Pleasant Creek	250	Fall only	3.5	875
Divide Canyon	180 (x2)	Spring and fall	2	720
Dry Bench	Not regularly used	N/A	4	0
Lower South Desert	200	Spring and Fall	9.3	1,860
			Total stock miles:	**5,345**

[a] The following trailing routes analyzed in this EA do not traverse recommended wilderness: Jones Bench, Highway 24, Notom Road, and Hartnet.

Grazing-related structures are a reminder of modern human influence in the wilderness. Over 20 miles of fences, some of which denote the park boundary, are in recommended wilderness. Fenced monitoring exclosures are in certain areas, with metal T-posts and barbed wire. Many stock ponds in the allotments are in recommended wilderness. Access roads are not in recommended wilderness but are surrounded by recommended wilderness.

PERMITTEE TRADITIONAL USES AND SOCIOECONOMICS

Ranching communities maintain and transmit cultural heritage, including folk stories and local ecological knowledge, through their interactions with historic working landscapes. Experiential learning forges the emotional ties to the land and community that are necessary for cultural continuity. Local ecological knowledge is useful for adaptive comanagement, monitoring, and conservation.

Continuity of local ecological knowledge is a major factor in the resilience of ranching culture, rural pastoral economies, and working landscapes (Kirner 2015). So long as the ranching system remains intact, including its diverse places and related cultural heritage, families would be able to continue their way of life, and the broader community and culture would be sustained. If too many challenges are encountered through economic stress, the loss of cultural heritage motivates younger generations to discontinue the ranching lifestyle, or with too many constraints limiting flexible management, ranches could begin to be at risk for failure. When too many ranches fail in a community, the integrity of the entire system—cultural, economic, and ecological—is at risk (Kirner 2015).

Surveys of public land ranchers in Utah suggest that many operators are committed to the ranching lifestyle, despite fluctuating profits. Survey results also indicate that producers have the capacity to absorb low levels of changes in pasture availability on public lands (Headwaters Economics 2011).

The National Park Service recognizes livestock grazing, trailing, and ranching collectively as a traditional cultural use in Capitol Reef. Under its management policies (2006), the National Park Service considers the permit holders and the local ranching community as traditionally associated peoples. This is because of their deep emotional and cultural ties to the landscape of Capitol Reef and the long, multigenerational history of livestock grazing and ranching in and next to the park.

Grazing allotments, trailing routes, and the variety of natural and cultural resources that the community defines as heritage resources are considered ethnographic landscapes by the National Park Service. Ethnographic resources are structures and other objects, such as cabins, corrals, fences, and certain landscapes, linked inextricably to livestock grazing. Traditional cultural properties are ethnographic resources eligible for listing on the National Register of Historic Places.

Cattle producers face two principal sources of uncertainty: prices and weather (and the effect of weather on forage). Through the timely adjustment of stocking rates, producers hope to effectively buffer the adverse effects of uncertainty, relative to forage availability and livestock prices. The ability to adjust may help producers survive the occurrence of an undesirable event, such as drought, and may thus decrease the risk of an undesirable outcome (Riechers et al. 1989).

As with grazing and trailing on all public lands, permittees operating at Capitol Reef face uncertainty as a result of the need to balance permitting of grazing and trailing with resource management mandates. For example, depending on a variety of factors, permittees may periodically have to adjust operations. Examples of such factors are weather, forage availability, rangeland health, and condition of other resources, including threatened and endangered species (see Chapter 2 for the types of adjustments that may occur at Capitol Reef under each alternative).

This uncertainty can adversely affect the income potential of these operations and the ability of permittees to carry out their traditional ranching lifestyle. This is because permittees would need to evaluate whether they want to invest new capital into their operations on public lands in any given year; however, such business decisions are at the discretion of the permittee, so the economic, social, and cultural impacts on the permittee associated with business decisions that may be made to address this uncertainty cannot be reasonably predicted.

Historically, the price paid for cattle in the United States runs in cycles. As the price declines, the number of cattle raised goes down. As herd sizes are reduced, the price paid is raised and cattle numbers are increased. Calf price increases in 2013, 2014, and 2015 triggered an expansion of cattle herds. Even though herd expansion slowed somewhat in 2016 and 2017, additional replacement heifers are now in place to expand herds into 2019. Thus, the price paid for cattle is expected to continue to decline in the near future. Beef prices are projected to bottom out in the 2019–2020 time frame.

Livestock graze on the park during the fall, winter, and early spring grazing seasons, then they move on to other ranges outside of Capitol Reef National Park for the summer growing and grazing season. The literature suggests the winter dormancy period is the ideal time to graze semiarid rangelands in the park (Cook and Stoddart 1963; Holechek et al. 2011). The literature also supports that grazing during the spring growing season could be detrimental to palatable cool-season plants (Cook and Stoddart 1963; Holechek et al. 2011). Although improper spring grazing could be harmful, grazing at this time of year is necessary to maintain the permittees' ranching operations. Capitol Reef National Park rangelands allow ranchers to maintain a yearlong cow/calf operation. The spring growing season typically starts in March and ends in June (NRCS 2014).

Concerns for Capitol Reef National Park grazing and trailing permit holders are the current and projected low cost of beef and the ability to make a profit on their ranching operations. The permit holder's ability to maintain grazing and trailing permits in Capitol Reef National Park will help ensure their cattle have sufficient forage available at a reasonable price. Reasonably priced forage should help permit holders maintain and increase weight on animals, depending on the time of year. Increased animal weight can help with birthing and weaning calves and can improve the odds of calf weight gain (Cow-Calf Management Guide & Cattleman's Library). Healthy animals at a preferred weight increase

the opportunity to make a profit; however, areas of Capitol Reef National Park are seeing a decrease in cool-season grass species that are preferred forage for livestock.

Sandy 3 Allotment

The current grazing permit holder is the daughter of the permit holder that used the allotment in 1971 when the park was designated. The permit holder did not provide information to Capitol Reef National Park on the ranching operations.

In the absence of any information or data from the permittee, the National Park Service is estimating that the permittee currently has 70 calves (assuming an 85% calving success rate of 82) to sell in the fall. The National Park Service also assumes that calf weights in the fall would be around 550 pounds and that the cattle markets would remain low; therefore, using the 2017 cost per hundred weight (cwt) estimated at 155 cwt (www.beefmagazine.com; www.cmegroup.com), the gross income dollar amount for each calf is assumed to be $852.50 (155 cwt multiplied by 5.5). This would result in the potential to generate approximately $60,000 in gross income ($852.50 per calf multiplied by 70 calves).

Trailing Permit Holders

Trailing through the park allows permit holders to access livestock allotments outside Capitol Reef National Park. Trails used by current permit holders are noted in Table 2.1. Based on the information presented in Appendix E, it is estimated that trailing livestock through the park costs permittees between $1,000 and $3,000 per trailing event (BLM 2015c). Many variables can contribute to these costs, including distance trailed and elevation gained, beginning weight when trailing starts, and intensity under which animals are moved.

The former permit holder of the recently retired Hartnet allotment maintains grazing permits on the Fishlake National Forest and on BLM-administered lands. To get 200 head of cattle from one allotment to the other, the permittee must truck livestock around the park in the absence of a trailing permit through the park. It is estimated that trucking would cost between $5,300 and $12,300 (see Appendix E).

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Environmental consequences are the beneficial and adverse impacts that are expected to result from implementing the alternatives.

In accordance with the Council Environmental Quality (CEQ) regulations (40 CFR 1502.16), the analysis in this chapter addresses the direct, indirect, and cumulative impacts of implementing each of the alternatives considered in this Draft Plan/EA. The resource topics presented in this chapter are those listed in Chapter 1 and retained for further analysis; they are presented in the same order as in Chapter 3.

The analysis is based on the assumption that the measures described under each alternative, including those taken to lessen the intensity and probability of the impacts, would be implemented.

The impacts analysis synthesizes scientific literature relevant to the topic, available data regarding expected impacts on resources, and the best professional judgment of park staff and resource experts. For this Draft Plan/EA, Capitol Reef National Park is in a favorable position for evaluating environmental consequences. This is because the park has substantial knowledge of resources in the park, including soil, vegetation, special status species, water resources, and riparian conditions. Where it does not have site-specific data, the park has used information applicable to similar arid and semiarid lands on the Colorado Plateau and the Chihuahuan and Sonoran Deserts.

The analysis is based on the assumption that the measures described under each alternative, including those taken to lessen the intensity and probability of the impacts, would be implemented. Analysis for Alternative 2 is also based on the expectation that funding would be available for Capitol Reef National Park to hire a range management specialist (or similar position), to purchase and install infrastructure, and to implement the monitoring and adaptive management necessary to achieve the desired conditions described in Appendix C. If funding is not available, or for some other reason desired conditions are not achieved, then impacts under Alternative 2 would be similar to those described for Alternative 1 until funding is available and actions are implemented to meet desired conditions.

Cumulative Impacts

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time.

Past, present, and foreseeable future actions that could affect resources in the planning area were identified in or near Capitol Reef National Park (see Table 4.1). With few exceptions, the park boundary was identified as the geographic boundary for cumulative impacts analyses. Exceptions are soils, archeological resources, and wilderness qualities on land next to the park. For creeks, the geographic boundaries include areas of the watersheds upstream of the park boundary, in which actions (mostly those that may affect water quality) could affect trailing routes or the allotment. The life of the plan, estimated to be 20 years, is the temporal boundary to identify reasonably foreseeable future actions.

TABLE 4.1. PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

Project	Description	Impact Topics
Livestock grazing and trailing	Cattle and sheep grazing was introduced into the Capitol Reef National Park area in the late 1870s and 1880s. Areas including the recently retired Hartnet allotment and Sandy 3 allotment have been grazed since then, for approximately 130 to 140 years. Trailing across park lands has been practiced for a similar period. An unquantified portion of observed changes to soil, vegetation, and water resources in the allotments may be attributed to past grazing and trailing. It is difficult to determine and quantify impacts on resources from grazing over the past 30 years. This is when compared with overall impacts from approximately 130 years of grazing on what has become the park. The number of livestock was substantially greater and presumably the season of use was longer in the past, particularly in the recently retired Hartnet allotment. For example, before July 1998 when 54% of the AUMs were purchased, 2,106 AUMs were available on the recently retired Hartnet allotment, compared with the 1,140 AUMs that were grazed from 1998 to 2018.	All
Reservoir Development Upstream of Oak Creek	In the early 1900s, reservoirs created as range improvements west of the park have allowed water derived from Boulder Mountain to be diverted to either Oak Creek or Pleasant Creek. It is unknown whether Oak Creek was intermittent or perennial prior to this human-made diversion, which has allowed for increased flows in Oak Creek over natural flow regimes. The reservoirs are still used today. (See Chapter 3 for a description of the current condition of Oak Creek.)	Soils, riparian vegetation, water resources, MSO, migratory and resident birds, permittee socioeconomics
Relinquishment of Hartnet Grazing Permit	In March 2018, the Hartnet allotment permit holders willingly sold their grazing permit to a nongovernmental organization. In April 2018, as a condition of the sale, the permit holders relinquished in writing their rights to graze livestock in Capitol Reef National Park; therefore, grazing will no longer occur in the Hartnet allotment within the park, which encompasses over 70,000 acres of which approximately 19,000 acres were actively grazed.	All, except permittee traditional uses and socioeconomics
Road maintenance	Garfield and Wayne Counties and the Utah Department of Transportation maintain roads in the recently retired Hartnet allotment, the Sandy 3 allotment, and along the Highway 24 trailing route. Road maintenance includes grading, repairing washout and stream crossings, maintaining water bars, cleaning culverts, and chip sealing or paving Highway 24. Graders and dump trucks are typically used for these activities. The frequency of road maintenance is variable but typically occurs once per year in the recently retired Hartnet allotment and two to three times per year in the Sandy 3 allotment.	All, except permittee traditional uses and socioeconomics
Orchard operations	Capitol Reef National Park has approximately 35 acres of orchards in the Fruita Rural Historic District. Agricultural practices require the orchards to be mowed three to four times per year to prevent the grass cover crops between fruit trees from growing too high.	Migratory and resident birds
Invasive plant management	The Lake Mead National Recreation Area Exotic Plant Management Team spends approximately 8 days per year in Capitol Reef National Park removing invasive vegetation. The focus is tamarisk, Russian olive, and tree-of-heaven along the	Upland and riparian vegetation, migratory and

TABLE 4.1. PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

Project	Description	Impact Topics
	Fremont River, Pleasant Creek, and Sulphur Creek. The Exotic Plant Management Team uses chainsaws and hand tools and applies herbicides to cut trees. Capitol Reef National Park employees periodically remove or treat invasive weeds (cheatgrass, Russian thistle, halogeton, and mustard) with herbicides.	resident birds, wilderness
Road construction and paving	Garfield County, Utah, owns 1 square mile of land in Capitol Reef National Park. It straddles the Burr Trail road, with the east property boundary very near the base of the Burr Trail switchbacks that cross the Waterpocket Fold. The east boundary of the Garfield County land is approximately a quarter-mile west of the Sandy 3 allotment boundary. Garfield County has developed plans to pave its portion of the Burr Trail, approximately 2 miles of road; however, the schedule is unknown.	All, except permittee traditional uses and socioeconomics

SOILS

Impacts under Alternative 1

Under alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing, meaning that livestock have unrestricted and uninterrupted access to an allotment during a certain time of the year. The types of impacts of livestock grazing that are influencing the current condition of soils in the park (see Chapter 3) would continue to occur in actively grazed area of the Sandy 3 allotment and along currently permitted trailing routes. For example, livestock grazing and trailing can compact soils and make them more susceptible to erosion and reduced water infiltration (Marble and Harper 1989; Trimble and Mendel 1995; Van Haveren 1983). These impacts, which are influenced by the duration, timing, and intensity of grazing, are described generally below, and applied in conducting the allotment-level analysis that follows.

Soil-forming processes are inhibited by excessive grazing and trampling, which are major factors in soil degradation (Thurow 1991; Wright and Bailey 1982). Soil degradation caused by livestock grazing in arid landscapes has been shown to increase soil compaction and bulk density and to decrease infiltration rates (Abdel-Magid et al. 1987; Fleischner 1994; Gamougoun et al. 1984; Herrick et al. 1999; Herrick and Jones 2002; Schlesinger et al. 1990; Weltz and Wood 1986). As the physical properties of soils become affected by grazing, the lack of uniform infiltration rates increases runoff and overland flow rates (DeCoursey 1996; Fielder et al. 2002).

Impacts of defoliation and trampling by livestock may increase the number and spatial extent of bare soil gaps, causing a shift toward physical processes, such as wind and water erosion, to dominate (Thurow 1991). Increases in bare ground would increase soil temperature, which accelerates losses of organic matter. Insufficient cover also reduces the ability of rangelands to dissipate the energy of raindrops before they strike the soil, leading to further erosion (Blackburn 1975; Blackburn et al. 1986). Elevated soil temperature and soil losses have the direct impacts of increasing evapotranspiration and decreasing infiltration rates, nutrient retention, and biologic function (Wright and Bailey 1982; Neary et al. 1999).

Biological soil crusts are fragile and easily damaged by livestock grazing (Fleischner 1994). Livestock grazing and trailing reduce biological and physical soil crusts. This is because trampling increases the potential for damage or destruction of soil crusts that are important for nutrient cycling and soil stability (Fleischner 1994; Henderson et al. 1988; Marble and Harper 1998; Neff et al. 2005). Biological soil crusts contribute to soil stability, moisture, nutrients, and seedling establishment (Belnap 1992 and references therein; Harper and Belnap 2001).

Soil crust recovery rates are slow to respond to management changes, with some studies showing that soil crusts can take more than 40 years to recover (Belnap 1993). Because the arid Southwest receives little nitrogen from the atmosphere, the decrease in soil fertility caused by land use change and subsequent loss of biological soil crusts caused by livestock grazing could permanently alter the species composition of arid systems. It is an important mechanism of desertification (Evans and Belnap 1999; Klass et al. 2012).

Sandy 3 allotment. The impacts described above from partial-year continuous grazing at current stocking rates in the absence of a management plan would occur across the 10,200 grazed acres in the Sandy 3 allotment. When translated into intensity of grazing, this would be considered moderate use (based on utilization of 45% by weight of preferred forage and as little as 5% by weight of less palatable vegetation; see Holechek et al. 2006). The following describes how these effects would translate to the soils in the Sandy 3 allotment.

As described in the Chapter 3 discussion of rangeland health assessments and reference conditions for soil and site stability, substantial portions of the allotment are in a state of departure from reference conditions (Table 3.2).

There is uncertainty in how the impacts described above and the trends described in the affected environment would influence the departure from reference conditions under Alternative 1; nevertheless, the National Park Service expects these impacts would cause areas of moderate and moderate-to-extreme departure from reference conditions for the IIRH soil site stability attribute (59% of the actively grazed areas in the Sandy 3 allotment) to continue in its present condition or to continue to degrade. This is supported by the fact that 28 years (1988 to 2016) after AUMs were reduced by 50% on the recently retired Hartnet allotment, 65% (12,300 acres) of the area that used to be actively grazed in the retired Hartnet allotment is still in a state of moderate or moderate-to-extreme departure from reference conditions.

These continued or worsening impacts on soil would affect the overall integrity of soil resources in the Sandy 3 allotment. This is because of the severity of impacts (e.g., loss of soil) and the long recovery time (often decades) for elements of soil, such as the soil A horizon and biological soil crust.

Grazing management infrastructure—New fencing to protect sensitive natural or cultural resources would not be constructed under Alternative 1. Existing boundary fences would continue to be maintained. New stock ponds or other water development features would not be constructed, and existing stock ponds would not be refurbished. Under Alternative 1, impacts on soils would not change from current conditions.

Livestock trailing. Under Alternative 1, trailing in the park would continue along currently permitted trailing routes(Jones Bench, Gray Bench-Cathedral Valley, Highway 24, Pleasant Creek, Oak Creek, Dry Bench, Notom Road, and Divide Canyon) in the absence of a comprehensive plan to manage this use, and current impacts on soils would continue. Assuming a 100-foot buffer on either side of the trails, this results in impacts on 1,400 acres of soil (Table 4.2). The width and therefore amount of area

TABLE 4.2. AREA OF IMPACT WITHIN A 100-FOOT BUFFER OF TRAILING ROUTES

Route	Length (miles)	Area of Impact (acres)
Trailing Routes Used by Current Permit Holders		
Jones Bench	0.7	17
Gray Bench-Cathedral Valley	8.9	215
Highway 24	13.6	328
Pleasant Creek	7.0	169
Oak Creek	4.6	110
Dry Bench	4.8	116
Notom Road	16.6	403
Divide Canyon	2.1	50
Routes Requiring New Permits		
Hartnet Trail	12.1	294
Lower South Desert*	11.8	533

*Area of impact based on 100-foot buffer along the trailing route with additional quarter-mile around water sources.

affected would vary depending on duration and speed of trailing, and number of animals. The total amount of soil affected may vary also depending on the current trail substrate. For example, portions of the Highway 24 route are over paved road, and portions of the Notom Road route are well-established dirt road, and impacts on soils are minimal on these surfaces.

The length of time it takes livestock to cross the park varies by route, and is authorized to take less than 24 hours in some cases, and up to six days in others (see Table 2.1). Capitol Reef National Park does not have quantitative data regarding soil conditions along the trailing routes currently used by permit holders; however, field observations indicate that currently permitted trailing routes have reduced vegetation and biological soil crust, and have a defined compaction layer within 2 to 4 inches of the ground surface, resulting in decreased infiltration rates and gullies forming in some locations.

Under Alternative 1, impacts would be more intense near water sources and in riparian, resting, and overnight areas. For example, Chapter 3 describes impacts on channel stability, stream bank structure, and channel sedimentation, leading to a designation of nonfunctional condition along the Oak Creek trailing route. These impacts on soil caused by trailing are similar to those observed in the grazing allotment; however, the frequency and duration of trailing (less than 1 day up to 12 days per year, depending on the trail) are much lower than grazing (daily for up to 7.5 months).

Monitoring and adaptive management. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. As a result, adaptive management options would be minimal because adaptive management must be based on data. Without sufficient monitoring, Capitol Reef National Park would have little capacity to understand and respond to changing soil conditions.

Cumulative impacts. While reservoir development upstream of Oak Creek has some contribution to the overall development of riparian soils along this route, as described in Chapter 3 and above, decades of livestock grazing and trailing has impacted soils in the Sandy 3 allotment and along trailing routes, including Oak Creek. These impacts include:

- Increased bare ground
- Loss of biological soil crust
- Soil loss through sheet flow, channel runoff, and wind scour

- Deposition of windblown sediments in dunes and on lee faces
- Alteration and loss of vegetation
- Decreased infiltration of precipitation

The recent retirement of the Hartnet allotment is expected to result in recovery of soils on 19,000 acres of the park. Recovery of soils would be a long-term process, occurring over decades to centuries; however, stabilization of soils through reestablishment of biological soil crusts would improve infiltration and reduce soil loss and the amount of bare ground in the short term (10-50 years), and improve carbon and nitrogen cycling and vegetation recruitment, further stabilizing soils, over the long term (50+ years; see Chapter 3: Soils and references therein). Park staff have observed recovery of biological soil crust in the Cathedral/Rock Springs allotment, which has been retired from grazing for approximately 30 years.

Several other actions have the potential to combine with the impacts of Alternative 1 to result in cumulative impacts on soils (see Table 4.1). Road maintenance in the recently retired Hartnet allotment and the Sandy 3 allotment is usually restricted to existing roads; however, road maintenance work, such as installing water bars, extracting mired vehicles, and routing around obstructions, occasionally extends outside the prism of the roads in the allotments. When this occurs, impacts on soil would include all of those listed above.

Potential paving of about 2 miles of the Burr Trail, immediately west of the southern portion of the Sandy 3 allotment, would replace 12 to 15 acres of gravel road with asphalt and concrete. Paving would create an impervious barrier to water infiltration, increasing runoff from the road surface. This could increase soil erosion next to the paved surface and in runoff channels, such as Lower Muley Twist, intersected by the road.

While most of these past, present, and reasonably foreseeable future actions would adversely affect soils through degradation of soils themselves and diminution of their ecological functions, the retirement of the Hartnet allotment is expected to result in the recovery of soil integrity and restoration of ecological functions on 19,000 acres of soils, which would result in a collective beneficial effect compared with current conditions. When combined with the continuation of soil degradation on 11,600 acres of soils under Alternative 1 (10,200 grazed acres and 1,400 acres along currently permitted trailing routes), the overall cumulative impact on soils would still be beneficial compared with current conditions, again, largely due to the anticipated recovery of 19,000 acres of soils in the retired Hartnet allotment. The incremental contribution of Alternative 1, however, would reduce the cumulative beneficial impacts that would be realized.

Conclusions. Capitol Reef National Park has 107 named SMUs, based on the NRCS soil survey. Seventeen of the SMUs are in the grazing allotment, and 7 soils are included in the IIRH plots. More generally, Capitol Reef National Park's fundamental resources and values related to soils include geology and geologic processes and assemblage of ecosystems (NPS 2017a).

Soils are included in the spectrum of geologic processes necessary for the park to fulfill its purpose. Soils are fundamental to the creation and survival of ecosystems in the park, including in the grazing allotment and along trailing routes. Soils in or near a reference condition promote ecosystem health through biological soil crusts, delivery of nutrients, absorption and infiltration of water, and other benefits. Soils in good condition support robust ecological processes.

Under Alternative 1, the park would lack information and management tools that could address future changes in soil conditions. As described previously, while it is uncertain how continued soil impacts in

the absence of a management plan and using partial-year continuous grazing would be reflected in the Sandy 3 allotment rangeland health assessments, the areas of moderate and moderate-to-extreme departure from reference conditions for the IIRH soil and site stability attribute (approximately 6,000 acres or 59% of the grazed area in the Sandy 3 allotment) would likely continue in their present condition or would continue to decline. It is also possible that the remaining areas of the Sandy 3 allotment (which had none-to-slight or slight-to-moderate departures from reference condition) would also be degraded further under Alternative 1.

In addition, approximately 1,400 acres of soils along currently permitted trailing routes have exhibited similar impacts as the soils in the Sandy 3 allotment, which would also be expected to continue or worsen under Alternative 1. The total acreage of Capitol Reef National Park is approximately 242,000 acres, and the total acreage of soil (excluding exposed bedrock and water) is approximately 199,700 acres. As a result, the overall integrity of these soil resources in the grazed areas of the Sandy 3 allotment and along currently permitted trailing routes would be degraded by livestock grazing and trailing, resulting in the continuation or worsening of impacts on 6% (11,600 acres) of soils park-wide.

When the impacts of other cumulative actions are combined with the impacts under Alternative 1, the overall cumulative impact on park soils would be beneficial. While 11,600 acres of soils would continue to be affected under Alternative 1, reducing the overall cumulative benefit, the retirement of the Hartnet allotment would result in the recovery of 19,000 acres of soils, resulting in an overall benefit.

Although uncertain, increasing temperatures associated with climate change are expected to have negative impacts on soils and their ability to sustain native vegetation communities for livestock forage in Capitol Reef National Park. Increasing temperatures increase soil aridity, because a greater proportion of precipitation is lost immediately through evaporation and transpiration than under past conditions. This results in less infiltration and storage of water in the subsurface (Copeland et al. 2017; Prein et al. 2016; Cook et al. 2015; Seager et al. 2007). Soil aridity also increases susceptibility to erosion from wind and water. The adverse impacts on soils could be further exacerbated by these impacts from climate change, and recovery of soils may be slower.

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock grazing on soils in the park, which are described under the Alternative 1 analysis above, would be reduced compared to current conditions in actively grazed areas of the Sandy 3 allotment and along trailing routes, including those used by current permit holders and those where new trailing permits could be issued.

Sandy 3 allotment. The intensity of grazing would not change from current conditions, because the proposed stocking rate under Alternative 2 would remain the same as under Alternative 1. While the proposed pasture rotation system in the Sandy 3 allotment, in which two pastures are grazed in succession, in different patterns over consecutive 2 years, results in a higher concentration of cattle in each pasture, increasing the potential for impacts described previously, it also results in resting each pasture in a different season every other year. When coupled with a season of use through March 31, nonuse during key periods of the growing season allows vegetation, especially key forage species, to recover from grazing impacts (Holechek et al. 2006, 2011). Improvement in vegetation (e.g., increased cover) would reduce exposure of soils to such impacts as trampling, biological soil crust disturbance, and protective vegetation loss.

While Capitol Reef National Park cannot be certain of the extent of soil improvements from a pasture rotation system alone, it is reasonable to consider that it would move soils toward, and ultimately

achieve, desired conditions described in Appendix C, on 10,200 acres of actively grazed soils in the Sandy 3 allotment. This would result in a decrease in bare ground, an increase in biological soil crust, a reduction in susceptibility of soil to and soil loss from wind and water erosion, and an increase in the ability of soils to infiltrate and retain moisture and nutrients. These benefits to soils are expected to decrease the acreage rated as moderate or moderate-to-extreme departure from reference conditions (approximately 6,000 acres or 59%) in the Sandy 3 allotment.

Soils in the 8 acres of monitoring exclosures proposed under this alternative are expected to move toward desired conditions at a faster pace than soils in the portions of the allotment that would continue to be grazed. This is based on field data for existing grazing exclosures and former allotments in which permits were purchased and, therefore, have not been grazed in 25 to 30 years.

Refurbishing five existing stock ponds would be expected to better distribute livestock throughout the allotment, benefitting soils by reducing concentrated impacts at the allotment level; however, the soils within a quarter-mile of each stock pond would be expected to have additional impacts, including trampling, soil compaction, bare ground increase, and potential soil loss due to increased erosion. This would affect approximately 625 acres in the Sandy 3 allotment.

The proposed pasture rotation system would require moving livestock between pastures, most of which would occur on the Notom Road. An alternate route would be through a gate in the newly installed pasture fence. If livestock are moved through a gate, rather than on the road, approximately 1 acre (0.01% of the Sandy 3 allotment soils) would be affected by concentrated livestock use before dispersal to the adjacent pasture. Impacts would include trampling, soil compaction, bare ground increase, and potential loss of soil because of increased potential for erosion. The location of the gate would be selected to minimize impacts on biological soil crust and other sensitive soil properties and resources. While livestock would only be expected to be present for a few hours before passing through the gate, depending on the extent of grazing and trampling that occurs in that time, this could have impacts on soils as described under Alternative 1 that could last many years.

Grazing management infrastructure and tamarisk removal—Under Alternative 2, the construction of approximately 2 miles of fence to delineate pastures and monitoring exclosures, and refurbishing five existing stock ponds, all of which are next to Notom Road, would result in approximately 28.5 acres of soil disturbance (3.5 acres for fences assuming a 15-foot disturbance corridor, and 5 acres for each pond, including the pond itself, the construction footprint, and 0.25 miles of access routes). Installing one livestock guard in Notom Road would not affect soils, because it would be installed in the existing road. In addition, approximately 8 acres of soil would be disturbed by tamarisk removal at Little Lake Mead under this alternative.

All of these activities would result in physical disturbances, such as trampling and removing soils, potential disturbance of the biological soil crust, and loos of soil by increased susceptibility to erosion, to approximately 0.4% of soils in the grazed portion of the Sandy 3 allotment for up to a year. Stock pond work would have the greatest potential for these impacts because it would require the use of heavy equipment that would compact or excavate soils, including biological soil crusts. Access for fence construction and tamarisk removal would be by foot or horseback, minimizing the potential for these impacts.

In addition, during tamarisk removal, work crews would travel to and from the area by a different route each day to minimize the impacts. Burning piles of dead tamarisk could affect soil properties related to infiltration potential and could kill any vegetation, including the biological soil crust. Burn piles would be located to minimize impacts on soils, biological soil crust, and vegetation. Burning would likely occur 1 year after tamarisk cutting to allow the wood to dry sufficiently for efficient burning. Ashes

would be raked gently after burning to spread them into a single thin layer. The impacts of tamarisk removal and burning would persist for 3 to 5 years after burning.

Livestock trailing. Impacts on soil from livestock trailing on trailing routes analyzed in this EA would be similar to those described under Alternative 1. If the number of livestock trailing on Pleasant Creek trail, Highway 24 trail, and Divide Canyon trail increases as allowed under Alternative 2, the impacts could be greater. However, the use of best management practices (e.g., adjustments to the number of livestock to be trailed on a given day, the total number of trailing days and whether they are consecutive or spaced apart, potential modifications to route alignments, and moving livestock at a deliberate pace) would reduce impacts on the 1,400 acres of soil associated with currently permitted trailing routes by reducing the area of soil trampled and, therefore, the potential loss of soil by wind and water erosion. A reduction in the area of direct impacts would encourage vegetation recovery next to trails, subsequently stabilizing soils and reducing erosion; however, the extent and quantity of these impacts are uncertain.

In addition, under Alternative 2, issuing two new permits on the Hartnet and Lower South Desert trailing routes would have similar effects on soils on 830 acres in the recently retired Hartnet allotment (Table 4.2). The majority of soils in the recently retired Hartnet allotment are already in a state of departure from reference conditions (Chapter 3: Soils, Appendix B), and trailing on new routes is expected to temporarily contribute to increased bare ground, decreased biological soil crust, increased susceptibility of soil to and soil loss from wind and water erosion, and decreased ability of soils to infiltrate and retain moisture and nutrients. On the Hartnet trail, however, trailing would only occur for 1 day, and best management practices noted above would be applied and would be expected to reduce impacts as described. Soils would, therefore, be expected to have time to recover in the 6 months to 1 year between trailing events.

On the Lower South Desert route, trailing would occur over 1–2 days. Livestock would be moved into the south end of the Lower South Desert after having trailed 20 miles down the Highway 24 trail route from Torrey. Livestock would overnight unrestrained in the Lower South Desert and may travel up the Lower South Desert on their own as far as Deep Creek or Baker Post Seep (4–8 miles); therefore, the area of potential impact on soils would be greater, especially around water sources (up to a quarter-mile of concentrated use), where soils may become trampled, resulting in increased bare ground, decreased biological soil crust, increased susceptibility of soil to and soil loss from wind and water erosion, and decreased ability of soils to infiltrate and retain moisture and nutrients. The duration of trailing is short, however, and soils would be expected to have time to recover in the year between trailing events.

Monitoring and adaptive management. Alternative 2 includes range and trail monitoring and adaptive management actions and concepts. Implementing a regular monitoring program with a dedicated range staff (assuming funding allows), including forage production and utilization, livestock distribution, and riparian, rangeland, and environmental conditions, would provide Capitol Reef National Park with data on which to base range management decisions. Short- and long-term monitoring would determine if range conditions are moving toward or away from desired conditions and would be evaluated to determine the reasons for the observed conditions. Monitoring would alert managers to potential negative impacts from grazing and trailing and would provide quantitative data to support adaptive management actions, such as moving livestock to a new pasture when forage utilization targets are met or implementing mechanisms to provide better distribution of livestock, such as supplements (salt blocks), riders on horseback, and temporary fencing. Adaptive management would protect vegetation from overutilization, which would help meet desired conditions established in this plan, such as the percentage of bare ground and biological soil crust, which would improve soil conditions.

Moving livestock would result in additional direct impacts on soils from riders on horseback, including a potential increase in bare ground or additional loss of biological soil crust. If supplements were used,

soils would be heavily trampled for a radius of approximately one-quarter mile around the supplements, as livestock congregate in the area. This would increase bare ground, would result in a potential loss of biological soil crust next to the supplement, would increase susceptibility to erosion, and could decrease infiltration capacity caused by developing a compaction layer.

Other adaptive management actions that could be implemented to meet desired conditions are stocking rate adjustments, the duration of the grazing season or season of use in response to abundant forage, insufficient forage, and changing range conditions. Potential impacts from these actions could be beneficial or detrimental to soils, depending on specifics of the adaptive management action. For example, if the season of use were extended because of abundant forage, there could be additional impacts on soils, as described in preceding paragraphs; however, if the season of use were extended, the stocking rate would be reduced to avoid exceeding mandated limits on AUMs. Reducing the stocking rate would tend to counteract impacts of extending the season, and there may be no quantitative or qualitative impacts on soils.

A potential adaptive management strategy would be to allow livestock on the allotment in mid-October rather than November 1. This would encourage targeted forageing on green cheatgrass to help control its abundance and spread. Supplements may also be used to attract livestock into areas with cheatgrass and Russian thistle. If livestock feed on invasive species during the vulnerable green stages, the competitive advantage of invasive species over native species would be reduced. If native species, such as Indian ricegrass and sagebrush, were able to outcompete invasive species, the increased cover and structure that they provide would improve overall soil conditions, including additional potential for biological soil crusts to recover.

If permittees use Dry Bench as an alternative to the Oak Creek trailing route in some years, this would result in an overall benefit to soils. This is because livestock would not be moving through a perennial stream and associated riparian area when using the Dry Bench trail. The two trails are similar in length, but the Dry Bench trail traverses an upland pinyon-juniper ecosystem, instead of a mostly riparian ecosystem. The Dry Bench trail does not have the stream banks and point bars that are regularly crossed by livestock and that are highly susceptible to erosion. In addition, the Dry Bench route is generally narrower and livestock trails are substantially less braided than trails along Oak Creek; therefore, less acreage would be affected if the Dry Bench trail is used.

If PFC assessment ratings continue to be nonfunctional at Deep Creek Springs, approximately 1 to 2 acres could be fenced to exclude livestock from riparian resources. A 2-acre exclosure would disturb approximately 0.4 acres, with impacts on soils the same as those from pasture fencing; however, impacts from construction of the exclosure would last approximately 1 year, while the exclosed area would realize benefits such as a decrease in bare ground, an increase in biological soil crust, a reduction in susceptibility of soil to and soil loss from wind and water erosion, and an increase in the ability of soils to infiltrate and retain moisture and nutrients.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

Alternative 2 would result in adverse impacts on 830 acres of soils along the proposed Hartnet and Lower South Desert trailing routes that would be minimized through best management practices. While this could delay recovery of soils along these trailing routes, when combined with the other beneficial impacts of Alternative 2 on soils in the Sandy 3 allotment and along other trailing routes analyzed in this EA, there would be an overall beneficial cumulative impact on soils. Alternative 2 would have a

substantial contribution to these beneficial cumulative effects because conditions on 11,600 acres on the Sandy 3 allotment and currently permitted trailing routes would be expected to improve.

Conclusions. Capitol Reef National Park's fundamental values related to soil, as described under the *Conclusions* for Alternative 1, are the same for Alternative 2.

Potential impacts on soil in the grazed portion of the Sandy 3 allotment and along trailing routes analyzed under this alternative would be similar to those described under Alternative 1, for example, loss of soil, loss of biological soil crust, and reduced capacity for infiltration of moisture; however, implementation of a rest-rotation pasture system would reduce the length of time soils would be exposed to trampling, biological soil crust disturbance, and protective vegetation loss. Permittee riders moving livestock along trails and other best management practices would reduce the time livestock are in the park and minimize the distance livestock stray from the trail, thereby reducing exposure of soil to livestock impacts. These practices should minimize adverse impacts along proposed trailing routes as well.

Although there is uncertainty in how much soil integrity would improve and how long it would take, especially in the grazed portion of the Sandy 3 allotment, implementing these actions with monitoring and adaptive management to meet desired conditions in Appendix C would stabilize soil degradation and improve soil integrity on 11,600 acres throughout the allotment and along the currently permitted trailing routes analyzed under this alternative. Conditions along an additional 830 acres of proposed trailing routes in the recently retired Hartnet allotment would likely move toward desired conditions, but at a slower rate. In addition, soil in the 8 acres of monitoring exclosures in the Sandy 3 allotment, and an additional 1–2 acres if Deep Creek Spring is fenced, would be expected to move toward desired conditions at a faster pace than soil in the portions of the allotments that continue to be grazed.

Fence construction, monitoring or sensitive resource exclosure construction, stock pond refurbishment, or tamarisk removal and burning at Little Lake Mead in the Sandy 3 allotment would result in the disturbance of approximately 36.5 acres of the 10,200 acres of soils in the allotment (approximately 0.4%) and 199,700 acres of soil park-wide (approximately 0.01%). While the construction-related impacts would not persist beyond approximately 1 to 5 years, the approximately 625 acres of soils exposed to concentrated livestock use around the five existing stock ponds to be refurbished would have similar effects as noted under Alternative 1. These impacts would occur across 0.6% of the planning area.

When the impacts of other cumulative actions, including soil recovery on 19,000 acres in the recently retired Hartnet allotment, are combined with the impacts under Alternative 2, the overall cumulative impact on park soils would be beneficial. Soil stabilization and improvements under Alternative 2 would contribute substantially to an overall cumulative beneficial impact on soils. These benefits would support the park's fundamental resources and values regarding the geologic process and assemblages of ecosystems. Ecosystem health depends on various features of soils, such as biological soil crust, infiltration and retention of moisture, nutrients for vegetation, and erosion minimization. As described under *Conclusions* for Alternative 1, increasing temperatures associated with uncertain climate change would have negative impacts on soils; however, management actions under Alternative 2 are expected to increase resiliency of park soils to the impacts of climate change.

UPLAND AND RIPARIAN VEGETATION ASSOCIATIONS

Impacts under Alternative 1

Under alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The types of impacts of livestock grazing that are influencing the current condition of upland and riparian vegetation in the park (see Chapter 3) would continue in actively grazed areas of the Sandy 3 allotment and along currently permitted trailing routes. These impacts, which are influenced by the duration, timing, and intensity of grazing, are described generally below, and applied in conducting the allotment-level analyses that follow.

Impacts on Individual Plants, Species, and Vegetation Communities

Individual plants and species—Livestock grazing would directly affect individual plants through defoliation and trampling. Defoliation from grazing immediately reduces a plant's biomass. Regrowth varies with species, amount and timing of defoliation, and previous intensity of grazing (Cook and Child 1971; Vallentine 2001; Holechek et al. 2004).

The ability of a plant to continue production following defoliation (known as compensatory growth) greatly influences rangewide productivity and the level of grazing that can be supported. Compensatory growth depends on environmental conditions, plant genetics, and the developmental stage of the affected plant (McNaughton 1983). Overcompensation, or greater regrowth following defoliation, is rare (Belsky 1986; Belsky et al. 1993; Briske and Richards 1994). Continued defoliation may result in conversion to less productive growth forms, for example, hedged forms of shrubs or sod forms of grasses (Blaisdell and Holmgren 1984; Holechek and Galt 2000), reducing rangewide productivity (McConnell and Smith 1977).

Defoliation may also affect reproductive success through removal of reproductive structures. Annual forbs and shrubs are often highly dependent on seed reproduction (Vallentine 2001), while perennial grasses may rely more on vegetative reproduction (Sindelar 1988).

Livestock trampling may reduce biomass, without subsequent compensatory growth. Physical damage to plant tissue can result in forage loss of up to 5%, with greater loss at higher stocking rates (Quinn and Hervey 1970). Trampling also indirectly affects vegetation through impacts on soils, such as increased erosion, compaction, and biological soil crust destruction. Biological soil crusts improve soil stability, moisture, nutrients, and seedling establishment (Belnap 1999, 2006; Belnap and Gillette 1997; Darby 2006; Neff et al. 2005; also see *Soils*, above), all of which contribute to plant productivity and abundance (Belnap 2003; USGS 2001).

Impacts from livestock grazing can be understood by describing species in terms of their tolerance. Species that are considered tolerant to grazing are those that increase under grazing pressure (increasers), and those that are intolerant would decrease (decreasers; NRCS 2003). Table 4.3 shows common species in the planning area and their predicted response to grazing—whether they are increasers or decreasers.

TABLE 4.3. COMMON SPECIES' RESPONSE TO MODERATE LIVESTOCK GRAZING AND GROWTH SEASON OF GRASSES

Shrubs/Trees	Forbs	Grasses	Grass Growth Season
DECREASERS			
Artemisia bigelovii	*Sphaeralcea* spp.*	*Achnatherum hymenoides*	Cool season
Atriplex canescens		*Bouteloua eriopoda*	Warm season
A. cuneata		*Elymus elymoides**	Cool season
Kochia americana		*Hesperostipa comata*	Cool season
Krascheninnikovia lanata		*Poa fendleriana*	Cool season
Ephedra torreyana		*Pleuraphis jamesii**	Warm season
Salix spp.		*Sporobolus contractus*	Warm season
		S. airoides	Warm season
		S. cryptandrus	Warm season
INCREASERS			
Artemisia filifolia	*Astragalus* spp.	*Aristida purpurea*	Warm season
A. tridentata	*Cryptantha flava*	*Bouteloua gracilis*	Warm season
Atriplex confertifolia	*Eriogonum inflatum*	*Distichlis spicata*	Warm season
A. corrugata	*Lupinus pusillus*	*Elymus elymoides**	Cool season
A. cuneata	*Machaeranthera canescens*	*Leymus salinus*	Cool season
A. gardneri	*Opuntia* spp.	*Muhlenbergia pungens*	Warm season
Chrysothamnus nauseosus	*Sphaeralcea* spp.*	*Pleuraphis jamesii**	Warm season
C. viscidiflorus	*Scabrethia scabra*		
Coleogyne ramosissima			
Ephedra viridis			
Eriogonum corymbosum			
Gutierrezia sarothrae			
Quercus gambelii			
Sarcobatus vermiculatus			
Tetradymia spp.			
Yucca spp.			
Juniperus osteosperma			
Pinus edulis			

*Literature suggests that these species may either increase or decrease in response to grazing.
Table adapted from Heil et al. (1993)

Preference by livestock also plays a role in how species respond to grazing; highly palatable species are preferred, meaning they would be eaten before lower palatability species. Differences in tolerance, in combination with palatability and availability to animals in the grazing allotment or along trails, result in changes to plant community composition, diversity, and productivity over time (Eldridge et al. 2016; Holechek et al. 2006; Jones 2000; Milchunas et al. 1993; Munson et al. 2016).

Plant communities—Because plant communities in much of the Intermountain West evolved in the absence of large ungulate grazers, many species lack adaptations that promote resilience to heavy grazing; consequently, they may be more negatively affected by heavy grazing (Milchunas 2006; Mack and Thompson 1982). In general, grazing in the arid Intermountain West has contributed to the spread of woody shrub species and decreased palatable grass cover (Heil et al. 1993; Schlesinger et al. 1990; Van Auken 2000). Cool-season and warm-season grasses have been observed to respond differently to grazing, with cool-season grasses declining and warm-season grasses increasing (Munson et al. 2016; Holechek et al. 2006; Table 4.4).

Studies of livestock grazing impacts on plant community composition, diversity, cover, and production are conflicting (Jones 2000; Holechek et al. 2006; Lacey and Van Poollen 1981; Van Poollen and Lacey 1979). For example, in southeast Utah, one study found a 20% decrease in plant cover in sites grazed by livestock, compared with historically ungrazed sites (Fernandez et al. 2008). Another study found no change in plant cover or diversity in grazed versus ungrazed sites (Ware et al. 2014). Differences in these findings may be attributed to numerous factors among study areas referenced above; examples are local site conditions, plant species, drought or weather patterns, differences in plant species, and the timing, intensity, and duration of grazing.

Plant communities have complex responses to grazing, in part due to multiple factors contributing to plant growth. In arid ecosystems, precipitation is the primary factor influencing individual species' growth and productivity; however, grazing can interact with climate to modify responses. For example, Munson et al. (2016) found that cool-season grasses and shrubs did not respond as strongly to precipitation when they were also subject to heavy grazing. Similarly, grazing, combined with environmental stressors such as drought, may increase the abundance of invasive species (Loeser et al. 2007).

Riparian vegetation. In riparian areas, livestock grazing is often more concentrated and consequently more damaging, especially in arid regions, where livestock are attracted to water sources (Bock et al. 1993). Removal of vegetation, compaction and erosion of soils, and reduced water infiltration contribute to a decreased density of vegetation (Platts 1986; Holechek et al. 1989). If herbaceous cover is depleted, livestock would browse on riparian shrubs, such as willow or cottonwood (*Populus spp*.) saplings, further reducing vegetation necessary for bank maintenance and preventing development of a diverse plant community and structural complexity (Clary and Webster 1989; Kovalchick and Elmore 1992).

Invasive species. Grazing could alter plant community composition and decrease diversity by facilitating the incursion of invasive species (Bartuszevige and Endress 2008), while simultaneously decreasing the abundance of perennial grasses and forbs (Belsky and Gelbard 2000; Brotherson and Brotherson 1981; Rawlings et al. 1997). The spread of invasive species has already affected millions of acres of rangeland across the United States, leading to decreased plant community diversity and reduced forage production for livestock (DiTomaso 2000).

The invasion of some species, such as cheatgrass, can be exacerbated by drought (Loeser et al. 2007). Once invasive species have become established on a range, a reduction in grazing pressure is not likely to return the range to previous conditions without intervention by management (Vallentine 2001; DiTomaso 2000).

Grazing Systems and Vegetation

Grazing systems—Partial-year continuous grazing, the method currently applied in the Sandy 3 allotment, has been seen as detrimental to vegetation, but heavy grazing and poor livestock distribution likely contributed to negative impacts in many cases (Vallentine 2001). Herbel (1974) reviewed the literature on grazing impacts and concluded that other grazing systems were only slightly more successful than partial-year continuous grazing.

The level of grazing intensity plays an important role; light grazing may benefit plant productivity in the short term by removing litter, but heavy grazing would likely reduce overall productivity. Continuous grazing methods can be sustainable if livestock are properly distributed across the landscape, appropriate stocking rates are applied, and the proper season of use is employed (Heady and Child 1994; Laycock et al. 1996); however, negative impacts on vegetation occur when this is not the case.

At Capitol Reef National Park, it is clear from monitoring that vegetation communities have changed over time (see Chapter 3: Upland and Riparian Vegetation). These changes can be generally characterized as a shift in community composition from cool-season, grass-dominated grasslands to warm-season grasses and an increased abundance of invasive species. Fisher et al. (1991) analyzed phytoliths and found that 200 to 800 years ago, the plant communities in grazed sites were dominated by cool-season grasses and had more forbs and shrubs. Highly palatable species, such as winterfat (*Krascheninnikovia lanata*) and Indian rice grass, were historically common, but have declined or become locally extripated since the introduction of nonnative ungulates (Heil et al. 1993; Cole et al. 1997). Cover of low palatability woody shrubs, such as broom snakeweed, rabbitbrush, and prickly pear cactus (*Opuntia* spp.), have increased (Heil et al. 1993; Cole et al. 1997). Under current levels of grazing, even these have been observed to be heavily grazed.

Season of use—The impacts of grazing on species and communities can vary with season of use. Livestock grazing during spring can have negative impacts by removing reproductive structures, thereby reducing seed production and the plant's ability to respond to environmental stress (Cook and Stoddart 1963). Late spring and summer grazing limits desert plants' ability to restock nutrient reserves, leading to overall decreased production or mortality; early spring, late fall, and winter grazing may have less impact (Clary and Holmgren 1982; Vallentine 2001).

Cool- and warm-season grasses (see Table 4.3) are affected differently by season of use. Cool-season perennial grasses and winter annual grasses begin growing in the fall, remain dormant but green over winter, and continue growing and flower in spring (White and Wight 1973); thus, grazing during spring and fall/winter favors warm-season grasses, while summer grazing favors cool-season grasses (Vallentine 2001). Grazing at higher intensities in all seasons is more likely to have detrimental impacts (Cook 1977; Holechek et al. 2004).

Livestock Distribution—Livestock tend to concentrate around water sources; therefore, forage utilization is reduced with distance from water (Valentine 1947). Beyond a certain distance, utilization may be very low, even if good forage is abundant. Livestock tend to forage farther from water in spring, fall, and winter, when temperatures are cooler (Valentine 1947).

Sandy 3 allotment. The impacts described above at the beginning of the Alternative 1 analysis would occur across 10,200 acres of grazed areas in the Sandy 3 allotment. The following describes how these effects would translate to the vegetation communities of the Sandy 3 allotment, which would continue to be grazed at current levels from late fall to spring (November 1 to March 31).

The vegetation associations that comprise most of the Sandy 3 allotment are shown in Table 3.3 in Chapter 3. In these communities, forage utilization by livestock under Alternative 1 would decrease cover and abundance of preferred, highly palatable, cool-season grasses, including Indian ricegrass and needle-and-thread grass (Table 4.3; Munson et al. 2016). The growing season in the grazed portions of the Sandy 3 allotment can begin as early as mid-February, resulting in up to 45 days of grazing pressure on plants, as they are growing and developing reproductive structures. This negatively affects cool-season grasses, such as Indian ricegrass and needle-and-thread grass, preventing them from developing and setting seed and replenishing their seed bank (Cook and Stoddart 1963; Cook 1977). This may further contribute to a decrease in their abundance. Warm-season grasses, such as blue grama, saltgrass, purple three-awn, sandhill muhly, and galleta grass, may have a competitive advantage due to the season of use; thus, they may increase in relative cover and abundance across the landscape (Table 4.3; Milchunas 2006; Holechek 2006). Total grass production, however, may still be reduced under moderate or greater intensity grazing, or in drought years with low production (Holechek 2006).

Common, highly palatable shrubs in the grazed areas, such as shadscale and valley saltbush (*Atriplex cuneata*), are likely to decrease in cover and abundance, while less palatable woody shrubs, such as greasewood, rabbitbrush, Mormon tea, broom snakeweed, crispleaf buckwheat, and big sagebrush, may increase (Table 4.3; Heil et al. 1993; Schlesinger et al. 1990; Van Auken 2000). Under current levels of grazing, even these have been observed to be heavily grazed.

Changes due to grazing have been observed in the Sandy 3 allotment and would continue, specifically, hedging of saltbushes, greasewood, and Mormon tea. This indicates heavy to severe grazing intensity (Holechek et al. 2006). This would reduce productivity for these species. Pinyon pine and juniper are both species that may increase under grazing, but pinyon pine may be more vulnerable to climate change (Breshears et al. 2005; Munson et al. 2011). A decrease in pinyon pine abundance and increased juniper are consistent with observed shifts in vegetation at the park; however, these changes may be due to factors other than grazing (Cole et al. 1997).

Late-growing season defoliation may have negative impacts on shrubs, if seed sources are removed. Most shrubs at Capitol Reef National Park set seed before grazing begins on November 1; however, species that flower into October are sand sagebrush (*Artemisia filifolia*), Bigelow's sagebrush, and crispleaf buckwheat. Bigelow's sagebrush and crispleaf buckwheat are common in the mixed desert shrubland and pinyon-juniper/xeric shrub woodlands. Current data from the rangeland health assessments (Chapter 3) show that 32% of plots in the Sandy 3 allotment have moderate to total departure from reference condition, with respect to reproductive capability. Under Alternative 1, cool-season grasses and late-flowering shrubs would be negatively affected through removal of seed structures, resulting in reduced reproductive capacity and a continuation or worsening of the current condition.

Invasive species monitoring and control are limited under Alternative 1 and would occur only on an ad hoc basis in the Sandy 3 allotment. Soil disturbance from livestock trampling would facilitate further incursion of invasive species (Bartuszevige and Endress 2008), and grazing may prevent recruitment of native species (Belsky and Gelbard 2000; Brotherson and Brotherson 1981; Rawlings et al. 1997). The rangeland health assessments show that 70% of plots in the Sandy 3 allotment have moderate to total departure from the reference condition, with regard to invasive plants. Cheatgrass, a strong competitor against native perennial grasses, has invaded and created large, continuous, low-diversity stands. Once cheatgrass is established, it is prohibitively expensive to remove or control, and it would likely continue to spread. Other invasive species—Russian thistle, halogeton, African mustard, and tamarisk—would also continue to spread, displacing higher palatability native grasses and forbs. Black greasewood shrubland, which has a sparse herbaceous layer, is particularly susceptible to invasion by halogeton (Coles et al. 2009); therefore, under Alternative 1, invasive species would continue to spread and negatively affect vegetation communities, by competing with desirable native species and decreasing diversity and rangeland health.

The changes described here are consistent with, and a continuation of, the long-term changes in plant communities at Capitol Reef National Park, as described by Heil et al. (1993) and Cole et al. (1997). Under Alternative 1, forage utilization by livestock would decrease cover and productivity of individual plants, especially preferred forage species, in shrubland communities. There would be a continued shift in species composition for these communities, characterized by decreased abundance of highly palatable cool-season grasses and shrubs, and increased abundance of warm-season grasses and less palatable woody shrubs. Although there is uncertainty in how the impacts described above, and the trends described in the affected environment, would influence the departure from reference conditions under Alternative 1, the National Park Service expects these impacts would cause areas of moderate and moderate-to-extreme departure from reference conditions for the IIRH to continue in their present condition, or they would continue to degrade.

Livestock concentrating around water sources leads to higher grazing intensities in riparian areas (Bock et al. 1993). Although riparian vegetation comprises a relatively small percentage of the grazed area in the Sandy 3 allotment (60 acres, 0.5%), this community is ecologically important, supporting watershed function and wildlife habitat. Riparian vegetation in the Sandy 3 allotment would continue to be heavily affected, through defoliation and trampling. Removing vegetation, specifically grasses, sedges, and rushes, and inhibiting the establishment of willows or cottonwood would occur at Bitter Spring, Bitter Spring Creek, and multiple stock ponds. Similarly, tamarisk temporarily flooded shrublands along Halls Creek, Bitter Creek, Bitter Spring Creek, and stock ponds would be negatively affected. This is because grazing would prevent reestablishment of native species, even after tamarisk dieback or death due to beetle kill. Under Alternative 1, impacts on riparian vegetation would occur in all grazed areas and would result in the loss of critical ecosystem function as described throughout this chapter.

Grazing management infrastructure. New fencing to protect sensitive natural or cultural resources would not be constructed under Alternative 1. Existing boundary fences would continue to be maintained. New stock ponds or other water development features would not be constructed, and existing stock ponds would not be refurbished. Impacts on vegetation from potential boundary fence maintenance are trampling or uprooting of individual plants, but these would be minimized if materials were carried in on horseback.

Livestock trailing. Under Alternative 1, trailing in the park would continue along currently permitted trailing routes in the absence of a comprehensive plan to manage this use, and current impacts on vegetation would continue. The number of livestock trailed and season of use varies by trailing route (Table 2.1). The total acreage of vegetation affected along trailing routes, assuming a 100-foot buffer, is approximately 1,400 acres (see Table 4.2); however, most trails have some unvegetated portions. For example, Highway 24 has paved road, and Notom Road has dirt road, which is unvegetated. The specific acreages for vegetation community type and complexes that would be affected are shown in Table 3.4.

The impacts on vegetation caused by trailing are similar to those observed in the grazing allotment, but the frequency and duration of trailing (1–12 days per year, depending on the trail; see Table 2.1) are much lower (daily up to 7.5 months); during trailing, livestock would have opportunities to graze along trails. If livestock are moved along rapidly, grazing impacts should be limited mainly to resting and overnight areas, and include defoliation and trampling, as well as indirect impacts from soil compaction and disturbance. Assuming trailing takes place over 1–12 days, impacts on upland vegetation would be minimal under Alternative 1 and would result in no change to plant community composition or species abundance in upland associations.

Livestock trailing can facilitate the spread of invasive or weedy species (DiTomaso 2000; Perkins and Lenhart 2013; Vallentine 2001; Wells et al. 2012). Invasive species monitoring and control are limited under Alternative 1 and would occur only on an ad hoc basis along trailing routes. One exception is the NPS Lake Mead Exotic Plant Management Team, which would continue controlling tamarisk and Russian olive trees along portions of the Fremont River corridor that correspond with the Highway 24 livestock trail. Under Alternative 1, limited monitoring and control of invasive species would result in their continued spread along trailing routes, which would decrease diversity and rangeland health.

Trailing along streams can be detrimental to riparian vegetation (Bock et al. 1993). Using the PFC assessment method, riparian conditions in Oak Creek were rated as nonfunctional, in part due to poor vegetative condition, characterized by overgrazing of native plants, the presence of invasive species, and the lack of native plant regeneration and structural diversity (see Chapter 3, Springs and Creeks; Martin and Wagner 2015). Most of the riparian area along Oak Creek route lacks native herbaceous riparian

wetland species, such as Baltic rush, common threesquare (*Schoenoplectus pungens*), or coyote willow. The lack of palatable vegetation has led to highly unpalatable species, such as tamarisk, being grazed.

Trailing 1,100 livestock in spring and fall would contribute to worsening riparian condition. This would be the result of continued defoliation of streambanks and of facilitating the spread of invasive species, such as yellow and white sweetclover (*Melilotus officinalis*). Native willow and cottonwood trees would have difficulty establishing, thereby decreasing structural diversity in the plant community. In Oak Creek, the presence of unauthorized livestock outside of the designated trailing window has contributed to greater adverse impacts on vegetation.

In Pleasant Creek, 250 livestock are trailed only in the fall, and vegetation conditions along this route are good, contributing to a PFC rating of functional (Martin and Wagner 2015). Continued trailing here would result in some defoliation and trampling to such species as Baltic rush, common threesquare, and horsetail (*Equisetum* spp.); however, changes to overall community composition and productivity are unlikely, since regrowth could occur the following spring. Livestock would continue to be held overnight at the end of Pleasant Creek trail at the park boundary, which consists of desert wash shrubland mosaic. This area would continue to be subject to heavy grazing, and species in this vegetation complex are likely to decrease in abundance and productivity.

Adaptive management and monitoring. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. This would include utilization monitoring, forage production monitoring, rangeland condition assessments, riparian condition assessments, and photo monitoring at trend monitoring sites. The Sandy 3 allotment has two small exclosures that would continue to be maintained. New exclosures would be established in the Sandy 3 allotment, as funding becomes available.

Monitoring and evaluation are a critical part of range management (Rinehart 2008). Properly adjusting stocking rates, redistributing livestock, and protecting and restoring deteriorated range relies on the regular collection of range data. Overgrazing may occur without adaptive management and monitoring, because forage utilization would be unknown throughout the season. Management would not be able to adjust stocking rates if forage were used earlier than expected or drought conditions were to lower available forage in a given year. Under Alternative 1, management decisions would be based on qualitative observations, which are harder to justify.

Cumulative impacts. While reservoir development upstream of Oak Creek has some contribution to the overall development of riparian vegetation along this route, as described in Chapter 3 and above, decades of livestock grazing and trailing has impacted upland and riparian vegetation in the Sandy 3 allotment and along trailing routes, including Oak Creek. These impacts include:

- Decreased productivity
- A decrease in palatable cool-season grasses and increase in warm-season grasses and woody shrubs
- Decreased reproductive capability of native grasses and shrubs
- An increase in invasive species in the allotment and along trailing routes

The recent retirement of the Hartnet allotment, however, is expected to have beneficial impacts on vegetation on 19,000 acres. Recovery of vegetation would be a long-term process, occurring over decades, and some areas may never return to pre-grazing conditions; however, based on observations in the retired Cathedral and Rock Springs allotments, Capitol Reef National Park expects an increase in

productivity, cover, and reproductive capability of native species; reestablishment of native cool-season grasses; and stabilization of incursion of by invasive species.

Several other ongoing and future management actions could have additional impacts on vegetation. Routine road maintenance, including road grading and creating or maintaining water bars, along Highway 24, Notom Road, and Cathedral Valley road may disturb or uproot vegetation in the planning area.

The potential paving of the Burr Trail switchbacks in Garfield County may likewise disturb or uproot vegetation. Disturbed areas are susceptible to incursion by invasive species; however, this could be mitigated with the restoration of native plants. Impacts from road maintenance or paving would affect a small portion of the planning area and would likely not contribute to overall changes in plant productivity or composition.

The NPS Lake Mead Exotic Plant Management Team routinely controls invasive species along the Fremont River corridor, including portions along the Highway 24 livestock trail. Control efforts are also occasionally conducted along the Oak Creek and Pleasant Creek livestock trails. This directly benefits native vegetation along Fremont River, Oak Creek, and Pleasant Creek in the planning area by removing competition from invasive species.

While most of these past, present, and reasonably foreseeable future actions would adversely affect vegetation through defoliation, trampling, and loss of ecological function, the retirement of the Hartnet allotment is expected to result in vegetation recovery on 19,000 acres of soils, which would result in a cumulative beneficial effect compared with current conditions. When combined with the continuation of soil degradation on 11,600 acres of vegetation under Alternative 1 (10,200 grazed acres and 1,400 acres along currently permitted trailing routes), the overall cumulative impact on vegetation would still be beneficial compared with current conditions, again, largely due to the anticipated recovery of 19,000 acres of soils in the retired Hartnet allotment. The incremental contribution of Alternative 1, however, would reduce the cumulative beneficial impacts that would be realized.

Conclusions. A fundamental resource of Capitol Reef National Park is the assemblage of ecosystems. The park's foundation document states "The varied landscape and environmental conditions of Capitol Reef National Park allow for a wide-range of intact ecosystems and habitats supporting a diversity of plant and animal communities" (NPS 2017b). The plant communities described in Chapter 3 are a critical part of these ecosystems. When evaluating the importance of adverse impacts on vegetation, the impacts on the broader ecosystem (as described in other sections of this chapter) should be considered. For example, a loss of plant cover creates greater basal and canopy gaps, contributing to greater soil erosion, which in turn reduces nutrient availability in soils and makes it harder for new plants to establish (see *Soils*). Negative feedback loops such as this would magnify impacts on vegetation across ecosystems in the allotments. Similarly, fundamental resources, such as scenery and wilderness (see *Wilderness*), are negatively affected by the adverse impacts on vegetation. This happens when plants appear trampled and have reduced cover, or communities have become dominated by invasive species, such as cheatgrass.

Under Alternative 1, current impacts and trends in plant communities would continue, including trampling, changes in plant morphology to less productive growth forms, reduction in palatable species cover, shifts in species composition to warm-season dominated grasslands, and spread of invasive species, resulting in impacts on 11,600 acres of vegetation. As a result, 6% of vegetation park-wide would be adversely affected.

In addition to the total acreage adversely affected by Alternative 1, grazing or trailing takes place on three of the five perennial waterways in the park. Adverse impacts on vegetation in riparian areas can be disproportionately impactful, because they support a wide range of ecosystem services, including critical wildlife habitat. As described under *Mexican Spotted Owls*, Oak Creek is potentially important foraging habitat for owls inhabiting a nearby PAC; therefore, the poor condition of vegetation along this trailing route has adverse impacts that extend to the broader ecosystem.

While some of the plant communities and species described are widespread across the Colorado Plateau, the diversity of community types supported in the relatively small area of Capitol Reef National Park is unique.

Plant community changes in arid environments are slow and can be difficult to quantify without robust monitoring; however, it is expected that Alternative 1 would continue to affect plant communities as long as grazing continues, and in perpetuity along trails, and trends would continue to move away from desired conditions. Native cool-season grasses, such as Indian ricegrass and needle-and-thread grass, have large ranges; however, they are susceptible to decline across the Colorado Plateau, due to increased aridity resulting from climate change (Munson et al. 2011). Grazing is an additional stress, because these are highly palatable forage species.

When the impacts of other cumulative actions are combined with the impacts under Alternative 1, the overall cumulative impact on park vegetation would be beneficial. While the 11,600 acres of vegetation would continue to be affected under Alternative 1, reducing the overall cumulative impact, the retirement of the Hartnet allotment would result in the recovery of 19,000 acres of vegetation, resulting in an overall benefit.

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock grazing on upland and riparian vegetation in the park, which are described under the Alternative 1 analysis above, would continue but be reduced compared to current conditions in actively grazed areas of the Sandy 3 allotment and along currently permitted trailing routes, including those used by current permit holders and those where new trailing permits could be issued. In addition, similar impacts would be expected along the other routes analyzed under this alternative (e.g., Hartnet and Lower South Desert trailing routes). These impacts, which are influenced by the duration, timing, and intensity of grazing, are applied in conducting the analyses that follow.

Sandy 3 allotment. Livestock grazing would be managed using a two-pasture rotation system in the Sandy 3 allotment, from November 1 to March 31. Shadscale shrubland is the primary vegetation association affected, with approximately 30% cover in each pasture; however, the pastures differ in the other vegetation association types (see Table 4.4). Upper Sandy 3 has a high proportion of pinyon-juniper/mesic shrub (30%) and pinyon-juniper/xeric shrub (15%) woodlands, while Lower Sandy 3 has black greasewood (20%) and saltbush badlands (20%) shrublands.

Pasture rotation systems, also referred to as deferred rotation or rest rotation, allow vegetation to rest in different seasons periodically by moving livestock among pastures. The benefit to plants depends on the timing and duration of the rest period. Resting in spring allows plants to restock on nutrient reserves when plants are vulnerable, to take advantage of regrowth, and to maximize seed production for cool-season grasses. Resting in summer and fall also allows for nutrient buildup and seed production for shrubs, annuals, and warm-season grasses (Booysen and Tainton 1978).

TABLE 4.4. COMMON VEGETATION ASSOCIATIONS IN GRAZED SANDY 3 ALLOTMENT BY PASTURE FOR ALTERNATIVE 2

Vegetation Association	Upper Sandy 3 Pasture		Lower Sandy 3 Pasture	
	Acres	Percent Total	Acres	Percent Total
Black Greasewood Shrubland Complex	270	5	800	20
Desert Wash Shrubland Mosaic	90	2	100	2
Fremont Cottonwood Woodland Complex	4	<1	20	<1
Gypsum Badlands Sparse Vegetation	70	1	<1	<1
Mixed Desert Shrubland Complex	120	2	170	4
Mixed Grasslands Complex	150	3	100	3
Pinyon-Juniper/Mesic Shrubs Woodland Complex	1,600	30	170	4
Pinyon-Juniper/Mixed Grass Woodland Complex	150	3	40	1
Pinyon-Juniper/Xeric Shrubs Woodland Complex	800	15	90	2
Saltbush Badlands Shrubland Complex	110	2	800	20
Shadscale Shrubland Complex	1,600	31	1,300	33
Tamarisk Temporarily Flooded Shrubland	1	<1	30	1
Torrey Mormon Tea Shrubland Complex	70	1	10	<1
Willow Shrubland Complex	0	0	6	<1

Species dependent on seeds for reproduction may require periodic resting if they are to tolerate grazing long term (Vallentine 2001). Under certain circumstances, rangeland vegetation may require a year or more to rest from grazing to recover (Brown and Stuth 1986). This would be the case during drought or times of environmental stress, which, while uncertain, are predicted to increase in magnitude and frequency due to climate change (Schwinning et al. 2008; Anderson et al. 2010).

Under pasture rotation, individual plants can periodically rest from grazing, allowing them to restock nutrient reserves and set seed. Deferred rotation allows preferred forage plants, such as Indian ricegrass, to gain vigor and set seed periodically (Holechek et al. 1998). Removing livestock by March 31 would also benefit individual plants, particularly cool-season grasses and annual forbs, by allowing them time to develop reproductive structures, set seed, and restock nutrient reserves for the environmentally stressful summer (Cook and Stoddart 1963).

Although there would be benefits due to the pasture rotation system, direct benefits to vegetation from pasture rotation versus continuous grazing in arid ecosystems are debatable (Herbal 1974; Holechek et al. 1998; Briske et al. 2008) . There is some evidence that pasture rotation can more evenly distribute grazing pressure throughout the pasture, reducing heavy impacts on vegetation in preferred patches, such as those near water sources (Teague and Dowhower 2003; McCarthy 2003; Holechek et al. 1998); however, others argue that pasture rotation is ineffective for redistributing livestock (Briske et al. 2008; Bailey and Brown 2011). Refurbishing stock ponds would additionally contribute to even distribution of livestock throughout the pasture; however, impacts on vegetation in the quarter-mile surrounding the stock ponds would be subject to concentrated use, increasing defoliation and soil disturbance over approximately 625 acres. Regardless, good distribution of livestock could increase cover and production for plants that are overused throughout the allotment.

Riparian vegetation at the springs, creeks, and stock ponds listed under Alternative 1 would likely benefit from the pasture rotation system. As with upland vegetation, periodic rest and a better distribution of livestock would allow riparian plants to gain biomass and set seed, resulting in increased cover and abundance.

As described in Alternative 1, large, continuous stands of cheatgrass are present in the Sandy 3 allotment. The pasture rotation system implemented in Alternative 2 would likely have little impact on the extent and spread of cheatgrass. The benefits to native species from periodic rest and better livestock distribution would benefit cheatgrass as well; however, adaptive management described in *Adaptive management and monitoring*, below, may help control cheatgrass under Alternative 2.

Grazing management infrastructure and tamarisk removal. Under Alternative 2, the construction of approximately 2 miles of fence to delineate pastures and monitoring exclosures, and refurbishing five existing stock ponds, all of which are next to Notom Road, would result in approximately 28.5 acres of vegetation disturbance (3.5 acres for fences assuming a 15-foot disturbance corridor, and 5 acres for each pond, including the pond itself, the construction footprint, and 0.25 miles of access routes). Installing one livestock guard in Notom Road would not affect vegetation because it would occur in an unvegetated area.

These activities would result in physical disturbances to approximately 0.4% of vegetation in the grazed portion of the Sandy 3 allotment, as vegetation in the construction and equipment travel areas would be uprooted or trampled and from the impacts of increased soil erosion and loss of biological soil crusts. These impacts would be limited to individual plants and would not change community composition. In addition, stock pond work would have the greatest potential for these impacts because it would require the use of heavy equipment, while access for fence construction and tamarisk removal would be by foot or horseback, minimizing the potential for these impacts. In addition, impacts would be minimized during fencing by conducting limited clearing of rocks or vegetation.

Tamarisk removal at Little Lake Mead would be also be considered under Alternative 2, depending on the extent and condition of tamarisk at this site. Some tamarisk has been infected by the tamarisk beetle already, and removing dead vegetation may prevent regrowth. Removing tamarisk over 8 acres may benefit native riparian vegetation; however, without protection from livestock grazing, reestablishment of invasive species is likely. Additionally, continued monitoring should follow tamarisk removal, if eradication is the goal (Dreesen and Fenchel 2009).

Vegetation in 8 acres of monitoring exclosures would benefit by being protected from defoliation and trampling, resulting in increased cover and production of individual plants; however, this would have no impact at the community level.

Livestock trailing. Impacts on vegetation from livestock trailing on trailing routes analyzed in this EA would be similar to those described under Alternative 1. If the number of livestock trailing on Pleasant Creek trail, Highway 24 trail, and Divide Canyon trail increases as allowed under Alternative 2, the impacts could be greater. However, the use of best management practices (e.g., adjustments to the number of livestock to be trailed on a given day, the total number of trailing days and whether they are consecutive or spaced apart, potential modifications to route alignments, and moving livestock at a deliberate pace) would benefit 1,400 acres of vegetation associated with currently permitted trailing routes, particularly riparian vegetation in Oak Creek and Pleasant Creek. Oak Creek would be expected to move toward PFC because of increased cover and abundance of native riparian species, which stabilize soil and improve terrestrial and aquatic wildlife habitat. Riparian vegetation would still be defoliated, but less so than if livestock were allowed to move slowly along the trail. Greater control of the duration and method of trailing may allow native willow and cottonwood seedlings to become established. Upland vegetation, which may be grazed if livestock are allowed to stray from the trail, is less likely to be affected under this alternative. Greater control of livestock that overnight at the park's eastern boundary along Pleasant Creek would similarly reduce direct impacts on vegetation and indirect impacts from soil trampling and loss of biological soil crusts.

Under Alternative 2, there would be two trailing routes newly permitted (Hartnet and Lower South Desert), resulting in additional impacts on vegetation on 830 acres in the recently retired Hartnet allotment (Table 3.4). Vegetation in the recently retired Hartnet allotment is already in a state of departure from reference conditions (Chapter 3: Upland and Riparian Vegetation, Appendix B), and trailing on new routes would contribute similar impacts, including defoliation, trampling, and loss of reproductive structures; however, trailing along the Hartnet trail would only occur for 1 day in the fall, and best management practices described above would be expected to reduce impacts. Trailing along the Lower South Desert would affect a relatively larger area, because livestock would not be moved deliberately and may graze farther from the trailing route, and they may linger at water sources overnight. The resulting impact may be greater defoliation and trampling along 530 acres of this route, including Deep Creek Spring and Baker Post Seep. The overall impact of issuing these new routes would be minimal because of the short duration of trailing and the opportunity for vegetation to grow during the rest of the year.

Adaptive management and monitoring. Alternative 2 allows for multiple monitoring and adaptive management actions that would benefit vegetation in the Sandy 3 allotment and along trailing routes analyzed in this EA.

For example, if forage utilization is greater than the desired level, then livestock may be moved to a new pasture at an earlier date. This would allow vegetation to rest and restock nutrient reserves and ultimately would increase cover and abundance of native plants. Monitoring vegetation conditions, in combination with drought monitoring, is critical in preventing overutilization of forage in drought years (Allison et al. 2007).

Actions to distribute livestock more evenly throughout pastures would benefit vegetation by reducing the potential for plants in specific areas, such as near water sources, to become overgrazed. Pasture rotation systems may encourage this behavior; however, if this is not the case, short-term monitoring of livestock movements and forage utilization would inform managers and allow them to take further action to encourage better livestock distribution. These actions include using supplements, riders on horseback to move livestock, temporary fencing, or alternate trailing routes.

Under Alternative 2, greater monitoring and control for invasive species management would benefit native species by reducing competition. A decrease in cover and abundance of invasive species would move rangelands toward desired conditions. For example, Alternative 2 allows managers to consider the use of supplements to target the cheatgrass- or Russian thistle-dominated areas for grazing. Cheatgrass, a cool-season grass, can green up in fall, and grazing at that time may help control its abundance and spread. In some years, livestock may be allowed onto the Sandy 3 allotment in mid-October, rather than November 1, for targeted grazing of cheatgrass. This would improve rangeland health and provide a greater abundance of native species at a community level.

If PFC assessment ratings continue to be nonfunctional at Deep Creek Springs, approximately 1 to 2 acres could be fenced to exclude livestock from riparian resources. A 2-acre exclosure would disturb approximately 0.4 acres, with impacts on vegetation the same as those from pasture fencing. Impacts from construction of the exclosure would last approximately 1 year, while the exclosed area would realize benefits such as recovery of plants and seed banks, resulting in improved function by stabilizing soil, providing improved wildlife habitat, and cooling water through shading. Riparian areas generally are more likely to recover quickly from overgrazing, and this has been previously observed at Capitol Reef National Park (Barth and McCullogh 1988).

Unauthorized use by livestock outside the permitted trailing period has contributed to the poor condition of vegetation in Oak Creek. Under Alternative 2, unauthorized use would be monitored, owners would

be contacted, and unauthorized livestock would have to be removed immediately. Noncompliance would result in penalties and may ultimately lead to loss of future trailing privileges. Conditions in Oak Creek would be monitored annually, including monitoring stubble height. These actions would promote the growth of native riparian vegetation, such as coyote willow, Baltic rush, and common threesquare, and may allow willow and cottonwood seedlings to become established. Greater plant cover and regeneration of native shrubs and trees would move Oak Creek toward PFC. No new trailing permits would be issued until the riparian corridor is in PFC.

The adaptive management and monitoring framework under Alternative 2 would allow managers to make decisions on the reduction of localized overgrazing, invasive species, forage utilization, riparian condition, and vegetation trends, with specific and quantitative information. This would allow them to make changes to management that would move vegetation toward desired conditions by increasing cover and reproduction of individual plants. At the community level, this could increase the abundance of native cool-season grasses.

Even with rest from grazing or better management of livestock, precipitation may be the primary driver of vegetation productivity in arid ecosystems. With uncertain but predicted greater frequency of drought and changing precipitation patterns due to climate change, adaptive management would be critical in responding to year-to-year variation in environmental conditions for the benefit of vegetation communities. Monitoring drought conditions and adjusting AUMs or season of use in response may be particularly beneficial in the arid ecosystems at Capitol Reef National Park.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative 2. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

Alternative 2 would result in adverse impacts on 830 acres of vegetation along the Hartnet and Lower South Desert trailing routes and 653.5 acres of vegetation in those areas where fences are built and stock ponds are refurbished in the Sandy 3 allotment. These impacts would be minimized by best management practices, as described under *Adaptive management and monitoring*. While this may slow recovery of vegetation in these areas, when combined with the other beneficial impacts of Alternative 2 on vegetation in the Sandy 3 allotment and other trailing routes analyzed in this EA, the overall cumulative impacts on vegetation would be beneficial. Alternative 2 would have a substantial contribution to these beneficial cumulative impacts because 11,600 acres on the Sandy 3 allotment and currently permitted trailing routes would be expected to improve despite the fact that the magnitude of change due to Alternative 2 is uncertain, and plant communities would not necessarily be expected to return to historical conditions.

Conclusions. Capitol Reef National Park's fundamental values related to vegetation, as described under the *Conclusions* for Alternative 1, are the same for Alternative 2. The conclusions regarding the unique assemblages of vegetation complexes and importance of riparian ecosystems described under Alternative 1 are valid for Alternative 2.

Under Alternative 2, conditions in 11,600 acres of plant communities (approximately 4% of the vegetated areas of the park) would improve, compared with current conditions, and conditions in an additional 830 acres along proposed trailing routes would improve, but at a slower rate. This would come about through an increase in the following:

- Plant cover and reproductive success

- Abundance of native cool-season grasses at a community level
- Plant cover and recruitment of trees and shrubs in riparian areas
- Control of invasive species

Faster recovery of vegetation in Oak Creek from improved monitoring and control of unauthorized livestock would greatly benefit the park by bringing this riparian system into PFC. Since there are a small number of perennial waterways in the park, it is even more critical that they all be functioning properly.

Fundamental resources, including intact ecosystems, scenery, and wilderness (NPS 2017b), would be positively affected by these changes to vegetation under Alternative 2. It would likely take 20-plus years for some of these benefits to be realized, particularly the change in plant community composition. It is uncertain how long it would take for vegetation to reach desired conditions, given factors such as drought or disturbance that also play a role in structuring plant communities, and some areas may never fully recover. However, vegetation in the 8 acres of monitoring exclosures in the Sandy 3 allotment, and an additional 1–2 acres if Deep Creek Spring is fenced, would be expected to move toward desired conditions at a faster pace than vegetation in the portions of the allotment and trails that continue to be grazed.

Fence construction, monitoring or sensitive resource exclosure construction, stock pond refurbishment, or tamarisk removal at Little Lake Mead would disturb approximately 36.5 acres of vegetation in the allotment. While the construction-related impacts would not persist beyond approximately 1 to 5 years, the approximately 625 acres of vegetation exposed to concentrated livestock use around the five existing stock ponds to be refurbished would have similar effects as noted under Alternative 1. These impacts would occur across 0.6% of the planning area, would be limited to individual plants, and would not change overall plant community composition or ecosystem function.

When the impacts of other cumulative actions, including vegetation recovery on 19,000 acres in the recently retired Hartnet allotment, are combined with the impacts under Alternative 2, the overall cumulative impact on park vegetation would be beneficial. Although there is uncertainty in how much upland and riparian vegetation would improve and how long it would take, when coupled with the considerations above, including implementation of a monitoring and adaptive management program intended to achieve the desired future conditions described in Appendix C, Alternative 2 would have beneficial impacts, including cumulative beneficial impacts, on the park and its resources. This is because of the critical role vegetation plays in ecosystem function, the relatively quick recovery of rested areas, and the expected increase in desirable, native, cool-season grasses and critical riparian ecosystems.

WATER RESOURCES

Impacts under Alternative 1

Under alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The types of impacts of livestock grazing that are influencing the current condition of known park water resources (see Chapter 3) would continue to occur in actively grazed areas of the Sandy 3 allotment and along currently permitted trailing routes. These impacts, which are influenced by the duration, timing, and intensity of grazing, are described generally below, and applied in conducting the analyses that follow.

Known park water resources, soils, and vegetation are affected by livestock grazing due to the direct impacts of trampling, increased bare ground, and functional changes in vegetation communities; therefore, the reader is encouraged to review the other sections in this chapter discussing soils and vegetation, in addition to this section. Impacts on known park water resources from livestock grazing and trailing would occur mostly where livestock have direct access to springs and streams and the adjacent riparian areas. Impacts from livestock grazing and trailing are as follows:

- Increased nutrient loads (Alexander et al. 2008; Zaimes et al. 2004, 2008)
- Increased sediment loads (Stevens et al. 1992; Winegar 1977)
- A loss of streambank stability

Each of these impacts has cascading effects. For example, a loss of stream bank stability frequently leads to undesirable changes in channel morphology and in-stream and streambank vegetation (Belsky et al. 1999; Kauffman et al. 1983; Platts 1986; Platts and Nelson 1989). Loss of bank stability and resultant channel degradation can change the overall fluvial system. These could eliminate properly functioning riparian areas by changing, reducing, or eliminating vegetation and by lowering the water table.

Livestock grazing in riparian areas can lead to a substantial reduction in woody riparian plant cover, which can contribute to higher stream temperatures (Duff 1977; Platts 1986; Platts and Nelson 1989). A loss of riparian and upland vegetation in the vicinity of known park water resources would increase sediment loading and change channel stability. Reduction or loss of riparian vegetation would degrade its ability to dissipate energy during floods. It also could lead to eventual loss of connection between a stream channel and the surrounding landscape. When vegetation is insufficient to dissipate energy during times of high water levels, the energy is transferred to erosion and changes channel morphology. Under some circumstances, channels are widened and braided; under other circumstances channels are deepened and become more similar to gullies.

Sandy 3 allotment. The impacts described above at the beginning of the Alternative 1 analysis would also occur for known park water resources within the approximately 10,200 acres of grazed areas in the Sandy 3 allotment. The following describes how these effects would translate to the known park water resources in the Sandy 3 allotment.

Although there is uncertainty in how the impacts described above, and the trends described in the affected environment, would influence functioning condition under Alterative 1, the National Park Service expects that because livestock would continue to have direct access to all known park water resources under Alternative 1 for several months, conditions would persist or worsen, especially for Bitter Creek and Bitter Spring Creek. Continued pressure from grazing and hoof action with partial-year continuous grazing would result in the following:

- Alteration of the chemical, physical, and bacteriological aspects of water quality, including increased nutrients, temperatures, turbidity, and sediment loads. The increased sediment loads could result from a loss of vegetation caused by grazing or from natural causes in an area of generally unstable soil conditions, combined with steep slopes.
- Degradation of bank stability, channel structure, and morphology by direct trampling and long-term (months each grazing season) livestock persistence in springs and streams and the associated riparian zones
- Degradation or elimination of functioning riparian ecosystems, including substantial vegetation loss. Continued loss of riparian vegetation and bank stability under Alternative 1 can result in

channel incision in the presence of fine-grained soils and appropriate gradients, both of which are present in the Sandy 3 allotment. Channel incision results in a feedback mechanism of increased loss of riparian vegetation, less connection to the floodplain, and potential lowering of the groundwater table, which can lead to reduction in spring discharge. Loss of vegetation also reduces floodplain function by reducing water depth, velocity, and power during floods, and removing soil and vegetation that store water. An increase in peak flood velocity and energy, and loss of channel sinuosity, can lead to further erosion.

Stock ponds—Many of the stock ponds in the Sandy 3 allotment are no longer functioning because of sedimentation and lack of maintenance. Under Alternative 1, the stock ponds would remain in the same nonfunctional condition.

Grazing management infrastructure—Under Alternative 1, Capitol Reef National Park has no plans to protect known park water resources by installing fences or to develop additional water sources, such as stock ponds.

Livestock trailing. Under Alternative 1, trailing in the park would continue along currently permitted trailing routes with known park water resources, Oak and Pleasant Creeks. Oak Creek is in a nonfunctional condition, due to a combination of trailing and trespassing cattle (NPS PFC 2015). Even if trespass livestock were eliminated, Oak Creek would be affected by trailing approximately 1,100 livestock over 4 to 6 days twice a year. Continued impacts on Oak Creek would be as follows:

- Alteration of the chemical, physical, and bacteriological aspects of water quality, including increased nutrient, sediment loads, and temperature
- Degradation of channel structure and morphology
- Degradation of bank stability
- Degradation of functioning riparian ecosystems, including vegetation loss

Pleasant Creek is currently in PFC and would be expected to retain that condition under Alternative 1. This is because the number of livestock and frequency of use would not change; therefore, Pleasant Creek would continue to provide substantial ecosystem services, and proper hydrologic functions would continue.

Trailing infrastructure—No infrastructure related to livestock trailing would be developed.

Monitoring and adaptive management. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. As a result, adaptive management options would be minimal because adaptive management must be based on data. Without sufficient monitoring, Capitol Reef National Park would have little capacity to understand and respond to changing conditions.

Cumulative impacts. While reservoir development upstream of Oak Creek has some contribution to the overall flow of this creek, as described in Chapter 3 and above, decades of livestock grazing and trailing has impacted this and other water resources in the analysis area. These impacts include:

- Loss of riparian vegetation
- Loss of bank stability
- Stream channel incision
- Loss of floodplain services

- Increased sediment loading

These impacts have resulted in nonfunctioning condition for many known park water resources. In addition to past and continuing grazing, several other actions (see Table 4.1) could combine with the impacts of Alternative 1 to result in cumulative impacts on known park water resources.

The retirement of the Hartnet allotment is expected to allow recovery of multiple known park water resources, including the following springs: Ackland Springs, South Desert Spring, Ringwater Spring, Bull Spring, Deep Creek Spring, Notch Water Spring, Willow Canyon Seep, and Baker Post Seep; and streams: Hartnet Draw, Polk Creek, and Deep Creek. In the absence of partial-year continuous grazing, vegetation at the springs would regrow, stabilizing bank and shading and cooling water. As soils throughout the retired allotment stabilize, sediment loading to streams should decrease. As springs recover, the ability of these reaches to dissipate energy during large flows would improve. Finally, without livestock present, water quality would improve because of reduced nutrient and bacterial loading.

As described under the impacts on soil, paving a portion of the Burr Trail, west of the Sandy 3 allotment, would create an impervious barrier to water infiltration. This would increase runoff from the road surface, which could degrade water quality in runoff channels intersected by the road, such as Lower Muley Twist.

Controlling invasive vegetation next to water sources in the allotments and trailing routes could also affect water quality from herbicides; however, herbicides are not applied directly to water, and they are selected because they do not affect water-based ecosystems.

Most of these past, present, and reasonably foreseeable future actions would adversely affect known park water resources, reducing water quality at springs, increasing sediment loads, causing the loss of riparian and floodplain function, and degrading channel morphology and function. The retirement of the Hartnet allotment, however, is expected to contribute beneficial impacts on four springs that are currently nonfunctional (Ackland Springs, Ringwater Spring, Deep Creek Spring, and Bull Spring), four that have not recently been evaluated (South Desert Spring, Notch Water Spring, Baker Post Seep, and Willow Canyon Seep), and three intermittent-to-ephemeral streams (Polk Creek, Deep Creek, and Hartnet Draw). When combined with the continued adverse impacts on approximately 20% of the known park water resources that occur in the Sandy 3 allotment (e.g., Bitter Creek, Bitter Spring Creek) and Oak Creek, the overall cumulative impact on known park water resources would still be beneficial due to the anticipated recovery of the approximately 50% of known park water resources in the retired Harnett allotment. The incremental contribution of Alternative 1, however, would reduce the cumulative beneficial impacts that would be realized.

Conclusions. Capitol Reef National Park's fundamental resources and values include known park water resources because of their action as an agent of landscape change, providing travel corridors, and supporting biologically diverse ecosystems. Springs and streams may be considered uncommon from the perspective of the assemblage of known park water resources.

Under Alternative 1, current impacts on known park water resources would continue in the Sandy 3 allotment and along trailing routes.

With minimal monitoring and adaptive management options, the park would lack information and management tools that could address future changes in water conditions. Although there is uncertainty in how the impacts described above, and the trends described in the affected environment, would influence the proper functioning condition under Alternative 1, the National Park Service expects that the overall integrity of known park water resources and their ecosystem values in the Sandy 3 allotment,

and along trailing routes analyzed under this alternative, would continue in their present condition or degrade further. This is because of the severity of impacts (for example, from sediment loading and turbidity), the widespread nature of impacts (for example, only one of four sources would be in PFC), and the long recovery time, in years, for a return to PFC. The springs and water sources in the Sandy 3 allotment and along the trailing routes represent approximately 20% of the known park water resources in Capitol Reef National Park; therefore, the nonfunctional and at-risk conditions represent substantial degradation of overall known park water resources.

When the impacts of other cumulative actions are combined with the impacts under Alternative 1, the overall cumulative impact on known park water resources would be beneficial. While approximately 20% of springs and streams would continue to be adversely affected, the larger number of springs and streams recovering in the recently retired Hartnet allotment would result in an overall benefit.

Although uncertain, increasing temperatures associated with climate change are expected to have negative impacts on known park water resources and their ability to sustain native vegetation communities (livestock forage) in Capitol Reef National Park. Increasing temperatures result in an overall loss of water from the ecosystem. This is because of evaporation and transpiration over past conditions, resulting in less surface water, less infiltration, and less water storage in the subsurface (Copeland et al. 2017; Prein et al. 2016; Cook et al. 2015; Seager et al. 2007).

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock grazing on known park water resources, which are described under the Alternative 1 analysis above, would continue to occur in actively grazed areas of the Sandy 3 allotment and along trailing routes analyzed under this alternative where livestock have access to water resources. These impacts, which are influenced by the duration, timing, and intensity of grazing, are applied in conducting the allotment-level analyses that follow.

Sandy 3 allotment. Under Alternative 2, livestock would continue to have direct access to Bitter Creek and Bitter Spring Creek; when livestock are present, the impacts on these known park water resources would be similar to the impacts described under Alternative 1.

However, the proposed pasture rotation system is expected to be beneficial for both creeks. Because each pasture would be grazed in succession, the creeks would be affected by livestock for fewer days each season (approximately 76 days) compared with current management. Riparian areas would likely benefit from the pasture rotation system. Periodic rest and better distribution of livestock would allow riparian plants to gain biomass and set seed, resulting in increased cover and abundance, as described under *Upland and Riparian Vegetation*. The refurbishment of five existing stock ponds is also intended to reduce the use of current water sources, particularly the springs at Bitter Spring Creek and Bitter Creek. This is expected to improve riparian vegetation because livestock would have alternative water sources away from riparian areas. Over time, recovery of plants and seed banks in these communities would result in improved function of riparian areas by stabilizing soil, providing improved wildlife habitat, and cooling water through shading. Riparian areas generally are more likely to recover quickly from overgrazing, and this has been previously observed at Capitol Reef National Park (Barth and McCullogh 1988). This would move these known park water resources toward desired conditions, namely PFC, resulting in improved ecosystem function.

Grazing management infrastructure—Construction of a fence creating two pastures in the Sandy 3 allotment would not affect known park water resources. Refurbishing the stock ponds next to Notom

Road could result in less use of other water resources in the allotment, but the activities associated with refurbishment would not affect water resources.

Livestock trailing. Impacts on known park water resources from livestock trailing would be similar to those described under Alternative 1; however, use of best management practices proposed under Alternative 2 are anticipated to benefit known park water resources by minimizing livestock bunching and the length of time they are in water and riparian areas as they trail. This would reduce trampling and stream bank disturbance, stream sediment loading, and riparian vegetation degradation.

Oak Creek would be expected to move toward PFC because of increased cover and abundance of native riparian species, increased stabilization of soils, and reduced sediment loading. Riparian vegetation would still be defoliated, but less so than if livestock were allowed to move slowly along the trail.

Additional impacts on known park water resources under Alternative 2 from the proposed Hartnet and Lower South Desert trailing routes include grazing and trampling of vegetation, disturbance to soil, and contribution of sediment and dung to the water channel in the riparian areas of Ackland Springs (Hartnet) and Deep Creek Spring, Baker Post Seep, and Willow Canyon Seep. On the Hartnet trail, livestock would be moved through in 1 day, so the described impacts would be minimal. On the Lower South Desert route, livestock would be allowed to move overnight at their own pace up the trail, and would be more likely to linger overnight at Deep Creek Spring and Baker Post Seep, resulting in greater defoliation of vegetation, disturbance of soil, and contribution of sediment and dung to the water channel. The short duration of trailing, however, would result in minimal overall impacts on these known park water resources and allow vegetation to recover.

Monitoring and adaptive management. Alternative 2 includes monitoring of riparian conditions for springs and streams, particularly Oak Creek. If Oak Creek were not moving toward PFC, adaptive management actions could include using an alternate trailing route. These actions would result in additional rest for Oak Creek, which would lead toward recovery of riparian vegetation, reduced stream sediment loading, and improved bank stabilization; these impacts would move Oak Creek toward PFC.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative 2. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

The additional impacts on Ackland Springs along the Hartnet trail, and Deep Creek Spring and Baker Post Seep along the Lower South Desert trailing route, would be offset by the rest from grazing throughout the remainder of the year, as a result of the retirement of grazing in the Hartnet allotment. Impacts would be further reduced by best management practices for trailing on the Hartnet route, and adaptive management actions available to protect Deep Creek Spring. The recovery of these known park water resources as a result of retirement of the Hartnet allotment would not be impaired by the impacts from 1–2 days of trailing.

Under Alternative 2, reducing the days that known park water resources in the Sandy 3 allotment are accessible to livestock under pasture rotation, implementing best management practices for trailing, and implementing an adaptive management framework to meet desired conditions for proper functioning condition would benefit riparian resources as described above. When combined with the other past, present, and reasonably foreseeable future actions, Alternative 2 would have substantial contributions to an overall beneficial cumulative impact on known park water resources, because conditions would be expected to improve on approximately 20% of known park water resources

Conclusions. Capitol Reef National Park's fundamental values related to known park water resources described in *Conclusions* for Alternative 1 are the same for Alternative 2. The conclusions regarding the uncommon nature of known park water resources and potential impacts of uncertain climate change, described under the Alternative 1 discussion, are also valid for Alternative 2.

Implementing the proposed pasture rotation system under Alternative 2 in the Sandy 3 allotment is expected to be beneficial for Bitter Creek and Bitter Spring Creek. Under Alternative 1, these known park water resources could be affected by livestock for 152 days; under Alternative 2, they could be affected by livestock for approximately 76 days, a reduction of 50%. Oak Creek is expected to benefit from livestock being moved quickly through the riparian corridor and more actions taken to reduce the incidence of trespass livestock. Impacts on Ackland Springs and Deep Creek Spring would be short lived (up to several hours or one night), providing adequate time for known park water resources to recover prior to the next trailing event. Although there is uncertainty in how much the integrity of known park water resources would improve and how long it would take, especially in the actively grazed portions of the allotment, given the considerations above, including implementation of a monitoring and adaptive management program intended to achieve the desired conditions described in Appendix C, the National Park Service expects Alternative 2 to improve the condition of springs, seeps, and creeks in the allotment and along the trails analyzed under this alternative.

Impacts on streams and springs would be similar to those described under Alternative 1, namely nutrient and sediment loading, loss of riparian vegetation, and degradation of channel morphology and function; however, Alternative 2 benefits known park water resources because it would reduce the duration of grazing. Each pasture would be grazed in succession, and the pattern would change each year. Because of this, Bitter Creek and Bitter Spring Creek would be affected by livestock for fewer days than current conditions.

The effects on known park water resources from fence construction, stock pond refurbishment and construction, or tamarisk removal and burning at Little Lake Mead in the Sandy 3 allotment would be minimal. Alternative 2 incorporates extensive range monitoring, including evaluating known park water resource conditions, which would provide data to support adaptive management actions. An example of such an action is adjusting livestock distribution, AUMs, or season of use, if desired conditions were not being met.

Adaptive management would be especially important in the face of uncertain but predicted climate change, so that detrimental impacts from increased temperature or aridity could be accounted for in managing future grazing. Options could include reducing stocking rates or season of use.

When the impacts of other cumulative actions, including recovery of springs, seeps, and streams in the recently retired Hartnet allotment, are combined with the impacts under Alternative 2, the overall cumulative impact on park vegetation would be beneficial. Although there is uncertainty in the extent to which conditions would improve and the length of time it would take, when coupled with the considerations above, including implementation of a monitoring and adaptive management program intended to achieve the desired future conditions described in Appendix C, Alternative 2 would have beneficial impacts, including cumulative beneficial impacts, on the park and its resources. This is because of the critical role riparian areas and water sources play in ecosystem function.

If for some reason desired conditions are not achieved, then impacts under Alternative 2 would be similar to those described for Alternative 1 until adaptive management actions are implemented to meet desired conditions.

SPECIAL STATUS SPECIES

The National Park Service is required under the ESA to ensure that federally listed threatened and endangered species and their designated critical habitats are protected on lands within the jurisdiction of the agency. This section addresses three federally listed plant species—Winkler cactus, Wright fishhook cactus, and Last Chance townsendia—and the federally listed MSO.

Special Status Plants

Impacts under Alternative 1

Direct and Indirect Impacts Common to All Listed Plants
Under Alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The impacts of livestock activities that are influencing the current condition of Wright fishhook cactus in the park (see Chapter 3) would continue to occur along the Gray Bench-Cathedral trailing route. These impacts, which are influenced by the duration, timing, and intensity of trailing, are described generally below, and applied in conducting the analyses that follow.

Livestock grazing, trampling, and resultant habitat degradation have been identified as primary threats to the three listed plant species in the planning area (USFWS 2008b, 2013, 2015b; Spector 2013). Numerous studies have addressed the impacts of livestock grazing on Winkler and Wright fishhook cacti over the past 30 years (USFWS 1985; Neese 1987; Kass 1990; San Juan College 1994; Clark 2006, 2008a, 2008c; Clark and Clark 2007, 2008b; BLM 2015a, 2015b; NPS 2014a, 2014b; Clark et al. 2015; Hornbeck 2017). Based on these studies, Spector (2013) provides a comprehensive review of direct and indirect impacts of livestock on these two species and how they may be affected at the population level. Spector (2013) concludes that the impacts on cacti from livestock include direct damage, from trampling and uprooting, and habitat degradation. Most of these studies assess chronic impacts from season-long grazing rather than impacts from short-duration (1–2 days) trailing by livestock, as would occur in this project. Information from some of these studies that would apply to impacts on the listed plant species in the planning area from short-duration livestock trailing are described below.

In addition to the direct impacts discussed above for the listed plant species, livestock can affect them indirectly through loss or degradation of suitable habitat. Spector's (2013) review of livestock impacts on cacti provides an excellent summary of these indirect impacts, which also apply to Last Chance townsendia.

Livestock trampling disturbs the soil, increasing erosion, compaction, sedimentation, and destruction of biological soil crusts. Biological crusts benefit soil stability, moisture retention, nutrient cycling, and seedling establishment (Belnap 1992; Harper and Belnap 2001). Damaged crusts can take over 40 years to recover (Belnap 1993). Reduced soil stability can increase wind erosion, resulting in airborne dust particulates that settle on vegetation. Dust can inhibit photosynthesis, transpiration, respiration, and productivity of plants (Farmer 1993; Sharifi et al. 1997). Belnap and Gilette (1998) found that when soils were disturbed by livestock hooves, their susceptibility to wind erosion increased by 69% to 5,247%, compared with undisturbed soils.

Soil compaction by livestock can reduce water infiltration, soil porosity, and root development (Castellano and Valone 2007; Sharrow 2007). Soil compaction and disruption are especially problematic in areas where livestock congregate around water developments or along livestock trails.

Livestock trampling may affect the ability of seeds to germinate and for seedlings to become established, due to their sensitive and vulnerable developing root systems (Sisk et al. 2010). Cacti seedlings are difficult to detect and are most likely undercounted during monitoring; therefore, the impacts of livestock on seedlings may also be underreported. Grazing can also affect the recruitment of cacti by removing protective vegetation.

Adverse impacts of livestock trampling on water infiltration can reduce a plant's resiliency, especially in arid areas, where water is already limited. Livestock-trampled soil may lead to plant dehydration, exacerbating the impacts of drought on plants (Spector 2013).

During their long-term demographic study, Clark and Clark (2008a) reported high mortality of Winkler cactus (22% to 31%), which coincided with several years of drought. Cacti seedlings are especially vulnerable, even to mild droughts, due to their low water storage capacity; thus, livestock trampling that affects the water-holding capacity of soils may adversely affect cactus survival, especially during periods of drought.

Livestock can affect the listed plant species by altering vegetation composition and facilitating the introduction of invasive, invasive plant species (Bartuszevige and Endress 2008). Invasive species have been documented as being detrimental to plant community structure, soil stability, and ecosystem functions, as they compete with native plants for space, water, and nutrients (DiTomaso 2000; Fleischner 1994). The invasive species Russian thistle, halogeton, and cheatgrass have been documented in the planning area, including in localities with listed plants (Clark and Grobner 2003). African mustard, an aggressive invasive forb, occurs in both the Sandy 3 and the retired Hartnet allotments. It was first documented in the recently retired Hartnet allotment in 2015 in three locations, all heavily used by livestock, including one Winkler cactus locality.

Livestock can indirectly affect the habitat for pollinators of listed plants. Livestock trampling can damage habitat for ground-nesting pollinators; grazing on forbs can affect pollinator abundance and thus seed production (Tepedino et al. 2004; USFWS 1993, 2013). Both cacti species require pollination for seed production. Pollination is limited by the foraging distance of the ground-nesting bees that pollinate them. Tepedino (2000) found that the maximum distance traveled for the two genera of bees that pollinate Wright fishhook cactus was approximately 0.25 miles (400 meters).

Livestock grazing and trampling can fragment cacti habitat, creating isolated cacti populations too far apart for pollinators to visit. This could result in inbreeding and self-pollination, causing reduced reproduction and fitness (Jennersten 1988; Agren 1996).

Plants that are damaged or disturbed by livestock may have lowered defenses, making them more susceptible to some insect pests (Koricheva et al. 1998); examples are the cactus borer beetle, which infects both listed cacti species in the planning area, and the larva of the *Rhagea* moth, which infects Wright fishhook cacti (Clark 1998; Kass 2001b; Clark 2006, 2008a; BLM 2015b; NPS 2014b; Borthwick 2016b; Borthwick and Livensperger 2017b). Livestock can change the species diversity, abundance, composition, and richness of small mammal populations (Jones 2000, 2001; Hall et al. 2005). These have been documented as significant causes of mortality or damage to both cactus species (Kass 2001a; BLM 2015a, 2015b; Clark 2009). If rangelands are overgrazed, rodents may target cactus as they compete with livestock for suitable browse (Vorhie and Taylor 1933).

Wright fishhook cactus. One of the early studies to assess the impacts of livestock on Wright fishhook cactus was conducted by Kass (1990), who found cacti damaged by trampling in areas where livestock activity was intense or near water sources. He noted that cacti were easily uprooted by livestock, were more abundant where livestock trampling was limited, and were often found growing under shrubs in

heavily used areas. Kass suggested that damage from trampling may affect the establishment and survival of individuals and recommended better management of livestock herds to prevent further impacts.

Studies have found that trampled Wright fishhook cacti that do not die often have reduced reproductive output (San Juan College 1994; Clark and Clark 2007). Data collected by Clark and Clark (2007) indicate that livestock may affect the survival of cacti greater than 4 cm in diameter. This would result in a population distribution skewed toward smaller, less reproductive cacti. If cacti do not survive to reach their reproductive potential, small populations may be at risk from extinction, especially during periods of drought (Clark and Clark 2007).

Using data from their 2007 study, Clark and Clark (2010) developed a population dynamics model for Wright fishhook cactus. The model shows that reducing mortality is the only factor that allows populations at a site to be stable or to increase. Manipulating other parameters, including seed production, growth rate, and germination rate, does not result in maintaining or increasing the population.

A demographic study in Capitol Reef National Park conducted from 2013 through 2016 found that chronic livestock activity from 7 months of grazing each year in the recently retired Hartnet allotment negatively affected population structure and growth rates, resulted in reduced survival and reproduction, and contributed to a downward population trend for Wright fishhook cactus (Hornbeck 2017). The species appears to be incompatible with chronic livestock disturbance, particularly in the presence of other impacts, such as uncertain climate change, rodent herbivory, and insect predation (Hornbeck 2017).

Sandy 3 allotment. Existing livestock management would continue in the Sandy 3 allotment, where there are no listed plant species; therefore, none of the actions taken under Alternative 1, including invasive plant control, would affect the listed plant species.

Livestock trailing. Under Alternative 1, livestock trailing would continue on the eight currently permitted trailing routes. The Gray Bench-Cathedral Valley trail, which passes through occupied Wright fishhook cactus habitat, is the only trail in which a listed species or its occupied habitat would be affected. There are 113 documented Wright fishhook cacti within a 300-foot buffer on each side of the Gray Bench-Cathedral Valley livestock trail. More cacti could exist as the entire 300-foot buffer area has not been surveyed for rare plants. Individual cactus would continue to be subject to trampling by livestock and habitat alterations, such as soil disturbance and increased erosion. Soil disturbance facilitates the spread of invasive plant species, which can be concentrated along livestock trails (Vallentine 2001; Perkins 2016). Trampled Wright fishhook cacti that do not die could have reduced reproductive capability (San Juan College 1994; Clark and Clark 2007).

In addition to passing through habitat for Wright fishhook cactus, the Gray Bench-Cathedral Valley trail also crosses rangewide habitat for Winkler cactus and Last Chance townsendia that is not occupied. The degree of impacts on cacti and habitat would depend on the duration, intensity, and timing of trailing and the speed at which livestock are moved along the trail, which affect how far livestock stray from the trail. Under Alternative 1, 140 to 180 livestock would travel the length of the trail in less than 1 day each fall, disturbing approximately 650 acres of Wright fishhook cactus and Last Chance townsendia habitat and 450 acres of Winkler cactus habitat along the trail. Because this is the nonreproductive period, there is no threat of flowers or fruits being dislodged from a plant. Livestock typically travel along braided trails that exist on either side of a main trail. According to USFWS guidelines, potential impacts on listed plant species should be considered up to 300 feet on either side of the main trail (USFWS 2011).

Capitol Reef National Park would continue to cooperate with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive vegetation along four of the livestock trails: Highway 24, Oak Creek, Pleasant Creek, and Gray Bench-Cathedral Valley. Livestock have been shown to increase the potential for invasive vegetation to displace native vegetation (Ohmart 1996). Russian thistle and tamarisk are consistently detected along the portion of the Gray Bench-Cathedral Valley livestock trail that follows the Cathedral Valley road and appear to be increasing in frequency and percent cover (Perkins 2016). At the time of the 2015 monitoring, Russian thistle was the most widespread invasive species along the Cathedral Valley Road section of this livestock trail and also had the highest average percent cover (Perkins 2016). Seeds from invasive plants established along this trail could be dispersed throughout the adjacent park lands by wind, water, animals, and vehicles.

Invasive plant species that become established in Wright fishhook cactus habitat could displace Wright fishhook cacti, substantially degrading their habitat, and extending the impacts of livestock trailing beyond the trail itself. Herbicides would not be used close to any known Wright fishhook cactus; instead, hand-pulling or other mechanical means would be used to control invasive plants.

Range monitoring and adaptive management. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. Potential negative impacts of livestock trailing on habitat, which indirectly affects listed plant species by, for example, soil degradation, altered hydrology, decreased plant vigor, altered species composition, and invasive species, would continue along the Grey Bench-Cathedral Valley trail as would direct damage and disturbance to individual Wright fishhook cactus. Impacts on cacti at select localities would be monitored after each trailing event, as described in Appendix C. If the threshold of damage or disturbance to Wright fishhook cactus is exceeded (i.e., $\geq$5% of cacti damaged or $\geq$15% disturbed), actions would be taken to reduce the impacts. For example, livestock could be trailed on an alternative route or alignment, or temporary fencing could be installed to contain livestock within a designated corridor to keep them away from populations of listed plant species. Designating corridors would help keep trailing livestock in a defined area, rather than allowing them to stray off trail, thereby minimizing the potential for trampling listed plants and their habitats.

Cumulative impacts. The cumulative impact analysis considers impacts on listed plant species along the Gray Bench-Cathedral Valley trailing route. It focuses on the incremental impact of actions under Alternative 1, when added to other past, present, and reasonably foreseeable actions.

As described in Chapter 3, decades of livestock grazing and trailing in the planning area have degraded rangeland conditions, including reduced vegetation cover and density, altered species composition with incursion of invasive plants, decreased plant vigor and vegetation complexity, and lack of vegetation recruitment. The presence of cheatgrass and Russian thistle, which occur throughout the planning area, including along the Gray Bench-Cathedral Valley livestock trail, is related to past grazing.

In addition to past grazing practices, other actions in or near the planning area contribute cumulative impacts on Wright fishhook cactus. Maintenance on the Cathedral Valley dirt road, especially road grading and water bar creation or maintenance, could result in plants being dislodged or damaged by heavy equipment. As in the past, this could result in direct mortality or loss of habitat for Wright fishhook cactus.

The recent relinquishment of grazing in the NPS portion of the Hartnet allotment is expected to result in substantial benefits to Wright fishhook cactus by protecting habitat and individuals from impacts of chronic livestock grazing (Hornbeck 2017). This recently retired allotment includes much of the habitat and nearly 50% of the known Wright fishhook cactus individuals in the park. The population of Wright fishhook cacti within the allotment is expected to recover once impacts from livestock grazing, which

have occurred in the allotment for 7 or more months each year for more than 100 years, are removed. Populations should respond positively to decreased habitat degradation and reduced damage and disturbance to individuals. Because Wright fishhook cacti are long-lived species with low fecundity rates, recovery to stable populations could take decades. Surveys conducted in May 2017 in the Rock Springs allotment, which has been retired from grazing for approximately 30 years, recorded some of the highest densities of Wright fishhook cacti in the park.

While most of the past, present, and reasonably foreseeable actions would adversely affect Wright fishhook cactus by causing mortality of some individual plants and degradation of habitat, retirement of the Hartnet allotment is expected to result in nearly 19,000 acres of the species habitat and nearly 50% of the known individuals in the park being protected from the impacts of livestock grazing, which would result in a cumulative beneficial effect compared with current conditions. When combined with the continuation of adverse impacts on Wright fishhook cacti (at least 113 individuals) and their habitat (approximately 650 acres) under Alternative 1, the overall cumulative impact on Wright fishhook cacti would still be beneficial compared with current conditions, again, largely due to the anticipated recovery of 19,000 acres of Wright fishhook habitat and the individuals therein. The incremental contribution of Alternative 1, however, would reduce the cumulative beneficial impacts that would be realized.

Conclusions. Capitol Reef National Park provides important habitat for the Wright fishhook cactus. Under the ESA, the National Park Service is mandated to protect and recover federally listed species. NPS Management Policies (NPS 2006) states that the National Park Service would, under its authority, contribute to both the survival and recovery of federally listed species and manage for native species in NPS units. Protecting listed plants requires healthy functioning and resilient ecosystems, which depend on various ecological features, such as biological soil crust, vegetation diversity, native species assemblages, properly functioning hydrologic systems, and robust ecological processes. Such a healthy assemblage of ecosystems that protects listed plant species is one of the park's fundamental resources and values (NPS 2017b).

Under Alternative 1, Wright fishhook cactus and its habitat would continue to be adversely affected by livestock trailing along the Gray Bench-Cathedral Valley trailing route (Kass 1990; San Juan College 1994; Clark and Clark 2007; NPS 2014b). Approximately 650 acres of Wright fishhook habitat along the trail would be disturbed 1 day each fall by 140 to 180 livestock. These acres comprise less than 0.01% of the species' rangewide distribution (Spector 2013). This disturbance would decrease soil stability, facilitating wind and water erosion and the spread of invasive plant species along the trail and beyond as seeds are distributed by wind, water, animals, and vehicles.

At least 113 documented Wright fishhook cacti would be subject to potential damage and disturbance from livestock as they travel along the Gray Bench-Cathedral Valley trail 1 day each fall. Because the entire trail has not been surveyed, this should be considered a conservative number. The 113 documented individuals represent approximately 3% of the known number of Wright fishhook cactus in the park and 0.8% of the known number rangewide. These cacti would be vulnerable to trampling, uprooting, or disturbance by livestock, potentially resulting in mortality or reduced reproduction. Because trailing would occur in the fall, there would be no threat of livestock dislodging flowers or fruits of reproductive plants. Under this alternative, damage and disturbance to Wright fishhook cacti would be evaluated after each trailing event as described in Appendix C. If thresholds were exceeded, adaptive management measures described in Alternative 2 would be implemented. which would reduce damage and disturbance to cacti. The Sandy 3 allotment does not provide habitat for any of the federally listed plant species; therefore, there would be no impacts on listed plant species there.

When the impacts of other cumulative actions are combined with the impacts under Alternative 1, the overall cumulative impact on Wright fishhook cactus would be beneficial. While approximately 650

acres of habitat and at least 113 individuals would continue to be affected under Alternative 1, which would reduce the overall cumulative benefit, the retirement of the Hartnet allotment would result in the recovery of 19,000 acres of Wright fishhook cactus habitat and would protect more than 1,700 individuals from direct damage and disturbance by livestock, resulting in an overall benefit to the species.

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock activities on listed plant species in the park, which are described under the Alternative 1 analysis above, would continue to occur along the Gray Bench-Cathedral Valley livestock trail, affecting Wright fishhook cactus and its habitat. Similar impacts could also occur for all three listed plant species from issuing new trailing permits for the Hartnet and Lower South Desert trailing routes through the recently retired Hartnet allotment. These impacts, which are influenced by the duration, timing, and intensity of trailing, are applied in conducting the analyses that follow.

Winkler cactus. Documentation of livestock impacts on *Pediocactus* species dates back to the 1980s (Heil 1981; Neese 1987) and has continued through the present (Borthwick and Livensperger 2017a). Livestock trampling can crush Winkler cacti, entirely or partially uproot them, or damage their growing tip, resulting in an inability to reproduce (San Juan College 1994; Clark and Clark 2008a; Clark et al. 2015).

Clark et al. (2015) found that there was a cumulative impact on cactus mortality from multiple years of ungulate disturbance, defined as a track within 1 inch (2.54 cm) of a cactus. If a cactus was disturbed in the current year, the odds of it dying were 1.95 times greater than an undisturbed cactus. The probability of an undisturbed cactus dying was 3%; however, if it was disturbed twice, the probability increased to 9%, and if disturbed three times during any 3-year period, the probability of dying increased to 17% (Clark et al. 2015).

As with Wright fishhook cactus, Winkler cactus appears to be incompatible with chronic livestock activity, particularly in the presence of other impacts, such as uncertain climate change, rodent herbivory, and insect predation (Hornbeck 2017). This is consistent with findings by Clark and Clark (2008) who concluded that compounding impacts of persistent drought, low fecundity, and small numbers of cacti at sites make Winkler cactus vulnerable to other impacts. *Pediocactus* sites with large numbers of cacti are relatively uncommon (Clark and Clark 2008a; BLM 2015a; NPS 2012a, 2013b, 2014a). Sites with fewer cacti are more vulnerable to extirpation than sites with more. This information, coupled with the fact that these plants have a very low fecundity rate, suggests that many localities may be at risk. The authors state that every adult cactus in a population is critical, and any impact that increases adult mortality would adversely affect overall population survival.

Last Chance townsendia. Livestock grazing has been cited as a threat to Last Chance townsendia, with a potential to cause direct and indirect impacts (USFWS 1993, 2013a); however, studies that document direct impacts of livestock on Last Chance townsendia are limited (Clark 2005, 2008b; USFWS 2013a). A demographic study of the species conducted by Clark (2008b) began in 1996, with 232 live plants in a 50-square-foot (15-square-meter) plot. Although livestock contributed to Last Chance townsendia mortality—6 of 13 trampled plants died—livestock use of this area was low, and impacts from livestock were not a substantial mortality factor (Clark 2008b; USFWS 2013a).

San Juan College researchers (1994) concluded that livestock grazing in the recently retired Hartnet allotment in Capitol Reef National Park was having a moderate to low impact on Last Chance townsendia, with damage to plants being infrequent. The major impact was degradation and destruction of suitable habitat through soil compaction, trailing, and loss of vegetation. The US Fish and Wildlife

Service (2008) rated livestock activities as being a moderate threat to Last Chance townsendia, based on its rangewide scope, the immediacy of the threat, and the small exposure of the threat, with less than 10% of the total population being exposed.

Sandy 3 allotment. There are no listed plant species or habitat in the Sandy 3 allotment, so none would be affected.

Livestock trailing. Under Alternative 2, livestock trailing would continue on the eight currently permitted trailing routes. Of these routes, the Gray Bench-Cathedral Valley trail, which passes through Wright fishhook cactus occupied habitat, is the only trail in which listed species or their occupied habitat would be affected. As described in Alternative 1, this trail also crosses rangewide habitat for Winkler cactus and Last Chance townsendia that is not occupied. The impacts from livestock trailing on listed plant species and their habitat along this trail would be the same as those described under Alternative 1, such as soil disturbance, spread of invasive plants, and damage and disturbance to individual cactus. Under Alternative 2, however, permit holders would be required to use riders to move livestock at a deliberate pace instead of allowing them to linger and spread out as they trail across park lands. This would reduce the amount of time livestock are in the park and the exposure of Wright fishhook cactus and their habitat to livestock trampling, grazing, and browsing.

The Hartnet trail passes through occupied habitat for all three listed plant species while the Lower South Desert trail passes through occupied habitat for the two listed cactus species (Table 3.13). Along these routes, plants would be subject to trampling by livestock, which could result in mortality or reduced reproductive capability (San Juan College 1994). Habitat alterations, such as soil disturbance and increased erosion, would occur along both trails. Soil disturbance facilitates the establishment of invasive plant species, which can be concentrated along livestock trails with potential to spread farther (Vallentine 2001; Perkins 2016).

Thirty to 150 livestock would be moved along the Hartnet trail in 1 day each October and possibly 1 day in June; on a case-by-case basis, trailing could occur over a 2-day period. Trailing in June would affect Wright fishhook cacti during their reproductive period when fruits on the plants could be dislodged. As described for the Gray Bench-Cathedral Valley trail, riders would be used to move livestock steadily along to reduce the amount of time livestock are in the park and the exposure of listed plant species and their habitat to livestock trampling, grazing, and browsing. If livestock trailing were to occur over a 2-day period, there would be an increased risk for damage and disturbance to individuals and habitat of all three listed species.

For the Lower South Desert trail, each fall up to 200 livestock would overnight at the beginning (i.e., south end) of this trail after having trailed 20 miles from Torrey down the Highway 24 trailing route. Because they would be unrestrained, it is possible that some livestock would move up the Lower South Desert during the night perhaps going as far as Deep Creek Spring (approximately 4 miles) or Baker Seep (approximately 8 miles) to water. Wright fishhook cactus is the only listed plant species with occupied habitat and individuals in the area between the beginning of the trail and these water sources. Because livestock would be unrestrained, approximately 1,030 acres of habitat that exists within that area could be subject to impacts from livestock. (The acres potentially affected are based upon a 0.25-mile buffer around water sources along the Lower South Desert trail, and a 300-foot buffer on portions of the trail outside the buffered water sources). There are 57 documented Wright fishhook cacti in the area that could be subject to livestock impacts, and likely more as that entire area has not been surveyed for rare plants.

The next day riders would push the livestock up to Jailhouse Rock, then east up the Lower South Desert Overlook trail and beyond to BLM-administered lands. Riders would be used to move livestock quickly

through this area on a designated corridor to avoid sensitive resources in the area. Trained and qualified staff from the National Park Service would also be involved to ensure livestock keep moving and do not get into sensitive areas.

For Wright fishhook cactus, Winkler cactus, and Last Chance townsendia, the percentage of their known rangewide population exposed to livestock trailing for 1 day, once or twice a year under Alternative 2 is 2.7%, 4.3%, and 1.3%, respectively (Table 4.5). The acres of each species habitat along the trailing routes and the percentage of the rangewide distribution affected are shown in Table 4.6.

TABLE 4.5. NUMBER AND PERCENTAGE OF INDIVIDUALS RANGEWIDE POTENTIALLY AFFECTED UNDER ALTERNATIVE 2 FOR EACH OF THE THREE FEDERALLY LISTED PLANT SPECIES[a]

Species	Number known in the Planning Area	Percentage of Known Population of Species Affected Rangewide	Number of Known Localities[b]
Wright fishhook cactus[c]	402	2.7%, based on 14,576 known individuals	20
Winkler cactus	258	4.3%, based on 5,944 known individuals	11
Last Chance townsendia	86	1.3%, based on 6,848 known individuals	2

[a] Not all habitat along the trails has been surveyed, and the number of individuals and localities is expected to increase with future surveys.
[b] Localities are systematically surveyed areas with one or more individuals.
[c] Livestock trailing up the southern part of the Lower South Desert are expected to stay within the Deep Creek valley; however, because the exact trailing route is unknown, the number of Wright fishhook cactus includes all individuals within the Lower South Desert area. Beyond that point to BLM-administered lands, livestock would be herded along a designated route.

TABLE 4.6. ACRES OF HABITAT AND PERCENTAGE POTENTIALLY AFFECTED UNDER ALTERNATIVE 2 FOR EACH OF THE THREE FEDERALLY LISTED PLANT SPECIES

Species	Acres of Habitat Along Trailing Routes[a]	Percentage Potentially Affected Within Occupied Distribution
Wright fishhook cactus	2,554	0.40% (based on 696,100 acres; Spector 2013)
Winkler cactus	1,280	0.70% (based on 189,000 acres; USFWS 2015)
Last Chance townsendia	1,404	15.6% (based on 9,000 acres; USFWS 2013a)

[a] Based on a 300-foot buffer on either side of the portion of the trailing route within the species rangewide distribution. For the Lower South Desert trail also includes acres within a 0.25-mile buffer around spring sources where livestock may concentrate as they travel up the Lower South Desert.

As under Alternative 1, Capitol Reef National Park would continue to cooperate with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive plants along four of the livestock trails: Highway 24, Oak Creek, Pleasant Creek, and Gray Bench-Cathedral Valley. Under Alternative 2, Capitol Reef National Park would initiate invasive plant control along all livestock trails analyzed in this EA as needed and as staff and funds allow. Herbicides would not be used close to listed plant species; instead, hand-pulling or other mechanical means would be used.

Controlling invasive plants along the Gray Bench-Cathedral Valley, Hartnet, and Lower South Desert trailing routes would benefit the three listed plant species. If left uncontrolled, seeds from invasive plants established along these trails could spread throughout the habitat of listed plant species by wind, water, animals, and vehicles. Once established, invasive species could outcompete and displace listed plant species and degrade their habitat, thereby extending the impacts of livestock trailing well beyond

the trail itself. Well-established populations of invasive plants can fragment listed species habitat and impact the habitat of their pollinators.

Range monitoring and adaptive management.
As under Alternative 1 and as described in Appendix C, listed plant species in select localities along trailing routes would be monitored after each trailing event. If the threshold of damage or disturbance to listed plants is exceeded (≥ 5% damaged or ≥15% disturbed), actions would be taken to reduce the impacts. This could include trailing livestock on an alternative route or installing temporary fencing to keep livestock away from populations of listed plant species. Designating corridors would help keep trailing livestock in a defined area, rather than allowing them to stray off trail, thereby minimizing the potential for trampling listed plants and their habitats.

Adaptive management actions for the Lower South Desert trail would include using temporary fencing to contain livestock overnight rather than allowing them to slowly make their way up the Lower South Desert to Deep Creek Spring or Baker Seep. This would reduce damage to Wright fishhook cactus habitat and reduce the potential for damage to individual cactus. Habitat in the area where livestock are confined would be lost.

Adaptive management actions could also include modifications to the trailing routes or temporary fencing. Temporary fencing along trail corridors could also have impacts, such as soil disturbance from installation and potential incursion of invasive plant species. Because temporary fencing would typically be used to protect sensitive resources during trailing, it would be in place for only 1 to 2 days; therefore, it would not have impacts from permanent fencing, such as habitat loss due to livestock walking along the fence line.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative 2. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

In addition, cumulative actions for Alternative 2 would include maintenance of the unpaved Hartnet Road, which the Hartnet trailing route follows. Activities such as road grading and water bar creation or maintenance could result in plants of all three listed plant species being dislodged or damaged by heavy equipment. This could result in the direct mortality or loss of habitat for these species. Regardless, given that populations of each species are expected to respond positively to the release from chronic exposure to livestock through the retirement of the Hartnet allotment, which has been documented as negatively affecting population structure and growth rates of both cactus species (Hornbeck 2017).

When the impacts of cumulative actions, including recovery of listed species and their habitat in the recently retired Hartnet allotment, are combined with impacts under Alternative 2, the overall cumulative impact on listed plant species would be beneficial. While trailing through the recently retired Hartnet allotment could delay recovery of listed species habitat and populations along these two trails, the condition of the habitat would be expected to improve because habitat and plants would be exposed to livestock for 1 to 2 days, once or twice per year, rather than for up to 7.5 months each year, as has occurred for more than 100 years. This, combined with the monitoring and adaptive management actions proposed under Alternative 2, would result in beneficial cumulative impacts on listed species and their habitat compared with current conditions.

Conclusions. Habitat degradation by livestock grazing is described as a primary adverse impact on all three federally listed plant species in the planning area (USFWS 2008b, 2013a, 2015b; Spector 2013). Although trailing livestock as proposed under this alternative would have adverse impacts on listed

plant species and their habitat, the short duration and low frequency of the trailing events would result in substantially reduced impacts compared with months of grazing each year, which most of the studies cited previously are based upon. Also, most trailing events through listed species habitat would occur in the fall outside the reproductive season and when Winkler cacti are typically at or below the ground surface, so they may be somewhat protected from livestock trampling.

Capitol Reef National Park's mandate to protect and recover listed plant species under the ESA and NPS Management Policies, and the fundamental values related to listed species as described under the *Conclusions* for Alternative 1, also apply to Alternative 2.

Impacts on listed species habitat and individuals along the trailing routes analyzed under this alternative would be similar to those described under Alternative 1, for example, decreased soil stability, increased erosion, an increase in invasive plant species, and damage and disturbance to individual listed plants resulting in mortality or reduced reproduction. Because there are two additional trails under Alternative 2, however, more listed plant species habitat and individuals would be exposed to livestock impacts than under Alternative 1. Impacts would occur to Winkler cactus and Last Chance townsendia, in addition to Wright fishhook cactus addressed in Alternative 1.

Compared with Alternative 1, Alternative 2 would result in potential habitat disturbance to an additional 1,900 acres for Wright fishhook cactus, 830 acres for Winkler cactus, and 760 acres for Last Chance townsendia. This is less than 1% of the occupied distribution for Wright fishhook cactus and Winkler cactus, respectively, and nearly 16% of the occupied habitat for Last Chance townsendia (Table 4.6). Compared with Alternative 1, Alternative 2 would result in approximately 289 more Wright fishhook cactus, 258 more Winkler cactus, and 86 more Last Chance townsendia potentially being exposed to livestock activities for 1 to 2 days, once or twice each year. These are documented individuals and since not all habitat has been surveyed along the trails, these should be considered minimum numbers. The number of individuals of each species affected ranges from 1% to 4% of the species rangewide populations (Table 4.5).

Under Alternative 2, riders would be used to move livestock steadily along the Gray Bench-Cathedral Valley trail, the Hartnet trail, and the upper part of the Lower South Desert trail, which would reduce the time livestock are in the park, encourage livestock to trail in a line rather than in a bunch to minimize the distance livestock stray from the trail, and reduce exposure of listed plants and their habitat to livestock. These practices are expected to minimize adverse impacts on listed plant species along the trailing routes.

Alternative 2 proposes the same monitoring for listed plant species described under Alternative 1. Adaptive management actions proposed under Alternative 2, such as temporary fencing to contain livestock overnight or to designate trail corridors, would help reduce impacts on listed plants and their habitat along the trailing routes and facilitate meeting desired conditions (Appendix C).

When the impacts of other cumulative actions are combined with the impacts under Alternative 2, the overall cumulative impact on the three listed plant species would be beneficial. While approximately 5,200 acres of list plant species habitat and at least 746 individuals would continue to be affected from trailing 1 to 2 days, once or twice each year under Alternative 2, which would reduce the overall cumulative benefit, the retirement of the Hartnet allotment would result in the recovery of 19,000 acres of listed plant species habitat and would protect approximately 4,500 individuals from direct damage and disturbance by livestock, resulting in an overall benefit.

Mexican Spotted Owls

Impacts under Alternative 1

Under Alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The types of impacts of livestock grazing that are influencing the current condition of MSO in the park (see Chapter 3) would continue to occur in actively grazed areas of the Sandy 3 allotment and along currently permitted trailing routes. These impacts, which are influenced by the duration, timing, and intensity of grazing or trailing, are described generally below, and applied in conducting the allotment-level analyses that follow.

Livestock can adversely affect MSO, mostly through degrading riparian and meadow plant communities, diminishing the prey availability and abundance, and reducing the ability of plant communities to develop into more suitable MSO habitat (USFWS 2012a). Within MSO foraging habitat, livestock grazing and vegetation trampling can reduce vegetation density and diversity, affect species composition, and reduce the complex vertical structure of vegetation. This would lower the overall plant cover and create bare ground, ripe for incursion of invasive plant species (Willey 1994; Earnst et al. 2005; USFWS 2012a).

Invasive plants affect species diversity, community structure, soil stability, and ecosystem functions (DiTomaso 2000). Invasive plants can displace native vegetation, thereby altering species composition and community structure. This can adversely affect cover and food sources for spotted owl prey.

Poorly managed livestock grazing affects the ability of plant communities to recover and develop into more suitable spotted owl habitat (USFWS 2012a). Riparian and meadow plant communities are especially vulnerable to trampling and grazing. Deteriorating riparian vegetation can lead to channel widening, which can lead to elevated water and soil temperatures. This can contribute to evaporation and lower water tables, and significantly increase the potential for accelerated flood damage. These events could alter the microclimate and vegetation of riparian areas and impair their use by MSOs and their prey (USFWS 2012a).

Block et al. (2005) commented that MSO recovery should not only address roosting and nesting habitat but should also manage the habitat of preferred prey species. Healthy stands of vegetation are required to provide protective cover and food for the owl's prey species, including voles and woodrats (USFWS 2012a).

Moderate to high-intensity grazing over several consecutive seasons can reduce vegetation productivity and change species composition, density, vigor, and cover. This can result in overall fragmented prey habitat and reduced prey species diversity or distribution, ultimately diminishing food availability for owls (USFWS 2012a). Willey and Willey (2010) attributed differences in rodent species diversity and abundance to the impacts of livestock grazing or lingering in riparian habitats. The number of woodrats and mice, the primary prey of spotted owls, were reduced in two grazed riparian areas, compared with two ungrazed riparian areas, with nearly identical precipitation patterns, vegetation composition, elevation, and stream flows (Willey and Willey 2010).

The Mexican Spotted Owl Recovery Plan (USFWS 2012a) identifies riparian habitats that are key areas for owl recovery. Riparian areas provide important foraging habitat for owls and can act as refuges for small mammals during droughts. Degraded riparian areas do not provide suitable foraging habitat for spotted owls, which can lead to declining owl populations (USFWS 2012a).

Intense grazing during the growing season could diminish native seed availability or production, especially when bare ground is encroached upon by invasive plant species (Belsky and Gelbard 2000). Many of the spotted owl's prey species use seeds for food. Prey availability would likely decrease if herbaceous cover and seed production are sufficiently damaged over consecutive years in riparian habitats.

Reduced food availability would result in an energy or food shortage, which would be most critical during the breeding season and could contribute to reproductive declines (USFWS 2012a; Willey and van Riper 2014). Starvation can be a major factor for juvenile spotted owl deaths and can result from low abundance or availability of prey (Willey and van Riper 2000). Maintaining suitable habitat for prey would reduce the threat of starvation.

The impacts highlighted here are most likely to affect owls if they forage in or next to grazed areas preferred by livestock (Ward and Block 1995; Willey and Willey 2010; Willey and van Riper 2014; USFWS 2015a).

The Mexican Spotted Owl Recovery Plan (USFWS 2012a) lists the following specific livestock grazing guidelines that should be applied to grazing management in all PACs and recovery habitats that include riparian foraging habitat. These guidelines would be met by conducting PFC assessments in Oak Creek to determine if PFC is maintained; if not, then adaptive management would be implemented.

- Conduct site-specific assessments using standardized monitoring techniques to identify: a) habitat conditions for MSO prey species; b) conditions of riparian habitats including their functional processes (BLM 1996)
- Establish and enforce residual vegetation (e.g., stubble height) targets during plant growth and dormant periods that are consistent with light to moderate grazing intensity
- Implement management strategies for livestock and wild ungulates that would improve degraded riparian communities in owl habitats to proper functioning ecological condition as soon as possible and implement monitoring programs to evaluate improvement in habitat conditions. Implement management strategies that would restore "good" range condition to degraded riparian communities, as soon as possible

Activities associated with livestock trailing may slightly increase human presence in spotted owl habitat, which may affect the behavior of the owls during breeding, nesting, and foraging (USFWS 2015a). Human presence and the rapid increase in the localized density of livestock associated with trailing in owl foraging areas could temporarily displace owls over the days trailing occurs. This impact would be slightly higher during the breeding season, from March 1 through August 31 (USFWS 2012a).

Livestock trailing. Under Alternative 1, the above-noted impacts from livestock activities are expected to continue along trailing routes. The following describes how these effects would translate to the Pleasant Creek and Oak Creek trailing routes.

Livestock typically trail across park lands in large groups, affecting vegetation on approximately 279 acres of vegetation along the Oak Creek and Pleasant Creek trailing routes. Trailing in the Pleasant Creek corridor would typically occur in early to mid-October. Livestock overnight within the park at the east end of the trail. The next morning they are moved out of the park and continue to trail to their BLM allotment. The trailing is expected to have minimal impacts on spotted owl prey habitat, because it is outside the vegetation growing season and the MSO reproductive season.

Based on riparian assessments conducted in 2014 and 2016, Pleasant Creek's riparian system was in PFC, which suggests that impacts of livestock trailing under Alternative 1 would not be sufficient to degrade the system; the area would continue to provide suitable habitat, such as vegetation cover and diversity, for MSO prey; however, the 250 livestock that would be held overnight at the east end of the Pleasant Creek trail could cause localized impacts on riparian habitat through trampling and grazing.

In the future, new permits would be considered for trailing on Pleasant Creek on a case-by-case basis; however, with an occupied MSO PAC within 0.3 miles of Pleasant Creek, the National Park Service would need to develop and implement such mitigation measures as limiting the number of livestock and not allowing trailing during the MSO breeding season. This would ensure proper functioning of Pleasant Creek riparian habitat and would protect spotted owl foraging habitat.

Livestock would be allowed to trail in Oak Creek once in early June and again in mid-October, with approximately 1,100 livestock trailed each season. Livestock trail the 4 miles across park lands in a large group, affecting vegetation and soils on approximately 110 acres. Riparian condition assessments of Oak Creek conducted in 2014 and 2016 rated the riparian area as nonfunctional, based on the poor hydrologic, vegetation, and streambank conditions (Martin and Wagner 2015; Capitol Reef National Park 2016).

Repeated unauthorized livestock use of Oak Creek is believed to contribute substantially to the poor riparian conditions. Due to the unauthorized livestock, it is not possible to evaluate the extent to which authorized trailing contributes to the nonfunctional riparian condition (USFWS 2015a). Under this alternative, park staff would continue to determine ownership of unauthorized livestock and request their removal. Under Alternative 1, additional permits would not be considered for the Oak Creek trail until the riparian corridor in the park is in PFC.

Although there is uncertainty in how the impacts described above, and the trends described in the affected environment, would influence functioning condition under Alternative 1, the National Park Service expects that conditions would continue or worsen, because the nonfunctional rating of Oak Creek was due in part to the poor condition of vegetation in the riparian area, including low diversity, cover, vigor, and recruitment of plants, resulting from livestock trampling and herbivory (Martin and Wagner 2015; Capitol Reef National Park 2016). The nonfunctional rating suggests that the primary constituent element of spotted owl critical habitat related to maintaining adequate prey species is degraded (USFWS 2015a). Lack of adequate vegetation density, structure, and cover (another primary constituent element for foraging habitat) could affect the diversity and abundance of spotted owl prey species (Willey and Willey 2010).

Impacts from the June trailing would be greatest, because reduced vegetation cover and productively could reduce the spotted owl prey species abundance during its reproductive period, when prey availability is most critical (USFWS 2012a, 2015b). In Capitol Reef National Park, spotted owl juveniles typically fledge in June; however, they still depend on the adults to provide food. Juveniles require more food the older they are. Adverse impacts on prey availability could result in a localized reduction in spotted owls. This would come about by limiting food resources and therefore reproductive success of the owls and survival of young. There is one occupied PAC within 0.75 miles of Oak Creek, and another within 2 miles, making it very likely that Oak Creek is important foraging habitat for owls if not for poor conditions resulting from livestock activity.

Activities associated with livestock trailing would increase human presence and disturbance in spotted owl habitat. This could affect the behavior of the owls during breeding, nesting, and foraging (USFWS 2015a). The human presence and rapid increase in the localized density of livestock trailing through the Pleasant Creek and Oak Creek riparian corridors would likely cause foraging owls to avoid the areas

until the activity has ended. Foraging spotted owls would be most affected by being displaced from Oak Creek during the June trailing. This is because it occurs when juvenile owls have fledged but still depend on their parents for food. This requires greater foraging effort by adults, compared with the nonbreeding season.

Capitol Reef National Park would continue to cooperate with the NPS NCPN and the NPS Lake Mead Exotic Plant Management Team to monitor and control invasive vegetation along Pleasant Creek and Oak Creek. Invasive plants along these creeks include cheatgrass, Russian thistle, Russian olive, and tamarisk (Perkins 2016). Tree-of-heaven also has been detected along Pleasant Creek (Perkins 2015). The encroachment of tamarisk and Russian olive trees into cottonwood and willow habitat in Oak Creek and Pleasant Creek affects the physical and biological features essential to the recovery of the species. It does this by changing riparian vegetation diversity, density, structure, and cover important to MSO prey species.

Continued moderate to severe livestock browsing on cottonwood and willow in Oak Creek, as documented in the 2014 and 2016 riparian assessments over consecutive years (Martin and Wagner 2015; Capitol Reef National Park 2016), would give invasive trees, which are unpalatable to livestock, a competitive advantage. Replacing native trees and shrubs by invasive species changes the composition and structure of riparian vegetation and therefore could degrade habitat for MSO prey species. In a study along the Virgin River in the Mojave Desert, desert woodrats (*Neotoma lepida*), a primary prey of MSO, were found to be associated with native trees and woody debris, rather than with *Tamarix*-dominated stands (Bateman and Ostoja 2012).

Monitoring and adaptive management. Capitol Reef National Park would monitor MSO habitat in Oak Creek and Pleasant Creek according to protocols developed with the US Fish and Wildlife Service. This would include using the livestock grazing guidelines from the 2012 recovery plan (USFWS 2012a).

Riparian condition assessments would continue to evaluate whether the riparian area is maintaining or moving toward PFC. Stubble height of 10 to 15 centimeters would be monitored to determine if utilization standards are being met (see *Desired Conditions* in Appendix C). In addition, monitoring in accordance with the MSO recovery plan (UWFSW 2012) would continue. This data would inform land managers about issues related to unauthorized livestock trailing of Oak Creek and whether desired conditions for MSO habitat are being met. If, through monitoring, it is determined that conditions are not being met, the National Park Service would implement adaptive management intended to meet the desired conditions. This could include working with permittees to use Dry Bench instead of Oak Creek.

Meeting desired conditions would result in vegetation that supports a healthy population of small mammal prey species. This would improve survival and reproductive success of spotted owls. Monitoring would be conducted annually in Oak Creek. Because Pleasant Creek is in PFC, monitoring would be conducted every 3 years, unless changes occur that could affect its condition.

Cumulative impacts. While reservoir development upstream of Oak Creek has some contribution to the riparian conditions important to foraging MSOs, as described in Chapter 3 and above, decades of livestock trailing, as well as repeated unauthorized livestock use, has impacted foraging habitat for MSOs along the Oak Creek Trail. Examples are reduced cover and density, altered species composition, introduced invasive plants, decreased vegetation complexity, and lack of vegetative recruitment. These degraded conditions affect small mammal species diversity and abundance (Rosenstock 1996; Willey and Willey 2010). This has adversely affected the quality of foraging habitat for spotted owls where these conditions overlap with spotted owl populations or designated critical habitat.

Other present and foreseeable actions in or near the planning area and identified previously in this chapter that could have cumulative impacts on resources are not expected to cumulatively affect MSOs in Oak Creek. When the impacts of past trailing are combined with the adverse impacts on MSOs and their foraging habitat under Alternative 1, such as reduced vegetation cover and structure in Oak Creek for small mammal prey, there would be an overall adverse impact on MSOs and their habitat. This could increase mortality and decrease owl reproduction. The impacts on owl foraging habitat from livestock trailing through Oak Creek with little herd management or adaptive management under Alternative 1 would contribute substantially to this impact within the Oak Creek area and the closest PACs.

Conclusions. Both Pleasant Creek and Oak Creek are in suitable MSO habitat. They have been identified as having potential foraging habitat for owls, which could be affected by livestock grazing and trampling (Willey and Zambon 2014; USFWS 2015a). There is a PAC within 0.3 miles of Pleasant Creek and PACs within 0.75 and 2.0 miles of Oak Creek. Both creeks are likely important forging habitat for owls occupying those PACs.

During the 2014 and 2016 riparian condition assessments, Pleasant Creek was rated as being in PFC (Martin and Wagner 2015; Capitol Reef National Park 2016); therefore, continued fall trailing of 250 livestock down this corridor is not expected to affect owl foraging habitat. Local habitat could be degraded along the eastern portion of the trail, where livestock would be held overnight; however, the impacts are not expected to be substantial, given the short duration and timing of when livestock would be there. Vegetation that is grazed or trampled would have the spring growing season to recover and would provide habitat for small mammals during the MSO reproductive season of March through August.

Oak Creek, however, was rated as nonfunctional during the 2014 and 2016 riparian condition assessments (Martin and Wagner 2015; Capitol Reef National Park 2016). Under this alternative, conditions are not expected to improve, and there would be no change in the number of livestock or the duration and frequency of trailing. There could be improvements if unauthorized livestock use were eliminated; however, it has not been possible to separate the impacts of trailing from unauthorized livestock use, so the magnitude of the potential improvement is unknown.

Livestock would continue to trail the 4 miles across park lands in large groups, affecting vegetation and soils on approximately 110 acres along Oak Creek. Impacts associated with grazing and trampling of soils and vegetation would adversely affect the primary constituent elements (i.e., physical and biological features essential to the recovery of the species). This includes the ability of riparian habitat to support adequate prey species and to facilitate reproductive success for owls foraging in Oak Creek.

Under the ESA, Capitol Reef National Park is not allowed to destroy or adversely modify MSO-designated critical habitat. The NPS Management Policies (2006) also requires that the National Park Service protect and recover listed species and their habitats. Although specific adaptive management actions are not included in Alternative 1, if it were selected, conservation measures, developed with the US Fish and Wildlife Service, would be used to minimize or avoid potential adverse impacts on the habitat. As described previously, monitoring also would be conducted to evaluate whether desired conditions were being met.

In conclusion, under Alternative 1, livestock grazing and trampling vegetation in the Oak Creek riparian corridor would continue to degrade habitat for MSO prey species. This would affect owls that use Oak Creek as foraging habitat, such as those in the two PACs within 2 miles of Oak Creek. Those owls could have a reduced ability to feed and successfully raise their young, due to a lack of prey species in Oak Creek. As a result, Alternative 1 would contribute to an overall adverse cumulative impact on MSOs in

the planning area. This would be due to reduced quality of foraging habitat in Oak Creek, which is within 2 miles of two of the nine PACs in the park.

Impacts under Alternative 2
Under Alternative 2, the types of impacts from livestock grazing on MSO in the park, which are described under the Alternative 1 analysis above, would continue to occur along Oak Creek and Pleasant Creek. These impacts, which are influenced by the duration, timing, and intensity of trailing activities, are applied in conducting the analysis that follows.

Livestock trailing. The types of impacts on spotted owl foraging habitat in Oak Creek and Pleasant Creek would be similar to those described under Alternative 1: vegetation trampling, habitat degradation, and spread of invasive plants; however, best management practices proposed under Alternative 2 would facilitate livestock moving more quickly through the park and staying closer to the trail, rather than straying and grazing. To minimize adverse effects on MSO critical habitat, park staff would monitor the trailing to ensure that livestock keep moving and none are left behind to loiter and graze. If these actions were successful, the area of disturbance along each side of the Oak Creek and Pleasant Creek trails would be reduced. This would benefit MSO primary constituent elements (PCEs) in Oak Creek and Pleasant Creek by reducing the amount of time livestock are in the park and the amount of riparian habitat subject to livestock trampling, grazing, and browsing.

Moving livestock more quickly would also reduce the time that foraging owls are displaced from the riparian area by the presence of humans, horses, and livestock. If permit holders use the Dry Bench trailing route as an alternative to Oak Creek in some years, it would reduce the number of livestock trailing in Oak Creek. This could facilitate improvement in the condition of spotted owl foraging habitat in Oak Creek, including the physical and biological features necessary to ensure conservation of the species, as described previously. Using Dry Bench would also decrease disturbance to foraging owls from human presence and the localized increase in livestock density associated with trailing.

Ownership of unauthorized livestock, which are believed to substantially degrade conditions in Oak Creek, would be determined. Owners would be contacted and would be required to promptly remove the livestock. Noncompliance would result in penalties and may ultimately lead to loss of future trailing privileges.

As a result of these management actions, the nonfunctional condition of Oak Creek would be expected to move toward PFC, with increases in vegetation and structural complexity. This would improve owl PCEs compared with current conditions, resulting in increased reproductive success. As under Alternative 1, no new trailing permits would be considered for Oak Creek until the riparian corridor in the park is in PFC.

Under Alternative 2, up to 300 livestock could be trailed down the Pleasant Creek trail each fall. Capitol Reef National Park would coordinate with the permit holder to develop adequate control for livestock that spend the night at the park's eastern boundary. This would restrict livestock from moving back upstream and grazing and trampling vegetation, which would reduce impacts to the PCE of foraging habitat. As described under Alternative 1, new permits would be considered for trailing on Pleasant Creek on a case-by-case basis.

As described under Alternative 1, Capitol Reef National Park would continue to work with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive vegetation along livestock trails. Under Alternative 2, Capitol Reef National Park would also initiate invasive plant control, as staff and funds allow. Additional efforts to control invasive plants would benefit MSO prey

species by allowing the persistence of native plant species that small mammals prefer (Bateman and Ostoja 2012).

Although there is uncertainty in how much foraging habitat would improve and how long it would take, given the considerations above, including implementation of a monitoring and adaptive management program intended to achieve the desired conditions described in Appendix C, livestock trailing management under Alternative 2, along with increased efforts to address unauthorized livestock use of Oak Creek and to control invasive plants, would benefit spotted owls. This would come about by improving vegetation for small mammals that the owls feed on.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative 2. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

The vegetation changes in Oak Creek can have lasting impacts on habitat suitability and foraging potential for spotted owls and therefore can contribute to cumulative impacts on spotted owl habitat. Under Alternative 2, the severity of these impacts would be reduced, due to the proposed actions of moving livestock more quickly through Oak Creek, monitoring riparian conditions, and implementing adaptive management actions. When combined with the beneficial impacts of Alternative 2, there would be an overall beneficial cumulative impact on MSOs and their critical habitat.

Alternative 2 would contribute substantially to these benefits by moving Oak Creek riparian areas toward meeting PFC and also meeting desired conditions, including the biological and physical features necessary to ensure conservation of the owl, such as adequate levels of plant cover to maintain fruits and seeds and allow plant regeneration.

Conclusions. Although there is uncertainty in how much foraging habitat would improve and how long it would take, given the considerations above, including implementation of a monitoring and adaptive management program intended to achieve the desired conditions described in Appendix C, the actions proposed under Alternative 2 provide for continued and improved protection and recovery of MSO habitat along the Pleasant Creek and Oak Creek livestock trails. Both creeks include potential foraging habitat for spotted owls, which could be affected by livestock grazing and vegetation trampling (USFWS 2015a).

Best management practices proposed under Alternative 2 would result in livestock trailing more quickly through the riparian corridors and fewer being left behind to loiter and graze, than under Alternative 1. This would reduce the amount of time livestock are in the riparian areas and the area of disturbance and the time that foraging owls are displaced due to trailing. Applying penalties for unauthorized livestock would provide incentive for their prompt removal.

Alternative 2 would move the Oak Creek riparian area toward meeting the physical and biological features that are associated with maintaining adequate prey species for spotted owls: diversity of tree and plant species. This would result in improved reproductive success for owls foraging in Oak Creek.

Because there is an occupied PAC within 0.75 miles of Oak Creek and another within 2 miles, it is likely important foraging habitat for owls occupying those PACs. A single owl was detected in Oak Creek during surveys conducted in 2015 and 2016; this was not a nesting owl, but it may have been foraging in the area.

Additional benefits to owl foraging habitat could be realized any time a permit holder uses the Dry Bench trailing route as an alternative to Oak Creek. Having all or a portion of the approximately 1,100 livestock that currently trail Oak Creek each spring and fall use the Dry Bench trail instead would help improve the riparian conditions and foraging habitat for spotted owls. It also would reduce disturbance to foraging owls from trailing.

During the 2014 and 2016 riparian condition assessments, Pleasant Creek was rated as being in PFC (Martin and Wagner 2015; Capitol Reef National Park 2016); therefore, fall trailing of up to 300 livestock down this corridor, 50 more than under Alternative 1, is not expected to affect owl foraging habitat. Under Alternative 2, Capitol Reef National Park would coordinate with the permit holder to develop adequate control of livestock held overnight at the park's eastern boundary to restrict livestock from moving back upstream and degrading habitat by grazing and trampling vegetation. Because there is an occupied PAC within 0.3 miles of Pleasant Creek, it is critical to maintain the riparian habitat in PFC to provide suitable foraging habitat for spotted owls.

Alternative 2 supports the ESA requirement to protect and recover MSO-designated critical habitat by implementing actions, including riparian monitoring and adaptive management, to minimize adverse impacts on habitat. It also supports NPS Management Policies (2006) to protect and recover listed species and their critical habitats.

As under Alternative 1, Capitol Reef National Park would work with the US Fish and Wildlife Service to develop conservation measures and monitoring protocols to ensure that riparian conditions in Pleasant Creek are maintained and that in Oak Creek they are moving toward desired conditions, including PFC. This would improve foraging habitat for spotted owls.

The benefits to MSOs and their habitat under Alternative 2 would support the park's fundamental resources and values for preserving a healthy assemblage of intact park ecosystems (NPS 2017b). Overall, the minimal impacts of Alternative 2 and adaptive management actions would result in beneficial impacts on MSOs and their designated critical habitat.

MIGRATORY AND RESIDENT BIRDS

Impacts under Alternative 1

Under Alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The types of impacts of livestock grazing that are influencing the current condition of migratory and resident birds in the park (see Chapter 3) would continue to occur in actively grazed areas of the Sandy 3 allotment and along trailing routes. These impacts, which are influenced by the duration, timing, and intensity of grazing, are described generally below, and applied in conducting the allotment-level analyses that follow.

Many bird species are adversely affected by livestock grazing, with impacts directly related to the habitat requirements of each species (Bock et al. 1993; Willey 1994; Krueper et al. 2003; Earnst et al. 2005). Livestock can directly affect ground- and shrub-nesting birds by trampling or disturbing nests (Bock et al. 1993; Paine et al. 1996) and reducing the reproductive success of individual birds. Livestock disturbance in grassland and shrublands that could result in nest failure or abandonment are trampling nests, crushing or cracking eggs, knocking eggs out of nests, or covering eggs with manure (Paine et al. 1996). Studies have shown that the risk of nest disturbance by livestock is positively correlated with stocking rates (Schultz 2010; Rolek et al. 2016).

Livestock grazing and trailing may result in a reduced quality or loss of habitat, due to encroachment by invasive plants (Belsky and Gelbard 2000); a decrease in the density, cover, or diversity of shrub and grass species (Willey 1994); a decline in riparian vegetation density or diversity; or a loss of riparian area function (Nelson et al. 2011). Such changes in vegetation can fragment habitat and affect foraging habitat, escape cover, and thermal cover for birds (Bock et al. 1993).

Most bird species that are negatively affected by livestock grazing are those that depend on herbaceous and shrubby ground cover for nesting or for foraging, such as common yellowthroat, vesper sparrow (*Pooecetes gramineus*), and western meadowlark (*Sturnella neglecta*; Bock et al. 1993). Birds typically respond to plant species composition and habitat vegetation structure, which provide for nesting and courtship behavior, foraging perches, prey habitat, and cover from predators (Bock et al. 1993). For example, bird community diversity and species richness vary with vertical and horizontal vegetation structure (Roth 1976). Tramer (1969) found that bird diversity and species richness were greater in vegetation communities with numerous strata.

Depending on the magnitude of livestock activities, vegetation communities can be altered by reduced plant density, altered species composition, decreased plant vigor and vegetation complexity, decreased seed and insect production, and lack of vegetation recruitment (Knopf et al. 1988; Ohmart 1996; Belsky et al. 1999; Krueper et al. 2003; Milchunas 2006). Through trampling and grazing, livestock can affect plant species composition (Fondell and Ball 2004) and the structure of herbaceous and understory vegetation (Earnst et al. 2005). They can also simplify the complex vertical structure of the vegetation, resulting in lower overall plant cover (Willey 1994).

Because livestock affect both vertical and horizontal components of the habitat, they could have an impact, with varying degrees, on many bird species in the planning area. Such impacts on vegetation communities can in turn negatively affect bird reproductive success, food availability, bird density, abundance, and species richness, and survival through increased predation of nests and adults. They also could cause shifts in foraging techniques, distribution, and habitat use (Bock et al. 1993; Willey 1994; Milchunas et al. 1998; Krueper et al. 2003; Earnst et al. 2005). The severity of these impacts is related to the condition of the rangeland, intensity and timing of livestock grazing, and species-specific habitat preferences. For example, Brewer's sparrow abundance was significantly lower at sites with less than 25% cover in climax vegetation[1] than at sites with 25% or greater cover in climax vegetation (Paine et al. 1996).

Specific to Capitol Reef National Park, results from a 1989–1991 study on the impacts of livestock grazing on grassland birds in the recently retired Hartnet allotment's South Desert highlighted some important impacts of livestock grazing on birds (Willey 1994). Bird species richness, relative abundance, and density were all substantially lower in grazed sites, compared with ungrazed sites. The most dramatic and statistically significant differences occurred in habitats with less complex vertical vegetation structure and lower overall plant cover at grazed sites versus ungrazed sites. Bird species, such as vesper sparrows and black-throated sparrows, that select foraging or nesting sites based on those vegetation characteristics, were less abundant in grazed areas (Willey 1994).

Based on their literature review, Bock et al. (1993) provide conclusions on the probable impacts of livestock grazing during the growing season on neotropical migratory birds in the Intermountain West's shrub-steppe habitats. They conclude that the sagebrush sparrow, which is found in the planning area, responds positively to grazing by increasing in abundance; the following species respond negatively, by decreasing in abundance:

[1] Vegetation which, through the process of ecological succession, has reached a steady state

- Brewer's sparrow
- Vesper sparrow
- Western meadowlark
- Savannah sparrow (*Passerculus sandwichensis*)
- White-crowned sparrow (*Zonotrichia leucophrys*)

The following species are unresponsive or show mixed responses; that is, there is no change in abundance or different results among studies:

- Mourning dove
- Horned lark
- Loggerhead shrike (*Lanius ludovicianus*)
- Sage thrasher
- Lark sparrow
- Black-throated sparrow

In shrub-steppe habitats, some bird species, such as Brewer's sparrows and sage thrashers, are regularly associated with particular plant species, perhaps in response to insect abundance or availability (Wiens and Rotenberry 1981). Some shrub-steppe birds, such as mourning dove and lark sparrow, show a strong preference for grass seeds of certain species (Goebel and Berry 1976); therefore, when livestock selectively remove specific plant species, it would affect foraging habitat for some bird species, which could reduce their survival and reproductive potential (Martin and Finch 1995).

Deciduous riparian habitat is critical to maintaining bird populations. Although they comprise less than 1% of the western United States land area (Knopf et al. 1988), more than 50% of western bird species breed mostly or exclusively in riparian communities (Tewksbury et al. 2002). Riparian bird species most adversely affected by livestock grazing, such as MacGillivray's warbler (*Oporornis tolmiei*) and common yellowthroat, are those that nest or forage in shrub or herbaceous ground cover (Bock et al. 1993).

Based on a literature review that assessed changes in riparian bird species abundance in grazed versus ungrazed or lightly grazed areas, Bock et al. (1993) found that eight riparian species were positively influenced by grazing; that is, they increased in abundance. Five of the eight species are found in the planning area. Seventeen species were negatively influenced by decreasing in abundance; nine are in the planning area. Finally, 18 species were unresponsive or showed inconsistent or uncertain responses, and 12 are in the planning area.

Tewksbury et al. (2002) also reviewed the impacts of livestock on riparian birds in western North America. Of species that occurred along riparian systems, 63% were more abundant in ungrazed locations (Tewksbury et al. 2002). In Arizona, Krueper et al. (2003) found that 53% of species decreased in abundance with livestock grazing, 8% increased, and 39% showed no clear response.

When grazed sites are allowed to rest, vegetation can recover (Duff 1979; Rosenstock 1996). Duff (1979) reported a 350% increase in use and diversity of songbirds, raptors, and small mammals after 8 years of rest from grazing.

There are little data available on the impacts of livestock on raptors, such as eagles, owls, hawks, and falcons. Raptors, including the three species of concern that inhabit the Sandy 3 allotment (Table 3.15), typically begin breeding during the first few months of the breeding season, January to March (USFWS et al. 2015). Some raptor species, such as red-tailed hawks (*Buteo jamaicensis*) and golden eagles, respond negatively to human disturbance, with the rate of nest abandonment increasing with greater human presence (Smith and Murphy 1973; White and Thurow 1985; USFWS 2002).

The greatest impact on raptors would likely be from a reduction in suitable habitat for their prey species. Small mammals, such as mice, voles, rabbits, and woodrats, are common prey for many raptor species. Hayward et al. (1997) found that grazing negatively affected populations of many small mammal species by reducing plant cover. Additionally, livestock can affect small mammals directly by trampling burrows, compacting soil, and competing for food or indirectly by altering the structure or species composition of the vegetation in a manner that influences habitat selection by small mammals (Hayward et al. 1997).

Small mammals that den on the ground may be negatively affected by changes in the understory, as sites suitable for denning would be eliminated for some species (Knopf 1996). Rosenstock (1996) studied the impacts of livestock grazing on vegetation and small mammal species in semiarid shrub-grassland habitats in Capitol Reef National Park, including the recently retired Hartnet allotment. In the study, ungrazed sites had greater small mammal species richness and higher overall abundance. The impacts of livestock grazing on small mammal populations would translate to indirect impacts on raptors by reducing their prey species (Willey and Willey 2010).

Sandy 3 allotment. The impacts described above at the beginning of the Alternative 1 analysis would occur across the 10,200 acres of grazed areas in the Sandy 3 allotment. The following describes how these effects would translate to the migratory and resident birds in the Sandy 3 allotment.

The season of use in the Sandy 3 allotment (November 1 through March 31) would continue to overlap the first 3 months of the full breeding bird season (January through March; USFWS 2015). All but two (i.e., indigo bunting and Virginia warbler) of the 16 bird species in the planning area that nest in the ground-to-shrub level (Table 3.15) occur in the Sandy 3 allotment. These bird species would continue to be subjected to risk of nest failure due to trampling or disturbance (Paine et al. 1996). Two of these are bird species of concern: Brewer's sparrow and sagebrush sparrow. Impacts of grazing on cover and structure of vegetation, and therefore nesting and foraging habitat, could negatively affect songbird species in the allotment, specifically Brewer's sparrow, vesper sparrow, and western meadowlark, by decreasing their abundance (Bock et al. 1993).

Both nesting and foraging habitat for songbirds and raptors using the allotment during the breeding season or in winter would be affected by grazing and trampling. This would reduce vegetation cover, structural complexity, recruitment, and habitat for prey species, such as insects and small mammals (Schulz and Leininger 1991; Saab et al. 1995; Martin et al. 2005; Willey and Willey 2010). These changes in vegetation would decrease the ability of songbirds and raptors to find prey and would make songbirds and their nests more visible and vulnerable to predators.

A reduction in suitable foraging resources could also affect bird species that may use the allotment as a stopover site during migration. It is unlikely that the presence of livestock would discourage migrating birds from using the allotment; however, the adverse impacts of grazing on vegetation could lead to poor quality foraging habitat.

Under this alternative, songbirds, raptors, and their habitat within a mile of a water source, and especially within a quarter-mile, where livestock tend to congregate, would be most affected by grazing and trampling.

However, the season of use would end before the peak nesting season for most bird species, April through July (USFWS et al. 2015); therefore, most ground- and shrub-nesting songbirds would not be subject to nest trampling or disturbance. Songbirds that begin nesting in early April, however, could be vulnerable to predators and could have limited prey until grazed and browsed vegetation regrows sufficiently to provide nesting and escape cover and foraging habitat. Foraging habitat for raptors could also be affected until vegetation regrows sufficiently to provide habitat for small mammal prey species. This is especially true if winter grazing has removed residual vegetation from the previous growing season, which often provides protective cover for bird nests (Bock et al. 1993).

Grazing can reduce suitable habitat for raptor prey species, such as mice, voles, rabbits, and woodrats, by reducing vegetation cover and food sources, such as seeds and insect prey (Littlefield et al. 1992; Rosenstock 1996; Block et al. 2005; Johnson and Horn 2008; Powers et al. 2011). A lack of prey species, especially during the reproductive season, could affect the reproductive success of raptors (Johnson and Horn 2008), which could decrease the abundance and diversity of raptors (Hayward et al. 1997; Willey and Willey 2010). Under Alternative 1, the impact of livestock on raptor prey species would be a greater threat to raptors than the presence of humans; however, because livestock are removed by March 31, vegetation would be able to replenish during the growing season to provide habitat for raptor prey species.

Under Alternative 1, moving livestock into and out of the allotments requires several riders on horseback, which disturbs and negatively affects nesting birds, and raptors in particular. Gathering and moving livestock out of the allotment in late March overlaps with the breeding season of raptors and could negatively affect breeding success. Impacts range from temporary displacement from their territory while humans are present to nest abandonment for the breeding season. The presence of humans under this alternative is expected to be relatively low, because, once livestock are moved into the allotment, there is little active management of the herd or range condition monitoring.

Invasive species monitoring and control are limited under Alternative 1. Invasive species affect birds by altering species composition and the structure of nesting and foraging habitat for songbirds and foraging habitat for raptors. Most invasive plant control activities in Capitol Reef National Park involve removing tamarisk and Russian olive trees by the Lake Mead Exotic Plant Management Team along riparian corridors; therefore, there would be limited monitoring on control of invasive s species in the allotment.

As a result of the above, breeding, wintering, and migrating songbirds and raptors could be affected by ongoing habitat degradation in the allotment. Rangeland health assessment data (see Appendix B) show that 72% of the plots in the Sandy 3 allotment had moderate to total departure from reference condition for the biotic integrity attribute. The presence of monotypic stands of invasive species (mostly Russian thistle and cheatgrass) was the main vegetation indicator responsible for this departure. Areas dominated by these invasive species do not provide suitable nesting or foraging habitat for most songbirds or foraging habitat for raptors. This is due to a lack of structural complexity and species diversity.

Other indicators that contributed to the departure from reference condition included lack of cover and decreased reproductive capability of plants. Although there is uncertainty in how the impacts described herein, and the trends described in the affected environment, would influence departure from reference condition, the National Park Service expects that current conditions would continue or worsen.

Grazing management infrastructure—Grazing management infrastructure is limited under Alternative 1. Fencing would be constructed only when warranted, because of severe resource degradation or other need. In addition, maintaining select stock ponds in the Sandy 3 allotment would continue, as needed. Implementing construction projects in the bird reproductive season of January through August could cause breeding birds to permanently or temporarily abandon their breeding territories or nests during construction.

Livestock trailing. Under Alternative 1, livestock trailing would continue on the eight currently permitted trailing routes. Under current management, livestock typically trail across park lands in a group, spreading out and affecting vegetation on approximately 1,408 acres. The human presence and rapid increase in the localized density of livestock associated with trailing could trample nests and displace songbirds and raptors, temporarily or permanently, especially during the peak bird breeding season of April through July (USFWS et al. 2015). Livestock trails used during this time are Notom Road in mid-April and Jones Bench, Oak Creek, and Dry Bench in early to mid-June.

Trampling the nests of bird species using the ground-to-shrub level for nesting (see Table 3.15) and displacing birds, including raptors, due to disturbance could lead to a loss of bird diversity. Studies show that the risk of nest trampling by livestock is positively correlated with stocking rates in grazing allotments (Schultz 2010; Rolek et al. 2016). The probability of nest trampling by trailing livestock is expected to be similarly related to the number of livestock using the trail. The greater the number of livestock, the higher the likelihood of a nest being trampled or disturbed.

Additionally, when trailing through riparian habitats where nest density is typically higher (Schultz 2010), the risk of nest trampling or disturbance by livestock would be greater; therefore, livestock using the Oak Creek trail in June would have a high potential to affect nesting birds. This is because of the season of use, the riparian habitat, and the approximately 1,100 livestock trailed. This trail is also used in the fall by the same number of livestock.

The risk of nest trampling or disturbance is low along Notom Road. This is because most livestock walk on or near the road, trailing is in the early part of the songbird nesting season (mid-April), and approximately 120 to 140 livestock are trailed. Also, due to vehicle disturbance, nest density is likely reduced in vegetation next to the road (Forman and Alexander 1998).

One hundred to five hundred livestock are typically trailed on the Jones Bench trail during the bird breeding season (early June) each year. The Dry Bench livestock trail has been used infrequently in the past, but it could be used as an alternative to the Oak Creek trail in some years, with as many as 1,100 livestock using it in the spring, during the bird nesting season, or in the fall. Over 70% of these trails pass through pinyon-juniper/mesic shrub woodlands, a habitat used mostly by shrub- and tree-nesting songbirds. The potential for nest trampling would be low; however, nesting and foraging birds could be temporarily displaced while livestock pass through.

The other trails in the planning area—Pleasant Creek, Divide Canyon, Gray Bench-Cathedral Valley, and Highway 24—are all used during the nonbreeding season; therefore, potential impacts would consist of temporarily displacing foraging songbirds and raptors while livestock move through.

Pleasant Creek could have additional impacts, because 250 to 300 livestock would be held overnight at the east end of the livestock trail during mid-October trailing. This concentration of livestock has the potential to create localized impacts (i.e., heavily trampled and grazed vegetation) on riparian foraging habitat used by songbirds and raptors. Because this trailing occurs in the fall, there is opportunity for vegetation to recover and regrow during the subsequent growing season to provide nesting habitat for songbirds.

Capitol Reef National Park would continue to cooperate with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive vegetation along four of the livestock trails: Highway 24, Oak Creek, Pleasant Creek, and Gray Bench-Cathedral Valley. Livestock use of riparian areas has been shown to increase the potential for invasive vegetation to displace native vegetation (Ohmart 1996). Encroachment of invasive plants, such as tamarisk, Russian olive, and sweetclover, has been documented in the Pleasant Creek, Oak Creek, and Highway 24 trailing routes (Martin and Wagner 2015; Perkins 2016).

While tamarisk and Russian olive may provide nesting and foraging habitat for some birds, their documented displacement of more favored riparian species, such as cottonwood and willow, would affect nesting and foraging habitat for many bird species (Ohmart 1996; Knopf and Olson 1984; Bateman and Ostoja 2012). Tamarisk has been shown to degrade riparian systems that many migratory and resident bird species depend on, by increasing fire frequency (Dwire and Kauffman 2003), narrowing and channelizing streams (Friedman et al. 1994; Ohmart 1996), displacing native vegetation (Ohmart 1996), and providing little food for native wildlife species, including birds (Lovich 1996). By controlling invasive plants along trails, birds and their habitat would benefit. This is because native species would persist and provide the vegetation structure and composition that birds and their prey favor (Fleishman et al. 2003).

Overall, livestock trailing may result in individual songbird nests being trampled or disturbed, especially during Oak Creek trailing in June. This is because nest density is typically higher in riparian areas. Displacing nesting and foraging birds and affecting bird habitat could affect individual birds along all of the trailing routes, including species of concern and raptors.

Monitoring and adaptive management. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. The lack of a regular rangeland monitoring program would have adverse impacts on breeding, wintering, and migrating bird habitat. This is because there would be limited data available to inform land managers about livestock grazing and trailing and whether rangelands are moving toward or away from desired conditions, as described in Appendix C.

The negative impacts of livestock on vegetation communities, which indirectly affects birds, would continue, with minimal ability to regularly quantify impacts and health trends. While minor adjustments could be made to grazing permits, based on limited monitoring and observed conditions, such as the number of permitted livestock or the duration of the grazing season, management decisions would be largely based on qualitative observations; these are more difficult to justify. Without sufficient monitoring and implementation of an adaptive management program, birds and their habitat are at risk of further livestock-induced degradation and fragmentation.

Cumulative impacts. While reservoir development upstream of Oak Creek has some contribution to the development of riparian habitat important to birds, as described in Chapter 3 and above, decades of livestock grazing and trailing have degraded rangeland conditions, resulting in reduced vegetation cover and density, altered species composition with incursion of invasive plants, decreased plant vigor and vegetation complexity, and lack of vegetation recruitment. This is especially the case in the grazing allotment and along the Oak Creek livestock trail. These changes in vegetation can have lasting impacts on habitat suitability and foraging potential for resident and migratory bird species, including raptors and bird species of concern.

However, the recent retirement of the Hartnet allotment is expected to have beneficial impacts on vegetation and therefore bird habitat on 19,000 acres. Recovery of vegetation would be a long-term process, occurring over decades, and may require active restoration in areas that have been converted to

invasive vegetation such as Russian thistle and halogeton. Recovery and reestablishment of native vegetation would benefit breeding, wintering, and foraging birds in the retired allotment as well as raptors, as habitat for their prey species improves.

Riparian bird species would benefit from recovery of riparian habitat associated with several springs in the allotment. As discussed in Chapter 3, most springs in the allotment were rated as nonfunctional due to livestock impacts. With the removal of livestock, these springs would be expected to reach PFC as soils and vegetation recover. Vegetation associated with these springs is expected to increase in density, diversity, and structural complexity, providing important habitat for resident and migratory birds. In the absence of livestock impacts, vegetation would move toward desired conditions beneficial to birds (Duff 1979; Rosenstock 1996). In a study conducted in northern Utah, Duff (1979) reported a 350% increase in use and diversity of songbirds, raptors, and small mammals after 8 years of rest from grazing.

Within Capitol Reef National Park's Fruita Historic District, birds could be disturbed by the public picking fruit in the orchards, which occurs intermittently between June and October, and maintenance of the orchards, especially mowing. Depending on the duration and seasonal timing of actions, impacts could range from temporary displacement of individual birds from the area to potential nest failure, if there were a substantial project that overlapped the breeding season.

Due to vehicle traffic along roads, including the Burr Trail switchbacks, nest density is likely low in vegetation next to the roads (Forman and Alexander 1998). Roadside vegetation along Highway 24 typically is mowed in late summer or fall, after the peak bird nesting season. Paving the Burr Trail switchbacks could disturb raptors nesting in the area if it were conducted during the breeding season. This could result in raptors being temporarily or permanently displaced from their breeding territories.

Disturbance from road maintenance on Highway 24, Cathedral Valley Road, Hartnet Road, and Notom Road; the potential paving of the Burr Trail switchbacks near the Sandy 3 allotment; and public fruit picking would temporarily displace songbirds for one to several days, depending on the activity. Road maintenance on the Cathedral Valley, Hartnet and Notom Roads, all of which are dirt, includes grading, repairing washout and stream crossings, and maintaining water bars. Maintenance on Highway 24 includes chip sealing or paving, culvert cleaning, and roadside vegetation mowing. Ten orchards along Highway 24, consisting of 23 acres, are each mowed two to three times during the songbird peak nesting season of April through July. Three bird species that nest on the ground in Fruita and that may inhabit the orchards are lark sparrows, western meadowlarks, and common poorwill (*Phalaenoptilus nuttallii*). Nests and birds could be directly affected by the mowing, which could result in mortality of individual birds or loss of eggs.

In most years, the NPS Lake Mead Exotic Plant Management Team uses chainsaws, hand tools, and herbicides to control tamarisk and Russian olive trees along portions of the Fremont River corridor that correspond with the Highway 24 livestock trail. Less frequently, these activities also occur along the Pleasant Creek and Oak Creek livestock trails. Because they take place in the fall (typically October), there is no impact on breeding birds. Foraging resident and migratory birds may be temporarily displaced, but overall, riparian birds would benefit, if treated areas were recolonized by native cottonwoods and willows. Removing tamarisk and Russian olive trees and allowing native vegetation to persist would increase bird species diversity (Knopf and Olson 1984; Sogge et al. 2008).

While most of these past, present, and reasonably foreseeable actions would generally cause temporary disturbances to individual birds, as well as some mortality of individual birds and loss of eggs during implementation, retirement of the Hartnet allotment is expected to result in birds and nests no longer being trampled or disturbed by livestock across 19,000 acres. Upland and riparian vegetation diversity, density, and structural complexity would improve over time, which would result in improved habitat for

birds and raptor prey species. When combined with the adverse impacts on bird habitat, such as reduced vegetation cover, on 11,600 acres under Alternative 1 (10,200 grazed acres and 1,400 acres along trailing routes), the overall cumulative impact on birds would still be beneficial compared with current conditions due to the anticipated recovery of 19,000 acres of bird habitat in the Hartnet allotment. However, the incremental contribution of Alternative 1 would reduce the cumulative beneficial impacts that would be realized.

Conclusions. The breeding bird surveys that have been conducted in Capitol Reef National Park over the past few decades help to define the status of birds in the park; however, due to the limited areas surveyed and relative infrequency of the surveys, they cannot be used to establish a full assessment of the status and trend of Capitol Reef National Park bird communities. These surveys, however, do provide information on bird species that inhabit parts of the planning area, specifically the grazing allotment and the Pleasant Creek livestock trail. These species lists, combined with information from the literature, can be used to infer grazing and trailing impacts on those species.

Under the Migratory Bird Treaty Act and Executive Order 13186 (66 *Federal Register* 3853), Capitol Reef National Park is mandated to protect all birds in the park from harm, harassment, and death, especially the 15 bird species of conservation concern.

In the Sandy 3 allotment, because the grazing season does not overlap with the peak songbird nesting season, breeding birds are not likely to be subject to nest trampling or disturbance; however, if residual, lower-strata vegetation is grazed during the grazing season, early nesting birds could be without protective cover and habitat. This is because songbird and raptor prey species would be diminished until vegetation regrows.

Grazing and trampling of vegetation would continue throughout the allotment for the duration of the grazing season, reducing vegetation cover, structural complexity, and vegetation recruitment. These activities also would reduce habitat for prey species, especially insect prey for songbirds and small mammals for raptors (Schulz and Leininger 1991; Saab et al. 1995; Martin et al. 2005). These changes in vegetation would decrease the ability of birds to find prey and would make birds and nests more vulnerable to predators, with the potential to ultimately reduce survival and recruitment. Lack of pastures, fencing, and water developments limits the park's ability to manage livestock for improved rangeland health. The soil, biotic, and hydrologic indicators that were found to have moderate-to-extreme and extreme-to-total departure from reference conditions would not be expected to improve. Bird nesting and foraging habitat also would not improve.

Chronic impacts on vegetation that have occurred over time, such as changes in species composition, decreased structural complexity, and reduced plant vigor, would continue in the Sandy 3 allotment, without opportunities for vegetation to rest and recover. Birds nesting along trailing routes used in the spring and summer would be vulnerable to nest trampling and disturbance, especially along the Oak Creek trail. Trails that cross upland habitats, where nest densities are lower, would be less vulnerable to nest disturbance. Raptors nesting in the allotment or along livestock trails would be subject to human disturbance and reduced prey habitat from livestock grazing and trampling vegetation. These factors could temporarily displace nesting raptors and reduce reproduction.

When the impacts of other cumulative actions are combined with the impacts under Alternative 1, the overall cumulative impact on birds would be beneficial largely due to retirement of the Hartnet allotment. While under Alternative 1 some birds could experience nest damage and disturbance, and 11,600 acres of bird habitat would continue to be affected (e.g., reduced vegetation cover), which would reduce the overall cumulative benefit, the retirement of the Hartnet allotment would result in the

recovery of 19,000 acres of bird upland and riparian habitat, with no threats of nest trampling or disturbance from livestock, resulting in an overall benefit.

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock grazing on migratory and resident birds in the park, which are described under the Alternative 1 analysis above, would continue to occur in the Sandy 3 allotment and along the eight currently permitted trailing routes; however, many impacts would be minimized or reduced, as described in the analysis below. In addition, similar impacts would be expected along the two new routes analyzed under this alternative (i.e., Hartnet and Lower South Desert trailing routes). These impacts, which are influenced by the duration, timing, and intensity of grazing and trailing, are applied in conducting the allotment-level analyses that follow.

Vegetation would benefit from being rested during the full growing season every other year under a two-pasture rotation system, as described in Chapter 2. The deferred rotation would benefit vegetation by providing rest during the entire growing season, allowing plants, especially cool-season grasses palatable to livestock, to produce seed and regain vigor (Holechek et al. 1998). Over time, this would be expected to increase vegetation and structural diversity. This would benefit nesting, foraging, wintering, and migrating birds, including species of concern and raptors, by improving hiding cover for nests and habitat for prey; however, the increased density of livestock in each pasture could affect birds. Studies have shown that the risk of nest disturbance by livestock is positively correlated with stocking rates (Rolek et al. 2016; Schultz 2010). As a result, the higher density of livestock, compared with today, could cause more disturbance to birds and their habitat. It also could result in livestock using more of the allotment than under lower stocking densities. This could result in livestock grazing and trampling vegetation in bird habitat that had not previously experienced these impacts; however, the extent of these impacts, while concentrated, would be reduced if they occurred outside of the main breeding season for bird species.

As described under Alternative 1, grazing can adversely affect raptors by reducing vegetation cover and food sources, such as seeds, for their small mammal prey. A lack of suitable prey could decrease the abundance and diversity of raptors (Hayward et al. 1997; Willey and Willey 2010). The greatest impacts on prey habitat would occur within 1 mile of a water source, and especially within a quarter-mile of where livestock congregate.

This alternative includes refurbishing five existing stock ponds. This would benefit vegetation throughout the pastures by providing better distribution of livestock and more efficient use of forage. Better livestock distribution and alternating pastures is expected to improve rangeland health conditions, especially those indicators associated with the biotic integrity attribute (e.g., percentage of vegetation cover). This would benefit songbird nesting and foraging habitat by providing more vegetation for nests and habitat for prey. Improved vegetation conditions, and additional water sources provided by the refurbished ponds, would also benefit migratory birds by improving stopover habitat.

Vegetation within a mile of stock ponds would experience high utilization levels; areas within a quarter-mile of these stock ponds would be heavily grazed and trampled by concentrated livestock. This concentrated livestock use around the five existing stock ponds to be refurbished would degrade bird habitat over approximately 625 acres. In the vicinity of the ponds, this would result in localized impacts on individual birds, such as displacement due to livestock activity and lack of protective cover.

The pasture rotation would result in livestock being gathered and moved twice during the raptor breeding season of January through August, compared with once, under current conditions. Livestock

would be gathered and moved between pastures in mid-January and then gathered and taken off the allotment by March 31. Human activity associated with gathering livestock could negatively affect breeding raptors, such as golden eagles, prairie falcons (*Falco mexicanus*), and red-tailed hawks. Impacts could range from temporary displacement from their territory, while the activity is occurring, to nest abandonment for the breeding season, which would reduce raptor reproduction in the planning area.

As described under Alternative 1, Capitol Reef National Park would continue to cooperate with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive plants; however, under this alternative Capitol Reef National Park would start controlling invasive plants, as funding and staff allows. Controlling invasive plants would benefit native vegetation communities by reducing competition. This, in turn, would benefit birds by maintaining vegetation structure, prey habitat, and food availability (Ortega et al. 2006).

Grazing management infrastructure and tamarisk removal— Under alternative 2, the construction of approximately 2 miles of fence to delineate pastures and monitoring exclosures, and refurbishing five existing stock ponds all of which are next to Notom Road would result in approximately 28.5 acres of disturbance of bird habitat (3.5 acres for fences assuming a 15-foot disturbance corridor, and 5 acres for each pond, including the pond itself, the construction footprint, and 0.25 miles of access routes). This alternative also includes removing tamarisk around the Little Lake Mead stock pond.

Vegetation in the construction and equipment travel areas would be crushed, and soils would be disturbed, which would facilitate spread of invasive plants, such as cheatgrass and Russian thistle, which are common in the area. Displacement of native vegetation by invasive vegetation could reduce food availability and reproductive success for birds (Ortega et al. 2006). However, monitoring and invasive plant control would minimize this potential.

Human activity, heavy equipment, and noise associated with these projects during the bird breeding season of January through August could result in nest tramping and cause breeding songbirds and raptors to temporarily or permanently abandon their breeding territories or nests. If construction were to occur outside the peak nesting season of April through July, most breeding birds would be protected. Increasing the visibility of the fences after construction, such as attaching markers to the wires (see Appendix C), would reduce, but not eliminate, fence-related bird mortality and injury. This would affect individual birds but would not affect overall abundance or distribution of bird populations.

Eight acres of vegetation within the four monitoring exclosures would be protected from defoliation and trampling by livestock, resulting in increased cover and production of plants, which would benefit birds and their prey.

Although tamarisk can support populations of riparian bird species (Sogge et al. 2008), the condition of tamarisk trees around the Little Lake Mead stock pond is not likely to provide suitable nesting habitat. The tamarisk stand was infested with the tamarisk beetle in 2012, weakening some trees and causing mortality of many others. Eliminating the invasive tamarisk in the area would help reduce the spread of the tree, which outcompetes and displaces native cottonwoods and willow. Tamarisk habitats tend to support fewer bird species and individual birds than native habitats (Sogge et al. 2008).

Livestock trailing. Under Alternative 2, livestock trailing would occur on the eight currently permitted trailing routes and on the two new routes in the recently retired Hartnet allotment (i.e., Hartnet and Lower South Desert trailing routes). The types of impacts from livestock trailing on birds would be similar to those described under Alternative 1. If the number of livestock trailing on Pleasant Creek trail, Highway 24 trail, and Divide Canyon trail increases as allowed under Alternative 2, the impacts could be greater.

The two new routes through the recently retired Hartnet allotment would result in potential impacts on approximately 830 acres of vegetation, 300 acres along the Hartnet trail and 530 acres along the Lower South Desert trail. Because livestock would be unrestrained overnight in the Lower South Desert before being trailed onto BLM-administered land, the area potentially disturbed is greater than along other trails and includes disturbance around three springs where livestock may concentrate.

Vegetation in the recently retired Hartnet allotment is in a state of departure from reference conditions (see Chapter 3: Upland and Riparian Vegetation, Appendix B). With the discontinuation of 7.5 months of livestock grazing each year, vegetation in the retired allotment is expected to move toward desired conditions. Even vegetation along the trailing routes is expected to improve as livestock would only use those areas 1 to 2 days a year and typically in the fall. Recovery of vegetation along the trails may be slower than in other areas of the allotment but is expected to occur and would benefit nesting, wintering, and migratory birds as well as prey species for raptors. Because the trails would typically be used in the fall, there would not be impacts on nesting songbirds or raptors. The Hartnet trail has potential to be used in the spring, which could cause disturbance to nesting birds and damage to nests.

Under Alternative 2, best management practices would be implemented to reduce impacts on resources. These practices include using riders to move livestock at a deliberate pace, which would facilitate livestock moving more quickly through the park and staying together rather than straying and grazing. It also would reduce the amount of time livestock are in the park and the exposure of birds and their habitat to livestock trampling, grazing, and browsing. Other best management practices include using alternative routes, and adjusting the number of livestock trailed or the number days trailing occurs.

The National Park Service would determine the ownership of unauthorized livestock, which are believed to contribute substantially to degraded conditions in Oak Creek. Owners would be contacted and required to promptly remove the livestock. Noncompliance would result in penalties and could ultimately lead to loss of future trailing privileges. As a result of these actions, implementation of best management practices, and the potential use of Dry Bench if needed, the nonfunctional condition of Oak Creek would be expected to move toward PFC with increases in vegetation cover and structural complexity. This would provide hiding cover for nesting songbirds and habitat for insects that they feed on. Prey habitat for raptors would also be improved, potentially increasing their reproductive success. Moving livestock through riparian corridors more quickly would also reduce the amount of time raptors, such as MSOs, are displaced from foraging areas.

As under Alternative 1, Capitol Reef National Park would continue to cooperate with the NPS NCPN and the Lake Mead Exotic Plant Management Team to monitor and control invasive plants along four of the livestock trails: Highway 24, Oak Creek, Pleasant Creek, and Gray Bench-Cathedral Valley. Under Alternative 2, Capitol Reef National Park would control invasive plants along livestock trails, as staff and funds allow. Additional efforts to control invasive plants would benefit birds and their habitat along those trails by allowing native plant communities to persist.

Monitoring and adaptive management. Alternative 2 includes extensive range monitoring and adaptive management. Implementing a regular monitoring program (See Chapter 2) would provide Capitol Reef National Park with data on which to base range management decisions.

Short-term and long-term monitoring would be used to determine if range conditions are moving toward or away from desired conditions. If monitoring data indicate that rangelands are not meeting desired conditions, the park would implement adaptive management actions, such as adjusting stocking rates, season of use, length of the grazing season, and livestock distribution.

Moving livestock to a new pasture when forage utilization targets are met or implementing mechanisms to provide better distribution of livestock, such as supplements, riders on horseback, and temporary fencing, would protect vegetation from overutilization. This would help maintain vegetation cover and structure for birds. Habitat needs of nesting, foraging, wintering, and migrating birds would be improved by meeting desired conditions established in this plan (see Appendix C), such as 10% to 30 % grass cover and 15% to 30% shrub cover. Nesting birds would have sufficient cover to hide themselves and nests from predators. Also, there would be diverse vegetation structure for insect and small mammal prey, which would improve foraging habitat for songbirds and raptors. Annual breeding bird surveys would continue, conducted through the USGS Breeding Bird Survey routes and the NCPN Land Bird Monitoring, as described in Chapter 3.

Range monitoring and adaptive management are expected to improve range conditions, which would improve habitat for all birds; however, some actions could have adverse impacts on birds and their habitat. Using riders to move livestock when utilization targets are met or to improve livestock distribution could result in livestock or horses trampling or displacing nests. Use of supplements would result in vegetation being heavily grazed and trampled for a radius of approximately a quarter-mile as livestock congregate in the area. Nesting or foraging songbirds and raptors could be temporarily or permanently displaced due to increased activity and human presence.

Because the grazing season in the Sandy 3 allotment ends March 31, it is likely that these actions would take place before the peak nesting season for songbirds and raptors (April to July), resulting in minimal impacts on songbirds. This would degrade nesting habitat for songbirds and foraging habitat for songbirds and raptors.

The Sandy 3 allotment has extensive stands of cheatgrass, an invasive grass which can green up in the fall. A proposed adaptive management strategy would be to allow livestock on the allotment in mid-October rather than November 1, to encourage targeted use of the cheatgrass and help control its abundance and spread. Placing supplements may also be used to attract livestock into areas with cheatgrass and Russian thistle. If livestock feed on invasive species, their competitive advantage over native species would be reduced. If native species, such as Indian ricegrass and sagebrush, were able to outcompete invasive species, the increased cover and structure that they provide would improve nesting, foraging, and wintering habitat for all birds, including species of concern and raptors.

If PFC assessment ratings continue to be nonfunctional at Deep Creek Springs along the Lower South Desert livestock trail in the recently retired Hartnet allotment, approximately 1 to 2 acres could be fenced to exclude livestock from riparian resources. Although birds and their habitat would be affected during construction of the project, vegetation recovery in the enclosed area would benefit birds. Riparian habitats are the most important habitat type in Utah for breeding and wintering birds (Parrish et al. 2002). To avoid disturbing birds, the fence construction should occur outside the main breeding season of April through July.

Cumulative impacts. The past, present, and reasonably foreseeable future activities discussed under Alternative 1 also apply to Alternative 2. As noted previously, these actions would have an overall beneficial cumulative impact that would be largely driven by the retirement of the Hartnet Allotment from grazing.

Alternative 2 would result in improved vegetation conditions and bird habitat on 11,600 acres in the Sandy 3 allotment and along the eight currently permitted trailing routes. The two new trails in the recently retired Hartnet allotment would result in approximately 830 additional acres of disturbance to vegetation and birds; however, best management practices as discussed above would be implemented along these trails to reduce the impacts on birds. Also, the impacts on the 830 acres along these trails,

which would be used once or twice each year, are substantially less than impacts that occurred to bird habitat when the allotment was grazed 7.5 months each year.

Overall, when combined with the widespread beneficial impacts under Alternative 2 in the allotment and along trails, there would be overall beneficial cumulative impacts on birds. These beneficial impacts would be increased vegetation cover and complexity and reduced invasive species resulting from range monitoring, and implementation of adaptive management actions and best management practices during trailing. All of these actions would improve the quality of bird habitat. Alternative 2 would have a substantial contribution to these beneficial cumulative effects.

Conclusions. Although there is uncertainty in how much bird habitat and populations would improve and how long it would take, especially in the actively grazed portions of the Sandy 3 allotment, Alternative 2 proposes management actions, range monitoring, and adaptive management (including desired conditions listed in Appendix C) that, when combined, would substantially improve suitable habitat for wintering, breeding, and migratory birds, including raptors and species of conservation concern, in the Sandy 3 allotment and along livestock trails analyzed under this alternative.

This would be accomplished by the following:

- Using rotating pastures, which allows each pasture to be rested during the peak bird breeding season every other year in the Sandy 3 allotment
- Refurbishing stock ponds to improve livestock distribution
- Conducting rangeland monitoring and adaptive management to ensure that rangelands in the planning area make progress toward meeting desired conditions
- During trailing, moving livestock quickly through the park to minimize straying and grazing

Under this alternative, birds and their habitat are subject to potential adverse impacts from livestock activities in 10,200 grazed acres in the Sandy 3 allotment. Areas that experience little to no grazing comprise approximately 32% of the Sandy 3 allotment. These areas would continue to provide suitable nesting and foraging habitat for all birds; therefore, although species diversity and abundance of birds would be affected in the grazed areas of the allotment, population-level impacts in the planning area are not expected for any of the species.

The higher density of livestock, compared with today, could cause more disturbance to birds and their habitat. It also could result in livestock using more of the allotment than under lower stocking densities. This could result in livestock grazing and trampling vegetation in bird habitat that had not previously experienced these impacts; however, the extent of these impacts, while concentrated, could and would be reduced if they occurred outside of the breeding season for bird species. These impacts are also expected to recover as a result of rest provided by the pasture rotation system.

Birds nesting along the 10 livestock trails included in Alternative 2 would continue to be subject to potential trampling or disturbance and degraded habitat, although to a lesser extent. This would be due to best management practices incorporated into Alternative 2. Specifically, moving livestock along trails more quickly than under Alternative 1 would reduce the time livestock are in the park and the distance they stray from the trail. This would reduce the exposure of bird nests and habitat to livestock impacts.

These actions, along with applying penalties to unauthorized livestock use to encourage their prompt removal, would facilitate Oak Creek moving toward desired conditions, including a proper functioning riparian area. This would benefit songbirds, raptors, and their habitat.

Compared with Alternative 1, Alternative 2 includes grazing management infrastructure in the Sandy 3 allotment. Fence construction, stock pond refurbishment, and tamarisk removal at Little Lake Mead would disturb approximately 36.5 acres of vegetation and bird habitat in the allotment. Vegetation would be expected to recover within 1 to 5 years. Removal of invasive vegetation that may establish in the disturbed areas would be critical to the recovery of suitable bird habitat. Vegetation that establishes and recovers within the four 2-acre monitoring exclosures would provide habitat for upland bird species.

While some benefits arise with increased water resources, such as increased prey species for predatory birds and additional water sources during migration, the infrastructure projects could also have localized negative impacts on birds, such as displacement, nest damage, habitat loss, or degradation. Implementation of these projects outside the songbird and raptor breeding season of January through August would protect birds and their nests from damage or displacement. In addition, increasing the visibility of the fences after construction by using markers on the wires would reduce, but not eliminate, fence-related bird mortality and injury. Approximately 625 acres of bird habitat would be degraded in the Sandy 3 allotment due to concentrated use by livestock within a quarter-mile of the five existing stock ponds to be refurbished. However, birds and raptor prey species would benefit from improved livestock distribution that would result from the refurbished stock ponds.

Alternative 2 incorporates extensive range monitoring, including forage use and production, rangeland and riparian conditions, and environmental conditions. Breeding bird data would continue to be collected under the current NPS Inventory and Monitoring program and the USGS breeding bird survey routes conducted by Capitol Reef National Park staff. Range monitoring would provide data to support implementing adaptive management actions, such as adjustments in livestock distribution, AUMs, or season of use, if desired conditions are not being met. Such monitoring and adaptive management would protect vegetation from overutilization and would reduce trampling impacts on soil stability. This would help maintain habitat for birds and reduce the spread of invasive plants.

Adaptive management would be especially important in the face of uncertain, though predicted, climate change (see Chapter 3). On the Colorado Plateau, this is expected to result in higher temperatures and decreased precipitation (Schwinning et al. 2008).

As described under Alternative 1, grazing can adversely affect raptors by reducing vegetation cover and seeds and insects for their prey. A lack of suitable prey could decrease the abundance and diversity of raptors (Hayward et al. 1997; Willey and Willey 2010). Under Alternative 2, rangelands would be monitored, as described above, to ensure that they are meeting or moving toward desired conditions. This would ensure that habitat is suitable for raptors' small mammal prey species.

The impacts from human disturbance, when moving livestock between pastures and implementing infrastructure projects, could affect individual raptors nesting in the planning area; however, overall, the population of raptors in the planning area is not expected to be affected. This would be due to suitable prey habitat being maintained and lack of human disturbance outside the grazed areas.

Alternative 2 supports NPS policy to preserve and restore native plants, animals, and their habitat and to minimize human impacts on animals and the processes that sustain them (NPS 2006). Alternative 2 would comply with the Migratory Bird Treaty Act and Executive Order 13186 (66 *Federal Register* 3853) by reducing impacts on breeding birds. The benefits to birds under Alternative 2 would support the park's fundamental resources and values of preserving a healthy assemblage of intact park ecosystems (NPS 2017b). Many bird species are expected to benefit under Alternative 2; however, the response, measured in species diversity and abundance, would likely be delayed, due to the time it takes for the land to recover and vegetation to regenerate.

With the implementation of a livestock grazing and trailing management plan, as described above, to facilitate meeting desired conditions (Appendix C), Alternative 2 would have beneficial impacts on birds in the planning area. When the impacts of other cumulative actions, including the recovery of 19,000 acres of upland and riparian bird habitat in the recently retired Hartnet allotment, are combined with the impacts under Alternative 2, the overall cumulative impact on birds, including raptors and bird species of conservation concern, would be beneficial.

WILDERNESS

Impacts under Alternative 1

Under Alternative 1, grazing would continue to be permitted in the absence of a comprehensive grazing plan, and at current stocking rates using partial-year continuous grazing. The types of impacts of livestock grazing that are influencing the current condition of wilderness character in the park (see Chapter 3) would continue to occur in actively grazed areas of the Sandy 3 allotment and along trailing routes. The impacts described below on wilderness character would continue to occur across all 9,070 grazed acres of recommended wilderness in the Sandy 3 allotment and 300 acres of trailing routes (Gray Bench, Oak Creek, Pleasant Creek, Divide Canyon, and Dry Bench). The 8,800 acres subject to grazing and trailing are approximately 5% of the total wilderness in Capitol Reef National Park.

Untrammeled quality—Although grazing and trailing are legally permitted in wilderness, livestock grazing and trailing and associated infrastructure, such as fences, could degrade the untrammeled quality of wilderness. Grazing is not specifically defined as a trammeling action (see, for example, Keeping It Wild 2, USDA 2015); however, introducing domestic grazing animals into a wilderness meets the definition of trammeling. This is because it is done willfully and is an action that controls or manipulates "the earth and its community of life." Infrastructure built to assist in grazing management, such as constructing fences to delineate pastures or developing monitoring exclosures, is also a trammeling action. This is because the infrastructure intentionally manipulates the natural biophysical environment—soils, vegetation, water resources, and other resources, as described previously in this chapter.

Natural quality—As described in the impact analyses for soils, upland and riparian vegetation, water resources, special status species, and migratory and resident birds, livestock grazing degrades native species populations and natural biophysical conditions and processes. These impacts come from foraging and trampling of native vegetation, including trampling federally listed plant species, altering forage availability and cover for native animal and bird species (including the federally listed MSO), introducing invasive plant species, degrading biological soil crusts and overall soil conditions, contaminating water sources, and precluding PFC of riparian areas. Some limited invasive plant control occurs in the allotment, and there are limited opportunities for adaptive management in response to forage availability and range conditions. Adaptive management, if used under Alternative 1, would provide limited benefits for natural quality. This would come about by removing invasive plants, promoting native plants, and minimizing impacts on overall rangeland condition.

Although there is uncertainty in how the impacts described above, and the trends described in the affected environment, would influence natural resource conditions under Alternative 1, the National Park Service expects that they would continue in their current state or be further degraded, resulting in ongoing or worsening impacts on the natural quality of wilderness. The adverse impacts of livestock grazing would continue to dominate ecological processes and diminish the natural quality of wilderness

across approximately 8,800 acres of wilderness in grazing allotments and trailing routes at Capitol Reef National Park.

Undeveloped quality—Infrastructure, such as fences and stock ponds related to managing grazing, adversely affect the undeveloped quality of wilderness with the signs of human presence and resource use. In the wilderness portions of the grazing allotment and trailing routes, the only fencing are those defining park boundaries, two small exclosures, and historic fences that predate recommended wilderness in Capitol Reef National Park. Remnant earth-berm stock ponds are present in wilderness in the grazing allotment; however, these stock ponds are not maintained, and some or many also may predate recommended wilderness in the park. No motorized vehicles or equipment related to grazing are used in the grazing allotments or along trailing routes in wilderness.

Solitude or primitive and unconfined recreation—Wilderness in Capitol Reef National Park, including in the grazing allotments and along livestock trails, presents an opportunity for the public to experience remoteness from the sights and sounds of human activity. The presence and long-term signs of livestock on the landscape would degrade the experience of solitude, remoteness, and self-reflection and of being away from civilization for some visitors; however, other visitors may not find the presence or signs of livestock as degrading solitude and primitive, unconfined recreation.

Capitol Reef National Park does not provide recreation facilities in wilderness, and, with the exception of limits on total group size and distance that visitors must camp from water, the park does not regulate or manage unconfined recreation in the grazing allotments or along trailing routes.

A primary impact from grazing and trailing on the opportunity for primitive and unconfined recreation is highly degraded water quality in springs and streams. Observations by park employees and written comments by visitors indicated that the quality of most water sources in the allotments is degraded such that visitors are not able to drink it or even attempt to filter out manure, urine, and turbidity. Some visitors alter their recreation choices and trip itineraries because there is a lack of water of even reasonable quality for drinking and cooking.

Under Alternative 1, there would be very little human presence for grazing management. This is because the permit holders do not actively manage livestock in the allotment. Trailing livestock through wilderness would have a greater intensity of impact on the opportunity for solitude. This is because the trailing routes are relatively narrow (some are confined to canyons) and the livestock are grouped together, so it would not be possible for a person who is present during trailing to avoid the experience; however, the impact is relatively short, compared with impacts in the allotments. This is because direct impacts would occur for 1 day on most trailing routes (with 10 to 12 days possible along Oak Creek); however, signs of trailing, such as manure, hoof prints, and browsed and trampled vegetation, could last for weeks or months, or even years in some cases.

Monitoring and adaptive management. Under Alternative 1, minimal monitoring would be conducted as collateral duty and on an ad hoc basis by Capitol Reef National Park staff to evaluate rangeland conditions. Monitoring that could be conducted in wilderness under Alternative 1 includes ongoing actions, such as monitoring threatened and endangered species, upland vegetation (by the NCPN), and breeding bird surveys. Of these monitoring actions, only threatened and endangered species are related directly to grazing and trailing. No adaptive management actions are contemplated under Alternative 1. Impacts related to monitoring and adaptive management include park employees leaving footprints on and around the various monitoring plots in wilderness. Impacts would not change, relative to current conditions under Alternative 1.

Cumulative impacts. The cumulative impact analysis considers impacts on wilderness character in the grazing allotment and along trailing routes, from the incremental impact of actions under Alternative 1, when added to other past, present, and reasonably foreseeable actions. As described in Chapter 3 and above, decades of livestock grazing and trailing have resulted in impacts on wilderness values in the Sandy 3 allotment and along trailing routes: untrammeled, natural, and undeveloped qualities and the opportunity for solitude or primitive and unconfined recreation. In addition to past and continued grazing, several other actions (Table 4.1) could combine with the impacts of Alternative 1 to result in cumulative impacts on wilderness values.

Invasive plant management constitutes a trammel and also affects naturalness. In the long term, wilderness character is improved because of invasive plant management. Livestock grazing and trailing is the largest contributor to adverse cumulative impacts on wilderness character. The retirement of the Hartnet allotment is anticipated to improve all wilderness qualities, though evidence of livestock grazing may remain.

Notom Road in the Sandy 3 allotment is not in wilderness; however, the wilderness corridor is narrow through most of the Sandy 3 allotment. Maintaining this road could degrade the wilderness value of opportunity for solitude or primitive and unconfined recreation. This is because the sights and sounds of road maintenance extend into wilderness.

Overall, the impacts on wilderness character would be limited to those areas of incursion, and impacts would be minimal. The retirement of the Hartnet allotment, coupled with invasive plant management, would have benefits throughout larger portions of recommended wilderness as opposed to the few locations where development would occur.

Conclusions. Capitol Reef National Park's fundamental resources and values include wilderness values. The park offers a remote wilderness expanse free from modern human manipulation and development. Composed of rugged slickrock domes, labyrinthine canyons, and sprawling desert vistas, this unique wilderness environment provides outstanding opportunities for solitude and reflection, as well as primitive and unconfined wilderness recreation. The natural acoustical environment, dark night skies, and wholly undeveloped nature of Capitol Reef National Park's wilderness are unique resources that contribute to the area's outstanding wilderness character.

Under Alternative 1, current impacts on wilderness values would continue in the allotments and along trailing routes in approximately 5% of the park's total recommended wilderness acreage. Impacts diminish the natural quality of wilderness, based on impacts on resources such as soils, vegetation, migratory birds, and special status species. Impacts on the undeveloped values are slight, and impacts on the opportunity for solitude or primitive and unconfined recreation are considered moderate. This is because of the degraded quality of the water that visitors depend on. The impacts on wilderness values do not affect the integrity of park wilderness resources, interfere with the park's ability to meet desired future conditions for wilderness, or affect Capitol Reef National Park's ability to fulfill its purpose. Alternative 1 represents a slight impact on wilderness values, based on the above discussion.

Impacts under Alternative 2

Under Alternative 2, the types of impacts from livestock grazing on wilderness character in the park, which are described under the Alternative 1 analysis above, would continue to occur in actively grazed areas of the Sandy 3 allotment and along trailing routes analyzed in this EA that are in recommended wilderness. These impacts, which are influenced by the duration, timing, and intensity of grazing, are applied in conducting the allotment-level analyses that follow.

Sandy 3 allotment and trailing routes. Under Alternative 2, 9,070 acres (89%) of the 10,200 grazed acres in the Sandy 3 allotment, and approximately 730 acres of trailing routes (assuming use of the Lower South Desert trailing route) would be affected in recommended wilderness. The impacts discussed below on wilderness character would continue to occur across all grazed acres of recommended wilderness in the Sandy 3 allotment, and 730 acres of trailing routes analyzed in this EA (Gray Bench, Oak Creek, Pleasant Creek, Divide Canyon, Dry Bench and the proposed Lower South Desert trailing routes). The 9,800 acres of recommended wilderness subject to grazing and trailing under Alternative 2 are approximately 5% of the total wilderness in Capitol Reef National Park.

Untrammeled quality—Constructing fencing to delineate pastures, four monitoring exclosures, and a sensitive resource exclosure at Deep Creek prevents grazing in resource protection areas and defines monitoring plots. The short-term impacts during construction would disturb approximately 5.5 acres, which is less than 0.1% of the wilderness acreage in the allotments; however, the fences would remain in place for the duration of grazing in Capitol Reef National Park.

Capitol Reef National Park does not have an estimate of the acreage that could be treated using herbicides. Herbicides would be applied almost exclusively in wilderness in the Sandy 3 allotment, which has extensive invasions of Russian thistle and cheatgrass. Herbicides also could be used along trailing routes in wilderness. The potential frequency of herbicide use has not been quantified; however, it could be used sporadically or annually during the life of this plan, depending on conditions observed in the allotments and along the trailing routes.

Tamarisk that are cut in wilderness, particularly around Little Lake Mead in the Sandy 3 allotment, are often burned after drying for a season or two, and Alternative 2 proposes this option. Felled tamarisks would be burned no more than three times, separated by 2 or 3 years.

By proposing better distribution of livestock and a pasture rotation system, Alternative 2 would result in more human presence on the landscape to periodically distribute livestock throughout pastures and to move livestock between pastures. Permit holder employees and possibly NPS staff could be present in the allotments, managing and moving livestock for 20 to 30 days during the grazing season. This increased human presence would remain in place for the duration of grazing in Capitol Reef National Park.

The above actions would be considered trammeling, because they intentionally manipulate the natural biophysical environment on approximately 9,800 acres of wilderness. Adaptive management actions, such as using supplements to achieve desired distribution of livestock or reseeding for native grasses, also would be considered trammeling actions.

Natural quality—Under Alternative 2, controlling invasive plant species would benefit native vegetation and wildlife and could improve forage conditions for livestock. Achieving better distribution of livestock and implementing a pasture rotation system would provide the ability to rest a pasture; the ability to rest a pasture during different portions of the grazing season in a yearly rotation is anticipated to benefit the natural quality of wilderness. This would come about by reducing the direct impacts on natural resources described elsewhere in this chapter. Conversely, constructing fences for pasture delineation, four monitoring exclosures, and sensitive resource exclosures would result in 5.5 acres of disturbance that would reduce naturalness, as would rehabilitation and use of existing stock ponds; however, this development accounts for less than 0.1% of wilderness in the planning area and would be localized.

Adaptive management actions would provide limited benefits for the natural quality by minimizing negative impacts on overall rangeland condition; however, several adaptive management actions, such

as using supplements to achieve desired distribution of livestock or reseeding with native grasses, could negatively affect the natural quality. Other potential adaptive management actions, such as changing stocking rates, AUMs, or the season of use, would typically be undertaken to benefit the natural quality of wilderness. This would be the result of reducing stocking rates, AUMs, or the season of use. In some circumstances, though, such as wet years with excellent forage, an increase in stocking rate, AUMs, or season of use may degrade the natural quality.

Undeveloped quality—The grazing management infrastructure proposed in wilderness under Alternative 2 is approximately 1 mile of new fence in the allotment, fences associated with four monitoring exclosures, and the refurbishment of stock ponds. As with Alternative 1, the only other infrastructure that would affect the undeveloped quality is remnant fences and earth-berm stock ponds. No motorized vehicles or equipment related to grazing would be used in the wilderness in the grazing allotments or along trailing routes, except possibly hand-operated motorized equipment for building fences (post-hole augers) or removing tamarisk (chainsaws).

Solitude or primitive and unconfined recreation—For some visitors, under Alternative 2, the presence and long-term signs of livestock on the landscape would degrade the experience of solitude, remoteness, and self-reflection and of being away from civilization; however, other visitors may not find the presence or signs of livestock as degrading the opportunities for solitude and primitive, unconfined recreation. Achieving better distribution of livestock and implementing a pasture rotation system would result in more human presence on the landscape and would reduce the overall opportunity for solitude; however, opportunities for solitude would be increased in the pasture that is rested each season. As described under Alternative 1, trailing livestock through wilderness would have a greater intensity of impact on the opportunity for solitude; however, the impact is relatively short, compared with impacts in the allotments.

Livestock trailing. The impacts under Alternative 2 would be the same as those under Alternative 1 for the regularly used trailing routes. The Lower South Desert trail, which could be permitted under this alternative, is within recommended wilderness; impacts on wilderness character would be the same as described in Alternative 1 for this area. Impacts on wilderness from trailing under Alternative 2 would total approximately 730 acres, with a little more than half of those acres (approximately 380 acres) along the Lower South Desert trail. The Hartnet trail is not in wilderness; however, during the 1 or 2 days of its use, there would be a localized impact on solitude if visitors observe or hear the livestock being moved along the road.

Monitoring and adaptive management. The impacts under Alternative 2 would be the same as those under Alternative 1.

Cumulative impacts. The impacts under Alternative 2 would be the same as those under Alternative 1.

Conclusions. Capitol Reef National Park's fundamental resources and values include wilderness values. Under Alternative 2, current impacts on wilderness values would continue in the allotments and along trailing routes in approximately 5% of the park's total recommended wilderness acreage. Impacts diminish the natural quality of wilderness by affecting resources such as soils, vegetation, migratory birds, and special status species.

Impacts on the untrammeled wilderness character would occur from fence construction, herbicide use, tamarisk burning, stock pond refurbishing, and increased human presence to manage and move livestock. They would control or manipulate "the earth and its community of life" and intentionally manipulate the natural biophysical environment. In addition, these impacts would continue for the duration of grazing in the park.

Impacts on the undeveloped quality are slight. Pasture fencing and fencing for four monitoring exclosures would be installed in wilderness, and the fence would remain for the duration of grazing; however, it could be removed in the future. Impacts would be limited to the area of fencing. Refurbishing five existing stock ponds would make them more noticeable and thus the area would appear more developed; this would be isolated to where the stock ponds are refurbished along Notom Road. Also, cumulative impacts, particularly from the retirement of the Hartnet allotment and invasive species management, would have long-term benefits to the undeveloped quality in these areas. Alternative 2 would have slight benefits for the natural quality and opportunity for primitive and unconfined recreation, as stated above.

In comparison with Alternative 1, the untrammeled and undeveloped qualities would be degraded under Alternative 2; however, the natural quality and opportunity for solitude or primitive and unconfined recreation would benefit, in comparison with Alternative 1. The impacts on wilderness values do not affect the overall integrity of park wilderness resources, interfere with the park's ability to meet desired future conditions for wilderness, or affect Capitol Reef National Park's ability to fulfill its purpose; therefore, Alternative 2 represents a slight impact on wilderness values, based on the above discussion.

PERMITTEE TRADITIONAL USES AND SOCIOECONOMICS

Impacts under Alternative 1

As with grazing and trailing on all public lands, permittees operating at Capitol Reef National Park face uncertainty as a result of the need to balance permitting of grazing and trailing with resource management mandates. For example, depending on a variety of factors, permittees may periodically have to adjust operations. Examples of such factors are weather, forage availability, rangeland health, and condition of other resources, including threatened and endangered species (see Chapter 2 for the types of adjustments that may occur at Capitol Reef National Park under each alternative).

This uncertainty can adversely affect the income potential of these operations and the ability of permittees to carry out their traditional ranching lifestyle. This is because permittees would need to evaluate whether they want to invest new capital into their operations on public lands in any given year; however, such business decisions are at the discretion of the permittee, so the economic, social, and cultural impacts on the permittee associated with business decisions that may be made to address this uncertainty cannot be reasonably predicted.

Sandy 3 allotment. Under Alternative 1, the permittee would continue to graze 82 cow/calf pairs from November 1 to March 31 of each year, which is equal to 410 AUMs. As a result, there would be no changes in the number of calves and cull animals that the permittee would be able to sell, when compared with current conditions. There would be no change to the permittees' socioeconomics under Alternative 1.

The permittees would benefit from the forage and browse on Capitol Reef National Park rangelands to maintain animal weights, allowing them to sell calves and cull animals. There would be no change in AUMs under this alternative, as described in Chapter 3. Because of this, the permittee could continue to gross approximately $60,000; however, due to many variables, the permittee would accrue additional costs. The National Park Service could not obtain data for costs such as those for labor, feed, veterinary care, replacement heifers, and trucking. These would likely result in less net income.

In the absence of definitive financial information from the permittees, the assumption is that continuing current management would provide permittees with similar levels of income, compared with current conditions, and they would be able to continue their traditional ranching lifestyle.

Livestock trailing. Ranchers who currently use trailing routes in the park would continue to use them to move livestock from one grazing area outside the park to another. They could do this at a reasonable cost, compared with rounding up animals and trucking them between allotments. Trailing activities under Alternative 1 would be on the lower end of the $1,000 to $3,000 range; however, data are not available, and many variables, such as distance traveled and the intensity under which animals are moved, can affect the cost. In the absence of definitive financial information from the permittees, the assumption is that continuing current management would provide permittees with similar levels of income, compared with current conditions. Also, they would be able to continue their traditional ranching lifestyle.

Trucking. Under Alternative 1, the operation that was formerly permitted in the Hartnet allotment would truck their livestock between their allotments on BLM-administered and National Forest System lands. The cost for trucking would not change under Alternative 1, which, as described in Chapter 3 and Appendix E, is estimated to be between $5,300 to $12,300, depending upon the route taken and the need for temporary corrals.

Cumulative impacts. Because livestock grazing under Alternative 1 would have no impacts on permittee traditional uses and socioeconomics compared to current condition, there would be no cumulative impacts.

Conclusion. Because Alternative 1 would continue current livestock grazing and trailing operations, there would be no change in the income potential of the permittees' cow/calf operations. There would also be no change in trucking or trailing cost to the former Hartnet allotment permittee or other trailing permit holders. The assumption is that continuing current management would provide the permittees with similar levels of income, compared with current conditions. Also, they would be able to continue their traditional ranching lifestyle; therefore, there would be no socioeconomic impacts, including cumulative impacts, under Alternative 1.

Impacts under Alternative 2

Sandy 3 allotment. Under Alternative 2, the stocking rate would be 82 cow/calf pairs, and AUMs would stay the same at 410; therefore, the permittee would still have the potential to gross approximately $60,000 from the sale of calves. However, there would also be costs incurred by moving animals in a two-pasture rotation system. As described for the Hartnet allotment, moving animals would cost the permittee $40 to $60 per animal (BLM 2015c), a total of approximately $3,300 per year, resulting in a potential gross income under Alternative 2 of $56,700. Again, there are many variables, and the permittee would accrue additional costs, for which the National Park Service could not obtain data. This would likely result in less net income.

If adaptive management indicates range conditions are declining and there is a need to further reduce stocking rates and AUMs, this could cause further economic losses (see Appendix E); however, if it is determined through adaptive management and monitoring that AUMs and stocking rates can be adjusted back to the maximum level allowed (410), this income potential could largely be restored.

Livestock trailing. Under Alternative 2, livestock would be trailed on the currently permitted trailing routes, and two new trailing permits would be issued. The National Park Service would work with the

permittees to move their livestock and would monitor trailing more closely to ensure permit terms are being met. Park staff would also increase riparian area monitoring along the Oak Creek and Pleasant Creek trails and ESA-listed species monitoring on the Gray Bench-Cathedral Valley, Hartnet, and Lower South Deserts trails. Some of these activities would be done as part of the adaptive management framework for this alternative, others are designed into the proposed action.

If sensitive riparian plant species or ESA-listed species were not being maintained to the specified ecological thresholds, alternative trailing routes may need to be used. For example, Dry Bench could be used to trail animals, though this route could require more time to move animals due to the elevation gain and greater distance between allotments. This would require more staff, and animal weight loss could be an issue, though this is hard to quantify. Trailing costs under Alternative 2 would approach the higher end of the $1,000 to $3,000 range; costs might exceed $3,000 if Dry Bench had to be used. Using the Oak Creek route would be on the lower end of the $1,000 to $3,000 range.

Trailing using the Hartnet or the Lower South Desert trailing routes would cost approximately $3,600. This would be a savings of $1,700 to $8,700 when compared with the current condition of trucking.

Cumulative impacts. While data are limited, as the permittees continue to operate in the park, the assumption is that past and present grazing and trailing has had, and would continue to have, socioeconomic benefits that would allow the permittees to sustain their operations and ranching lifestyle. The development of reservoirs upstream of Oak Creek would contribute to these benefits. These past and ongoing actions would allow the permittees to sustain their operations and ranching lifestyle, as evidenced by their continued operations in the park.

Under Alternative 2, besides increased costs related to rotation, there would be no change in the permitted AUMs for the Sandy 3 allotment initially or changes to livestock trailing numbers. Alternative 2 would, however, have limited cumulative adverse impacts on permittee traditional uses and socioeconomics from the need to invest additional time in implementing pasture rotation and moving livestock faster through trailing routes; however, this could also support jobs that could help maintain the traditional ranching lifestyle. In addition, Alternative 2 would reduce costs for the former Hartnet allotment permittees when compared with Alternative 1. These actions would have some limited benefits.

After a few years, monitoring could indicate the need to reduce AUMs in the Sandy 3 allotment, which could decrease income potential for the grazing permittees. If it is determined through adaptive management and monitoring that AUMs and stocking rates could be adjusted back to the maximum level allowed (410), the income potential would largely be restored. Monitoring may also indicate that trailing permittees need to use alternative routes, instead of Oak Creek. This could result in costs that exceed the higher end of the estimated range of costs.

While initially this alternative would have some limited adverse effects on the economics of existing permittees and limited benefits for the former Hartnet allotment permittee, the lack of data from the permittees makes it difficult to predict the impacts these lost income potential and additional costs would have on permittee traditional uses and socioeconomics. As a result, this alternative could contribute substantial cumulative adverse impacts, depending on the actual costs and lost income. Nevertheless, given the availability of other federal, state, and private lands, including base property, the National Park Service assumes the permittees would be able to sustain their operations and ranching lifestyle. Overall, there would be continued beneficial cumulative impacts on permittee traditional uses and socioeconomics. Alternative 2 would have the potential to diminish these overall benefits depending on the extent of adverse effects as described.

Conclusion. Under this alternative, the Sandy 3 permittee would see gross income potential reduced by about 6% (from $60,000 to $56,700) as a result of the need to move livestock in a two-pasture rotation system. This would reduce income; however, it could also support jobs that contribute to the traditional ranching lifestyle.

In addition, after 3 to 5 years, the National Park Service could adjust AUMs and stocking rates, if monitoring indicates resources and rangeland health are not moving toward desired and reference conditions. Although the National Park Service cannot predict if and when this may be needed, or how many AUMs would need to be reduced, Appendix E describes the financial impacts on the permittee for a reduction in AUMs.

Because the National Park Service has limited operational and economics data for grazing permits, there is a lot of uncertainty in the potential impact these losses of income would have on permittee traditional uses and socioeconomics. Also, in general, the cattle markets and commodities continued to slump in 2017–2018, making it challenging for permittees to maintain profitable operations. It is also important to note that, while cattle market projections can be estimated, a definitive dollar amount that identifies how much the permittees would gain or lose in a given year can only be estimated. As noted in Chapter 3, if too many challenges are encountered through economic stress, the loss of cultural heritage motivates younger generations to discontinue the ranching lifestyle, or if too many constraints limit flexible management, ranches could begin to be at risk for failure (Kirner 2015). The impacts mostly would be associated with potential future reductions in AUMs that may be made in response to resource and range monitoring; however, if it is determined AUMs and stocking rates can be adjusted back to the maximum level allowed in each allotment (based on monitoring and adaptive management), this income potential could also largely be restored.

Trailing using the Hartnet or the Lower South Desert trailing routes would cost approximately $3,600. This would be a savings of $1,700 to $8,700 when compared with the current condition of trucking.

While initially this alternative would have some limited adverse effects on the economics of existing permittees and limited benefits for the former Hartnet allotment permittee, the lack of data from the permittees makes it difficult to predict the impacts these lost income potential and additional costs would have on permittee traditional uses and socioeconomics. As a result, this alternative could contribute substantial cumulative adverse impacts, depending on the actual costs and lost income. Nevertheless, given the availability of other federal, state, and private lands, including base property, the National Park Service assumes the permittees would be able to sustain their operations and ranching lifestyle. Overall, there would be continued beneficial cumulative impacts on permittee traditional uses and socioeconomics.

Alternative 2 would have the potential to diminish overall benefits depending on the extent of adverse effects as described. As described in Alternative 1, there is some uncertainty associated with grazing and trailing on all public lands; however, business decisions made in response to this uncertainty would be at the discretion of the permittee. The economic, social, and cultural impacts on the permittee associated with business decisions that may be made to address this uncertainty cannot, therefore, be reasonably predicted.

As with grazing and trailing on all public lands, permittees operating at Capitol Reef National Park face uncertainty as a result of the need to balance permitting of grazing and trailing with resource management mandates. For example, depending on a variety of factors, permittees may periodically have to adjust operations. This uncertainty can adversely affect the income potential of these operations and the ability of permittees to carry out their traditional ranching lifestyle. However, such business decisions are at the discretion of the permittee, so the economic, social, and cultural impacts on the

permittee associated with business decisions that may be made to address this uncertainty cannot be reasonably predicted.

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CHAPTER 5: LIST OF AGENCIES AND PERSONS CONSULTED

This chapter provides a list of other federal, state, and local agencies, American Indian tribes, and other stakeholders consulted or contacted in preparing the Draft Plan/EA.

COOPERATING AGENCY INVOLVEMENT

Cooperating agencies provide information, expertise, and review of working documents. The following six agencies signed a memorandum of understanding with the National Park Service to become cooperating agencies for this Draft Plan/EA:

- US Forest Service
- Bureau of Land Management
- State of Utah Public Lands Policy Coordinating Office
- Garfield County
- Emery County
- Wayne County

AGENCY CONSULTATION

Endangered Species Act

In accordance with Section 7 of the ESA, the National Park Service conducted a number of discussions with the USFWS concerning potential impacts of an LGTMP on and conservation measures for threatened and endangered species.

In the future, in accordance with section 7 of the ESA, the National Park Service plans to prepare a biological assessment with its analysis of effect and effect determinations on federally listed species and designated critical habitat from the proposed action. When it submits the biological assessment to the USFWS, it will initiate formal consultation. The National Park Service will submit the biological assessment after the public comment period has concluded, which is expected to be in late February or early March 2018.

National Historic Preservation Act

In accordance with Section 106 of the NHPA, the National Park Service initiated consultation with Utah State Historic Preservation Office (SHPO). Sixty individuals and organizations were invited to become consulting parties for the Section 106 consulting process, which also informed development of the Draft Plan/EA. Following is a list of those who requested and were granted status as consulting parties or who were included as consulting parties because of their known interest in the action:

- Utah State Historic Preservation Officer

- Advisory Council on Historic Preservation (ACHP)
- Bureau of Land Management, Richfield Field Office
- Emery County Commissioners
- Grand Canyon Trust
- Great Old Broads for Wilderness
- Garfield County Commissioners
- Hopi Tribe of Arizona
- National Parks Conservation Association
- Pueblo of Sandia
- Santa Clara Pueblo
- US Forest Service, Fishlake National Forest
- Utah Professional Archaeological Council
- Utah Rock Art Research Association
- Utah Statewide Archaeological Society
- Wayne County Commissioners
- Wayne County Grazer's Association
- Western Watersheds Project
- Yellowstone to Uintas Connection
- Clyde Magnusson
- Jeffery Ranches
- Phillip Pace
- Stan and Jesse Wood

TRIBAL CONSULTATION

In accordance with Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, the National Park Service consulted with 32 American Indian tribes that are associated with Capitol Reef National Park and that could have an interest in the project.

The contacted tribes are as follows; only the Hopi Tribe responded requesting continued consultation:

- Pueblo of Acoma
- Pueblo of Cochiti
- Hopi Tribe
- Pueblo of Isleta
- Pueblo of Jemez
- Jicarilla Apache Nation
- Kaibab Band of Paiute Indians
- Kewa Pueblo
- Pueblo of Laguna
- Las Vegas Tribe of Paiute Indians

- Moapa Band of Paiute Indians
- Pueblo of Nambé
- Navajo Nation
- Ohkay Owingeh
- Pueblo of Picuris
- Pueblo of Pojoaque
- Confederated Salish and Kootenai Tribes
- Pueblo of Sandia
- Pueblo de San Ildefonso
- San Juan Southern Paiute Tribe
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Skull Valley Band of Goshute Indians
- Southern Ute Indian Tribe
- Pueblo of Taos
- Pueblo of Tesuque
- Ute Indian Tribe of the Uinta & Ouray
- Paiute Indian Tribe of Utah
- Ute Mountain Tribe
- White Mesa Ute
- Pueblo of Zia
- Zuni Tribe

DISTRIBUTION LIST

In addition to members of the public, the NPS solicited input from and will notify the following federal departments/agencies, state and county governments, tribal governments and/or organizations and/or will be notified of the release of the Draft Plan/EA:

Federal Departments and Agencies

- Advisory Council on Historic Preservation
- Bureau of Land Management
  - Cedar City Field Office
  - Grand Staircase- Escalante National Monument
  - Henry Mountains Field Station
  - Kanab Field Office
  - Richfield Field Office
- US Forest Service
  - Dixie National Forest
  - Fishlake National Forest
- National Park Service
  - Bryce Canyon National Park
  - Cedar Breaks National Monument
  - Dinosaur National Monument
  - Glen Canyon National Recreation Area
  - Golden Spike National Historic Site
  - Intermountain Regional Office
  - Southeast Utah Group
  - Timpanogos Cave National Monument
  - Zion National Park

- US Congress
  - Congressman Rob Bishop, 1st Congressional District, Utah
  - Senator Orrin Hatch
  - Senator Mike Lee
  - Congressman Chris Stewart, 2nd Congressional District, Utah
- US Fish and Wildlife Service
- Utah Ecological Services Field Office

State Government

- Public Lands Policy Coordination Office
- State Historic Preservation Office
- State of Utah Department of Natural Resources
- The Office of the Governor
- Utah Department of Environmental Quality
- Utah Department of Transportation
- Utah Division of Wildlife Resources
- Utah House of Representatives, District 73
- Utah State Senate, District 24

County and Local Agencies

- Emery County Commissioners
- Garfield County Commissioners
- Town of Torrey
- Town of Hanksville
- Town of Bicknell
- Town of Loa
- Six County Association of Governments
- Wayne County Business Association
- Wayne County Commissioners
- Wayne County Economic Development Office
- Wayne County Tourism Council

Organizations

- Cottonwood Environmental Law Center
- CSU Morgan Library
- Grand Canyon Trust
- Great Old Broads for Wilderness
- Jeffery Ranches, Inc.
- National Parks Conservation Association
- Pace Ranches
- Panguitch Library
- Richard Filmore
- Richfield Public Library
- Salt Lake City Public Library I
- Sierra Club
- Southern Utah Wilderness Alliance
- Utah Cattleman Association
- Utah Sandy Ranch
- Wayne County Library
- Western Watersheds Project

APPENDIX A. ACRONYMS AND ABBREVIATIONS, GLOSSARY, AND REFERENCES

Acronyms and Abbreviations

Acronyms and Abbreviations	Full Phrase
ACHP	Advisory Council on Historic Preservation
AUM	animal unit month
BLM	United States Department of the Interior, Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cwt	cost per hundred weight
EA	Environmental Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESD	Ecological Site Description
IIRH	interpreting indicators of rangeland health
LGTMP	Livestock Grazing and Trailing Management Plan
MSO	Mexican spotted owl
NCPN	Northern Colorado Plateau Network
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	United States Department of the Interior, National Park Service
NRCS	Natural Resources Conservation Service
PAC	protected activity center
PCE	primary constituent element
PFC	proper functioning condition
SHPO	State Historic Preservation Office
SMU	soil map unit
USFS	United States Department of Agriculture, Forest Service
USFWS	United States Department of the Interior, Fish and Wildlife Service
USGS	United States Department of the Interior, Geological Survey

Glossary

Action alternative—An alternative that proposes a different management action or actions to address the purpose, need, and objectives of the plan; one that proposes changes to the current management. Alternative 2 is the action alternative in this EA. (See also No-Action Alternative.)

Active preference—The forage allocated for livestock in an allotment under a permit expressed in animal unit months (see also Animal Unit Months).

Adaptive management—A system of management practices based on clearly identified outcomes and monitoring to determine whether management actions are meeting desired outcomes and, if not, facilitating management changes that will best ensure that outcomes are met or reevaluated. Adaptive management is an evolving process, involving learning (the accumulation of understanding over time) and adaptation (the adjustment of management over time). The sequential cycle of learning and adaptation leads naturally to two beneficial consequences: better understanding of the resource system and better management based on that understanding.[1]

Affected environment—The existing environment that may be affected by the proposed action (40 CFR 1502.15). Found in chapter 3, provides a description of current conditions of those resources that may be affected by the alternatives analyzed in detail; serves as the baseline for impacts analysis in Chapter 4.

Animal unit—One mature 1,000-pound cow and her suckling calf. Such a cow is expected to consume 26 pounds of dry matter of forage per day (20 pounds for the cow and 6 pounds for the calf).

Animal unit month (AUM)—The amount of forage necessary to sustain one cow or its equivalent for 1 month (43 CFR 4100.0-5)

Biological soil crust— Communities of living organisms on the surface of desert soils. Major components are cyanobacteria, green algae, fungi, mosses, liverworts, and lichens.

Critical habitat—Specific geographic areas formally designated by the US Fish and Wildlife Service that contain features essential to the conservation and recovery of an endangered or threatened species and that may require special management and protection.

Cultural resources—Prehistoric and historic districts, sites, buildings, objects, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons.

Ecosystem—An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials and energy between the living and nonliving.

Endangered species—"…any species (including subspecies or qualifying distinct population segment) that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6))." The US Fish and Wildlife Service is responsible for reviewing the status of the species on a 5-year basis.

[1] Byron K. Williams and Eleanor D. Brown. 2012. Adaptive Management: The US Department of the Interior Applications Guide. Adaptive Management Working Group, Washington, DC. Available online: https://www2.usgs.gov/sdc/doc/DOI-Adaptive-Management-Applications-Guide-27.pdf.

Ethnographic landscape—An area containing a variety of natural and cultural resources that traditionally associated people define as heritage resources. The area may include plant and animal communities, structures, and geographic features, each with their own special local names.

Ethnographic resource—Any site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

Floodplain—The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.

Habitat—The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).

Hundredweight (cwt)—Used as a unit of measurement for weight in trading livestock, grains, and other commodities contracts; equal to 100 pounds in North America.

Locality—Systematically surveyed areas where one or more individuals reside.

Migratory bird—In the legal context, this term describes a bird of a species that belongs to a family or group of species that the US Fish and Wildlife Service lists under 50 CFR 10.13, under the Migratory Bird Treaty Act of 1916 and/or under four bilateral conventions between the United States, Canada, Japan, Mexico, and Russia. The US Fish and Wildlife Service maintains this list and periodically updates and publishes in in the *Federal Register*.

National Register of Historic Places—A register of districts, sites, buildings, structures, and objects important in American history, architecture, archeology, and culture, as defined in 54 USC 300311.

Native species—One that occurs naturally within a region.

Obligate species—A species that is restricted to a particular condition of life; for example, one that depends on a particular habitat to breed.

Passerine—Of, relating to, or denoting birds of a large order distinguished by feet that are adapted for perching, including all songbirds.

Population (or species population)—A group of individual plants or animals that have common characteristics and that interbreed among themselves and not with other similar groups.

Raptor—A bird of prey, such as an eagle, hawk, falcon, or owl.

Recommended wilderness—An area that has been 1) studied and proposed by the National Park Service, 2) recommended by the Secretary of the Interior to the president for wilderness designation under the Wilderness Act of 1964, and 3) transmitted by the President to Congress. Once approved by the Secretary, the area can be considered recommended wilderness for management purposes. All references to wilderness in this EA fall under this category.

Riparian habitat—The interface between land and a river or stream. Riparian habitat occurs in or next to drainage ways or their floodplains and is further characterized by species or other life forms different from that of the surrounding area.

Scoping—An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

Stocking rate—The amount of land allocated to each animal unit for the grazable period of the year. It is typically expressed as the number of animal units per section of land.

Traditional cultural property—A property associated with cultural practices, beliefs, the sense of purpose, or existence of a living community that is rooted in that community's history or is important in maintaining its cultural identity and development as an ethnically distinctive people. Traditional cultural properties are ethnographic resources eligible for listing in the National Register of Historic Places.

Traditional cultural use—Longstanding, customary patterns of land and resource use tied to expressions of cultural identity and behavior, including religious beliefs and practices, social customs, foodways, resource gathering, and artistic and utilitarian crafts. Traditions are shared generally within a social and/or cultural group and span generations.

Traditionally associated peoples—Social/cultural entities such as tribes, communities, and kinship units, as well as park neighbors, traditional residents, and former residents who remain attached to a park area despite having relocated, are traditionally associated with a particular park when (1) the entity regards park resources as essential to its development and continued identity as a culturally distinct people; (2) the association has endured for at least two generations (40 years); and (3) the association began prior to establishment of the park.

Trailing—Herding and moving livestock from one pasture or allotment to another.

Ungulate—A hoofed, typically herbivorous, animal; includes domesticated animals such as horses and cows; as well as wildlife such as deer, elk, and bison.

Wetlands—Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil. Wetlands generally include such areas as swamps, marshes, and bogs.

Wilderness character—The five qualities of wilderness character are as follows:

- Untrammeled—Wilderness is essentially unhindered and free from modern human control or manipulation
- Natural—Wilderness ecological systems are substantially free from the impacts of modern civilization
- Undeveloped—Wilderness retains its primeval character and influence and is essentially without permanent improvement or modern human occupation
- Solitude or a primitive and unconfined type of recreation—Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation
- Other features of value—Wilderness preserves other tangible features that are of scientific, educational, scenic, or historic value; this quality captures important elements of wilderness that may not be covered in the other four qualities

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APPENDIX B: RANGELAND CONDITION ASSESSMENTS

In 2015, Capitol Reef National Park conducted 45 Interpreting Indicators of Rangeland Health (IIRH) assessments in the recently retired Hartnet allotment and 40 assessments in the Sandy 3 allotment. Approximately half the assessments were conducted in May and June, shortly after livestock had come off the allotments. The remaining assessments were conducted in September and October, after the summer growing season and before livestock came back onto the allotments. The IIRH assessments and the resulting data provide a rigorous and broadly accepted quantitative and qualitative overview of range conditions and provide an excellent basis for comparison during future monitoring and evaluation.

ASSESSMENT METHODS

In assessing the condition of rangelands in the recently retired Hartnet allotment and Sandy 3 allotment in 2015, Capitol Reef applied Interpreting Indicators of Rangeland Health v. 4 (Pyke et al. 2002; Pellant et al. 2005). This science-based assessment technique was developed jointly by a team of scientists from the Bureau of Land Management, the Natural Resources Conservation Service (USDA NRCS), the USDA Agricultural Research Service, and the US Geological Survey (USGS) (Pyke et al. 2002; Pellant et al. 2005).

In addition to broad-scale applications in the United States (e.g., Miller 2008; Herrick et al. 2010; Duniway et al. 2013), during the past 15 years this assessment technique has become widely accepted and used as a tool for characterizing the condition of arid and semiarid grasslands, shrublands, and woodlands worldwide (see http://jornada.nmsu.edu/monit-assess/manuals/assessment). Assessing the condition of key ecological attributes also has been proposed as a central component of integrated frameworks for adaptive land management (Herrick et al. 2006, 2012).

IIRH consists of qualitative and quantitative data developed at designated plots in the area of interest. Proper use of the protocol requires good understanding of the ecological site characteristics, ecological processes, vegetation communities and plant species, and soil characteristics for each site where it is applied. Capitol Reef's assessment was conducted by field teams of four or five individuals, with Colorado Plateau and southern Utah expertise, ranging from ecology and botany to soils, geology, and hydrology.

The foundational elements of IIRH are ecological sites and the soil map units (SMU) that define the various ecological sites. The NRCS develops and maps ecological site descriptions (ESDs). They provide an understanding of the land's potential to produce distinctive vegetation communities, considering soil types, topography, and climate. An IIRH assessment allows a quantitative and qualitative evaluation of the departure of an existing ecological site from its reference condition, where reference condition is defined as without human disturbance. Departure from the reference condition is described as none to slight (NS), slight to moderate (SM), moderate (M), moderate to extreme (ME), and extreme to total (ET).

The three interrelated attributes assessed by the IIRH protocol are soil and site stability, hydrologic function, and biotic integrity. Soil and site stability is the capacity of an area to limit loss and redistribution of soil by wind and water. Hydrologic function is the capacity of an area to capture, store, and slowly release water from precipitation and run-on (water running onto a less steep location from an area of steeper slope). Biotic integrity is the capacity of the biotic community to support ecological processes. These three attributes are evaluated in the field by assessing 17 qualitative indicators, as

follows (Pyke et al. 2002; Pellant et al. 2005), each of which is assigned its own departure from reference condition value:

1. Rills
2. Water flow patterns
3. Pedestals and terracettes
4. Bare ground
5. Gullies
6. Wind scoured, blowout, and depositional areas
7. Litter movement
8. Soil surface resistance to erosion
9. Soil surface loss or degradation
10. Plant community composition and distribution, relative to infiltration and runoff
11. Compaction layer
12. Functional/structural groups
13. Plant mortality/decadence[1]
14. Litter amount
15. Annual production
16. Invasive plants
17. Reproductive capability of perennial plants

The 17 qualitative indicators are used to arrive at three attributes for a site (Soil and Site Stability; Hydrologic Function; and Biotic Integrity). There is no single final condition description. Instead, there are three final condition descriptions that correspond to the three attributes. Each of the 17 indicators is related to one or more of the attributes. Ten of the 17 indicators are related to the Soil and Site Stability attribute, and the Hydrologic Function attribute. Nine of the indicators are related to the Biotic Integrity attribute. For example, the indicators of "soil surface resistance to erosion" and "soil surface loss or degradation" contribute to all three attributes whereas the "invasive plants" indicator contributes only to the biotic integrity attribute. For each attribute, the indicators are assembled in a histogram representing departure from reference conditions, and then the team conducting the IIRH evaluation determines the overall departure from reference condition for each attribute based on the shape of the histogram.

HARTNET AND SANDY 3 ALLOTMENTS RANGELAND HEALTH SUMMARY

Capitol Reef conducted 45 IIRH assessments in the recently retired Hartnet allotment and 40 assessments in the Sandy 3 allotment in 2015. A soil survey of Capitol Reef (NRCS 2014) combined with rangeland productivity and plant composition data for Capitol Reef (NRCS 2013), and ecological site descriptions formed the baseline reference condition data used during the assessments. Approximately half of the assessments were conducted in each allotment in May and June 2015, shortly

[1] Moribund, dying

after livestock had come off the allotments. The remaining assessments were conducted in September and October 2015, after the summer growing season and before livestock came back on the allotments.

Plots are approximately 1 acre (0.4 hectares) and consist of three parallel 164-foot (50-meter) transects, separated by 82 feet (25 meters). Plots were randomly selected initially, and then relocated as needed to ensure each ecological site was represented adequately. Because large areas of each allotment are inaccessible to livestock, most plots were in the grazed area of each allotment.

In the recently retired Hartnet allotment two of the plots evaluated are exclosures established in the early to late 1980s. The other plots in the recently retired Hartnet were collocated with existing NPS inventory and monitoring upland vegetation plots, established between 2007 and 2010. This allowed a comparison to previously collected ecological site-related data. Inventory and monitoring plots are not established in the Sandy 3 allotment; therefore, with the exception of one exclosure, established in 1984, new plots were established for the rangeland health evaluation.

The results of the IIRH evaluation indicate that approximately 60 percent of the plots in the recently retired Hartnet and Sandy 3 allotments are in a state of moderate (M) or moderate to extreme (ME) departure from reference conditions. The plots with the least departure from reference conditions typically are on slopes and higher elevations and are more distant from water. The plots that exhibit a greater departure from reference condition are on the topographically gentler valley bottoms and are within 1 to 2 miles of water.

Although all 17 indicators registered minor to substantial departure from reference conditions in various plots evaluated, the indicators that commonly led to a ranking of moderate (M), moderate to extreme (ME), or extreme to total (ET) are as follows:

- Wind-scoured areas, water flow patterns, and gullies, indicating substantial erosion (indicators 2, 5, and 6 from above list)
- Widespread bare ground and frequent loss of the soil A horizon (indicator 4 from above)
- Widespread loss of biological soil crust and undesirable changes in plant functional or structural groups (indicator 12 from above)
- Significant reduction in cool season native grasses (indicator 12 from above)
- Reduction in forage production and reproductive capacity of native perennial vegetation (indicators 15 and 17 from above)
- The presence of invasive plant species, particularly in the Sandy 3 allotment (indicator 16 from above)

Scat count data were of particular interest in the recently retired Hartnet allotment, because of the potential for damage to threatened or endangered plant species from ungulate (hooved species) trampling or disturbance. Scat was counted along a 6.5-foot-wide (2-meter-wide) belt straddling each of the 164-foot (50-meter) transects. The results of scat counts indicate a strong relationship: as the frequency of observation of livestock dung increases, there is a greater departure from reference conditions.

The IIRH assessment, which provides a rigorous and broadly accepted quantitative and qualitative overview of range conditions at Capitol Reef, indicates that the overall health of Capitol Reef rangelands is poor.

The IIRH protocols provide an understanding of rangeland status and an excellent basis for future monitoring and evaluation; however, they are specifically not intended to judge the relative causes of rangeland degradation. Determining the relative causes of rangeland degradation goes beyond the IIRH protocols and involves detailed knowledge of the historical use of an area, such as off-highway vehicles, road development, farming, land treatments, and grazing.

While all of these uses have historically occurred in the park, none of them, aside from livestock grazing, occurs now in Capitol Reef, and grazing is the primary cause of rangeland degradation. However, it is difficult to know, based on limited field work, if field observations and IIRH rankings are the result of relatively recent grazing or an accumulation of effects occurring over the past 130 years. Undoubtedly, both historic and recent grazing has influenced the observed range conditions. Future assessments would provide a better understanding of the relative effects of recent versus historical grazing through installation of new monitoring exclosures and comparison with the 2015 data. At the least, future monitoring would assist in understanding of how the range responds over time to a known level of grazing.

Recently Retired Hartnet Allotment

The results of the IIRH evaluation indicate that approximately 64% of plots in the recently retired Hartnet allotment are in a state of moderate or moderate to extreme departure from reference conditions. Furthermore, 19% to 33% of the plots are in a state of moderate to extreme or extreme to total departure from reference conditions. Table B.1, below, summarizes the departure from reference conditions for the recently retired Hartnet allotment; Figure B.1 presents the IIRH data on a map of the recently retired Hartnet allotment.

Because the individual assessment plots are characteristic of soils and ecological sites that define rangeland conditions, the overall condition of rangelands in the recently retired Hartnet allotment is substantially altered with respect to reference conditions. Plots that exhibit a greater departure from reference condition are on the topographically gentler valley bottoms and are within 1 to 2 miles of water. Plots that are more similar to reference conditions typically are on slopes and higher elevations and are more distant from water.

TABLE B.1. RECENTLY RETIRED HARTNET ALLOTMENT DEPARTURE FROM REFERENCE CONDITIONS FOR IIRH ATTRIBUTES

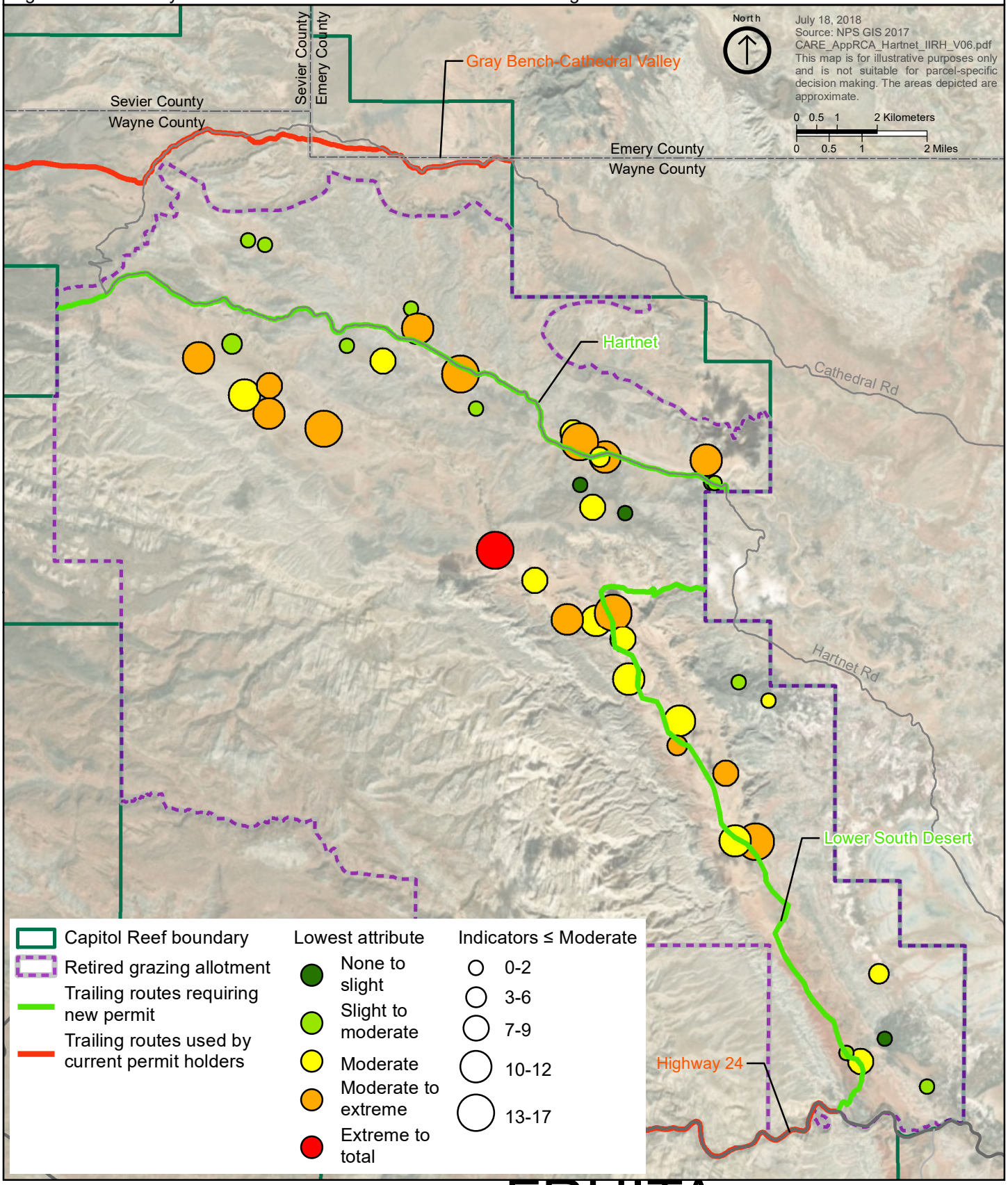
Departure from Reference Conditions	Attribute		
	Soil and Site Stability	**Hydrologic Function**	**Biotic Integrity**
None to slight	18.6%	18.6%	7.0%
Slight to moderate	16.3%	18.6%	30.2%
Moderate	34.9%	30.2%	44.2%
Moderate to extreme	30.2%	32.6%	16.3%
Extreme to total	0.0%	0.0%	2.3%
Moderate to extreme, plus extreme to total	**30.2%**	**32.6%**	**18.6%**

Rangeland health assessment indicators. Data regarding the 17 indicators used in the IIRH evaluations are presented in Figures B.2 through B.10 (the full names of each of the 17 indicators are presented in Chapter 1 and are used in the text of this chapter; however, some of the names are condensed in the figures to optimize space).

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA

National Park Service
U.S. Department of the Interior

Figure B.1: Recently Retired Hartnet Allotment - IIRH Indicator Ratings



Data presented in Figure B.2 indicate that soil alteration is the primary factor in altered rangeland conditions in the recently retired Hartnet allotment. Of the nine indicators most frequently associated with moderate to extreme and extreme to total departure from reference conditions (observed in at least seven plots), six have a direct bearing on soil conditions, as follows:

Bare ground

Wind-scoured, blowout, or depositional areas

Soil surface loss or degradation

Soil surface resistance to erosion

Water flow patterns

Pedestals or terracettes

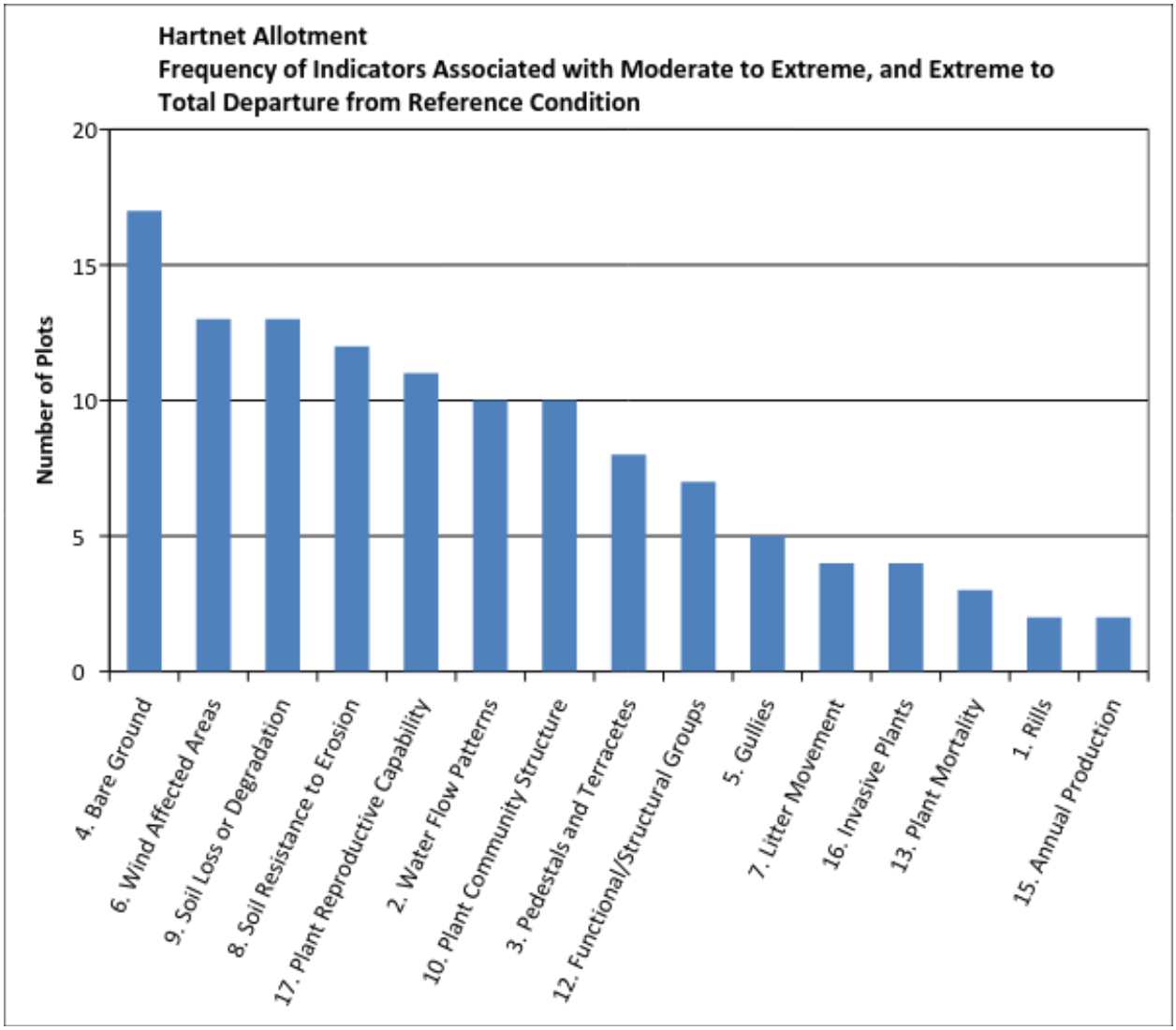


Figure B.2. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Recently Retired Hartnet Allotment

Two of the nine indicators are related to loss of biological soil crust, which also affects soil conditions: plant community composition and distribution relative to infiltration and runoff and plant functional/structural groups.

The percent of bare ground in the previously grazed Hartnet allotment averages 59% (median = 63%), based on percent bare ground recorded at the IIRH plots. Outside the grazed area, bare ground averages 33% (median = 32). Field observations indicate that the "A" soil horizon is nonexistent or has been eroded widely in a number of the plots evaluated and in areas outside the plots. At these locations, the reference vegetation communities will be unable to restore themselves without direct intervention and treatment.

Figures B.3 through B.6 present graphs of the percent bare ground for the ecological sites for which sufficient bare ground data are available. These data were collected at a single point in time and are not intended to represent a long-term trend. Rangeland conditions vary year to year, and quantitative measures, such as percent bare ground, also vary over time. However, bare ground caused by loss of the A horizon or widespread erosion is not likely to recover without a cessation or reduction in the stresses that created the bare ground.

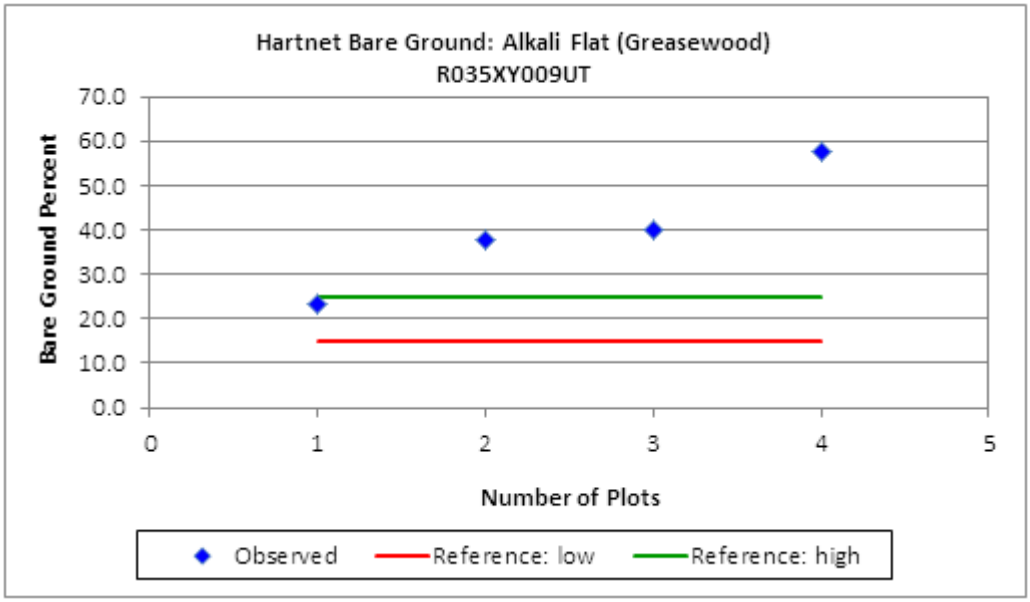


Figure B.3. Percent Bare Ground observed in Recently Retired Hartnet Allotment IIRH Plots

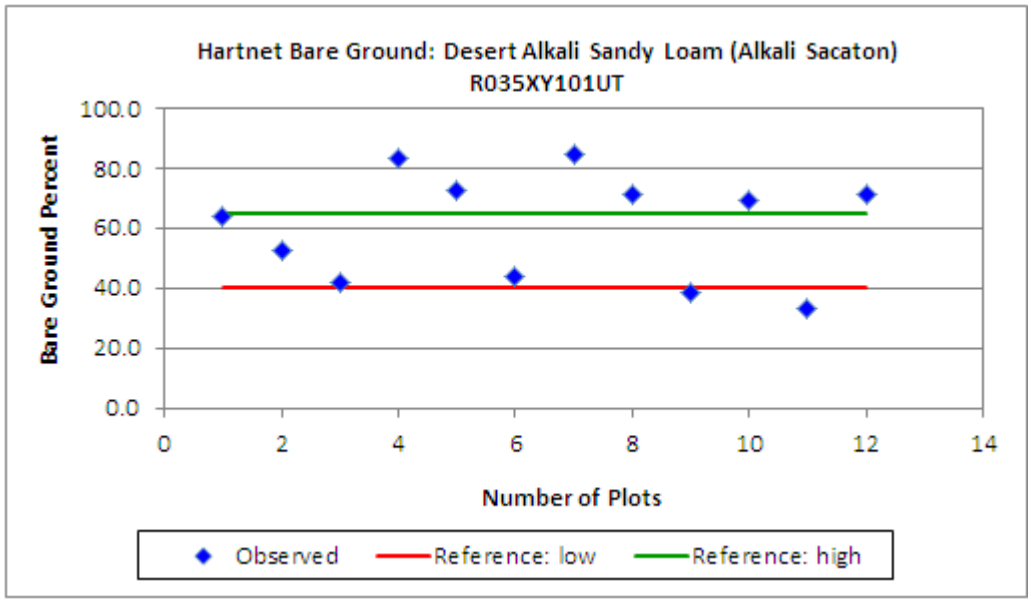


Figure B.4. Percent Bare Ground Observed in Recently Retired Hartnet Allotment IIRH Plots

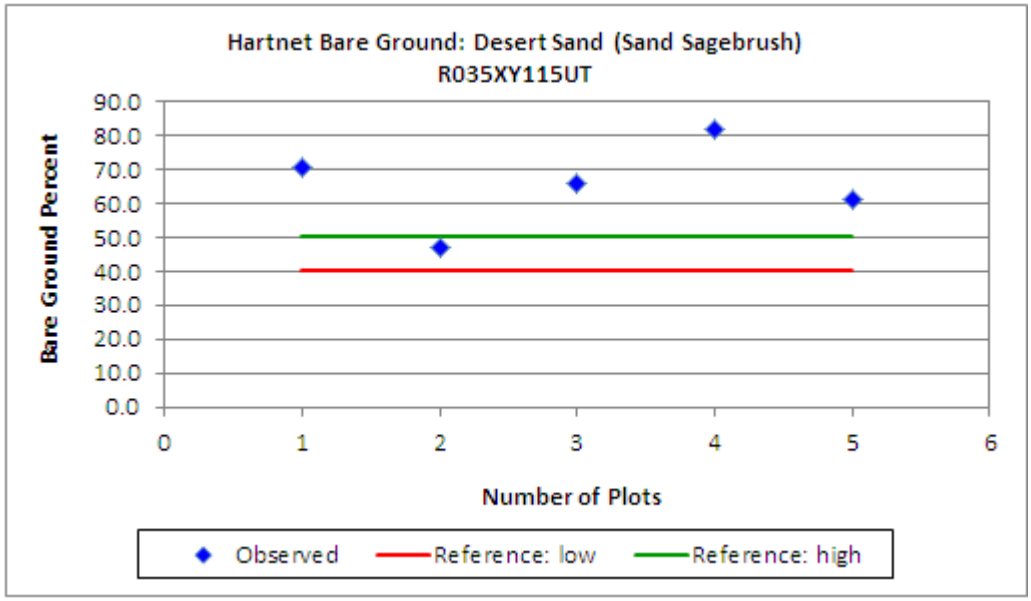


Figure B.5. Percent Bare Ground Observed in Recently Retired Hartnet Allotment IIRH Plots

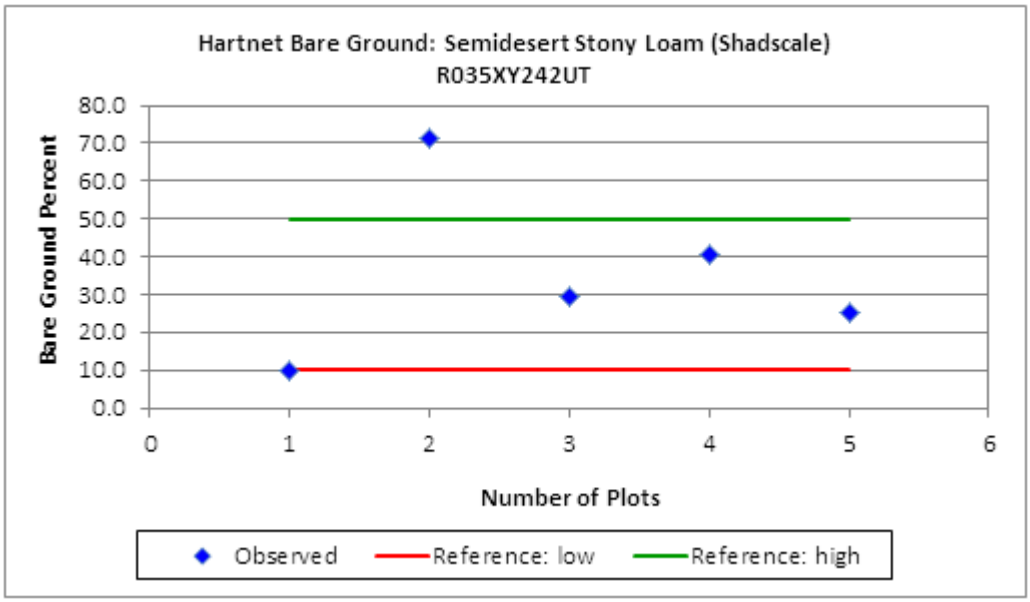


Figure B.6. Percent Bare Ground Observed in Recently Retired Hartnet Allotment IIRH Plots

The data indicate that the observed percent bare ground generally is greater than reference conditions for the Alkali Flat (Greasewood [R035XY009UT]), Desert Alkali Sandy Loam (Alkali Sacaton [R035XY101UT]), Desert Sand (Sand Sagebrush [R035XY115UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]) ecological sites. These sites represent approximately 27% of the grazed portion of the recently retired Hartnet allotment. The remaining ecological sites for which bare ground data are available, but only with two or three data points per ecological site, represent approximately 10% of the grazed portion of the recently retired Hartnet allotment and show a similar trend of bare ground greater than reference conditions.

Biological soil crust also has been altered with respect to reference conditions in portions of the allotment. The percent of biological soil crust as ground cover (as opposed to other vegetation, duff, rock, or bare soil) in the previously grazed Hartnet allotment averages 12% (median = 5%), based on data recorded at the IIRH plots. The average percent biological soil crust for reference conditions ranges between approximately 4 and 23%, depending on ecological site. In many of the IIRH plots, relict areas of biological soil crust often are present beneath plant canopies or on the margins of steep slopes, where they are protected somewhat from disturbance. This indicates that the potential for biological soil crust is greater than it is at present.

Figures B.7 through B.10 present graphs of the percent cover of biological soil crust for the ecological sites for which sufficient biological soil crust data are available. The data indicate that the observed percent biological soil crust generally is within the range of reference conditions, with most plots near or less than the lower range of reference conditions for the following ecological sites: Alkali Flat (Greasewood [R035XY009UT]), Desert Alkali Sandy Loam (Alkali Sacaton [R035XY101UT]), Desert Sand (Sand Sagebrush [R035XY115UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]). These sites represent approximately 27% of the previously grazed portion of the Hartnet allotment.

Soil and site stability attribute *(the capacity of an area to limit loss and soil redistribution by wind and water)*—Thirteen of 43 plots in the recently retired Hartnet allotment were rated as a moderate to extreme or extreme to total departure from reference conditions for the soil and site stability attribute. The indicators that contributed to these ratings for the 13 plots are shown in Figure B.11.

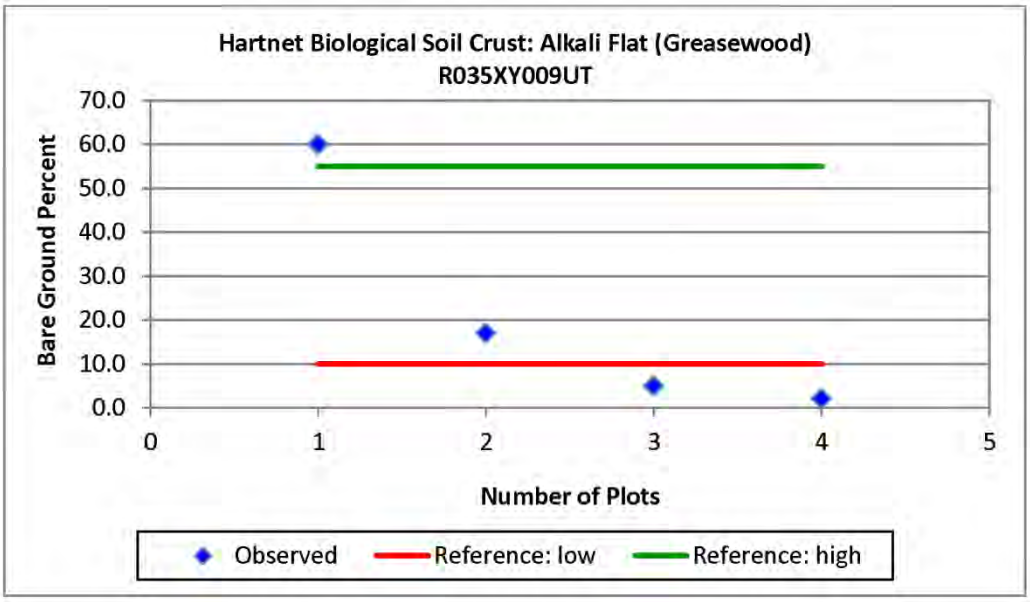


Figure B.7. Percent Cover of Biological Soil Crust Observed in Recently Retired Hartnet Allotment IIRH Plots

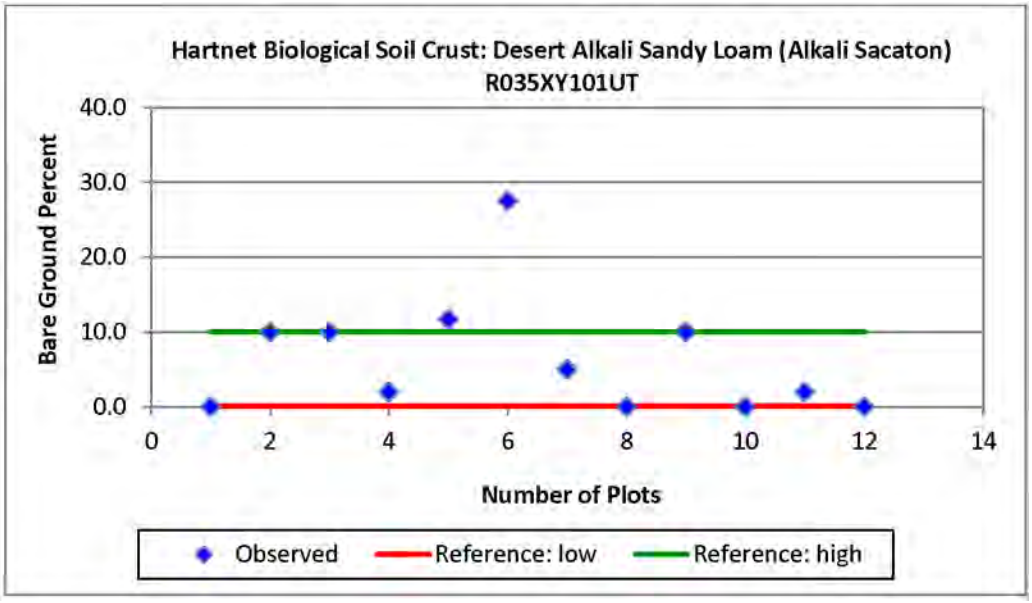


Figure B.8. Percent Cover of Biological Soil Crust Observed in Recently Retired Hartnet Allotment IIRH Plots

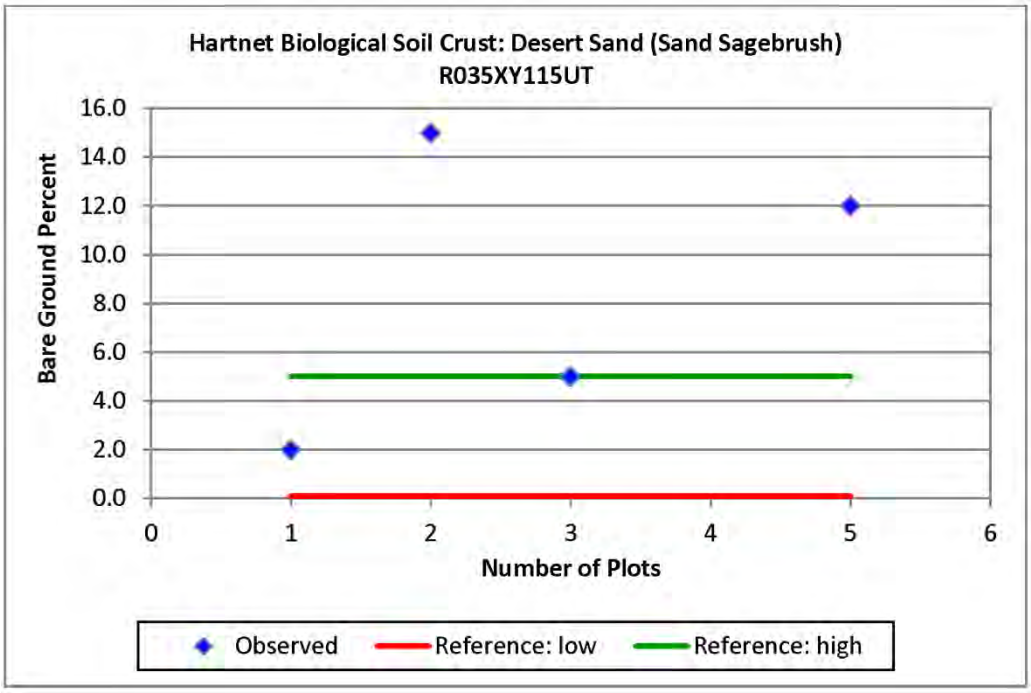


Figure B.9. Percent Cover of Biological Soil Crust Observed in Recently Retired Hartnet Allotment IIRH Plots

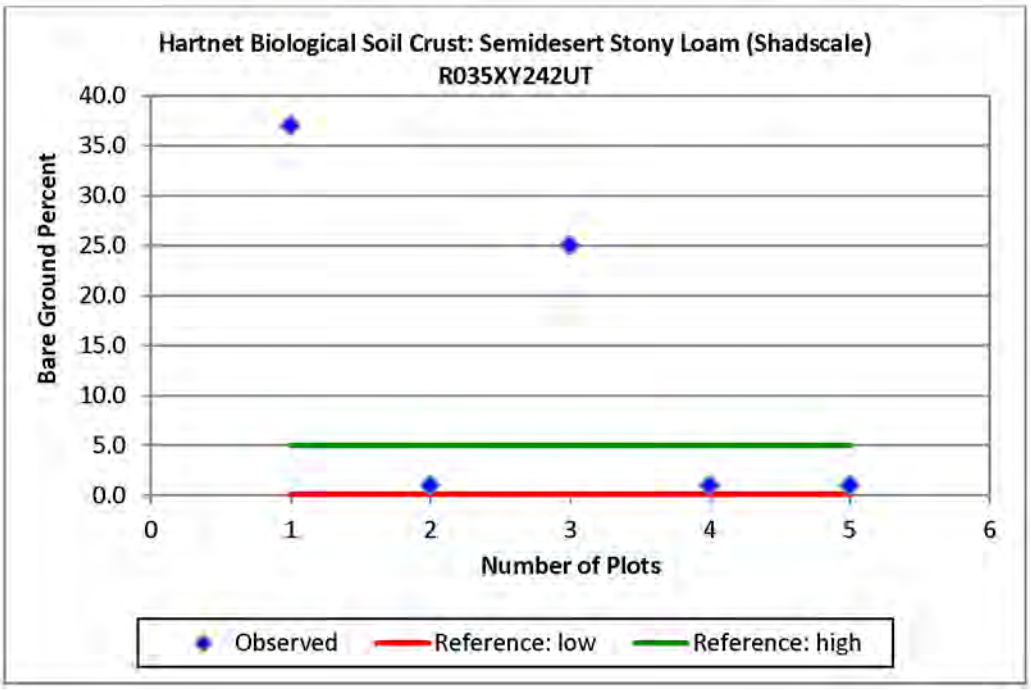


Figure B.10. Percent Cover of Biological Soil Crust Observed in Recently Retired Hartnet Allotment IIRH Plots

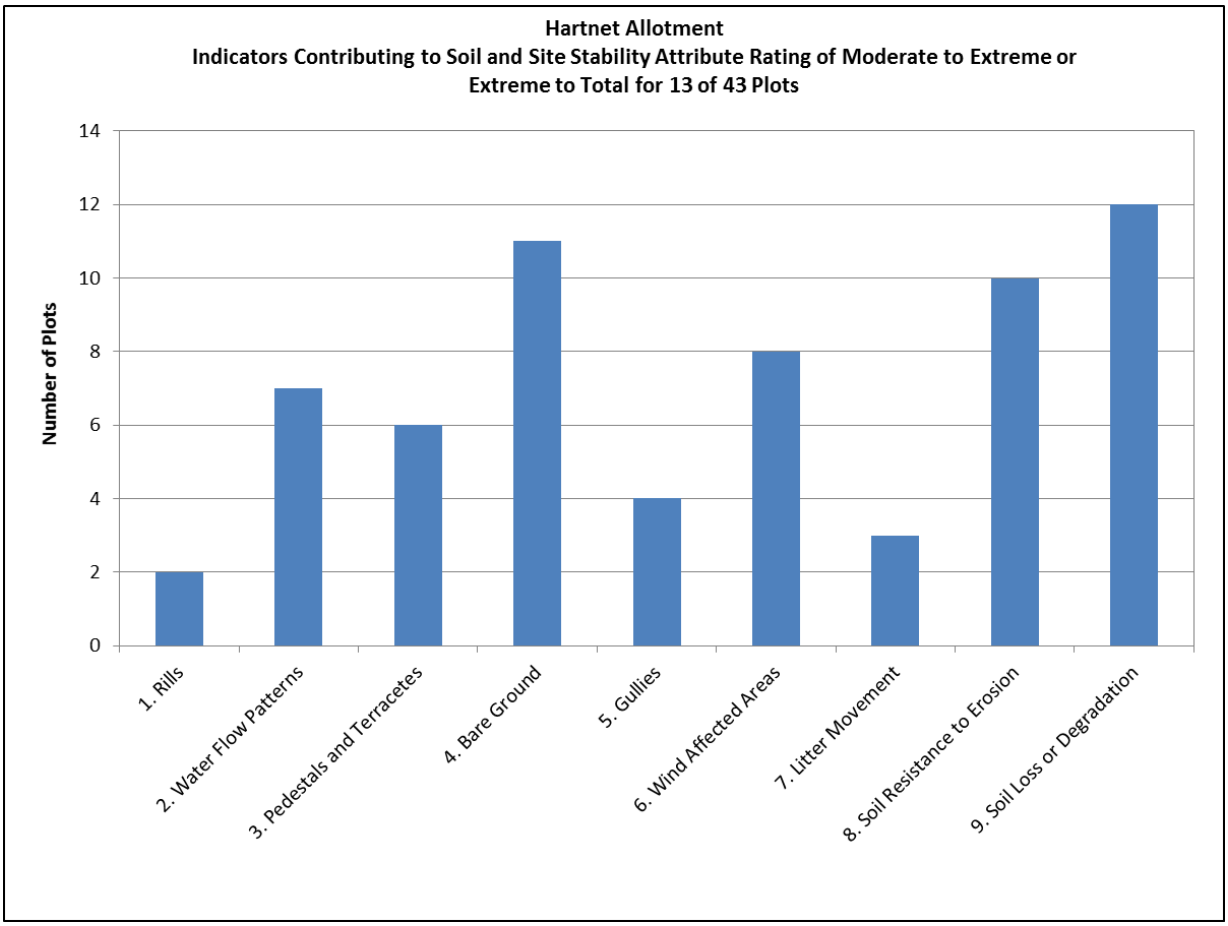


Figure B.11. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Soil and Site Stability Attribute, Recently Retired Hartnet Allotment

The four indicators most frequently associated with moderate to extreme and extreme to total departure from reference conditions are as follows:

Soil surface loss or degradation

Bare ground

Soil surface resistance to erosion

Wind-scoured, blowout, or depositional areas

Aggregate soil stability values in the previously grazed Hartnet allotment average 3.7, on a scale of 1.0 to 6.0. Average aggregate soil stability in the two existing exclosures is 5.5. The typical aggregate soil stability values for the ecological sites for which data are available are between 3.0 and 4.0.

Figures B.12 through B.15 present graphs of the aggregate soil stability for the ecological sites for which sufficient data are available. The data indicate that the observed soil stability values approximate reference conditions for four ecological sites: Alkali Flat (Greasewood [R035XY009UT]), Desert Alkali Sandy Loam (Alkali Sacaton [R035XY101UT]), Desert Sand (Sand Sagebrush [R035XY115UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]). These sites represent approximately 27% of the grazed portion of the recently retired Hartnet allotment.

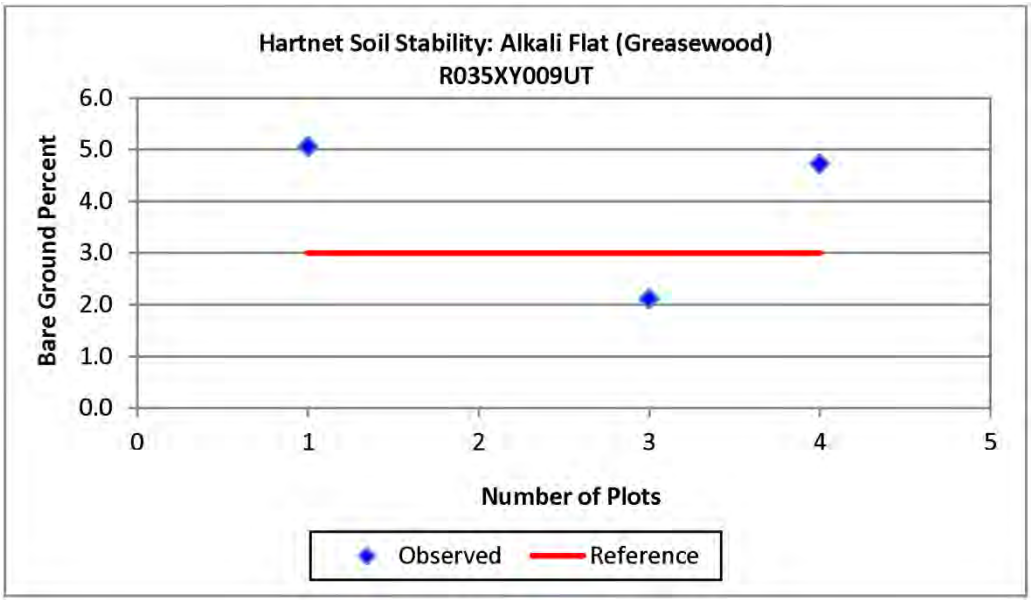


Figure B.12. Aggregate Soil Stability Measured in Recently Retired Hartnet Allotment IIRH Plots

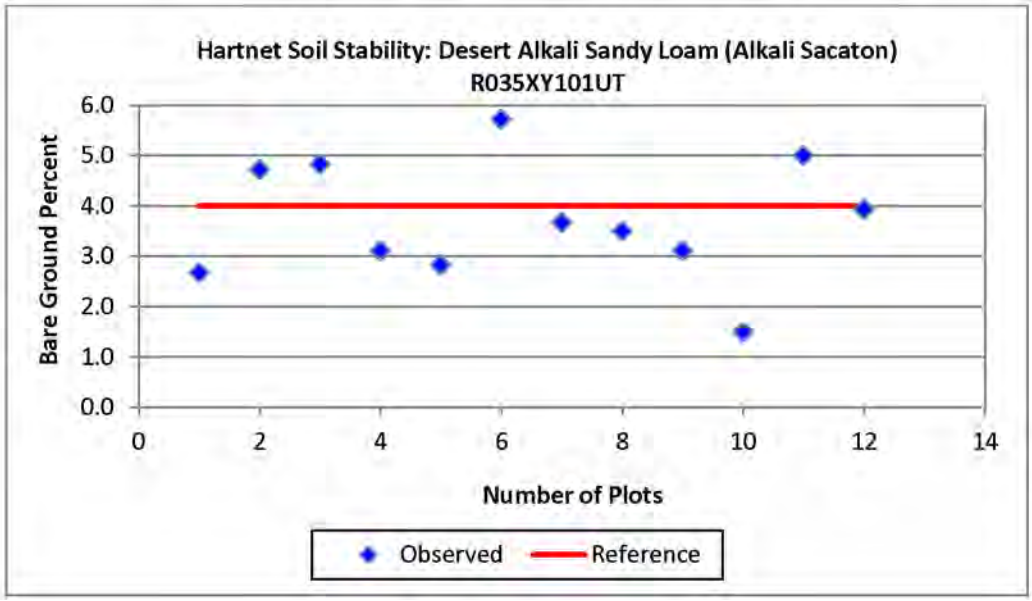


Figure B.13. Aggregate Soil Stability Measured in Recently Retired Hartnet Allotment IIRH Plots

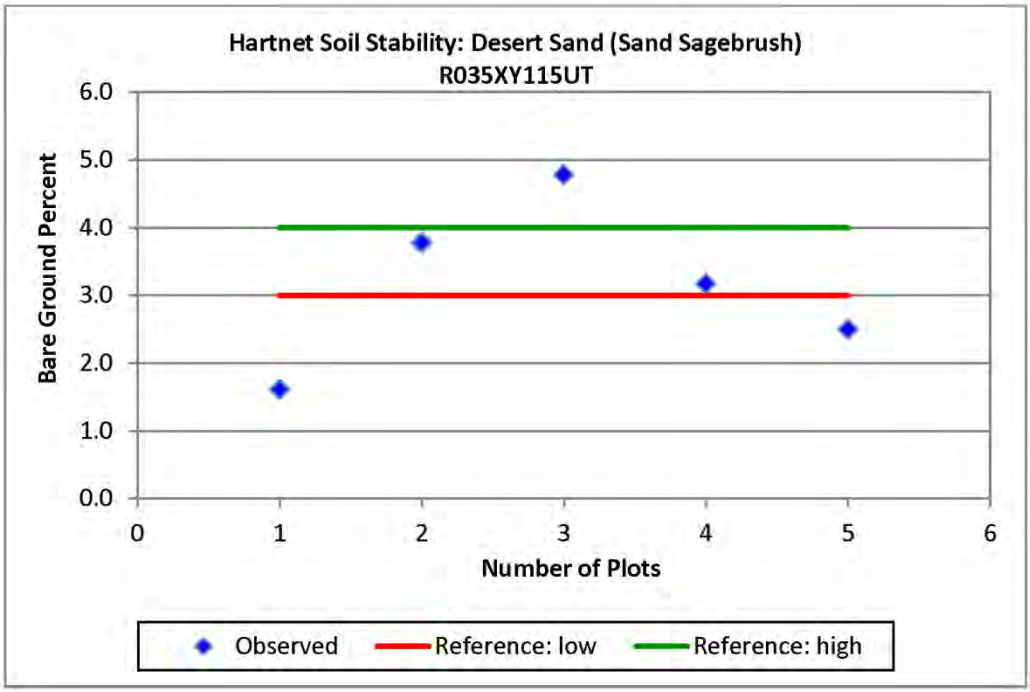


Figure B.14. Aggregate Soil Stability Measured in Recently Retired Hartnet Allotment IIRH Plots

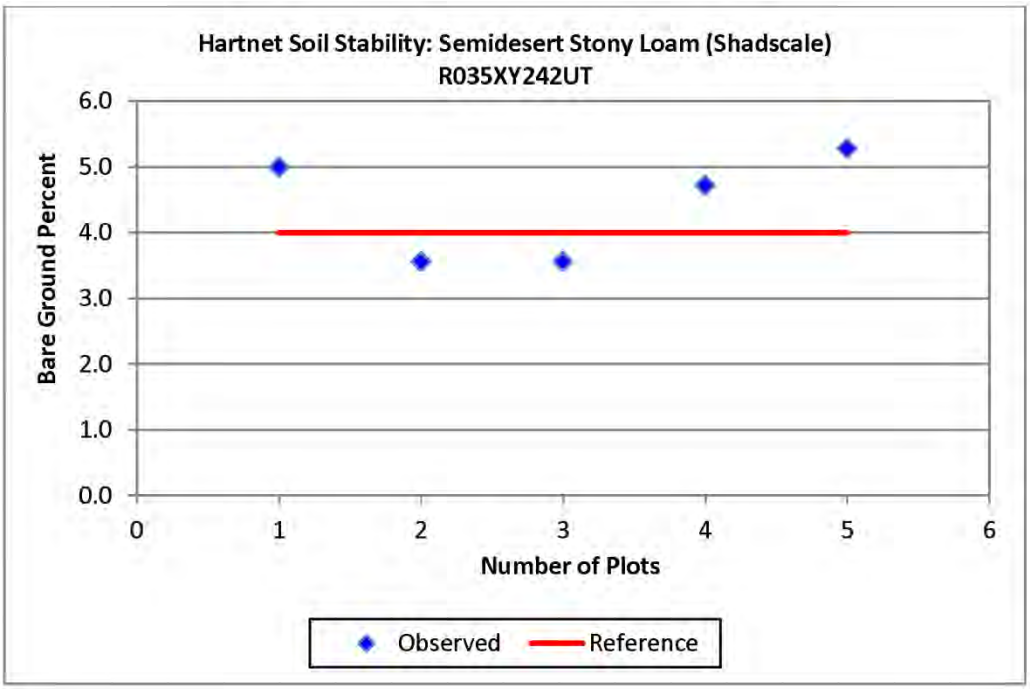


Figure B.15. Aggregate Soil Stability Measured in Recently Retired Hartnet Allotment IIRH Plots

Hydrologic function attribute *(the capacity of an area to capture, store, and slowly release water from precipitation and run-on)*—Fourteen of 43 plots in the recently retired Hartnet allotment were rated as a moderate to extreme or extreme to total departure from reference conditions for the hydrologic function attribute. The indicators that contributed to these ratings for the 14 plots are shown in Figure B.16.

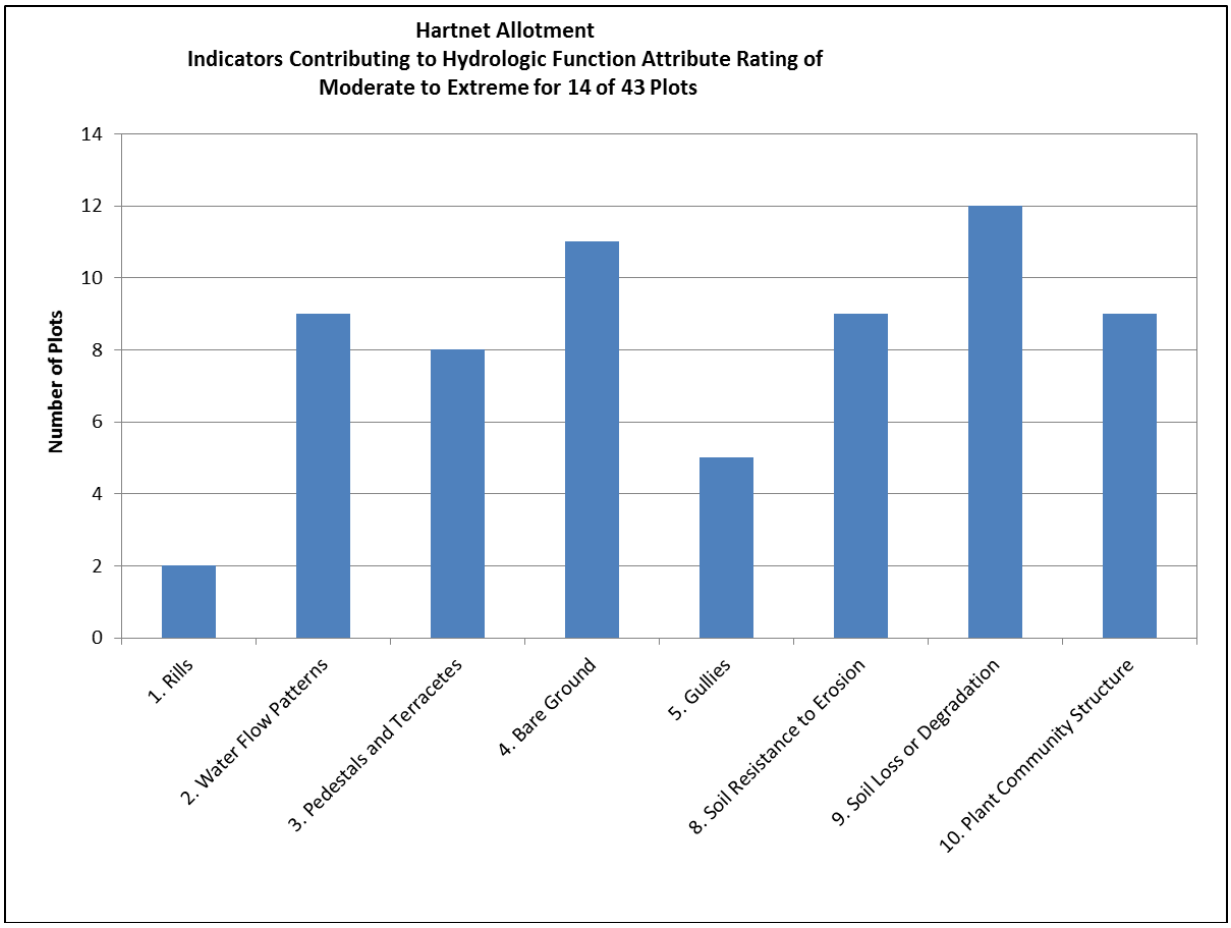


Figure B.16. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Hydrologic Function Attribute, Recently Retired Hartnet Allotment

The five indicators most frequently associated with moderate to extreme and extreme to total departure from reference conditions are as follows:

Soil surface loss or degradation

Bare ground

Water flow patterns

Soil surface resistance to erosion

Plant community composition and distribution, relative to infiltration and runoff

Field observations indicate that primary factors related to diminishing hydrologic function are alteration of soil and biological soil crust in the allotment and changes in vegetation communities. The hydrologic function is best in areas where biological soil crusts are relatively intact and vegetation communities are closer to reference conditions.

Biotic integrity attribute *(the capacity of the biotic community to support ecological processes)*—Eight of 43 plots in the recently retired Hartnet allotment were rated as a moderate to extreme or extreme to total departure from reference conditions for the biotic integrity attribute. The indicators that contributed to these ratings for the eight plots are shown in Figure B.17.

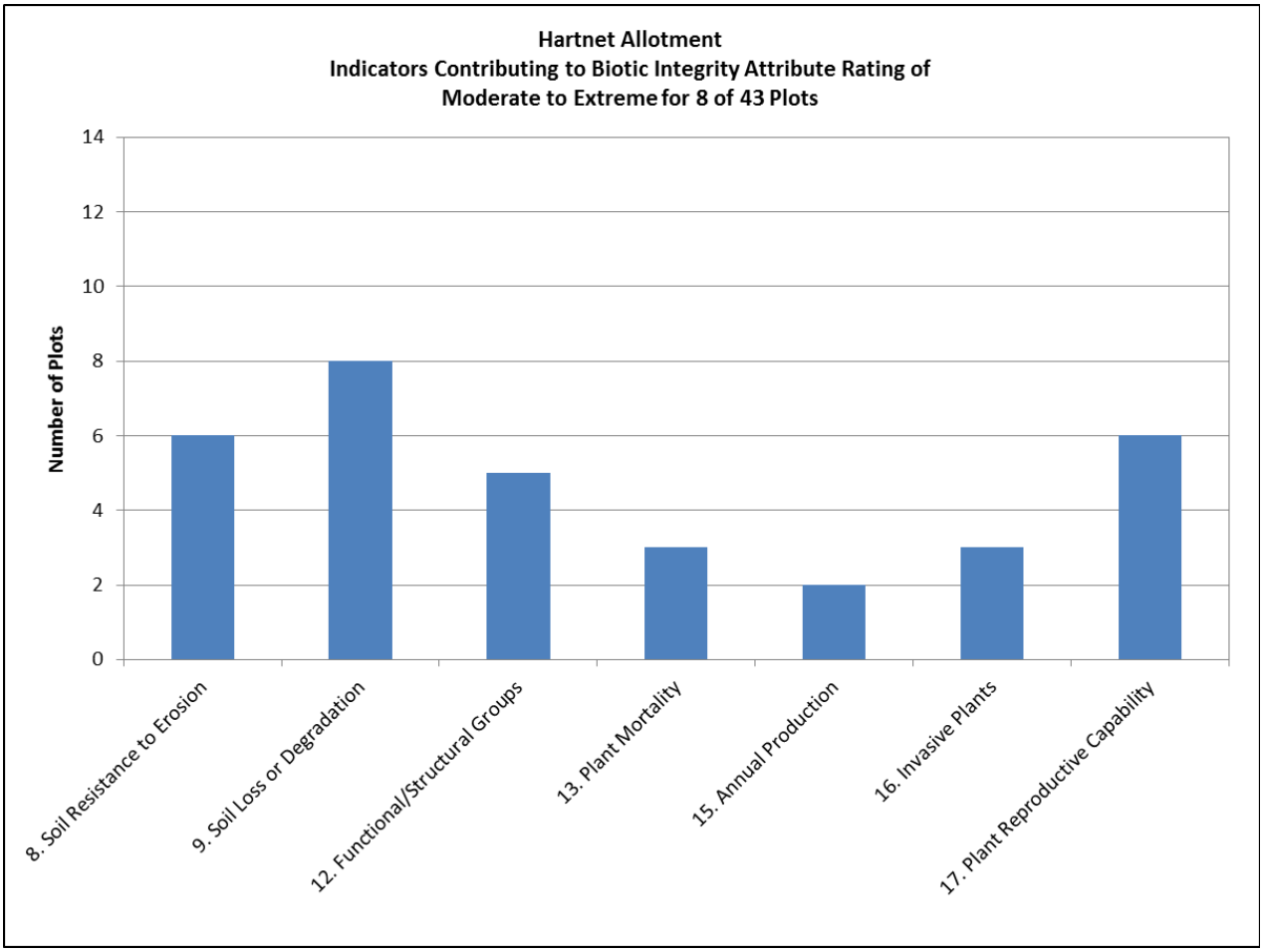


Figure B.17. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Biotic Integrity Attribute, Recently Retired Hartnet Allotment

The three indicators most frequently associated with moderate to extreme and extreme to total departure from reference conditions are as follows:

Soil surface loss or degradation

Soil surface resistance to erosion

Reproductive capability of perennial plants

Evaluation of the IIRH data and field observations indicate that overall biotic integrity is not as altered as soil conditions and hydrologic function in the recently retired Hartnet allotment. However, biotic integrity has been diminished with respect to reference conditions. Primary factors related to reducing biotic integrity are alteration of soil and biological soil crust in the allotment and changes in the ability of key species to reproduce.

Recently retired Hartnet allotment scat counts. In addition to the 17 IIRH indicators, scat counts were conducted in each plot. Livestock, elk, mule deer, pronghorn, and rabbit/hare scat was identified and counted along a 2-meter (6.5-foot) wide belt straddling each of the 50-meter (164-foot) transects in each plot. Count data were transformed to a density (the count of scat observed, divided by the transect area [100 square meters]) for evaluation and quantification of the results.

Scat count data were collected to evaluate the relationship between ungulate use and rangeland condition. The scat count data indicate a strong relationship between the frequency of observation of livestock dung and departure from reference conditions, where livestock dung is a proxy for the number of livestock grazing a particular area. Data were of particular interest in the recently retired Hartnet allotment because of the potential for damage to threatened or endangered plant species by trampling or disturbance from elk and livestock.

Livestock—Figure B.18 presents scat count density for livestock, in relation to the three attributes of rangeland health. Except for the hydrologic function attribute, the graphs in Figure B.18 show that an increasing density of livestock increases the probability of moderate to extreme departure from reference conditions. For soil and site stability and biotic integrity, a density of 20 scat counts per transect area indicates an approximate 40% probability of a moderate to extreme departure from reference conditions. At a density of 30, the probability of a moderate to extreme departure from reference is between 70 and 75%. A density of scat between approximately 7 and 12 counts per transect area results in greater than 50% probability of a moderate departure from reference conditions for soil and site stability and biotic integrity. Figure B.18 also demonstrates that a density as low as 3 to 10 results in a decline from approximately 75% to 0 in the probability of none to slight departure from reference conditions.

Hydrologic function suggests a different pattern (also observed in the Sandy 3 allotment), in which increasing scat density is related to an increase in moderate departure from reference conditions but not an increase in moderate to extreme departure from reference. The reasons for this pattern are unclear and will need additional research and evaluation. However, it is possible that hydrologic function is controlled more by overarching factors, such as soil type and precipitation patterns, and that once a moderate departure from reference conditions has been reached (a scat density as low as 5 counts per transect area), the system is reasonably stable until substantially more disturbance is applied.

Elk—Figure B.19 presents a substantially different result for elk when compared to livestock with regard to the effect of density on rangeland conditions. An increase in elk scat count density results in an increase in the probability of a slight to moderate departure from reference conditions, while the probability declines for moderate and moderate to extreme departure from reference. The graphs suggest that an elk scat count density less than 10 results from a moderate departure from reference conditions, and as the density of elk increases the probability of a moderate departure from reference declines. At first glance, this relationship seems counter-intuitive. However, field observations indicate that elk use different parts of the recently retired Hartnet allotment than livestock and rarely intermingle with livestock. As a result, and a low density of elk scat counts is correlated with a higher density of livestock. Where elk density is the least, livestock density is greatest, and where elk density is greatest, livestock density is least.

In each graph, probability of occurrence is shown on the y-axis and scat density is shown on the x-axis.

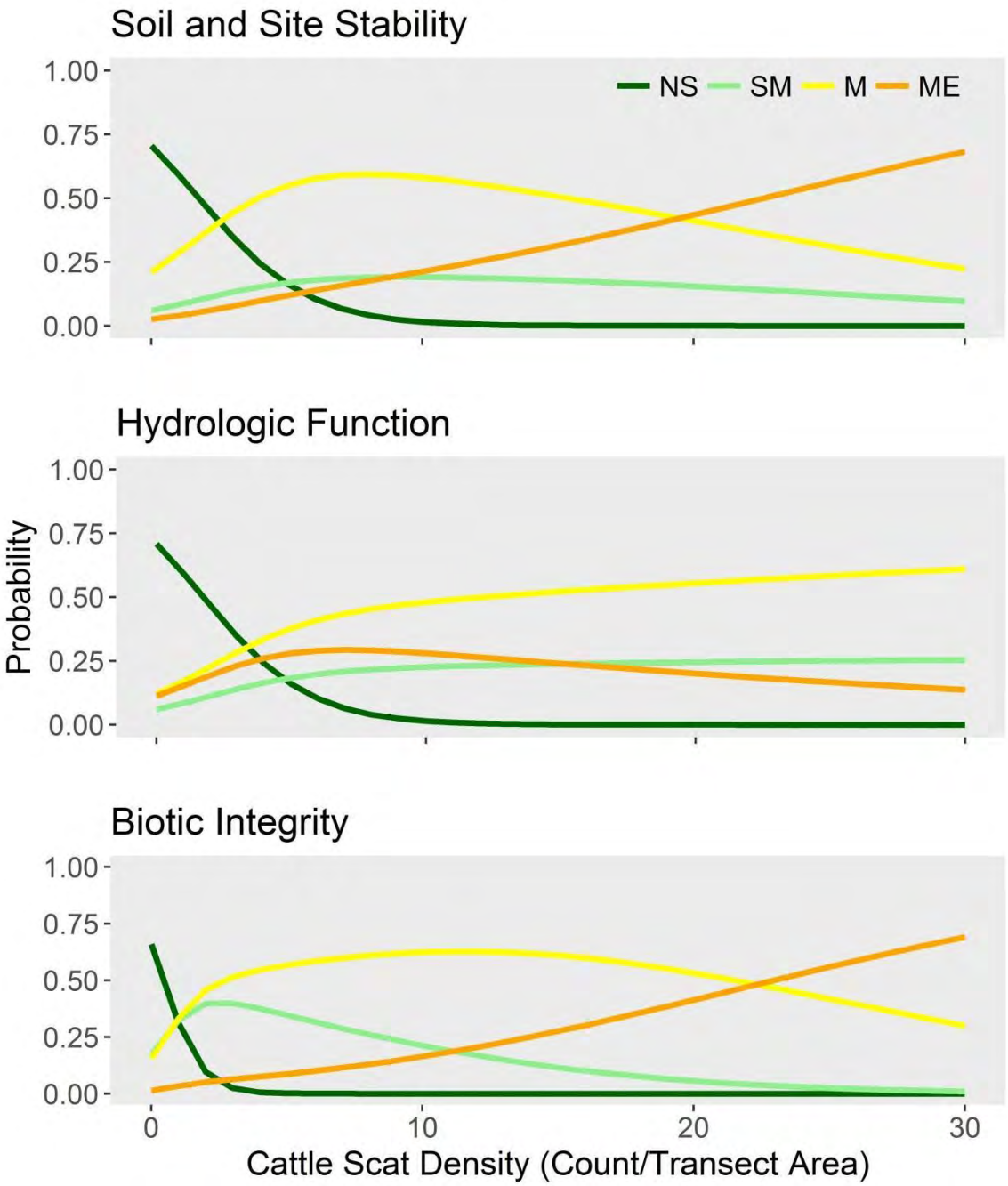


Figure B.18. Scat Count Density and Probability of Departure from Reference Conditions in the Hartnet Allotment: Livestock
(NS–none to slight; SM = slight to moderate; M = moderate; ME = moderate to extreme.)

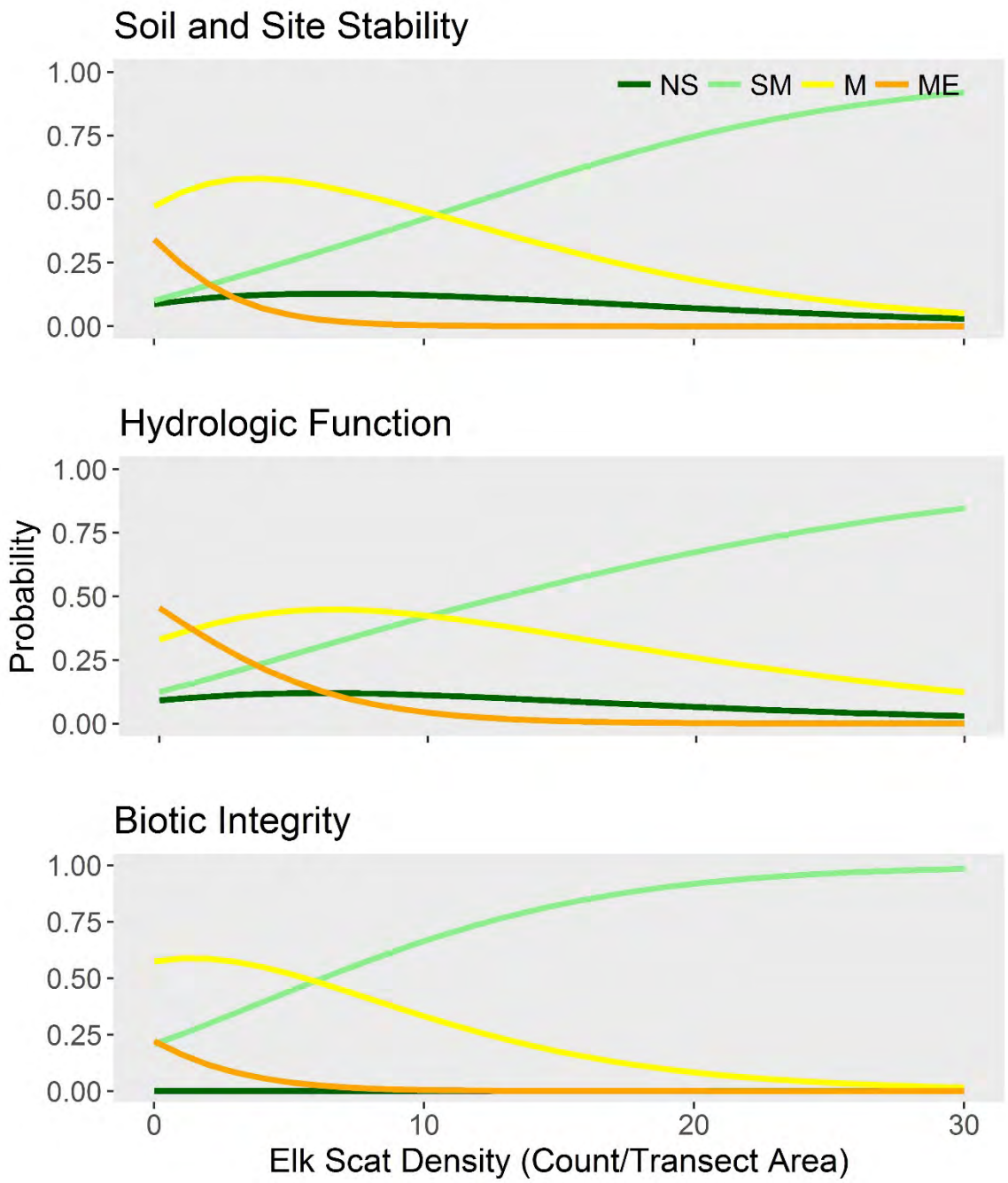


Figure B.19. Scat Count Density and Probability of Departure from Reference Conditions in the Hartnet Allotment: Elk
(NS–none to slight; SM = slight to moderate; M = moderate; ME = moderate to extreme.)

Sandy 3 Allotment

The results of the IIRH evaluation indicate that 59 to 69% of plots in the Sandy 3 allotment are in a state of moderate or moderate to extreme departure from reference conditions. Furthermore, 13 to 23% of the plots are in a state of moderate to extreme departure from reference conditions. Table B.2, below, summarizes the departure from reference conditions for the Sandy 3 allotment. Figure B.20 presents the IIRH data on a map of the Sandy 3 allotment.

TABLE B.2. SANDY 3 ALLOTMENT DEPARTURE FROM REFERENCE CONDITIONS FOR IIRH ATTRIBUTES

Sandy 3 Allotment			
Departure from Reference Conditions	**Attribute**		
	Soil and Site Stability	**Hydrologic Function**	**Biotic Integrity**
None to slight	17.9%	17.9%	15.4%
Slight to moderate	23.1%	25.6%	15.4%
Moderate	46.2%	41.0%	46.2%
Moderate to extreme	**12.8%**	**15.4%**	**23.1%**

Because the individual assessment plots are characteristic of soils and ecological sites that define rangeland conditions, the overall health of rangelands in the Sandy 3 allotment is poor. Plots that exhibit a greater departure from reference condition are on the topographically gentler valley bottoms and are within 1 to 2 miles of water. Plots with the least departure from reference conditions typically are on slopes and higher elevations and more distant from water.

Rangeland health assessment indicators. Figure B.21, below, indicates that the primary factors in altered rangeland condition in the Sandy 3 allotment are related to soil and vegetation, invasive plants, in particular. Of the eight indicators most frequently associated with moderate to extreme departure from reference conditions (observed in at least five plots), five have a direct bearing on soil conditions, as follows:

Soil surface resistance to erosion

Bare ground

Water flow patterns

Soil loss or degradation

Gullies

Three have a direct bearing on vegetation, including loss of biological soil crust, as follows:

Invasive plants

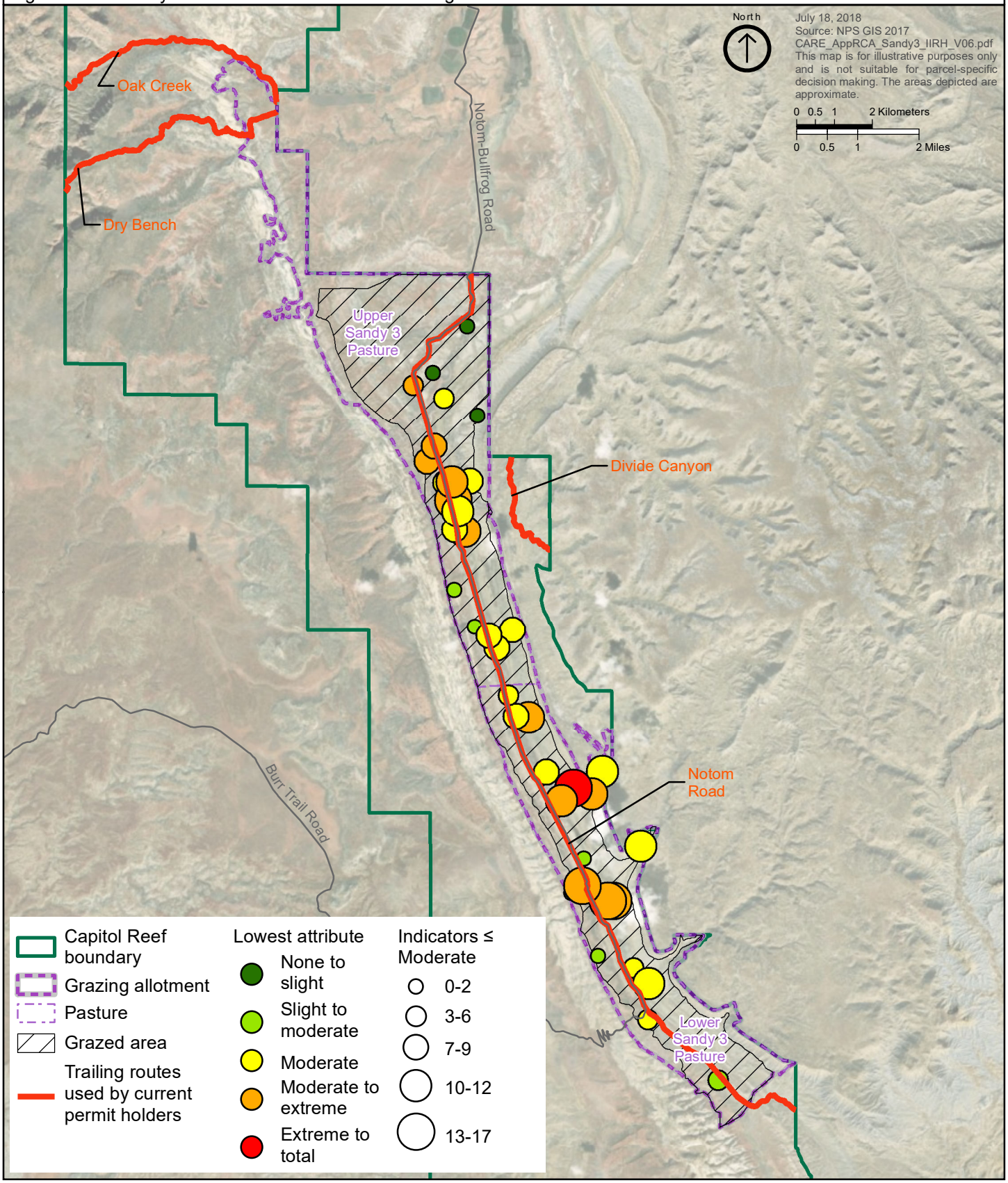
Plant functional/structural groups

Plant community composition and distribution, relative to infiltration and runoff

Capitol Reef National Park
Livestock Grazing and Trailing Management Plan/EA

National Park Service
U.S. Department of the Interior

Figure B.20: Sandy 3 Allotment - IIRH Indicator Ratings



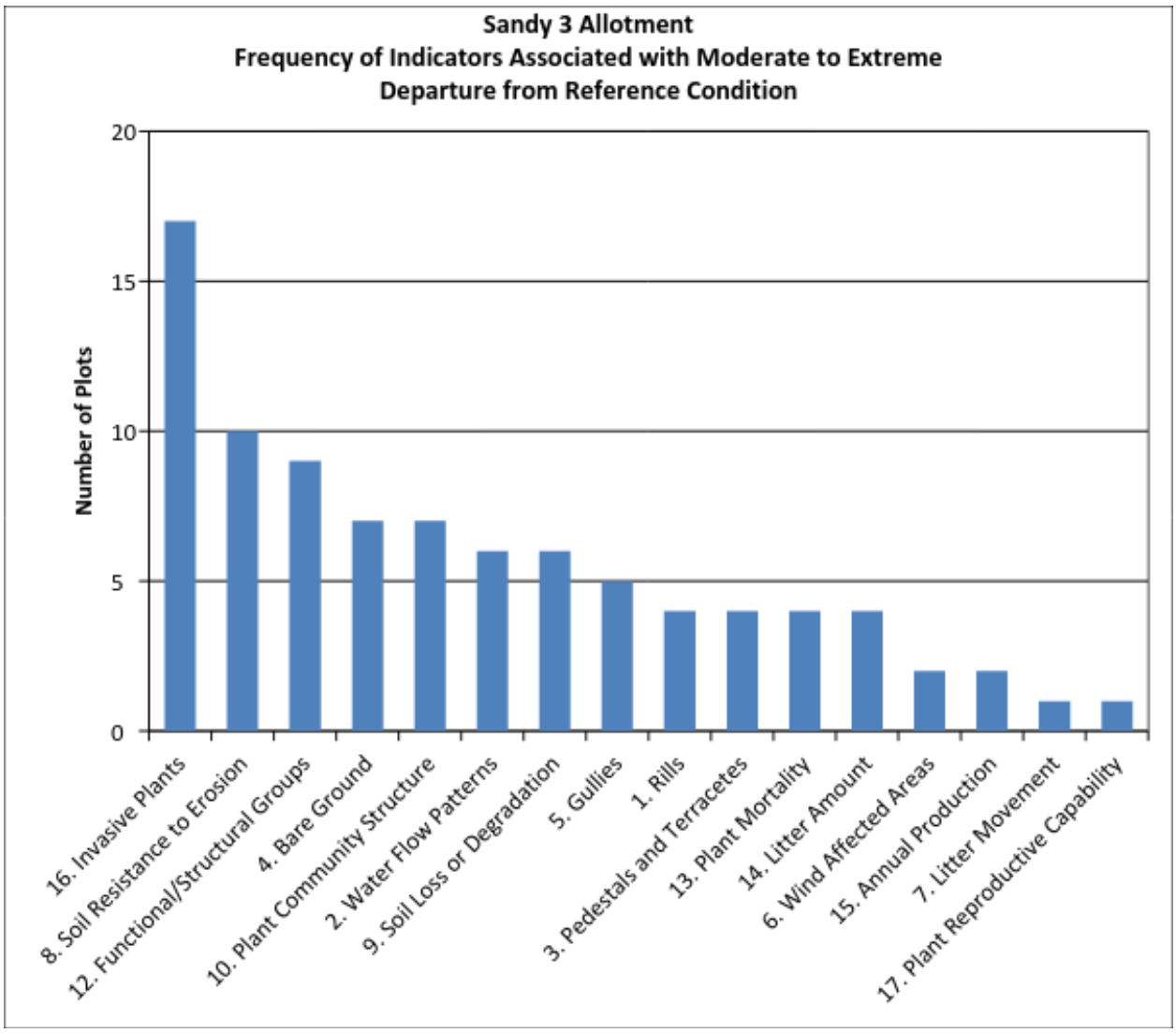


Figure B.21. Indicators Associated with Moderate to Extreme Departure, Sandy 3 Allotment

Invasive plants in the Sandy 3 allotment are cheatgrass, Russian thistle, and halogeton. These invasive plants are ubiquitous in large portions of the Sandy 3 allotment and result in moderate to extreme and extreme to total departures from reference conditions in many plots.

The percent of bare ground in the grazed portions of Sandy 3 allotment averages 46% (median = 48%), based on percent bare ground recorded at the IIRH plots. Outside the grazed area, bare ground averages 16% (median = 16). Field observations indicate that the A soil horizon is nonexistent or has been eroded widely in a number of the plots evaluated and in areas outside the plots. At these locations, the reference vegetation communities will be unable to restore themselves without direct intervention and treatment.

Figures B.22 through B.25 present graphs of the percent bare ground for the ecological sites for which sufficient bare ground data are available. These data were collected at a single point in time and are not intended to represent a long-term trend. Rangeland conditions vary year to year and quantitative measures, such as percent bare ground, also vary over time. However, bare ground caused by loss of the A horizon or widespread erosion is not likely to recover without a cessation or reduction in the stresses that created the bare ground.

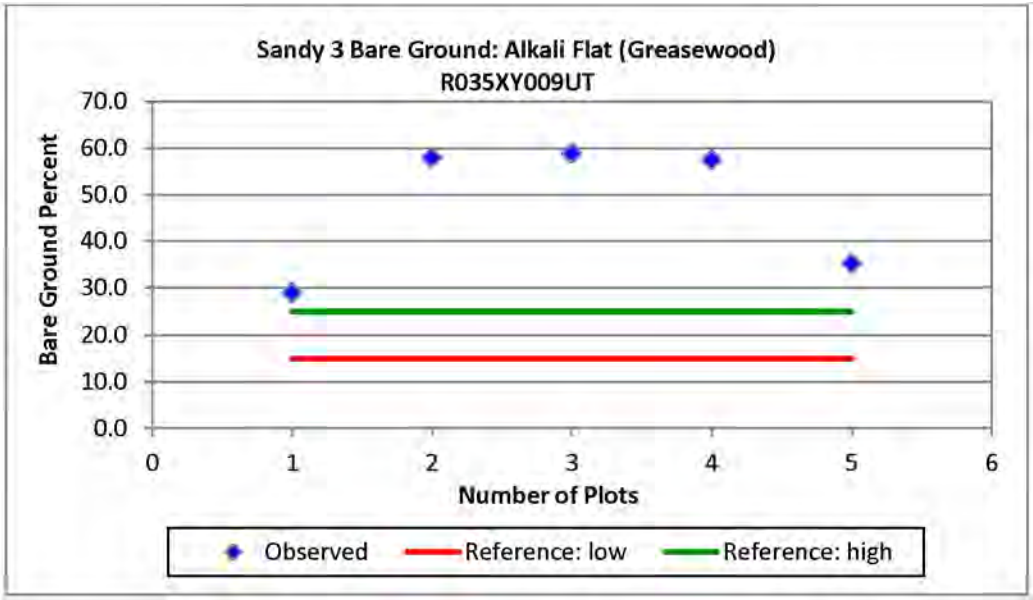


Figure B.22. Percent Bare Ground observed in Sandy 3 Allotment IIRH Plots, Ecological Site 003

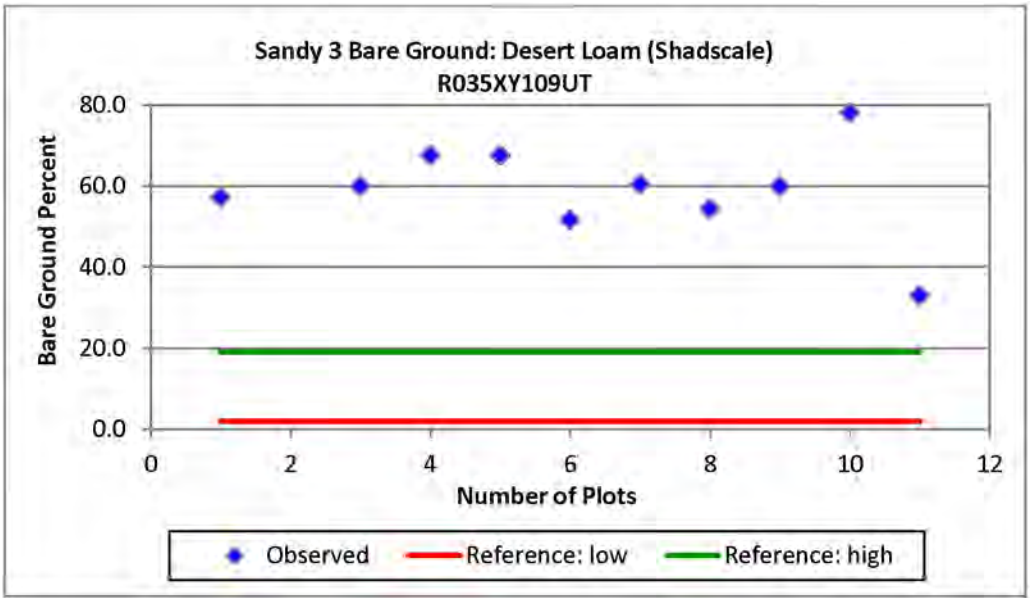


Figure B.23. Percent Bare Ground Observed in Sandy 3 Allotment IIRH Plots, Ecological Site 215

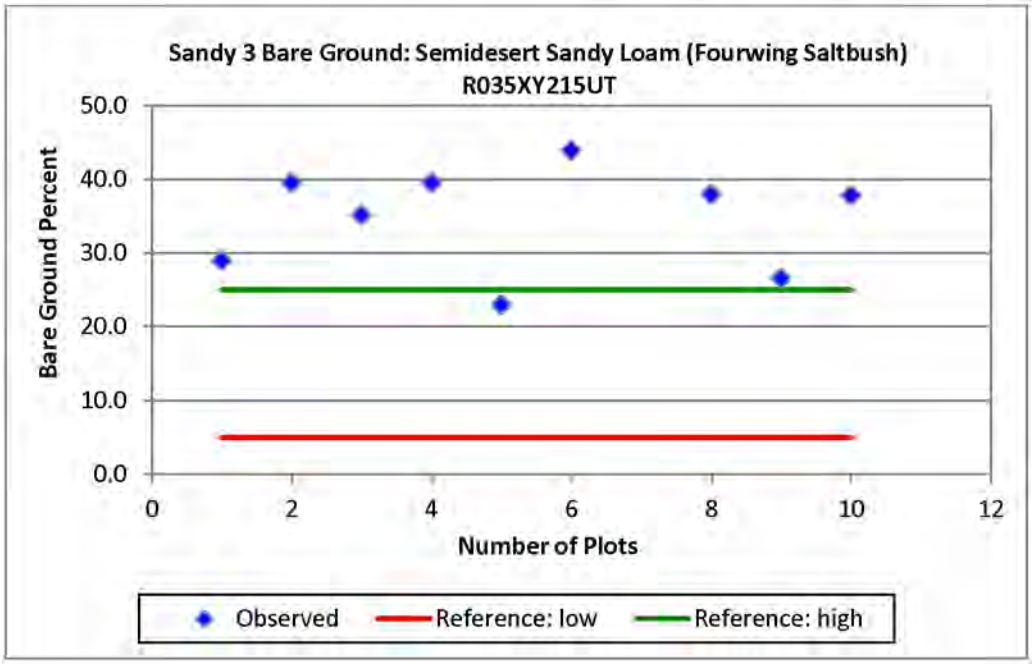


Figure B.24. Percent Bare Ground Observed in Sandy 3 Allotment IIRH Plots, Ecological Site 227

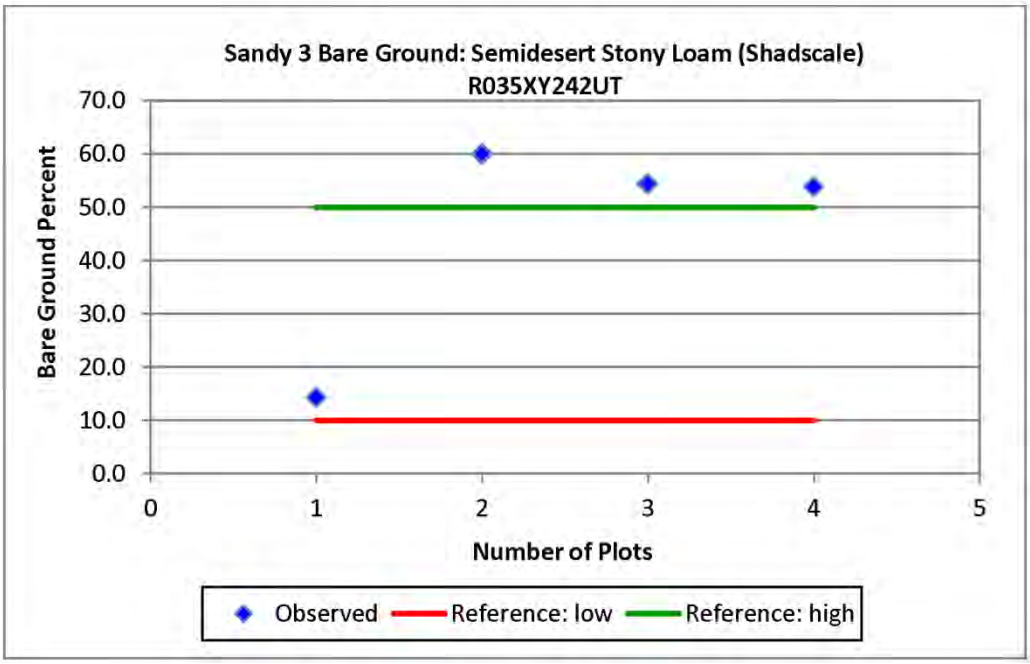


Figure B.25. Percent Bare Ground Observed in Sandy 3 Allotment IIRH Plots, Ecological Site 242

The data indicate that the observed percent bare ground generally is greater than reference conditions for the Alkali Flat (Greasewood [R035XY009UT]), Desert Loam (Shadscale [R035XY109UT]), Semidesert Sandy Loam (Fourwing Saltbush [R035XY215UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]) ecological sites. These four ecological sites represent approximately 41% of the grazed portion of the Sandy 3 allotment. The remaining ecological sites for which bare ground data are available, but only with two or three data points per ecological site, represent approximately

15% of the grazed portion of the Sandy 3 allotment and show a similar trend of bare ground greater than reference conditions.

Biological soil crust also has been altered with respect to reference conditions in portions of the allotment. The percent of biological soil crust as ground cover in the grazed Sandy 3 allotment averages 3% (median = 0%), based on data recorded at the IIRH plots. The average percent biological soil crust for reference conditions ranges between approximately 8% and 28%, depending on ecological site.

In many of the IIRH plots, relict areas of biological soil crust often are present beneath plant canopies or on the margins of steep slopes where they are protected somewhat from disturbance. This indicates that the potential for biological soil crust is greater than at present.

Figures B.26 through B.29 present graphs of the percent cover of biological soil crust for the ecological sites for which sufficient biological soil crust data are available. The data indicate that the observed percent biological soil crust generally is substantially less than reference conditions for the Alkali Flat (Greasewood [R035XY009UT]), Desert Loam (Shadscale [R035XY109UT]), Semidesert Sandy Loam (Fourwing Saltbush [R035XY215UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]) ecological sites. These four ecological sites represent approximately 41% of the grazed portion of the Sandy 3 allotment. The remaining ecological sites for which biological soil crust data are available, but with only two or three data points per ecological site, represent approximately 15% of the grazed portion of the Sandy 3 allotment. They show a similar trend of biological soil crust less than reference conditions.

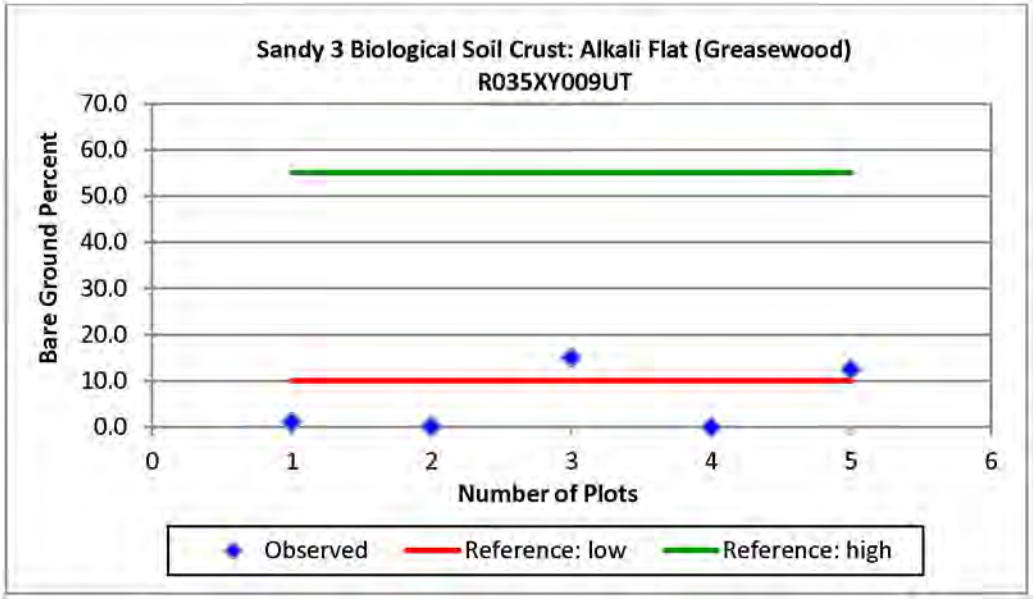


Figure B.26. Percent Cover of Biological Soil Crust Observed in Sandy 3 Allotment IIRH Plots

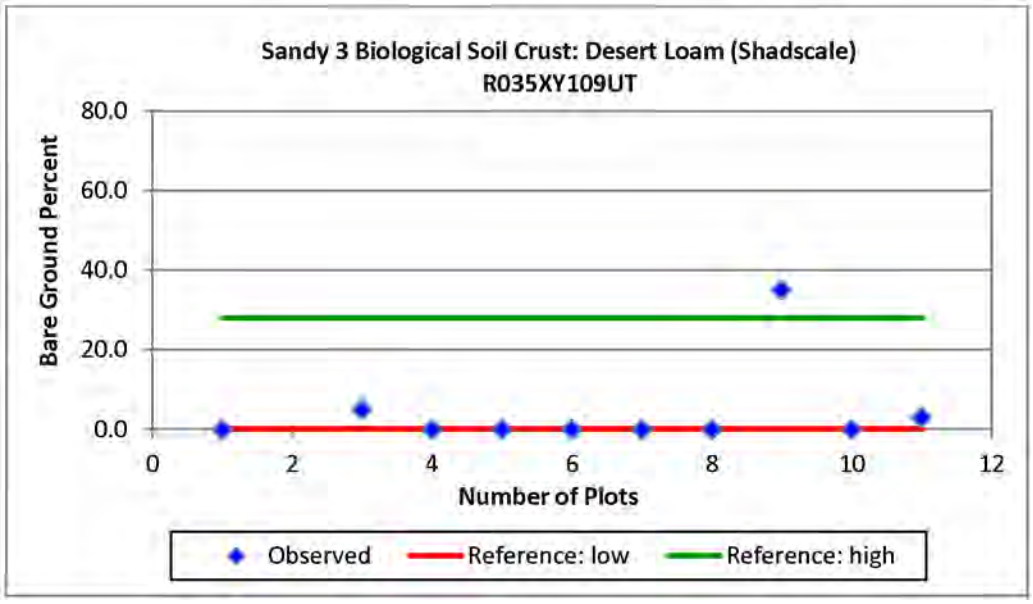


Figure B.27. Percent Cover of Biological Soil Crust Observed in Sandy 3 Allotment IIRH Plots

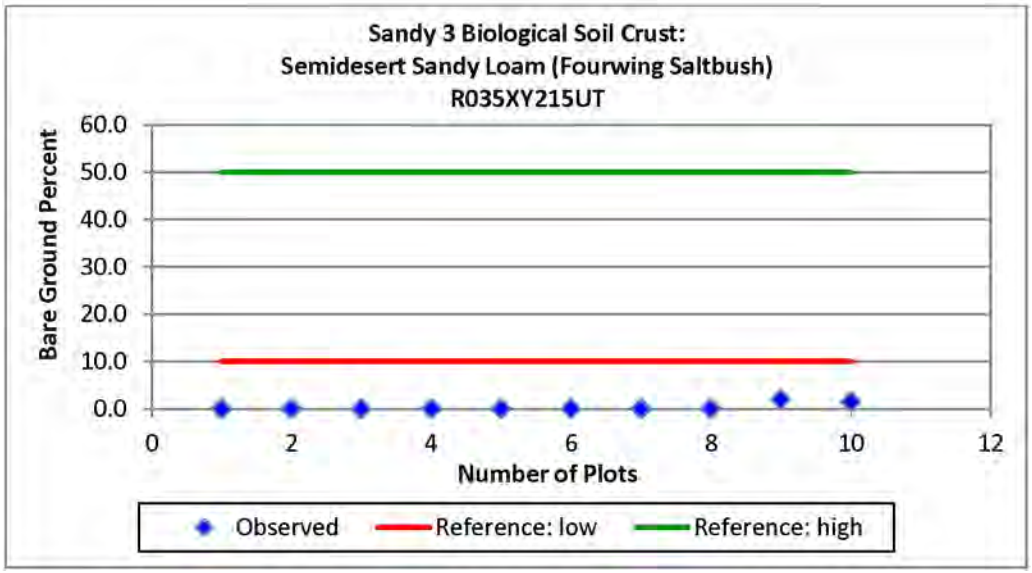


Figure B.28. Percent Cover of Biological Soil Crust Observed in Sandy 3 Allotment IIRH Plots

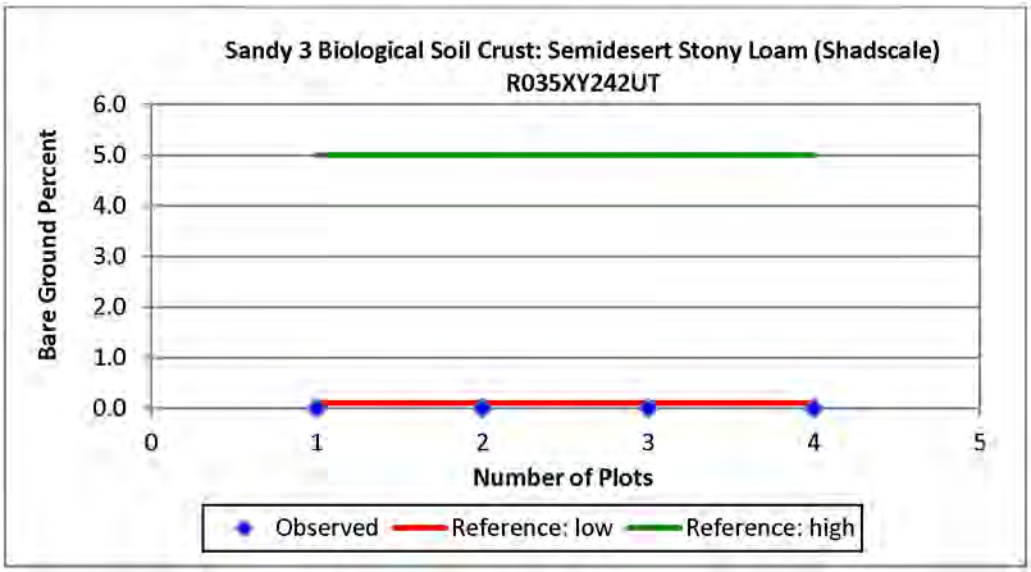


Figure B.29. Percent Cover of Biological Soil Crust Observed in Sandy 3 Allotment IIRH Plots

Soil and site stability—Five of the 39 plots in the Sandy 3 allotment were rated as moderate to extreme departure from reference conditions for the soil and site stability attribute. The indicators that contributed to the moderate to extreme rating for the five plots are shown in Figure B.30.

The five indicators most frequently associated with moderate to extreme departure from reference conditions are as follows:

Soil surface resistance to erosion

Soil surface loss or degradation

Rills

Pedestals and/or terracettes

Bare ground

The A soil horizon has been severely eroded in a number of the plots evaluated and in areas outside the plots. Biological soil crust has been severely altered in substantial portions of the allotment. Relict areas of biological soil crust often are present beneath plant canopies or on the margins of steep slopes where they are protected somewhat from trampling. Gullies are also prevalent in the Sandy 3 allotment.

Aggregate soil stability values in the grazed Sandy 3 allotment average 3.8, on a scale from 1.0 to 6.0; aggregate soil stability in the exclosure is 4.6. The typical aggregate soil stability values for the ecological sites for which data are available are between 2.0 and 5.0.

Figures B.31 through B.34 present graphs of the aggregate soil stability for the ecological sites for which sufficient data are available. The data indicate that the observed soil stability values approximate the reference conditions for the Alkali Flat (Greasewood [R035XY009UT]), Desert Loam (Shadscale [R035XY109UT]), Semidesert Sandy Loam (Fourwing Saltbush [R035XY215UT]), and Semidesert Stony Loam (Shadscale [R035XY242UT]) ecological sites. These four ecological sites represent approximately 41% of the grazed portion of the Sandy 3 allotment.

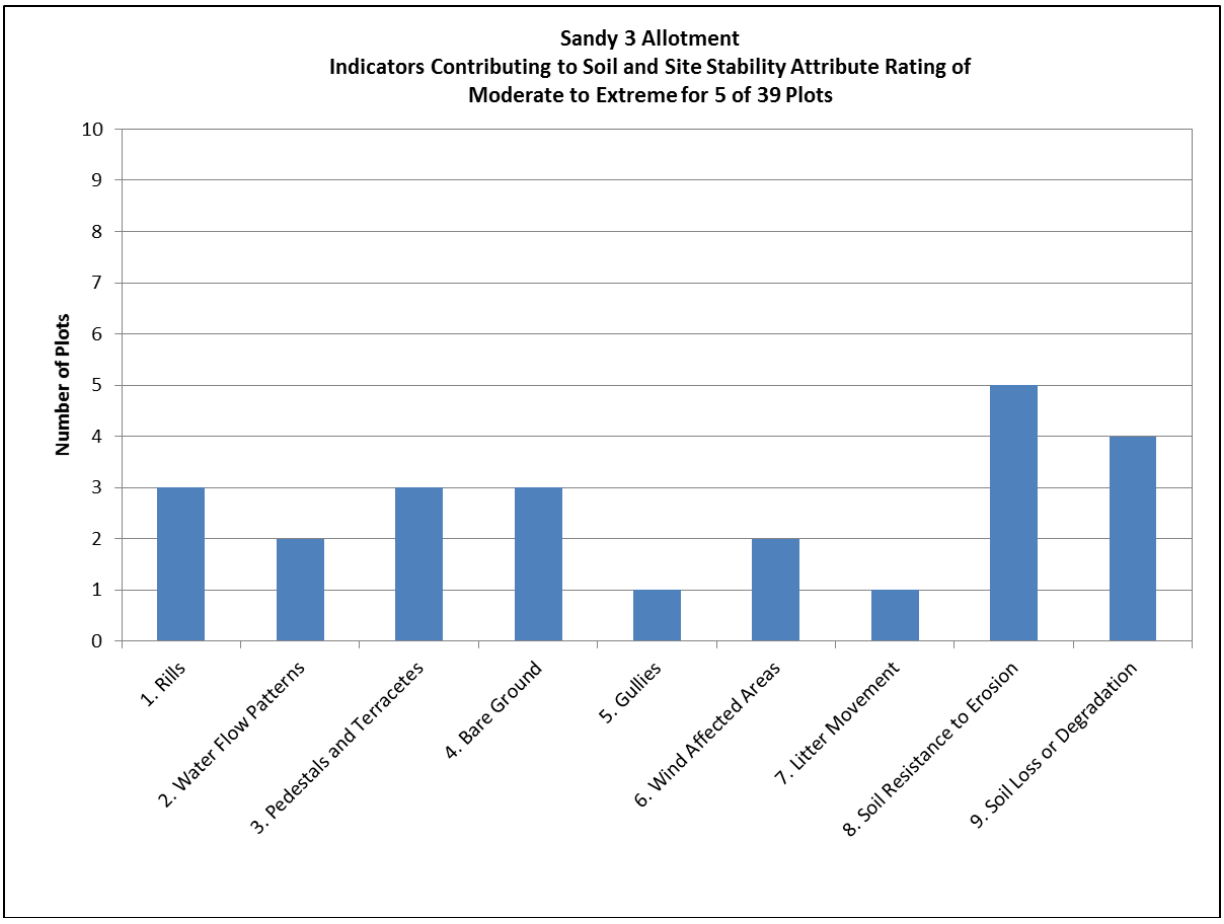


Figure B.30. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Soil and Site Stability Attribute, Sandy 3 Allotment

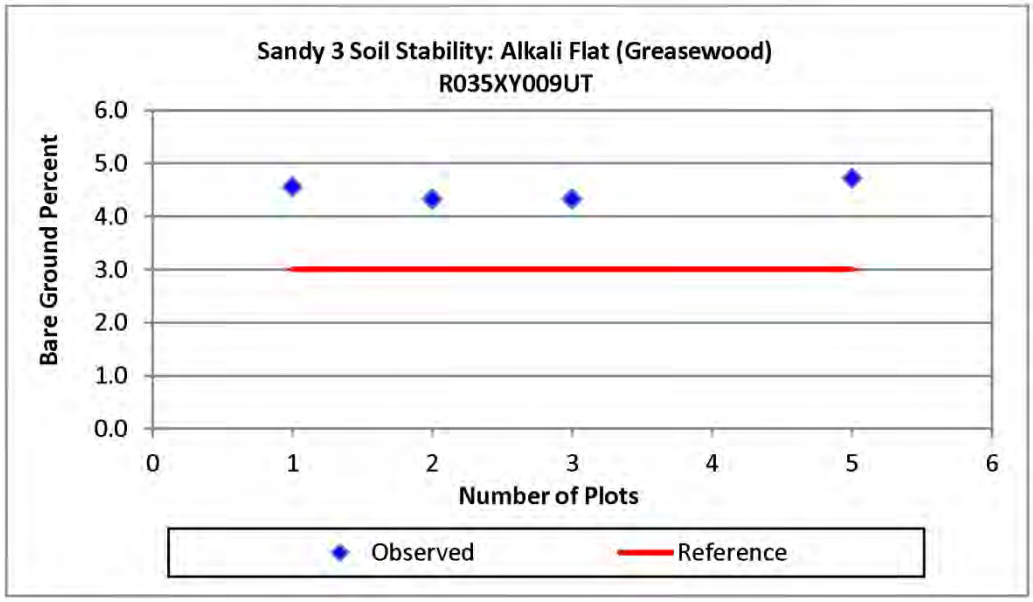


Figure B.31. Aggregate Soil Stability Measured in Sandy 3 Allotment IIRH Plots

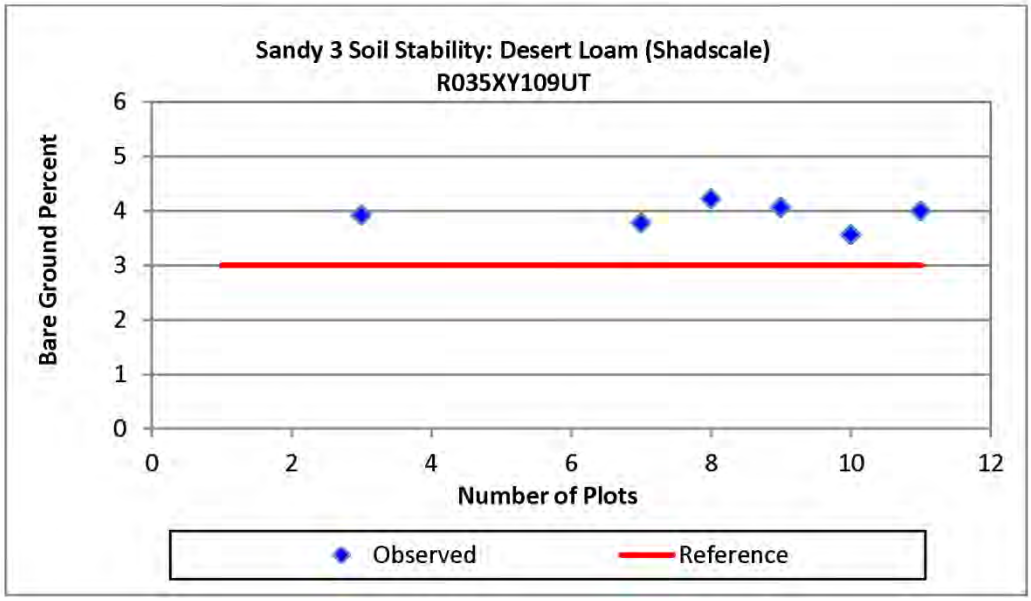


Figure B.32. Aggregate Soil Stability Measured in Sandy 3 Allotment IIRH Plots

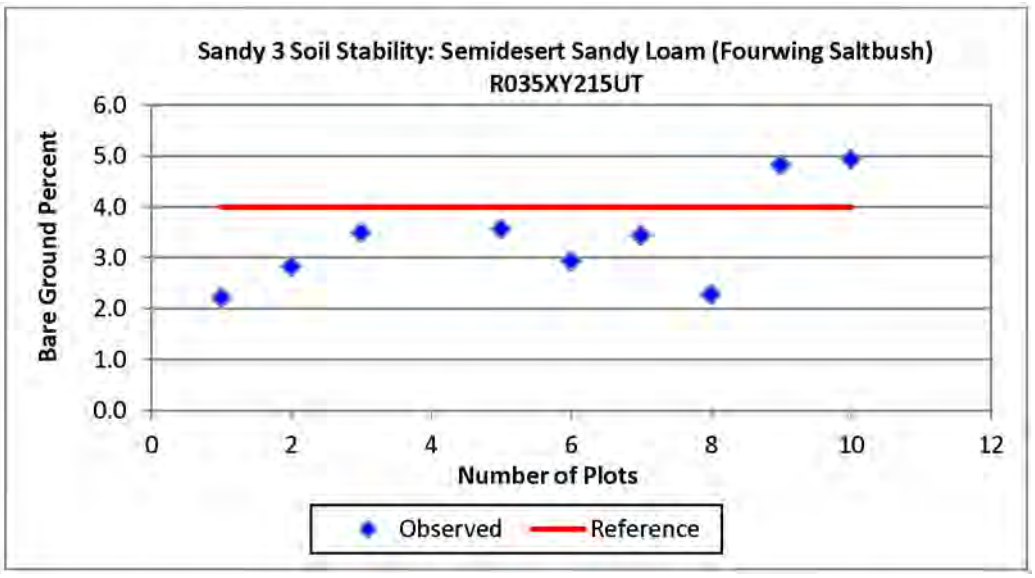


Figure B.33. Aggregate Soil Stability Measured in Sandy 3 Allotment IIRH Plots

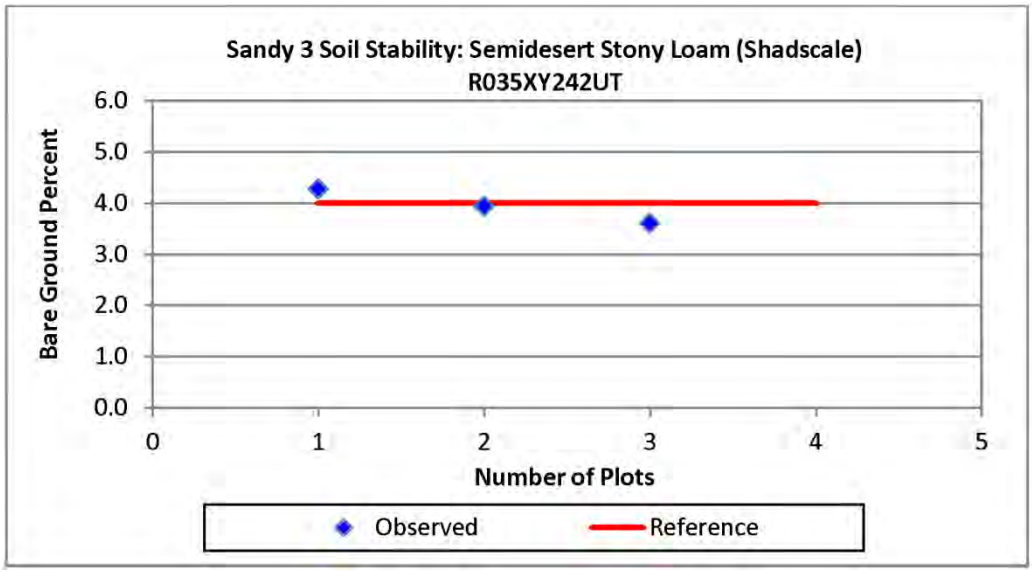


Figure B.34. Aggregate Soil Stability Measured in Sandy 3 Allotment IIRH Plots

Hydrologic function—Six of 39 plots in the Sandy 3 allotment were rated as a moderate to extreme departure from reference conditions for the hydrologic function attribute. The indicators that contributed to the moderate to extreme rating for the six plots are shown in Figure B.35.

The three indicators most frequently associated with moderate to extreme departure from reference conditions are as follows:

Soil surface resistance to erosion

Plant community composition and distribution, relative to infiltration and runoff

Rills

Field observations indicate that primary factors related to diminishing hydrologic function are degradation of soil, biological soil crust in the allotment, and changes in vegetation communities. The hydrologic function is best in areas where biological soil crust is relatively intact and vegetation communities are closer to reference conditions.

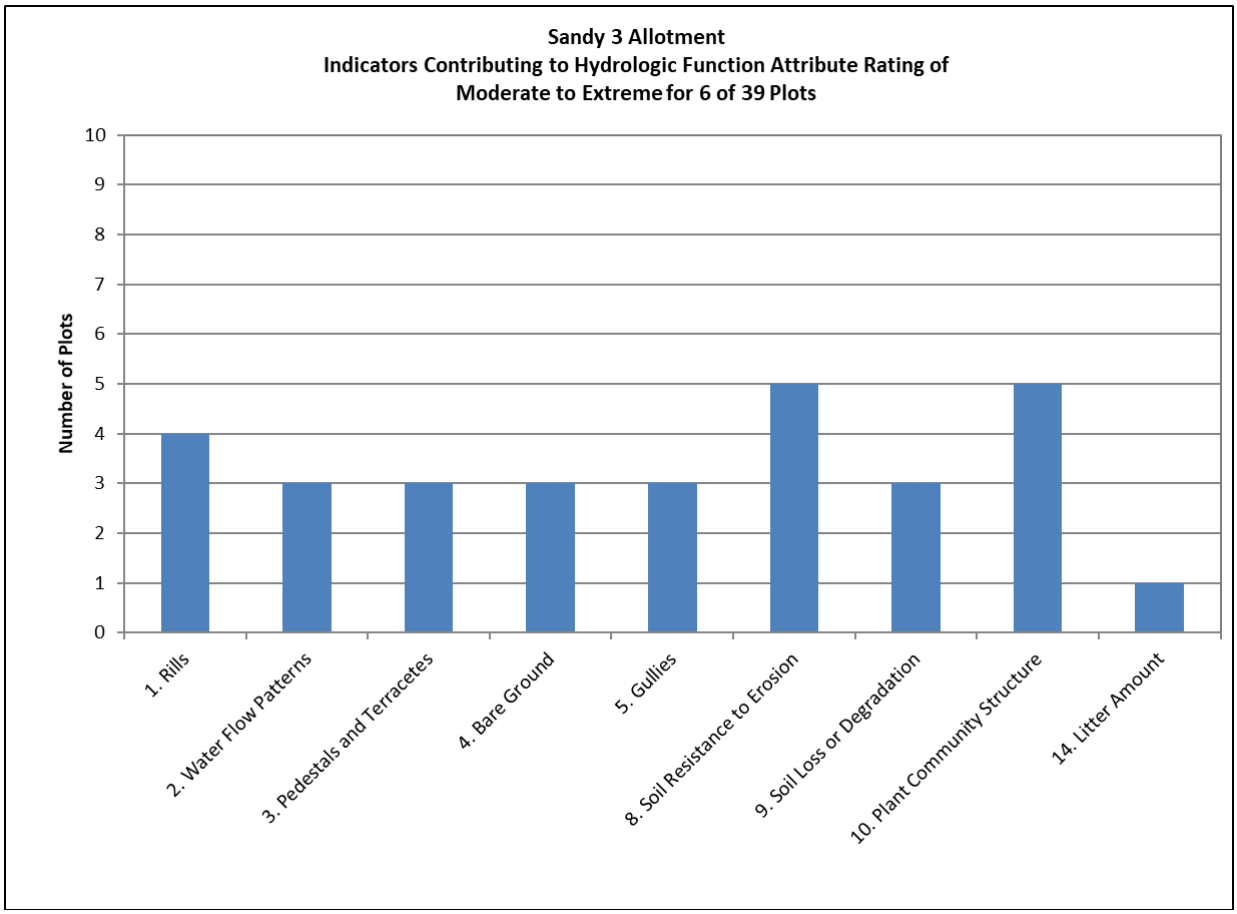


Figure B.35. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Hydrologic Function Attribute, Sandy 3 Allotment

Biotic integrity—Nine of 39 plots in the Sandy 3 allotment were rated as moderate to extreme departure from reference conditions for the biotic integrity attribute. The indicators that contributed to the moderate to extreme rating for the nine plots are shown in Figure B.36.

The four indicators most frequently associated with moderate to extreme departure from reference conditions are as follows:

Invasive plants

Plant functional/structural groups

Soil surface resistance to erosion

Litter amount

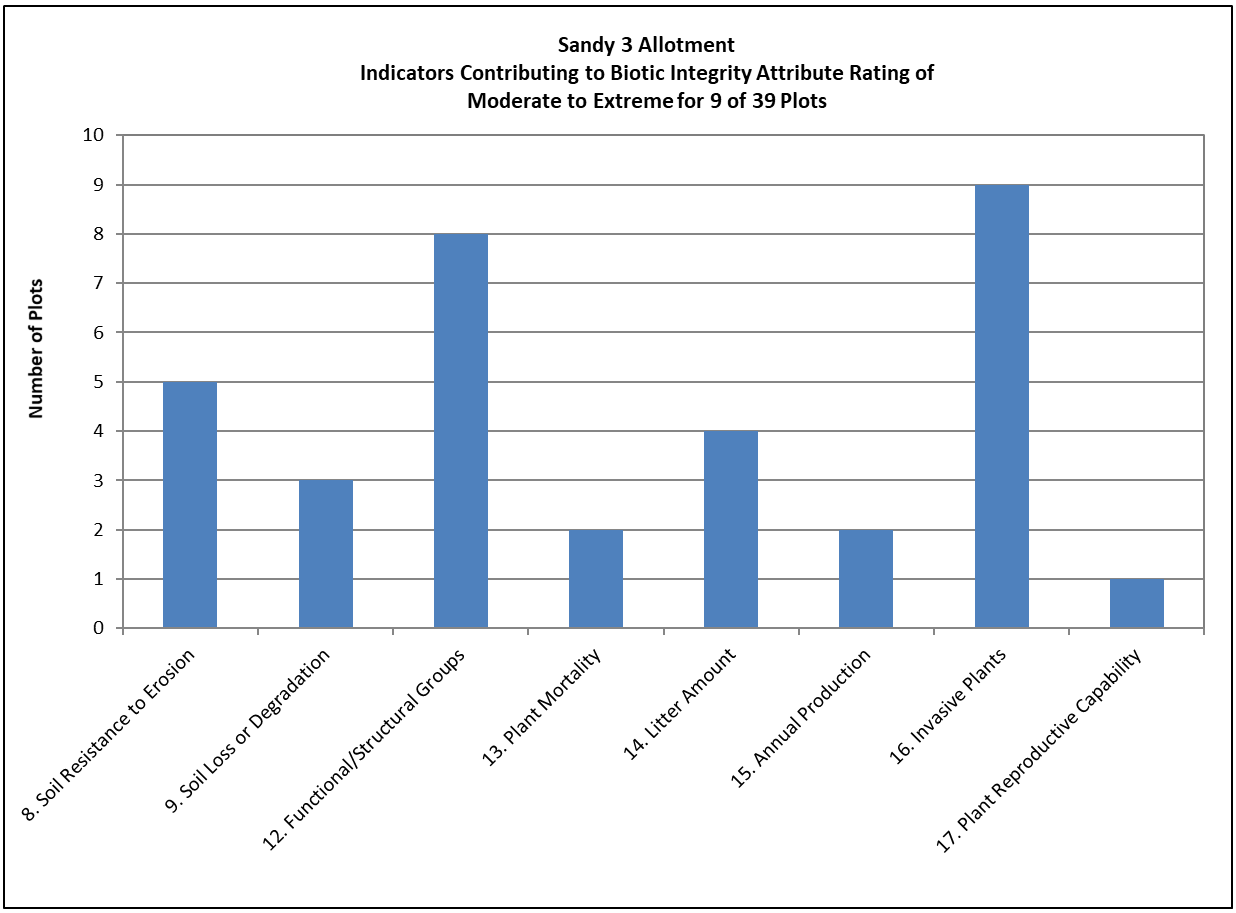


Figure B.36. Indicators Associated with Moderate to Extreme and Extreme to Total Departure, Biotic Integrity Attribute, Sandy 3 Allotment

Evaluation of the IIRH data and field observations indicate that overall biotic integrity is more degraded than soil conditions and hydrologic function in the Sandy 3 allotment. Primary factors related to reduction of biotic integrity are invasive plant species, as described above, and subsequent changes to vegetation function and structure.

Sandy 3 Allotment Scat Counts. In addition to the 17 IIRH indicators, scat counts were conducted in each plot. Elk are not present in the Sandy 3 allotment; therefore, scat counts were conducted for livestock, mule deer, pronghorn, and rabbit/hare. Scat was identified and counted along a 2-meter- (6.5-foot-) wide belt straddling each of the 50-meter (164-foot) transects in each plot. Count data were transformed to a density for evaluation and quantification of the results.

Figure B.37 presents scat count density for livestock, in relation to the three attributes of rangeland health.

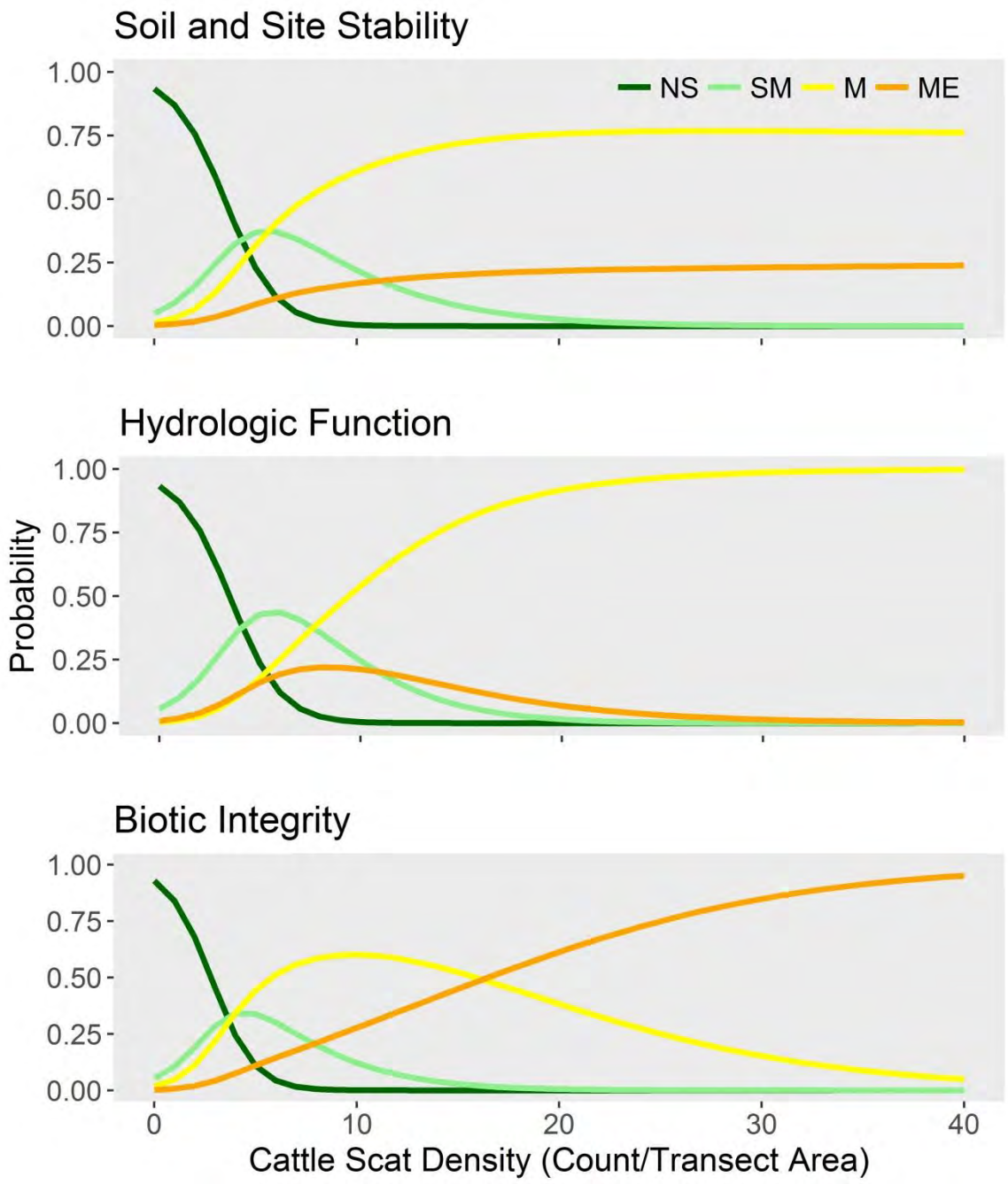


Figure B.37. Scat Count Density and Probability of Departure from Reference Conditions in the Sandy 3 Allotment: Livestock
(NS = None to Slight; SM = Slight to Moderate; M = Moderate; ME = Moderate to Extreme.)

In each graph, probability of occurrence is shown on the y-axis and scat density is shown on the x-axis.

Except for the hydrologic function attribute, the graphs in Figure B.37 show that an increasing density of livestock increases the probability of moderate or moderate to extreme departure from reference conditions. For soil and site stability, a density of approximately 15 scat counts per transect indicates an

approximately 75% probability of a moderate departure from reference conditions and an approximately 20% probability of a moderate to extreme departure from reference.

For biotic integrity, the probability of moderate to extreme departure from reference conditions increases from approximately 25%, at a density of 10, to almost 100%, at a density greater than 30. Figure B.37 also demonstrates that a density as low as 5 to 10 results in a decline, from approximately 90% to 0 in the probability of none to slight departure from reference conditions.

As in the recently retired Hartnet allotment, hydrologic function suggests a different pattern in which increasing scat density is related to an increase in moderate departure from reference conditions but not an increase in moderate to extreme departure from reference.

APPENDIX C: MONITORING AND ADAPTIVE MANAGEMENT, AND GENERAL ADMINISTRATION OF LIVESTOCK GRAZING AND TRAILING

RANGE MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management would address the relationships between duration, timing, and intensity of grazing, and rangeland conditions. Monitoring and evaluating grazing impacts would be based on desired conditions for vegetation communities, presence of biological soil crust, and forage utilization. They include appropriate indicators for park resources and range conditions.

Both short-term and long-term monitoring programs to collect a variety of rangeland data would be developed. Where possible, remote sensing to monitor range conditions would be evaluated and incorporated into range monitoring protocols. The National Park Service would work with the permit holders to evaluate the data collected and, after 3 to 5 years of implementing the LGTMP, to determine if resource and range conditions are moving towards desired conditions; and the potential reasons for the observed conditions. If monitoring data indicate that livestock grazing/trailing is impacting resources and rangelands such that they are not moving towards desired conditions, this would trigger adaptive management actions that would be coordinated with permit holders.

Desired Conditions

Capitol Reef Rangelands

Rangelands Desired Condition Statement. Capitol Reef rangelands are diverse and ecologically complex, dominated by native grass, grass-like plants, forbs, and shrub communities. Rangelands in the park have stable, non-degraded soils, and properly functioning hydrologic and biotic processes that are vital to the persistence and resilience of the range.

Rangelands Desired Condition Indicators. Management Policies (NPS 2006) state that the National Park Service will strive to restore the integrity of park resources that have been damaged or compromised in the past. Where impacts on natural systems have been disturbed by human actions, including overgrazing by domestic animals, the National Park Service will seek to return disturbed areas to the natural conditions and processes characteristic of the ecological site of the damaged resources. Efforts to return grazed rangelands to natural conditions (reference conditions) will not begin until livestock grazing has ceased in the park. Capitol Reef will consider quantitative vegetation and soil metrics based on NRCS ecological site descriptions and qualitative assessments of rangeland health, based on IIRH protocols.

Ecological site descriptions (NRCS 2016) were used to identify and develop desired conditions for rangelands in the planning area. These describe a reference state of vegetation and soil conditions for most grazed acres in the allotments.

Specific metrics of these desired conditions are provided in Table C.1 for select indicators. The desired condition values represent those in community phase 1.1 for each of the reference states. Community phase 1.1 was selected for consistency among ecological site descriptions. Some ecological sites, such as 009—Alkali Flat (Greasewood), have up to three phases in the reference state. The phases are based on natural disturbances, such as fire, extended drought, or wet periods. Any of these can change a

reference state from one dominated by grasses to one dominated by shrubs or vice versa. Other ecological sites, such as 242—Semidesert Stony Loam (Shadscale), have only one community phase.

The changes in desired conditions presented in Table C.1 could be substantial, based on which community phase is present. Individual species observed would likely be the same or very similar; however, the relative abundance of grasses compared to shrubs and forbs can vary. When specific monitoring locations are selected in the field, the community phase at each location will be determined and the reference conditions applicable to that community phase will be used as the desired conditions; therefore, actual desired condition values may vary somewhat from those provided in Table C.1.

TABLE C.1. DESIRED CONDITIONS, BY ECOLOGICAL SITE, FOR RANGELANDS WITHIN THE PLANNING AREA

Indicator	Ecological Site					
	003	109	215	221	227	242
% Bare ground	20–30	2–19	5–25	16–30	20–25	10–50
% Biological crust	0–20	0–28	10–50	0-52	N/A	0–5
% Litter	5–10	3–8	5–40	3-5	25–40	N/A
Soil stability	2–3	3	4	4	4	4
% Grass	10–30	10–20	20–50	0–5	19–21	19–21
% Forbs	5–10	5–13	5–15	0–2	4–6	4–6
% Shrubs	15–30	20–25	5–20	6–16	49–51	29–31

Source: NRCS Ecological Site Descriptions (2016)

The full names of the ecological sites listed in the table are as follows:

- R035XY003UT Alkali Bottom (Greasewood)
- R035XY109UT Desert Loam (Shadscale)
- R035XY221UT Semidesert Shallow Loam (Utah Juniper-Pinyon)
- R035XY227UT Semidesert Shallow Sand (Utah Juniper-Pinyon)
- R035XY215UT Semidesert Sandy Loam (Fourwing Saltbush)
- R035XY242UT Semidesert Stony Loam (Shadscale)

The desired condition for rangelands is that at least 50% of plots are rated as None to Slight or Slight to Moderate departure from reference conditions, and that no more than 50% of plots are rated as a Moderate departure from reference conditions. In addition, no more than 3 of the 17 indicators are worse than a Moderate departure from reference for any single plot. Zero plots would be rated as Moderate to Extreme or Extreme to Total Departure from Reference.

The indicators associated with the three attributes of rangeland health used to determine if ecological processes at a site are functioning within a normal range of variation are provided in Appendix A. These ecological processes include the water cycle (the capture, storage, and safe release of precipitation), energy flow (the conversion of sunlight to plant and then animal matter), and nutrient cycle (the cycle of nutrients through the physical and biotic components of the environment).

National Park Service staff will communicate with permittees to understand if they are meeting animal performance goals while on park rangelands.

Riparian Areas

Riparian Areas Desired Conditions Statement. Desired conditions for riparian areas and wetlands in grazing allotments and along trailing routes are based on their proper functioning condition (PFC), as described by the Bureau of Land Management (see Prichard et al. 1998, 1999).

Riparian Area Desired Condition Indicators. The widely used PFC assessments provide a robust qualitative assessment of riparian-wetland condition. The PFC assessment evaluates hydrology, vegetation, and geomorphologic elements and assigns one of three ratings: PFC, functional at risk, or nonfunctional. The functional condition of several streams, springs, and associated riparian areas in the allotments and along the Oak Creek and Pleasant Creek trailing routes have been previously assessed using the PFC protocol. The results of these assessments are described in Chapter 3, Water Resources.

The desired condition for all streams, springs, and associated riparian areas is a rating of PFC. The parameters used to evaluate riparian condition for stream (lotic) and spring (lentic) systems are shown in Appendix B, Attachment 1 (Lotic Areas Standard Checklist)[1] and Attachment 2 (Lentic Areas Standard Checklist).[2] An experienced team evaluates each parameter in the riparian area and assigns a response of yes, no, or N/A–not applicable.

The PFC protocol assessment is qualitative; therefore, a PFC rating is not based on a set number of yes responses on the checklist; rather, the balance of yes and no in each category, the severity of the situation for "no" answers, and the experience of the assessment team are used to make a final determination; however, if most or all of the responses are yes, then the system is very likely to be in PFC.

Desired Conditions for Federally Listed Species

Federally Listed Species Desired Condition Statements. The desired condition for federally listed species in the grazed area Sandy 3 allotment and along trailing routes is to improve habitat for each species, to ensure their continued existence, and to promote their recovery.

Mexican Spotted Owl (MSO) Desired Condition Indicators. The Mexican Spotted Owl Recovery Plan (US Fish and Wildlife Service [USFWS] 2012a) was used to develop desired conditions for MSO (*Strix occidentalis lucida*) foraging habitat, which can be affected by improperly managed livestock grazing and trailing. The plan provides guidelines for maintaining or restoring riparian habitats used by owls for foraging, roosting, making daily movements, dispersing, and potentially for nesting. The recovery plan also provides primary constituent elements of critical habitat related to maintaining adequate prey species for spotted owls.

- Attain a PFC rating for both Oak Creek and Pleasant Creek between 2021 and 2023, depending on weather conditions, to support small mammal populations that MSO feed on, which would help ensure recruitment of MSO. If PFC is not attained, the park will take action, such as reducing the number of cattle trailed or days of trailing, until PFC is attained.
- Maintain 4 to 6 inches (10 to 15 centimeters) of stubble height of grasses, to support streambank stability and provide habitat for MSO prey species; that is, small mammals (Leydsman-McGinty et al. 2009; Clary and Webster 1989; USFWS 2012a)

[1] See also Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and Supporting Science for Lotic Areas, Technical Reference 1737-15 (BLM 1998).
[2] See also Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and Supporting Science for Lentic Areas, Technical Reference 1737-16 (BLM 1999).

- Maintain a diversity of species and a wide range of size and age classes of trees, shrubs, forbs, and grasses, to provide habitat for MSO prey species
- Maintain adequate levels of residual plant cover to maintain fruits and seeds and to allow plant regeneration, which will benefit MSO prey species

Federally Listed Plant Species (Wright fishhook cactus [*Sclerocactus wrightiae*], Winkler cactus [*Pediocactus winkleri*], Last Chance townsendia [*Townsendia aprica*]) Desired Condition Indicators. The overall desired condition of maintaining and restoring populations and habitats of each of the three listed plant species is expected to be met by implementing goals, objectives, and guidance from each of the species' recovery plans (USFWS 1985, 1993, 2015b). The park has worked with the US Fish and Wildlife Service to develop monitoring protocols and thresholds of damage and disturbance to listed plants along livestock trails that would trigger adaptive management actions (see Trail Monitoring and Adaptive Management Section later in this appendix). Staying below these thresholds is expected to assist the National Park Service in meeting these desired conditions.

Sandy 3 Allotment Range Monitoring and Assessment. The monitoring program would consist of short-term and long-term monitoring, as shown in Table C.2.

TABLE C.2. RANGELAND MONITORING SCHEDULE

Monitoring Type	Annual	Every Second Year	Every Third Year	Every Fifth Year	Every Seven to Ten Years
Weather conditions	X				
Forage production	X				
Forage utilization	X				
Photo points	X				
Animal days grazing	X				
Breeding birds	X				
Threatened & endangered plant species	X				
Stocking rate		X			
Riparian condition		Possible	X		
Range infrastructure maintenance			X		
Cultural resources				X	
Long-term vegetation and soil trends				X	
IIRH condition assessments					X

Weather conditions and drought—Capitol Reef National Park would monitor weather continuously to help in evaluating expected range conditions. Drought conditions in the Capitol Reef region would be determined based on data published by the US Drought Monitor, a joint product of the National Oceanic and Atmospheric Administration, US Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska Lincoln. Regional drought information would be supplemented by ClimateAnalyzer.org, an organization providing site-specific climate and drought data to National Parks in the Intermountain West.

Forage production—Forage production is the pounds per acre of forage that is produced within a designated period and over a given area (Glossary of Range Management Terms No. 6.105). It would be evaluated by clipping and weighing vegetation in key areas and applying the results to a broader area, such as a pasture. Monitoring would give managers and permit holders an approximation of forage amount available for livestock and wildlife in any given year. Stocking rate calculations and duration and intensity of grazing would be evaluated, based on a dry weight analysis of clipped vegetation.

Forage utilization—A 45% utilization standard would be instituted for upland and riparian areas. During drought years, the utilization standard would be 25%–30% (Holechek et al. 2006; Holechek et al. 2011). Utilization monitoring would be used to evaluate the effects of grazing and browsing on rangelands. Utilization is typically the amount of available forage that is consumed or destroyed (Utilization Studies and Residual Measurements, Technical Reference 1734-3). Utilization monitoring techniques are included in Technical Reference 1734-3. They are percent utilization of key plant species in upland areas and stubble height measurements in riparian areas. Portable, forage utilization, wire cages (approximately 4 feet wide by 4 feet tall) would be used to assess vegetation recovery after grazing disturbance and also vegetation utilization during a grazing season. Utilization cages would be used annually in key areas of each pasture.

Photo points—Photo points would be used for comparative visual records of ecological conditions and would be conducted routinely. Photo points may be used for utilization cages, upland vegetation transects, riparian area transects, and grazed and ungrazed areas. Protocols would be developed for photo point collection and analysis that provide a general indication of resource condition and that complement other monitoring protocols used to manage grazing and trailing in Capitol Reef National Park.

Animal days of grazing and livestock distribution—Monitoring would be conducted annually to determine how stocking rates relate to observed conditions. Ideally, data would be from counts conducted by park staff using a variety of methods, including remote sensing. The park could also use the "actual use" report that permit holders provide at the end of each grazing season.

Breeding birds—The current NPS Inventory and Monitoring Program would provide such information as species detected, species diversity, and population trends, which could be applied when assessing the effects of grazing on breeding bird populations.

Stocking rate—Stocking rate is defined as the number of specific kinds and classes of animals (typically livestock, but may also include game animals) grazing a unit of land for a specific period (Glossary of Range Management Terms No. 6.105). Stocking rates would be calculated based on available forage, weather and precipitation trends, vegetation and soils monitoring, number of animals, duration of the grazing season, and intensity of grazing. Abundant or minimal forage would be determined based on clipping and weighing of representative forage in the allotment, other monitoring data, and a comparison of forage conditions with NRCS forage production values (NRCS 2013).

Riparian condition, including stubble height—In the Sandy 3 allotment, riparian conditions of Bitter Spring Creek and Bitter Creek, including vegetation stubble height, would be evaluated every 2 to 3 years, using PFC methods (Technical Reference 1737-15; Stacey et al. 2006). PFC and rapid stream-riparian assessment are tools that provide a consistent approach for considering hydrology, vegetation, and erosion and deposition attributes and processes to evaluate the condition of riparian-wetland areas along creeks and streams. The rapid stream-riparian assessment protocol provides quantitative data to support the PFC determination.

Range infrastructure maintenance—The integrity of fences, stock ponds, water sources, and mineral areas (if established and used) would be assessed to determine maintenance needs.

Cultural resources—Cultural resources that may be susceptible to adverse effects from livestock grazing or trailing would be monitored, in accordance with NPS protocols and policy, including 36 CFR, Part 800; the Secretary of the Interior's Standards for the Treatment of Historic Properties; the NPS Director's Order 28: Cultural Resource Management Guideline; and NPS Management Policies (2006).

Long-term vegetation and soil trends—The park would work with NCPN staff to establish long-term vegetation and soil monitoring plots to determine overall ecological trends. NCPN monitoring protocols for these vegetation trend plots can be found at https://science.nature.nps.gov/im/units/ncpn/Index.cfm.

Rangeland condition—Rangeland condition assessments would be conducted every 7 to 10 years at the plots established in the Sandy 3 allotment in 2015. Assessments would be conducted using the multiple-agency Interpreting Indicators of Rangeland Health protocols (Pyke et al. 2002; Pellant et al. 2005; see Appendix A).

Sandy 3 Allotment Adaptive Management Actions. Adaptive management actions could include the following adjustments depending on the results of monitoring and trends in desired conditions.

Stocking Rates—Adjust the stocking rate and/or duration of the grazing season in response to available forage or changing range conditions. During years of abundant or minimal forage, stocking rates and AUMs would be adjusted to match forage and overall range conditions, to a maximum of 410 AUMs as required by legislation.

Season of use—Season of use could be adjusted based on the following:

- Overall condition of range vegetation, particularly palatable forage
- Weather or climate conditions
- Observed impacts on sensitive species
- Advances in knowledge of the science of grazing and its impacts on ecosystems

In the Sandy 3 allotment, the season of use could be adjusted to allow livestock onto the allotment in mid-October instead of November 1, to help control cheatgrass. This action would be implemented specifically for targeted grazing of cheatgrass in preference to other forage.

Distribution of livestock—Develop and implement mechanisms to provide for better distribution of livestock in the pastures to enhance efficient forage utilization and to minimize the effects of livestock congregating in small areas. Concepts could include the following:

- Placing supplements in strategic locations to achieve desired distribution; if supplements are used, establishing buffers of between a quarter-mile and 1 mile between areas where supplements are placed and populations of sensitive species or water sources
- Using supplements to increase utilization of cheatgrass- and Russian thistle-dominated areas in the Sandy 3 allotment
- Using riders on horseback, moving livestock within pastures to improve distribution in response to weather as well as water and forage availability

Improve overall range and natural resource conditions—Specific adaptive management actions have not been developed for this broad topic; however, potential actions could include inhibiting erosion (gullies and head-cutting); improving native forage, riparian zone, and woody species ecological function; treating invasive plant species; and reseeding native grasses and shrubs. Such actions may require additional planning and compliance.

TRAIL MONITORING AND ADAPTIVE MANAGEMENT

Trail Monitoring and Assessment. The park would monitor trailing along routes with sensitive resources, particularly the Oak Creek, Pleasant Creek, Gray Bench-Cathedral Valley, Hartnet, and Lower South Desert routes. The National Park Service would coordinate with the permit holders and only use park staff with experience trailing livestock so that observation, monitoring, and assistance does not interfere with operations.

Oak Creek and Pleasant Creek Trailing Routes—Riparian conditions, including vegetation stubble height, would be evaluated annually in Oak Creek until the riparian corridor meets PFC criteria. Thereafter it would be evaluated every 2 to 3 years. Conditions, including stubble height, of Pleasant Creek would be evaluated every 2 to 3 years, using PFC methods (Technical Reference 1737-15; Stacey et al. 2006). If additional permits are issued, Pleasant Creek monitoring could occur more often. PFC and rapid stream-riparian assessment are tools that provide a consistent approach for considering hydrology, vegetation, and erosion and deposition attributes and processes to evaluate the condition of riparian areas and wetlands. The rapid stream-riparian assessment protocol provides quantitative data to support the PFC determination.

Gray Bench-Cathedral Valley, Hartnet, and the Lower South Desert Trailing Routes—Capitol Reef staff would work with the Fish and Wildlife Service to identify localities of listed plant species that warrant monitoring along each trailing route. These select localities would be surveyed within a week of each trailing event to quantify the percentage of plants damaged or disturbed by livestock. Each locality would be surveyed for 2 person-hours. If the percentage of plants damaged or disturbed at a locality is greater than or equal to 5% or 15%, respectively, the FWS would be contacted to discuss potential adaptive management actions. These are the damage and disturbance thresholds used for the Wright fishhook cactus in the park's cactus monitoring plan for the recently retired Hartnet allotment (NPS 2013d). If Winkler cacti are not aboveground after a fall trailing event, three 15-meter-long disturbance transects will be randomly established at each locality to document frequency of livestock tracks in the area. A habitat disturbance index will be used to predict the probability of cactus disturbance based on frequency of livestock tracks documented (Clark 2016). If localities selected for monitoring have no damage or disturbance for three consecutive trailing events, monitoring of those localities would be discontinued. If at other localities damage and disturbance to listed plants are consistently lower than the 5% and 15% threshold levels, frequency of monitoring could be decreased to every 3 years.

Riparian conditions, including stubble height, of Deep Creek Spring, Ackland Springs, and Notch Water Spring (which could be affected by issuing trailing permits for Hartnet and the Lower South Desert routes), would be evaluated every 2 to 3 years. The park would work with NCPN staff to develop monitoring protocols for springs. The park would engage stakeholders in this process by sharing draft protocols and requesting their input and comments.

Trailing Adaptive Management Actions

General—Adaptive management actions would be implemented if monitoring indicates that the percentage of listed plant species damaged or disturbed by livestock at select localities exceeds the established threshold or if riparian corridors used as livestock trails are not in proper functioning condition due to livestock activities. The following are potential adaptive management actions that could be used:

- Temporarily fence sensitive resources, including threatened and endangered species and cultural resources, while trailing occurs

- Enlist more riders or staff during trailing events to ensure livestock stay out of areas with listed plants
- Develop alternative trailing routes to avoid listed plant species
- Move livestock through sensitive resource areas more quickly
- For the Lower South Desert trail, contain livestock overnight rather than allowing them to drift up the Lower South Desert

Oak Creek—If Oak Creek becomes nonviable for any reason (i.e., due to continued "nonfunctional" PFC assessment ratings in this important MSO foraging habitat, or a natural event that prevents its use), the Dry Bench trailing route would continue to be available for use, and as needed, the park would use a trail crew to repair sections that are unsafe for livestock and riders. Repairs would include use of hand tools in areas where sandstone bedrock results in uncertain footing and potential fall hazards. Techniques would be similar to those used for hiking trails, in that projections would be smoothed, holes would be filled, and the overall width of the trail would be increased from the current approximately 3 to 4 feet to 7 or 8 feet. Three or four 20-foot sections of fence would be installed as a visual and physical barrier to keep livestock on the desired route. The length of trail needing more than minimal work is approximately 500 feet.

Deep Creek Spring—Deep Creek Spring is located in the Lower South Desert and could be affected by issuing permits for trailing through this part of the recently retired Hartnet allotment. If this riparian area continues to be affected by livestock during trailing (i.e., if riparian assessment ratings continue to be "nonfunctional"), approximately 1 to 2 acres could be fenced to protect Deep Creek Spring riparian resources. Water would not need to be piped out of the fenced area because the spring discharge is sufficient for water to flow outside the proposed fenced area. This fencing would be constructed in accordance with Range Construction Project Design Criteria described in the following section.

GENERAL ADMINISTRATION OF LIVESTOCK GRAZING AND TRAILING

Agency Coordination

Capitol Reef would coordinate with the Bureau of Land Management and the Forest Service on grazing and trailing management. The agencies would develop a common base of knowledge for addressing permit holder needs and responsibilities, the timing of grazing and trailing, monitoring of resource and range conditions, and responding to such issues as unauthorized livestock in the park.

Coordination with Permit Holders

The park would coordinate with grazing and trailing permit holders by conducting annual meetings before the grazing season begins. Additional meetings would be held during the grazing season, sometimes in the field, as needed, to discuss forage and range conditions. This could include any meetings needed to coordinate adjustments to stocking rates or grazing season, based on monitoring results. The park would notify permit holders if their livestock trespass into unapproved areas of the park, or if livestock are present on trailing routes outside the dates when trailing is authorized. On trails where there are sensitive plant species, park personnel would meet with permit holders before trailing begins, to identify sensitive areas that livestock must avoid.

Grazing permits, which could be multiyear, would be issued at the start of a season, and billing would be done at the end of a season, based on actual use.

Personnel at Capitol Reef National Park would coordinate with grazing and trailing permit holders on construction and maintenance of range developments and on management actions, such as fencing, cattle guards, stock ponds, use of supplements, and other issues. Personnel would provide opportunities for grazing and trailing permit holders to participate in resources and range condition monitoring and would allow them to evaluate the monitoring results. If hay is used for horses inside the park, certified weed-free hay would be required.

Unauthorized Livestock

Unauthorized livestock could result in penalties and may lead to loss of trailing privilege. When unauthorized livestock that do not belong to the Sandy 3 allotment permit holders are found in the allotment or on other park lands, Capitol Reef National Park personnel would determine ownership and notify the owners to remove the animals from the park. If ownership cannot be determined, the personnel would coordinate with permit holders and other agencies to remove livestock from the park. Capitol Reef National Park would improve communication with permit holders regarding unauthorized livestock use; personnel would encourage them to report unauthorized livestock to the appropriate park contact and to help the park identify owners of unauthorized livestock. The park would work with permit holders to ensure that only their livestock are grazing or trailing inside the park. Any enforcement for repeat offenders would follow current law and policy.

Staffing/Grazing and Trailing Management Activities

The park would pursue funding for a range management specialist or similar position. This employee would evaluate range conditions, monitor grazing and trailing actions and compliance with permits, suggest timing for movement between pastures, work with permit holders, and perform other functions necessary to successfully implement the Capitol Reef Livestock Grazing and Trailing Management Plan.

Range Construction Project Design Criteria

Under the LGTMP, the National Park Service would implement consistent approaches to the design, construction, and maintenance of range developments, such as stock ponds, fences, and water delivery.

Stock pond rehabilitation. Stock ponds typically fail when they fill with sediment, which is exacerbated by invasion of weeds, shrubs, and trees, or when the pond wall is breached. Rehabilitation would consist of removing vegetation and sediment from the interior of a pond and, where needed, reconstructing pond walls. Typical stock ponds in Capitol Reef are 40 feet to 60 feet in diameter and 3 to 4 feet at the deepest point.

Equipment used would typically include a backhoe, a small, steer skid loader, and rakes, shovels, and other hand tools. A backhoe could be driven across relatively gentle areas. Skid loaders would be used next to existing roads. Vegetation removed from stock ponds would be transported out of the park for disposal. Sediment would be stockpiled next to park roads and would be made available to Garfield County for use in road maintenance. Stock ponds would be maintained after being fully rehabilitated.

Fence construction. Depending on location, length, and purpose, fences may be constructed of wire, wood, or high-tensile electric wire. All fences would be constructed to allow ease of passage for wildlife and be visible to ungulates and birds. Each type of fence would generally be constructed as described below. If other fence designs are identified, they would be reviewed at that time for any additional compliance needs.

Conventional wire fences would consist of four strands of wire. The bottom and top strands would be barbless twisted wire, and the two middle wires would be barbed. The bottom wire would be 18 inches above ground surface, the second wire 23 inches, the third wire 28 inches, and the top wire 40 inches above ground surface. Stays are not planned; however, if needed, stays would be made of composite plastic or other material not easily bent. Steel T-posts or wood posts would be placed at intervals of 16.5 feet. Consideration would be given to placing the top strand of wire in a sleeve or attaching markers to increase visibility for wildlife.

Suspension wire fences would also consist of four strands in the same configuration as the conventional wire fence. Posts would be placed at intervals of 50 to 100 feet, closer in uneven terrain, and they would be either steel T-posts or wood posts. Posts would be braced to maintain wire tension. Composite plastic stays would be installed every 12.5 to 25 feet. Consideration would be given to placing the top strand of wire in a sleeve or attaching markers to increase visibility for wildlife.

Wood post and rail fences may be used to enclose smaller areas or to provide a more aesthetic look. A two-rail fence is most appropriate for wildlife passage, with the upper surface of the top rail 40 inches above ground and the lower surface of the bottom rail 18 to 20 inches aboveground. Posts would be installed at 10- to 14-foot intervals. If wire is substituted for the bottom rail, two strands of barbless twisted wire would be used. The bottom strand would be 18 inches above ground surface and the second 28 inches aboveground.

Electric fences would be constructed using three wires of high-tensile galvanized wire. Wire spacing is similar to other fence designs, with the bottom wire 22 inches above ground surface, the second wire 8 inches above the bottom wire, and the top wire 40 inches above ground surface. The top and bottom wires are electrified and the middle wire is grounded. Solar chargers would be used to provide power, and grounding rods would close the circuit. Fiberglass posts would be spaced at intervals of 45 to 60 feet. No stays would be used. Wood posts would be placed at corners, gates, and changes in direction. High-tensile wire is difficult for ungulates and birds to see, so markers would be attached to the top wire to increase visibility for wildlife.

Fences would be constructed to minimize impacts on natural and cultural resources. Where fences cross habitat of sensitive plant species, the proposed route would be surveyed for the presence of sensitive plants. Limited vegetation, rocks, and other features would be cleared to facilitate installation, but no right-of-way would be cleared. Gasoline engine, two-person power augers would be used to dig post holes, where possible, such as in areas proposed and managed as wilderness. Next to roads, such as with the Upper Hartnet Draw pasture, consideration would be given to digging post holes using a power auger mounted on the back of a small farm tractor. Where power augers could not be used, post holes would be dug using hand tools. Vehicles would deliver fence materials to locations next to roads; horses would deliver fence materials to locations distant from roads.

Temporary fencing would be made of various materials, such as steel T-posts or fiberglass rods, typically driven about 6 inches into the ground, with rope electrical fence or yellow caution tape strung to create a temporary physical obstruction. Temporary fences would typically be in place for 2 days and then removed.

Water delivery. As of the date this Draft Plan/EA was prepared, Capitol Reef had no plan to pipe water from springs to areas outside riparian zones. This is because water would flow naturally outside the limits of any fencing constructed to protect riparian areas; however, it is possible that in the future water may be piped from one or more springs to a location where it is available for livestock outside a riparian area. This Draft Plan/EA does not analyze the impacts of water delivery because there are no current plans that would require this. If future water delivery is determined to be appropriate, compliance would be assessed at that time. Nonetheless, basic procedures for developing and constructing water delivery features are described below.

In the event water needs to be piped, common actions would include the following:

- Developing an intake structure/water collection feature
- Installing piping and valves
- Developing a trough or other feature where water would discharge
- Including a float or shutoff valve to prevent waste of water from overflows

An intake structure is typically created by excavating a hole or short trench near a spring source. Excavations would be dug by hand at locations away from roads. Excavations would be 1 to 3 feet deep and 3 to 5 feet long (or in diameter), based on the physical attributes of water sources in the allotments. One end of a pipe would be placed in the excavation, which would be backfilled with gravel.

Depending on subsurface conditions and the volume of water needed, the downstream side of the excavation could consist of concrete or clay to act as a dam and retain water in the excavated and backfilled area. Piping would usually be sealed where it passed through the dam to minimize leakage. Pipe would be either polyvinyl chloride (PVC), other plastic material, or galvanized steel and would be 1.25 inches to 2 inches in diameter. The pipe would be buried in a shallow trench, where terrain permits, approximately 6 inches to 1 foot below ground to protect the pipe. Where the pipe could not be buried, it would be laid on the ground surface.

At locations distant from roads, trenches would be dug by hand, and pipe and fittings would be installed by hand. Galvanized steel troughs would be used as discharge locations for piped water. Wildlife escape ramps would be installed in all water troughs. Horses would deliver materials to locations distant from roads. All excavations would be conducted in the presence of an archaeologist, and all routes used for pipe would be surveyed for archaeological resources, using the Level III survey method. All fieldwork would be supervised by an archeologist. Mitigation may be required if archeological resources would be affected. In addition, surveys would be conducted to avoid disturbance to listed plant species during fence and pipeline installation.

Invasive Vegetation Management

Invasive plant species in Capitol Reef are controlled by park employees and by the invasive plant management team from Lake Mead National Recreation Area. Individuals who apply herbicides are licensed under State of Utah requirements, and Capitol Reef has a pesticide general use permit with Utah. Capitol Reef would work with local county weed management teams to the extent practicable.

All herbicides used in the park are approved for use by the National Park Service Pesticide Use Proposal System, and no herbicides are applied that have not been approved. Herbicides currently approved for use in Capitol Reef are Element 4, Fusilade II, Garlon 4, Garlon 4 Ultra, Last Call Selective, Nufarm Polaris, Quali-Pro Dithiopyr 2L, Rodeo, Roundup, and Weedmaster. Other herbicides could be used;

however, they must be submitted to the National Park Service's Pesticide Use Proposal System for evaluation and approval before use.

Tree and shrub species are typically treated by cutting the plant to a stump or hacking into the trunk and main branches, followed by direct application of the herbicide to the cuts. Smaller individuals are treated using basal bark or foliar application. Annual forb species are treated by direct spray.

Herbicides are applied using a backpack or handheld sprayer, and they target the specific plants to be eradicated. General area application is not permitted, unless the area consists of a uniform species, such as halogeton or cheatgrass. Areas near water are treated only with herbicides approved for use near water.

All herbicides are stored, handled, applied, and disposed of according to product labels and Material Safety Data Sheets and state and federal regulations. Proper personal protective equipment is used whenever herbicides are handled and applied.

Tamarisk (Tamarix spp.) removal—This is an option at the Lower Sandy 3 pasture stock pond, known informally as Little Lake Mead. The pond would be inspected to determine the extent of tamarisk (or other vegetation) removal desired. Because the pond is in proposed wilderness, if tamarisk needs to be removed, a minimum requirement analysis would be conducted to evaluate treatment methods.

If tamarisk were removed from Little Lake Mead, it would be conducted over approximately 5 to 8 acres. Access to the site for work crews would be on foot or on horseback, and equipment would be transported by horse. Chainsaws or handsaws would be used, based on the results of the wilderness minimum requirements analysis. Herbicides would be applied to any cut stumps or hacked trunks and limbs, regardless of the method used. Herbicides would be applied to new sprouts, using a basal bark or foliar application. Brush would be piled for future burning.

Education and Interpretation

Capitol Reef National Park would install signs on public gates. The signs would provide the allotment name, the dates of livestock grazing, and instructions on whether the gate should be open or closed. The park would prepare handouts for visitors, especially backcountry users, and would provide information on the park website regarding livestock grazing and trailing.

ATTACHMENT 1: LOTIC AREAS CHECKLIST

Standard Checklist

Name of Riparian-Wetland Area:_____

Date:_____ Segment/Reach ID: _____

Miles:_____ Acres:_____

ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Floodplain above bankfull is inundated in “relatively frequent” events
			2) Where beaver dams are present they are active and stable
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
			4) Riparian-wetland area is widening or has achieved potential extent
			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
			10) Riparian-wetland plants exhibit high vigor
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
			15) Lateral stream movement is associated with natural sinuosity
			16) System is vertically stable
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

(Revised 1998)

Remarks

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Summary Determination

Functional Rating:

Proper Functioning Condition	_____
Functional—At Risk	_____
Nonfunctional	_____
Unknown	_____

Trend for Functional—At Risk:

Upward	_____
Downward	_____
Not Apparent	_____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes	___
No	___

If yes, what are those factors?

___ Flow regulations	___ Mining activities	___ Upstream channel conditions
___ Channelization	___ Road encroachment	___ Oil field water discharge
___ Augmented flows	___ Other (specify)_____	

ATTACHMENT 2: LENTIC AREAS CHECKLIST

Lentic Standard Checklist

Name of Riparian-Wetland Area:_____

Date:_____ Area/Segment ID: _____ Acres:_____

ID Team Observers: _____

Yes	No	N/A	HYDROLOGY
			1) Riparian-wetland area is saturated at or near the surface or inundated in "relatively frequent" events
			2) Fluctuation of water levels is not excessive
			3) Riparian-wetland area is enlarging or has achieved potential extent
			4) Upland watershed is not contributing to riparian-wetland degradation
			5) Water quality is sufficient to support riparian-wetland plants
			6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities)
			7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway)

Yes	No	N/A	VEGETATION
			8) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			9) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery)
			10) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt)
			12) Riparian-wetland plants exhibit high vigor
			13) Adequate riparian-wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows
			14) Frost or abnormal hydrologic heaving is not present
			15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics

Yes	No	N/A	EROSION/DEPOSITION
			16) Accumulation of chemicals affecting plant productivity/composition is not apparent
			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils
			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation
			19) Riparian-wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)
			20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies

(Revised 1999)

Remarks

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Summary Determination

Functional Rating:

Proper Functioning Condition	_____
Functional—At Risk	_____
Nonfunctional	_____
Unknown	_____

Trend for Functional—At Risk:

Upward	_____
Downward	_____
Not Apparent	_____

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes	___
No	___

If yes, what are those factors?

___ Dewatering ___ Mining activities ___ Watershed condition
___ Dredging activities ___ Road encroachment ___ Land ownership
___ Other (specify)_____

APPENDIX D: ISSUES AND IMPACT TOPICS IDENTIFIED THROUGH SCOPING

ISSUES AND IMPACT TOPICS RETAINED FOR FURTHER ANALYSIS IN THIS DRAFT PLAN/EA

Table D.1 summarizes those issues identified through scoping and that have been retained for analysis and additional discussion in Chapters 3 and 4. The table also identifies the corresponding impact topics to which the issues relate. The level of detail in the description of each impact topic and the effects from implementing any of the alternatives also are described in Chapters 3 and 4, in proportion to their importance.

TABLE D.1. ISSUES AND IMPACTS AND RELATED IMPACT TOPICS

Issues	Impact Topics Related to the Issues
If grazing and trailing are not managed properly in the Sandy 3 allotment and along livestock trailing routes, these activities can result in the consumption and trampling of native plants, including three ESA-listed plants and six National Park Service sensitive plants (collectively known as special status plants). This can lead to changes in species abundance, distribution for native upland and riparian plant communities, exposure of soils, habitat alteration and fragmentation, and introduction and dispersal of invasive species that can affect breeding birds and special status species. This can create other issues and can:	
● Cause native vegetation loss, fragment habitat, alter soil properties, and introduce and disperse invasive plants that replace native vegetation	Special status plants, Upland and riparian vegetation associations, Migratory birds
● Reduce the ability of native plants to survive and reproduce and cause shifts in plant species composition, which result in long-term loss of productivity and loss of native plant species and associations	Special status plants, Upland and riparian vegetation associations, Migratory birds
● Result in changes to soil structure, increase the extent of bare ground, reduce rates of water infiltration and increase the volume of surface water runoff, accelerate rates of erosion from wind and water, and cause declines in biological soil crusts and soil productivity	Soils
● Affect the chemical and physical properties of the springs and associated wetlands that occur in the allotments and the floodplains that occur along the Oak Creek and Pleasant Creek livestock trailing routes	Water resources (springs and creeks in the allotments and along trails)
● Impact migratory and resident land bird species that nest in the ground- to shrub-level vegetation in grassland and shrubland habitats, by increasing the potential for livestock to trample nests, resulting in nest abandonment and destruction or offspring mortality	Migratory and resident land birds
● Affect habitat structure and vegetation diversity, which are important foraging habitats for raptors, including the MSO (an ESA-listed bird that inhabits the park), caused by the consumption and trampling of native plants and introduction of invasive vegetation. This includes impacts on MSO-designated critical habitat	MSO, habitat, prey base Migratory birds

TABLE D.1. ISSUES AND IMPACTS AND RELATED IMPACT TOPICS

Issues	Impact Topics Related to the Issues
Alterations to livestock grazing and trailing management practices may have an effect on the economic well-being and social values of permit holders and the social values of the local communities.	Permittee traditional uses and socioeconomics
Construction of range developments and livestock management facilities ultimately intended to improve the rangeland can affect resources, as follows:	
● Fence construction may require vegetation clearing, resulting in bare ground and an opportunity for invasive plants to become established.	Upland vegetation associations, Riparian vegetation associations, Soils
● Refurbishing stock ponds and the potential use of mineral supplements can concentrate livestock, resulting in areas of reduced vegetation and soil compaction or loss of biotic soil crusts.	Upland vegetation associations, Riparian vegetation associations, Soils
● Refurbishing stock ponds can alter hydrological function and processes.	Water resources (springs and creeks in the allotments)
● Migratory and resident land bird species may be affected through habitat alteration, fragmentation, disturbance, and direct mortality associated with construction and fences.	Migratory and resident land birds
● Require vegetation removal which can expose soils and reduce soil stability, creating the potential for soil movement and potentially affecting soil productivity, especially near springs, creeks, and wetlands.	Soils, water resources (springs and creeks in the allotments)
● They can affect the undeveloped and natural characteristics of areas intended to be managed as wilderness and can show that forces other than nature have shaped the area.	Wilderness qualities
If grazing and trailing are not managed properly in the Sandy 3 allotment and along livestock trailing routes, these activities can adversely affect five qualities related to wilderness character: untrammeled, natural, undeveloped, solitude and opportunities for primitive and unconfined recreation, and other features of value.	Wilderness qualities

ISSUES AND IMPACT TOPICS NOT CARRIED FORWARD FOR ANALYSIS

Several potential issues and impact topics were raised during scoping. The interdisciplinary team analyzed these issues and impact topics and determined they did not warrant more detailed discussion in this Draft Plan/EA.

Visitor use and experience. Most park visitors come to see and experience the features of the Waterpocket Fold and the Fruita Rural Historic District. Some go to the low desert areas of the Sandy 3 allotment, and some have expressed questions or concerns to park personnel about grazing and trailing in the park. Livestock grazing and trailing could affect visitor use and experience from encounters with livestock, poor water quality, and odors from livestock and their feces. Range developments, such as

fences and stock ponds, could also detract from the visual aesthetics for visitors. Livestock grazing and trailing would result in noises from livestock and operations that many people would consider unnatural in the context of a national park. These sounds occur outside of areas where most park visits occur and are seasonal. Because park legislation allows for continued grazing and trailing, the potential for these relatively low-intensity effects would continue under any of the alternatives.

Visitor use and experience could be affected through the adoption of one or more of the alternatives proposed in this Draft Plan/EA. Educating visitors about livestock grazing and trailing in the park is expected to help improve visitor use and experience. Moreover, implementing a comprehensive plan to manage these activities in a manner that promotes the shared conservation and stewardship of the resources and values of the park is expected to reduce impacts from grazing and trailing.

It is important to note that some visitors enjoy the opportunity to experience livestock grazing and trailing in the park; therefore, the continuation of grazing under any of the alternatives would have a beneficial impact on the experience of those visitors.

Archeological resources. The park initiated consultation under Section 106 of the NHPA with the Utah State Historic Preservation Office (SHPO). Consultation began in November 2014 and concluded in January 2017. The SHPO determined that livestock grazing does not significantly affect the character-defining features of the eligible properties nor diminish their eligibility for the National Register of Historic Places. The SHPO concurred with Capitol Reef's determination of No Adverse Effect for livestock grazing on the area of potential effect (see Chapter 5 for details).

Future projects could include installing fences and other infrastructure. Under NPS procedures, any new project would be subject to a project-specific archeological survey, and potential adverse effects would be resolved through the normal Section 106 compliance process with the Utah SHPO. This compliance ensures that all potentially affected cultural resources are identified and that appropriate mitigating measures are implemented. Consultation may result in additional mitigation.

For these reasons, archeological resources were dismissed from detailed evaluation in the Draft Plan/EA.

Historic structures and cultural landscapes. Livestock grazing is a part of the historical theme recognized through the Fruita Rural Historic District. There are historic structures in the Fruita Rural Historic District, none of which would be directly affected by any action proposed under any alternative. This is because they are not in a grazing allotment.

Livestock trailing is the only proposed action with the potential to affect historic structures and cultural landscapes. It is a short-lived event, occurring one to two times per year, so the effects are negligible. Trailing is a traditional historic use and is part of the cultural landscape. Livestock have been an element of this landscape for over a hundred years, and in this sense their presence is an authentic element of the historic landscape. Moreover, the rock formations, water courses, and the overall character of vegetation in the greater Waterpocket Fold landscape are unlikely to be compromised by livestock grazing and livestock trailing at the scale being proposed here. For these reasons, historic structures and cultural landscapes were dismissed from detailed evaluation in the Draft Plan/EA.

Native American uses. There are known ethnographic resources in the area of potential effect. A number of Indian tribes have ancestral ties to Capitol Reef National Park; however, the few specific locations that the tribes have identified as important would not be affected by livestock grazing. American Indian people used the Capitol Reef area over thousands of years for hunting and subsistence. Capitol Reef National Park holds many resources important to these tribes, including wildlife, minerals,

plants, and water. These resources do not always have a defined boundary, and many may occur in the area of potential effect. To date, the interested tribes have expressed no particular concerns about the impacts of grazing and livestock use, and the National Park Service will continue to consult with the tribes. For these reasons, Native American uses were dismissed from detailed evaluation in the Draft Plan/EA.

Fish and fish habitat. Livestock grazing in riparian systems could affect aquatic vertebrate species, such as fish. While creeks in the Sandy 3 allotment do not support fish or fish habitat, livestock trailing routes in the planning area traverse or follow sections of the Fremont River, Oak Creek, Sulphur Creek, and Pleasant Creek, all of which contain a diversity of aquatic species, including fish. Livestock trailing in and along these creeks may contribute to streambank instability and water quality degradation, which influence fish habitat quality (NPS 2004). Riparian-aquatic zones, such as those with streamside vegetation, have been degraded by livestock grazing and trailing; this is because these areas are more heavily grazed than upland terrestrial zones (Belsky et al. 1999; Ohmart 1996; Platts and Nelson 1989).

Degradation of riparian-aquatic zones affects fish habitats by reducing shade, cover, and terrestrial food supply; increasing stream temperature; changing water quality and stream morphology; and adding sediment through bank degradation and off-site soil erosion; however, based on the low frequency and short duration of livestock trailing along creeks in the planning area, impacts on fish and their habitat are expected to be negligible. For these reasons, fish and fish habitat have been dismissed from detailed evaluation in the Draft Plan/EA.

River and stream water quality. There is a concern that bacteria associated with livestock waste can move either directly or through overland flow from precipitation into streams. Increases in bacteria could decrease water quality. This is primarily of concern for the Fremont River, Oak Creek, Pleasant Creek, and Sulphur Creek, which livestock trailing routes follow or traverse.

Water quality in Capitol Reef is monitored primarily under the NPS Inventory and Monitoring Program, Northern Colorado Plateau Network (NCPN). The park also cooperates with the State of Utah Division of Water Quality for collecting samples tested for *Escherichia coli (E. coli*) bacteria. The NCPN collected 3,325 water samples from seven locations in and near Capitol Reef, between October 1, 2009, and September 30, 2015 (Natural Resource Technical Report 2013, 831; Natural Resource Report 2016, 1332).

Data for samples in which a constituent was detected at a concentration exceeding State of Utah water quality standards are presented in Tables D.2 and D.3. The two tables represent the two separate sampling periods—October 2009 through September 2012, and October 2012 through September 2015—described in the NCPN reports.

TABLE D.2. EXCEEDANCES OF SURFACE WATER QUALITY STANDARDS, SITES SAMPLED IN OR NEAR CAPITOL REEF (OCTOBER 1, 2009, THROUGH SEPTEMBER 30, 2012)

Location	Use code	Constituent	Numeric Standard	Units	Total Samples	Percentage of Samples Exceeding Standards
Fremont River Bicknell	3A	Temperature	20.00	°C	19	11
Oak Creek	2B, 3C, 4	pH	9.00	none	16	13
	2B	Phosphorus, total	0.05	mg/L	16	25

TABLE D.2. EXCEEDANCES OF SURFACE WATER QUALITY STANDARDS, SITES SAMPLED IN OR NEAR CAPITOL REEF (OCTOBER 1, 2009, THROUGH SEPTEMBER 30, 2012)

Location	Use code	Constituent	Numeric Standard	Units	Total Samples	Percentage of Samples Exceeding Standards
Pleasant Creek	1C, 2B	*E. coli*	206.00	MPN/100ml	8	13
	2B, 3A	Phosphorus, total	0.05	mg/L	10	40
	3A	Temperature	20.00	°C	11	18
Sulphur Creek Goosenecks	2A	*E. coli*	126.00	MPN/100ml	19	21
	1C	*E. coli*	206.00	MPN/100ml	19	16
	2A, 3A	Phosphorus, total	0.05	mg/L	30	33
	3A	Temperature	20.00	°C	29	10
	4	Total dissolved solids	1,200.00	mg/L	30	43
Sulphur Creek, Fremont	2A	*E. coli*	126.00	MPN/100ml	8	25
	1C	*E. coli*	206.00	MPN/100ml	8	25
	2A	*E. coli*	409.00	MPN/100ml	8	13
	2A, 3A	Phosphorus, total	0.05	mg/L	12	42
	3A	Temperature	20.00	°C	11	18
	4	Total dissolved solids	1,200.00	mg/L	12	75

NPS Inventory and Monitoring Program, Natural Resource Technical Report 2013, 831
Notes: 2A = primary-contact recreation; 2B = secondary-contact recreation; 3A = cold-water game fish; 3B = warm-water game fish; 3C = nongame fish; 1C drinking water; 4 = agricultural use; °C = degrees Celsius; mg/L = milligrams per liter; MPN = most probable number; ml = milliliter

TABLE D.3. EXCEEDANCES OF SURFACE WATER QUALITY STANDARDS, SITES SAMPLED IN OR NEAR CAPITOL REEF (OCTOBER 1, 2012, THROUGH SEPTEMBER 30, 2015)

Location	Use code	Constituent	Numeric Standard	Units	Total Samples	Percentage of Samples Exceeding Standards
Halls Creek	2B	*E. coli*	206.00	MPN/100ml	10	10
	3B	Temperature	27.00	°C	10	30
Oak Creek	2B	*E. coli*	206.00	MPN/100ml	16	31
	2B	Phosphorus, total	0.05	mg/L	16	38
Pleasant Creek	1C, 2B	*E. coli*	206.00	MPN/100ml	19	21
	2B, 3A	Phosphorus, total	0.05	mg/L	19	42
	3A	Temperature	20.00	°C	20	20
Sulphur Creek Goosenecks	2A	*E. coli*	126.00	MPN/100ml	10	30
	1C	*E. coli*	206.00	MPN/100ml	10	20
	2A	*E. coli*	409.00	MPN/100ml	10	20
	2A, 3A	Phosphorus, total	0.05	mg/L	9	33
	3A	Temperature	20.00	°C	10	30
	4	Total dissolved solids	1,200.00	mg/L	8	25
Sulphur Creek, Fremont	2A	*E. coli*	126.00	MPN/100ml	20	50
	1C	*E. coli*	206.00	MPN/100ml	20	40
	2A	*E. coli*	409.00	MPN/100ml	20	25

TABLE D.3. EXCEEDANCES OF SURFACE WATER QUALITY STANDARDS, SITES SAMPLED IN OR NEAR CAPITOL REEF (OCTOBER 1, 2012, THROUGH SEPTEMBER 30, 2015)

Location	Use code	Constituent	Numeric Standard	Units	Total Samples	Percentage of Samples Exceeding Standards
	1C	*E. coli*	668.00	MPN/100ml	20	10
	2A, 3A	Phosphorus, total	0.05	mg/L	19	26
	3A	Temperature	20.00	°C	20	30
	4	Total dissolved solids	1,200.00	mg/L	19	32

NPS Inventory and Monitoring Program, Natural Resource Technical Report 2016, 1332
Notes: 2A = primary-contact recreation; 2B = secondary-contact recreation; 3A = cold-water game fish; 3B = warm-water game fish; 1C drinking water; 4 = agricultural use; °C = degrees Celsius; mg/L = milligrams per liter; MPN = most probable number; ml = milliliter

The Fremont River downstream of the park (near Caineville) was sampled for water temperature and pH only during the October 2009 through September 2012 sampling; standards for pH and temperature were not exceeded. Temperature standards were not exceeded at the Fremont River near Bicknell in the October 2012 through September 2015 sampling.

Tables D.4 and D.5 provide a detailed discussion of parameters exceeding water quality standards in Oak Creek, Pleasant Creek, and Sulphur Creek. These streams originate west of the Capitol Reef and flow east through the park. Oak Creek and Pleasant Creek are livestock trailing routes, and Sulphur Creek intersects in several places with the Highway 24 trailing route.

TABLE D.4. TEMPERATURE EXCEEDANCES BY SAMPLING PERIOD

Percentage of Samples Exceeding Temperature Water Quality Standards		
	October 2009 through September 2012	October 2012 through September 2015
Pleasant Creek	18	20
Sulphur Creek, below Goosenecks	10	30
Sulphur Creek, above confluence with Fremont River	18	30

TABLE D.5. PHOSPHORUS EXCEEDANCES BY SAMPLING PERIOD

Percentage of Samples Exceeding Phosphorus Water Quality Standards		
	October 2009 through September 2012	October 2012 through September 2015
Oak Creek	25	38
Pleasant Creek	40	42
Sulphur Creek, below Goosenecks	33	33
Sulphur Creek, above confluence with Fremont River	42	26

Few of the exceedances of water quality standards in the Fremont River and Oak, Pleasant, and livestock grazing were attributed to livestock grazing or trailing; instead, they were associated with nonpoint sources, the natural occurrence of volcanic rock high in phosphorus, low-flow conditions, hot

summer temperatures, and elevated turbidity and flow (Hackbarth and Weissinger 2013); however, elevated levels of *E. coli* are likely a direct result of livestock grazing and trailing in and near water sources in the park. High-discharge events carry organic material, including fecal matter (the primary source of *E. coli*) from livestock, horses, humans, and wildlife into water bodies, contributing to elevated levels of the bacteria in water sources.

While water quality impacts on springs in the allotments have been carried forward, water quality in the Fremont River, Oak Creek, Pleasant Creek, and Sulphur Creek does not appear to be significantly influenced by current livestock trailing practices, and would be expected to improve with implementation of the action alternatives in the Draft Plan/EA; therefore, stream and creek water quality has been dismissed and is not carried forward for analyses.

Air quality and visibility. Two separate grazing-related issues could affect air quality in the park. The first is the effect that livestock grazing and trailing may have on meeting National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, and lead. The second issue is the effect livestock grazing and trailing and their management may have on regional haze, which affects visibility in the park. The park is designated as a Class I Airshed by the 1977 amendments to the Clean Air Act; therefore, it receives the greatest level of protection under the Clean Air Act.

Livestock grazing and trailing can contribute to criteria pollutants, primarily through emissions from vehicles used in program management. This includes fugitive dust from vehicular traffic on unpaved roads that provide access to the allotments and contribute to particulate matter.

The State of Utah Division of Air Quality (UDAQ) 2015 report (UDAQ 2015) on the air quality of the state identifies no areas near Capitol Reef that exceed NAAQS. Within the context of local and regional air quality, livestock grazing and trailing in the park would represent a very small proportion of all the sources of criteria pollutants and fugitive dust that could affect air quality.

The alternatives in this Draft Plan/EA are designed to improve range conditions, decrease impacts on soils, and improve vegetation in grazed areas, all of which would reduce the potential for grazing-related fugitive dust emissions.

Visibility is primarily affected by dust, soot, and other fine solid materials suspended in the atmosphere. Generally, visibility in the park is affected by sources outside the park boundaries, such as coal-fired power plants, off-highway vehicles, and fires. The NCPN inventory and monitoring program of the National Park Service acquires and analyzes air quality data from parks in the network, including Capitol Reef. Since 2003, the NCPN has analyzed the visibility data from Capitol Reef to determine the seasonal and annual status of visibility-reducing pollutants. The most recent monitoring report, published in 2010, discusses the results of monitoring from 2003 through 2008.

Although visibility in the park is still superior to that in many parts of the country, it is rated as being in only moderate condition; visibility in the park is often affected by light-scattering pollutants (haze) (Perkins and Houk 2009). Although visibility was estimated to be in moderate condition, there were no degrading trends, and visibility improved significantly on the clearest days for the 10-year period through 2008 (Perkins and Houk 2009).

As described above, livestock grazing and trailing can create fugitive dust that could contribute to haze, particularly in spring, when windy conditions are prevalent; however, these levels would not be expected to increase under any of the alternatives considered for implementation in this Draft Plan/EA. The alternatives are designed to improve range conditions and decrease impacts on soils, which would

reduce the potential for grazing-related dust impacts on air quality; therefore, air quality has not been carried forward for further analysis.

Greenhouse gas production and climate change. The issue of climate change is related to greenhouse gas emissions. Recent reports by the US Climate Change Science Program, the National Academy of Sciences, and the United Nations Intergovernmental Panel on Climate Change provide evidence that climate change is occurring because of rising greenhouse gas emissions and could accelerate in the coming decades. Such activities as fossil fuel combustion, deforestation, and other changes in land use are resulting in the accumulation of greenhouse gases, such as water vapor, carbon dioxide (CO_2), methane, nitrous oxide, ozone, and several hydrocarbons and chlorofluorocarbons.

Livestock grazing contributes greenhouse gases to the atmosphere. Although some carbon dioxide is released through animal respiration and some nitrous oxide is released from their manure, the primary greenhouse gas related to emissions from livestock is methane. The latest Environmental Protection Agency (EPA) calculation of greenhouse gas emissions estimates that agriculture contributes about 7.7% of all US greenhouse gas emissions. Of this total, about 26% of methane emissions are due to enteric fermentation in grazing animals. Enteric fermentation is a digestive process in which microbes in the digestive system break down feed so that it can be absorbed and metabolized.

Beef cattle are the largest contributor of methane emissions from enteric fermentation, accounting for 71% in 2013 (US EPA 2015). In 2013, the EPA estimated that beef cattle production in the United States resulted in the release of methane equivalent to about 117 million metric tons of CO_2. In 2013, the cattle inventory in the United States totaled about 89 million head (NASS 2013). The number of cattle grazed on the Sandy 3 allotment total approximately 82 cow/calf pairs, which represents a very small percentage of the total US cattle inventory. Because the greenhouse gas emissions from livestock that graze the Sandy 3 allotment represent such a small percentage of the national emissions, the effects on climate change would not be discernable, and this issue has not been carried forward for further analysis.

Paleontological resources/geology. The potential for livestock to trample paleontological resources and geological resources in the allotments or along trails was considered during internal and agency scoping discussions. The effects on related resources, such as soils and geomorphic features (e.g., floodplains) have been carried forward; however, no impacts on paleontological resources or geology have been identified from the ongoing livestock operations that have occurred in the park for decades. Moreover, no impacts are expected under any of the alternatives. Due to the limited potential for inconsequential impacts, these resources are not carried forward for further analysis.

Elk (*Cervus canadensis*). During scoping, a number of comments were received suggesting that the National Park Service should consider elk damage and disturbance to listed plants, relative to the damage and disturbance caused by livestock. Other commenters suggested that the National Park Service should address these impacts through this EA process. While elk management is outside the scope of this Draft Plan/EA, in response to these comments, the National Park Service has reviewed available information to assess the relative contribution of elk to impacts on listed plants.

Elk winter range overlaps much of Winkler and Wright fishhook cacti- and Last Chance townsendia-occupied habitat in the recently retired Hartnet Allotment. In 2012, the Utah Division of Wildlife Resources (UDWR) reported 109 elk in this area, incidentally, while doing aerial surveys for elk on adjacent National Forest System lands. During 2016 and 2017, the Utah Division of Wildlife Resources conducted winter aerial surveys for elk in the park, including the recently retired Hartnet Allotment. In 2016, 562 elk were recorded in or within 1 mile of the recently retired Hartnet Allotment; however, 141

of the total 562 elk (25%) were in the rugged western Waterpocket Fold in habitat not shared with livestock or cacti.

In 2017, the aerial surveys documented 609 elk in or within a mile of the recently retired Hartnet Allotment. All were in the Hartnet Draw area of the retired allotment; none were in the South Desert. An additional 661 elk were documented in areas 2 to 5 miles north of the recently retired Hartnet Allotment on Capitol Reef and BLM-administered lands.

During the 2011 through 2013 revisit surveys to known Winkler and Wright fishhook cactus localities, park staff recorded damage and disturbance (i.e., an ungulate track within 6 inches of a plant) from livestock and native ungulates, including elk. Of the 2,380 live Winkler cacti recorded, 1.2% were damaged and 6% were disturbed by elk compared with 4.4% damaged and 12% disturbed by livestock (NPS 2014a). In 2015 and 2016, 18 localities from the 2011 through 2013 surveys were resurveyed. Of the 1,562 cacti documented, 0.7% were damaged and 3.4% were disturbed by elk compared with 2.8% damaged and 13.4% disturbed by livestock (Borthwick 2016a; Borthwick and Livensperger 2017a).

Areas of the allotment with the most Wright fishhook localities and individuals are seldom used by elk. During the 2011–2013 repeat surveys, less than 1% of the 2,551 live Wright fishhook cactus found were damaged by elk, and less than 2% were disturbed by elk compared with 3.6% damaged and 33% disturbed by livestock (NPS 2014b). Similarly, during repeat visits to 10 localities in 2015 and 2016, none of the 573 cacti were damaged by elk and 3% were disturbed by elk compared with 2.1% damaged and 38.2% disturbed by livestock.

During 2015 and 2016, all known Last Chance townsendia localities in areas potentially accessible to livestock in the recently retired Hartnet Allotment were revisited. All were in the Upper Hartnet Draw and overlapped with elk winter range. Of the 914 Last Chance townsendia documented, 0.1% were damaged and 2.6% were disturbed by elk (Borthwick 2017), compared with 0.1% damaged and 0.2% disturbed by livestock.

These data demonstrate that to date, elk damage and disturbance to all three listed plant species have been relatively low, and for the listed cacti, less than that recorded for livestock. This may be because elk weigh about half as much as a domestic cow, have a smaller hoof print, and venture farther from water, thereby being more dispersed across the landscape. If elk use in areas of the recently retired Hartnet Allotment that overlap listed species habitat expands or intensifies, resulting in high frequency of damage and disturbance to listed species and their habitat, Capitol Reef would cooperate with the US Fish and Wildlife Service, Utah Division of Wildlife Resources, and other agencies to develop a solution to the problem. As noted previously, such management is outside the scope of this Draft Plan/EA and may require additional planning and compliance.

In addition to lesser impacts on listed species by elk, Appendix A includes analysis of field data documenting that elk have much less effect on rangeland condition than do livestock.

Bison (*Bison bison*). In 1941, 18 bison from Yellowstone National Park were translocated to the Henry Mountains area east of Capitol Reef. Although the Henry Mountains are within the historical range of plains bison, the area was most likely used only seasonally by bison and did not sustain high numbers due to the lack of water (DOI 2014). Over time the herd has expanded in number and distribution with approximately 350 to 450 individuals inhabiting BLM-administered land east of Capitol Reef.

Since the early 1990s, bison have occasionally entered the park off Swap Mesa through Divide Canyon, Swap Canyon, Bitter Spring Canyon, or Bitter Canyon. Evidence indicates that Capitol Reef is about 100 km or more south of the historical range of bison in Utah (Van Vuren 1992); however, vegetation,

soils, and geologic features in the park are similar to other areas, particularly in Colorado, where bison occurred. If bison did live in the park, they almost certainly would have been migratory (Van Vuren 1992). Summers may have been spent on Boulder Mountain or in the Henry Mountains, and winters would have been spent in lower-elevation areas such as Capitol Reef.

During recent winters, large numbers of bison have come into the Sandy 3 allotment within the park. In the winters of 2016-2017 and 2017-2018, 40 to 150 bison were documented in the allotment. Movement of bison into the park could be due to lack of suitable forage in the Henry Mountains due to extremely dry conditions, high population density resulting in bison seeking new ranges, disturbance from hunters, or likely, a combination of factors. The presence of bison in the Sandy 3 allotment caused concerns for the permit holders as livestock had to compete with bison for limited forage and water.

There was also concern with bison affecting newborn calves. Park staff is also concerned with the ecological impacts bison can have on upland and riparian vegetation communities in the park, especially given that the area is already being grazed by livestock, resulting in impacts from two large herbivores.

In March 2018, park staff determined that the bison were coming into the park primarily through the Bitter Spring Creek drainage, an important riparian area and source of water for Sandy 3 allotment livestock. Park staff repaired the fences and gates in Bitter Spring Creek and Bitter Creek. Fences will be checked each year before the grazing season, and repairs will be made as needed. It is uncertain whether this will resolve the problem, as regular livestock fences do not appear to be a barrier to bison.

Park staff will continue to work with the Utah Division of Wildlife Resources biologists to work toward a long-term solution to keep bison from entering the Sandy 3 allotment. This will include advocating that the herd size be reduced to the UDWR objective of 325 adults/yearlings after the hunting season and potentially installing taller fences that would have greater potential to exclude bison from the park.

NPS sensitive species. Six NPS sensitive plant species have been documented in the planning area. Habitat for each of these species, and where it occurs in the planning area, is summarized in Table D.6.

TABLE D.6. NATIONAL PARK SERVICE SENSITIVE PLANT SPECIES IN THE PLANNING AREA

Common Name	Scientific Name	Habitat Description	Location in Planning Area
Cataract gilia	*A. latifolia* ssp. *imperialis*	Shadscale and other desert shrub associations, along wash bottoms and bases of ledges, at 3,800 to 5,200 feet (1,158 to 1,585 meters). An annual that flowers from March through April.	Highway 24 livestock trailing route
Bicknell milkvetch	*Astragalus consobrinus*	Sagebrush-grasslands and pinyon-juniper associations at 5,200 to 9,000 feet (1,585 to 2,740 meters). A perennial that flowers from mid-May through July.	Unknown but potentially in Sandy 3 allotment and along trailing routes in sagebrush, grassland, and pinyon-juniper associations.
Harrison's milkvetch	*A. harrisonii*	Pinyon-juniper associations in sand derived from Navajo Sandstone and deposited on the Kayenta, Wingate, and Chinle formations at 5,100 to 6,200 feet (1,554 to 1,890 meters). A perennial that flowers from May through June.	Pleasant Creek livestock trailing route

TABLE D.6. NATIONAL PARK SERVICE SENSITIVE PLANT SPECIES IN THE PLANNING AREA

Common Name	Scientific Name	Habitat Description	Location in Planning Area
Maguire daisy	*Erigeron maguirei*	Canyon bottoms and mesa slopes in Wingate and Navajo sandstone formations at 5,380 to 7,115 feet (1,640 to 2,169 meters). A perennial that flowers from June through July.	Dry Bench livestock trailing route
Alcove bog-orchid	*Platanthera zothecina*	Moist stream banks, seeps, and hanging gardens in mixed desert shrub, pinyon-juniper, and oak associations at 4,000 to 6,200 feet (1,219 to 1,890 meters). A perennial that flowers from mid-June through July.	Pleasant Creek livestock trailing route
Welsh's aster	*Symphyotrichum welshii*	Wet meadows, streambanks, seeps, and hanging gardens at 4,345 to 8,000 feet (1,324 to 2,438 meters). A perennial that flowers from July through October.	Highway 24 livestock trailing route

In 1998, 45 Maguire daisy plants were documented along the Dry Bench trailing route; in 2017, 73 plants were documented along the route. Neither survey year covered all suitable habitat in the area, so the numbers found are conservative, and the population appears to be stable. Spring trailing would occur during Maguire daisy's flowering period in June. This could affect reproduction, if plants were grazed or trampled; however, Maguire daisy grows in cracks in Navajo sandstone, so they are unlikely to be trampled by livestock, and their habitat would not be affected.

Although there is some potential for damage to individual plants, the conservative estimate for the total population rangewide is approximately 162,700, with most occurring on sandstone habitats inaccessible to livestock (DOI and USDA 2006); therefore, population level effects on this species would not occur by implementing this Draft Plan/EA.

Bicknell milkvetch occurs throughout the park in sagebrush, grassland, and pinyon-juniper associations at 5,200 to 9,000 feet (1,585 to 2,740 meters). These habitats occur in the Sandy 3 allotment and along several of the upland trailing routes, along the Gray Bench-Cathedral Valley trailing route. Because it is a relatively common plant in the park, Bicknell milkvetch has not been a target of the park's rare plant monitoring, and localities have not been mapped. Because the species distribution overlaps areas that would be used by livestock under this Draft Plan/EA, individual plants could be trampled and grazed. This could result in mortality or reduced reproduction; however, because the plant is widespread throughout the park (Clark 2009), the population level of Bicknell milkvetch in the planning area would not be affected by implementing this Draft Plan/EA.

Harrison's milkvetch occurs along the Pleasant Creek trailing route. This species has a very restricted distribution, with all known localities occurring in Capitol Reef, with a total of approximately 7,000 plants. Individuals and habitat in the Harrison's milkvetch locality that occurs in uplands near Pleasant Creek would continue to be at risk of being grazed or trampled by trailing livestock. When surveyed in May 2017, 54 plants were found at this locality. Based on tracks and scat, livestock trail through this locality.

Other localities in the area are in side drainages that are not at risk from livestock trailing. For example, during the May 2017 surveys 229 Harrison's milkvetch plants were recorded in a portion of one side drainage; not all of the habitat was surveyed, and there are many more plants there.

Continued trailing down Pleasant Creek would result in trampling and grazing of individual plants at one Harrison's milkvetch locality; however, due to the number of other Harrison's milkvetch plants in protected areas of the park, including drainages near Pleasant Creek, implementing this Draft Plan/EA is not expected to affect the species' population levels.

The alcove bog orchid occurs along riparian areas of Pleasant Creek. Surveys conducted in 2002 and 2017 documented 38 and 48 plants, respectively. Livestock trailing down Pleasant Creek could destroy individual alcove bog orchids; however, because the Pleasant Creek population appears to be stable, despite regular trailing by livestock each fall, and approximately 60 populations exist outside the planning area, population-level effects are not expected by implementing this Draft Plan/EA.

Little is known about the current distribution or abundance of Welsh's aster or cataract gilia, other than that specimens of each were collected in the park along the Fremont River and Highway 24, east of Fruita in the 1980s. Welsh's aster is associated with wet meadows, streambanks, seeps, and hanging gardens, while cataract gilia occur in desert shrub associations along wash bottoms. Both could occur along the Highway 24 trailing route. They would be subject to trampling and potential habitat degradation, which could destroy or reduce reproduction of both species.

Welsh's aster is believed to be more widespread and occurs in a wider variety of habitats than previously thought (Alexander 2016); therefore, it is not expected to be affected at the population level by continued livestock trailing down Highway 24.

Little is known about cataract gilia, other than that populations tend to have few individuals; threats and trends are poorly known (Alexander 2016); therefore, it is difficult to judge if this species would be affected at the population level, especially since its current status in the planning area is unknown.

Overall, NPS Management Policies (2006) state that, to the greatest extent possible, the National Park Service will manage NPS sensitive species in a manner similar to its treatment of federally listed species; therefore, the proposed actions under this Draft Plan/EA are expected to ensure continued protection and recovery of these species.

Two NPS sensitive bat species—spotted bat (*Euderma maculatum*) and fringed myotis (*Myotis thysanodes*)—have been documented in the Sandy 3 allotment. Little research has been done on the impacts of livestock grazing and trailing on bat species of the southwestern United States (Chung-MacCoubrey 1996). It is likely that changes in the landscape due to livestock grazing, such as soil compaction and alteration of vegetation communities, influence arthropod diversity and abundance. Changes to arthropod diversity and abundance could result in livestock-related impacts on bat species (Chung-MacCoubrey 1996), such as fringed myotis or spotted bat. These bat species use riparian areas in the allotments and along livestock trailing routes for nighttime foraging. Since riparian conditions are expected to improve under the proposed action, impacts on bats have been dismissed from detailed evaluation in the Draft Plan/EA.

Three NPS sensitive raptor species occur in the planning area: peregrine falcon (*Falco peregrinus*), golden eagle (*Aquila chrysaetos*), and bald eagle (*Haliaeetus leucocephalus*). Impacts on these species and other raptors are related to impacts on their foraging habitat and disturbance during the nesting period. Impacts on raptors are addressed under the migratory bird section of the Draft Plan/EA.

Two NPS sensitive fish species occur in the Fremont River: Bluehead sucker (*Catostomus discobolus*) and flannelmouth sucker (*C. latipinnis*). These species could be affected by livestock crossing the Fremont River, from the Highway 24 trailing route to the recently retired Hartnet Allotment, during fall trailing. Bluehead sucker has also been documented in Pleasant Creek and could be affected by fall

livestock trailing. Impacts to fish in the Fremont River and Pleasant Creek are expected to be negligible. As discussed previously under *Fish and Fish Habitat*, overall impacts on these resources are expected to be negligible and have been dismissed from detailed evaluation in the Draft Plan/EA.

Other threatened and endangered species. The other 15 federally listed species that are known to occur in the planning area (see Table D.7) would not be affected by the proposed alternatives due to (1) lack of suitable habitat in the action area; (2) the action area is outside the known distributional range; or (3) the species is not expected to occur during the season of use. Additionally, there would be no off-site impacts on these other federally listed species by implementing the proposed alternatives; therefore, the proposed alternatives would have no effect on any of these other federally listed species, and they are not addressed further in the Draft Plan/EA.

Other mammals, reptiles, and amphibians. Capitol Reef National Park provides habitat for a variety of wildlife species. Found throughout the area are elk, mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*), coyote (*Canis latrans*), numerous species of birds, raptors, small mammals, reptiles, and amphibians. There are concerns over direct impacts on wildlife, alteration to habitat structure, and vegetation diversity decreasing. This would be due to livestock consuming and trampling native plants while grazing and trailing in the park. The impacts of livestock grazing on wildlife species at the park are described below.

The action alternatives considered under this Draft Plan/EA would not increase livestock numbers or areas open to grazing or extend the length of the grazing season. In general, livestock impacts on habitat structure and vegetation diversity and composition should decrease. While the effects on birds has been carried forward, there is little data available to assess impacts on other wildlife species from historical and ongoing livestock operations. Impacts that have occurred are expected to be reduced under either of the action alternatives, due to improved habitat conditions; therefore, impacts on other wildlife species have been dismissed from detailed evaluation in the Draft Plan/EA.

Ungulates. Several ungulate species occur in Capitol Reef National Park: mule deer, pronghorn (*Antilocapra americana*), elk, and bighorn sheep. Most native ungulates compete with domestic livestock when resources are limited (Vavra et al. 1999). Livestock grazing could alter vegetation in potential fawning areas, and it has been found that mule deer avoid livestock pastures during fawning season (Loft et al. 1987, 1991); however, vegetation alteration does not appear to impact pronghorn populations in the same way (Loeser et al. 2005).

Current livestock grazing practices at Capitol Reef have not significantly affected native ungulate populations. Proposed action alternatives in this Draft Plan/EA are unlikely to negatively affect current populations or influence population viability. Moreover, low- to moderate-intensity, well-managed livestock grazing practices can be used to develop and maintain plant communities that may be beneficial to native ungulates (Krueger et al. 2002); therefore, ungulates are not carried forward for further analysis.

Bighorn sheep disease transmission. Although there have been no recent, formal population or health surveys conducted in Capitol Reef National Park, based on observations, 60 to 80 desert bighorn sheep (*Ovis canadensis nelsoni*) are estimated to occur in the park. Throughout the range of bighorn sheep, there are concerns about potential disease transmission from domestic livestock to bighorn sheep. Of greatest concern is the risk of respiratory disease transmission from domestic sheep and goats (George et al. 2008; Wehausen et al. 2011; Cox and Carlson 2012).

TABLE D.7. THREATENED, ENDANGERED, CANDIDATE/PROPOSED SPECIES AND DESIGNATED CRITICAL HABITAT WITH THE POTENTIAL TO OCCUR IN THE PLANNING AREA

Species Common and Scientific Name	Status[1]	Potential to Occur	Critical Habitat in Action Area	Rationale for Exclusion[2]	Habitat Description and Range in the Action Area
Plants					
Barneby reed-mustard *Schoenocrambe barnebyi*	E	No	N/A	HAB	Semiarid canyonlands on steep slopes, generally with northern exposures. Occurs in Wayne and Emery Counties, Utah. Does not occur in the action area.
San Rafael cactus *Pediocactus despainii*	E	No	N/A	ODR	Found between 6,070 and 6,700 feet (1,850 and 2,042 meters) in elevation in pinyon juniper and salt desert shrub communities. Occurs in Emery County, Utah. Does not occur in the action area.
Jones cycladenia *Cycladenia humilis* var. *jonesii*	T	No	N/A	HAB	Found between 4,300 and 6,000 feet (1,310 and 1,828 meters) in elevation in desert scrub and juniper plant communities. Occurs in Emery, Grand, Garfield, and Kane Counties in Utah and in Mohave County, Arizona. Does not occur in the action area.
Ute ladies'-tresses *Spiranthes diluvialis*	T	No	N/A	HAB	Grows along stable wetland and seep areas. Occurs in the interior western US, including Utah, Wyoming, Nebraska, Colorado, Nevada, Idaho, Montana, and Washington. Does not occur in the action area.
Fish					
Bonytail chub *Gila elegans*	E	No	No	ODR	Warm-water species that favors main stem rivers, usually in or near deep, swift water. Occurs in the southwestern US, primarily in Arizona, California, Nevada, and Utah. Does not occur in the action area.
Colorado pikeminnow *Ptychocheilus lucius*	E	No	No	ODR	Habitat includes medium to large rivers. Adults use various habitats, while young prefer small, quiet backwaters. Migrates extensively to spawn. Occurs in the southwestern US, primarily Arizona, Colorado, New Mexico, and Utah. Does not occur in the action area.

TABLE D.7. THREATENED, ENDANGERED, CANDIDATE/PROPOSED SPECIES AND DESIGNATED CRITICAL HABITAT WITH THE POTENTIAL TO OCCUR IN THE PLANNING AREA

Species Common and Scientific Name	Status[1]	Potential to Occur	Critical Habitat in Action Area	Rationale for Exclusion[2]	Habitat Description and Range in the Action Area
Humpback chub *Gila cypha*	E	No	No	ODR	Inhabits large rivers. Adults use various habitats, while young prefer backwaters or shorelines. Occurs in the southwestern US, primarily in Arizona, Colorado, New Mexico, and Utah. Does not occur in the action area.
Razorback sucker *Xyrauchen texanus*	E	No	No	ODR	Inhabits medium to large rivers. Often associated with sand, mud, and rock substrate, in areas with sparse aquatic vegetation, where temperatures are moderate to warm. Occurs in the southwestern US. Does not occur in the action area.
Birds					
Southwestern willow flycatcher *Empidonax traillii extimus*	E	No	No	ODR	Habitat includes riparian and wetland thickets, generally of willow or tamarisk. Occurs throughout the southwestern US. Numerous bird monitoring in the park has not documented the species.
Yellow-billed cuckoo Coccyzus americanus	T	No	No	ODR	Habitat includes riparian cottonwood-dominated forests that line larger rivers running through arid country. Numerous bird monitoring in the park has not documented the species.
California condor *Gymnogyps californianus*	E	No	No	SEA	Found in mountainous country at low and moderate elevations, especially rocky and brushy areas with cliffs. Most likely to occur during the summer, throughout the western US. Numerous bird monitoring in the park has not documented the species.
Mammals					
Utah prairie dog *Cynomys parvidens*	T	No	N/A	ODR	Found in grasslands and underground burrow systems. Occurs only in southern Utah in Beaver, Garfield, Iron, Kane, Piute, Sanpete, Sevier, and Wayne Counties. Does not occur in the action area.

Sources: Tilley et al. 2011; Clark et al. 2015; Clark 2011; USFWS 2013b; Tilley et al. 2010; St. John and Ogle 2009; USFWS 2012b; NatureServe 2017

[1] **Status Codes: E** = federally listed endangered; **T** = federally listed threatened; **P** = federally proposed for listing; **C** = federal candidate for listing; and **CH** = designated critical habitat

[2] **Exclusion Rationale Codes: ODR** = outside known distributional range of the species; **HAB** = no habitat present in action area; **ELE** = outside of elevational range of species; and **SEA** = species not expected to occur during the season of use.

Capitol Reef does not intend, as part of this Draft Plan/EA, to permit the grazing of domestic sheep or goats. The only livestock permitted at Capitol Reef are cattle, which are of lesser concern for disease transmission to bighorn sheep (Foreyt and Lagerquist 1996). The overall lesser concern regarding cattle versus sheep or goats is reflected in the BLM and Western Association of Fish and Wildlife Agencies' guidance. It does not address cattle but focuses on bighorn sheep interactions with domestic sheep and goats (Cox and Carlson 2012).

The fact that the park permits cattle grazing and trailing only does not eliminate the risk of disease transmission to desert bighorn sheep; nevertheless, park staff have indicated there is low potential for interaction between cattle and bighorn sheep. This is based on very infrequent sightings of bighorn sheep in the Sandy 3 allotment or on trailing routes in the park. In addition, the National Park Service is not aware of any efforts by the Bureau of Land Management or the US Forest Service in the area to restrict or limit cattle grazing because of the potential for disease transmission (NPS, Fisk, pers. comm. 2016). This suggests there are no known concerns regarding diseases or their transmission to bighorn sheep in the areas surrounding the park; therefore, this issue has been dismissed from detailed evaluation in the Draft Plan/EA.

Small mammals. There are a number of small mammal species in the Capitol Reef area. Small mammals are both directly and indirectly affected by livestock grazing. Livestock can trample burrows, compact soil, and compete for food. Alternatively, they can indirectly alter the structure or species composition of the vegetation in a manner that influences habitat selection by small mammals (Hayward et al. 1997).

Species that den on the ground may be negatively affected by changes in the understory, as sites suitable for denning would be eliminated for some species (Knopf 1996). When grazing changes the quality and composition of the understory, the amount of food available for these species also changes. Vegetation is often greatly reduced on grazed, relative to ungrazed areas (Bock et al. 1984; Gardner 1950). Litter provides a secure habitat, food, and protection from predation for small mammal species, such as desert mice species (Bock et al. 1984). Heavy vegetation makes the area between the snowpack and ground surface more hospitable to voles and other small rodents (Birney et al. 1976) and is essential for their survival.

The composition of small mammal communities is affected by structural attributes (Grant et al. 1982). Reduced litter decreases prey species diversity and numbers; this indirectly affects the species addressed here. Species composition may also shift due to grazing. Small mammal species, such as shrews (family Soricidae), with a preference for habitats with substantial ground cover are more abundant on ungrazed sites, whereas species that prefer open areas are more abundant on grazed sites (Bock et al. 1984).

There is little data available to assess the impacts of current livestock grazing practices at Capitol Reef National Park on small mammal populations; however, because both of the proposed action alternatives are expected to improve vegetation conditions in the allotments, small mammal habitats would also be expected to improve.

Reptiles. Capitol Reef National Park provides habitat for numerous species of lizards and snakes. Impacts of livestock grazing on reptiles varies by taxa and are primarily indirect, due to alterations to vegetation structure, diversity, and cover (Bock et al. 1990; Hellgren et al. 2010; Romero-Schmidt et al. 1994). Reduced vegetation increases lizards' vulnerability to predation (Hellgren et al 2010; Romero-Schmidt et al. 1994). Some species of lizards prefer grazed areas over ungrazed areas. Sagebrush lizards (*Sceloporus graciosus*) are more abundant in native ungrazed sagebrush habitat, while short-horned lizards (*Phrynosoma douglassii*) prefer grazed sagebrush habitats (Reynolds 1979). In some instances,

light grazing pressure can increase reptile abundance and diversity, especially among lizard species (Jones 1981).

The impacts of livestock grazing on desert snakes are not well documented; thus, if impacts occur, they are likely to be indirect and associated with altered vegetation. This could alter the prey base or cover from predators for desert snake species. There is little data available to assess the impacts of current livestock grazing practices at Capitol Reef National Park on reptile populations.

The proposed action alternatives in the Draft Plan/EA are unlikely to significantly affect the viability of reptile populations in the park.

Amphibians. Livestock grazing can have negative or positive effects on amphibian species (Burton et al. 2009), and the impacts appear to be species specific. Livestock grazing has been identified as a threat to amphibians, particularly because of documented concentrated livestock use in riparian areas where amphibians are found (Keinath and McGee 2005). Severe vegetation trampling by livestock degrades habitat conditions, which could indirectly cause mortality by degrading microhabitats for both adults and young amphibians. Livestock grazing along riparian corridors removes aquatic and terrestrial vegetation. This reduces escape cover and foraging areas used by many amphibian species, thus increasing vulnerability to predation.

Livestock grazing in and next to breeding areas, migratory paths, and summer feeding areas could cause substantial impacts on frogs and toads (direct mortality of frogs, eggs, and metamorphs and degradation of habitat). Livestock trampling streambanks and creating trails along or across stream bands may degrade or collapse streambanks, which amphibians often use as cover from predators. Many amphibian species, including the canyon tree frog (*Hyla arenicolor*), are found primarily in vegetation or mud along pond, stream, or wetland margins, where livestock often concentrate during the summer.

Overlap in habitat use by livestock, frogs, toads, and salamanders results in a high potential for direct mortality of adults and young. Mortality of frogs and toads, including Woodhouse's toad (*Bufo woodhousii*) and northern leopard frog (*Rana pipiens*), due to livestocktrampling has been observed (Loeffler 2001; Maxwell 2000). Although livestock-related mortality of amphibians, including eggs, tadpoles, and juveniles, is expected in the planning area, it is unlikely to affect the viability of existing populations. Moreover, the proposed alternatives in this Draft Plan/EA would likely decrease the incidence of livestock-related mortality of amphibian species in the park.

Regional socioeconomics. Livestock grazing at Capitol Reef provides economic benefits to Wayne and Garfield Counties, as evidenced by a 2015 BLM study that showed that each AUM permitted for use in the region generates approximately $100 in economic activity (BLM 2015c). As such, any reduction in AUMs associated with the action alternatives could reduce economic activity in the counties; however, because the farm sector of the economy in Wayne and Garfield Counties constitutes a small and declining percentage of the overall economy (0.4% of total employment in the two counties and 8.2% of total earnings in 2014; Headwaters Economics 2016), the alternatives considered in this EA would not have an appreciable impact on regional economics.

The farm sector has been growing little, if at all, while non-farm sectors have grown steadily (Headwaters Economics 2016). Between 1970 and 2014, a period that experienced many economic shocks and changes in trends, farm employment remained essentially unchanged, ending the period with 486 jobs, down 2.2% from the 497 jobs at the beginning of the period. In contrast, non-farm jobs grew almost 185% over the period, from 1,711 to 4,862.

These patterns demonstrate the resilience of the livestock sector. This resilience is reinforced insofar as many ranchers, unable to earn an adequate living from livestock production alone, supplement their farm income with income earned through employment in other sectors. The off-farm income enables them to sustain their livestock-oriented lifestyle (Brown and Weber 2013; Power 1998).

Despite the above information indicating no measurable effect on the economy of Wayne and Garfield Counties, this Draft Plan/EA will evaluate the socioeconomic impacts on the grazing permit holder who operates in Capitol Reef National Park. In addition, the Draft Plan/EA recognizes the traditional uses of grazing and trailing, and the park seeks to continue developing relationships with permit holders and the surrounding communities.

APPENDIX E: METHODS FOR ANALYZING FINANCIAL IMPACTS OF POTENTIALLY REDUCING AUMS

INTRODUCTION

The National Park Service was unable to obtain detailed socioeconomic data from the grazing and trailing permittees who use Capitol Reef National Park. As a result, the socioeconomic analysis uses best professional judgement, information supplied by Cooperating Agencies, and information from the Grand Staircase-Escalante National Monument Livestock Grazing Monument Management Plan Amendment/EIS Socioeconomic Workshops Report (BLM 2015c) to inform the analysis of potential socioeconomic impacts. The Grand Staircase work is applicable because the herd size, environmental conditions, elevation, terrain, climate, and economic conditions are similar, and both areas are in southern Utah.

ASSUMPTIONS

Cattle ranching is typically divided into operations that are cow/calf and those that are stocker operators, who grow calves and yearlings. The former is used on Capitol Reef National Park rangelands. Cow/calf operations usually keep their mother cows on a yearlong basis and sell the calves, along with cull cows, which are those that would be sold for slaughter. The analysis uses a common assumption that 10% to 20% of animals would be culled each year (BLM 2015c). Ten percent of the yearly calf crop would replace stock for the culled animals; however, under this scenario, the National Park Service does not have sufficient data to determine how many head of livestock permittees have in their overall operation.

The analysis also assumes that 85% of calves survive and make it to sale and that calf weights in the fall would be around 550 pounds. Assuming the cattle markets would remain low and using the 2017 cost per hundred weight (cwt) estimated at 155 cwt (Ishmael 2018; CME Group 2017), the gross income dollar amount for each calf is assumed to be $852.50 (155 cwt multiplied by 5.5).

Rotational grazing models were included under Alternative 2, and the assumption is that it would cost $40 to $60 per animal to move livestock to another pasture (BLM 2015c). The National Park Service is proposing to implement a pasture rotation system, so the integrity and availability of forage can be maintained; therefore, the assumption is that, if cows have enough forage to eat, they should be able to maintain weight through the winter. Also, calves would have higher birth weights, which could make them easier to wean. If calves can put on weight throughout the grazing season, they should be able to reach production objectives and help increase income for permittees.

In the absence of accurate labor cost data from Capitol Reef National Park trailing permittees, this analysis assumes it would cost $1,000 to $3,000 to trail livestock through the park, taking into account labor costs and impacts on animals (BLM 2015c). Many variables can contribute to these impacts, such as distance trailed and elevation gained, beginning weight when trailing begins, and the intensity under which animals are moved. (Putting a dollar amount on the impacts on animals is challenging, and the costs provided above are an estimate.)

Traditional ranching in Utah is a lifestyle as well as a business; however, specific data—such as income needed to support the traditional ranching lifestyle, how big or small a ranching operation needs to be to support the ranching lifestyle, and what defines the "ranching lifestyle" in Utah—are not available to determine impacts on the local ranching lifestyle. Thus, this analysis assumes that if permittees' income

is reduced, this may have some level of impact on the local agricultural community activities and traditions and therefore the local ranching lifestyle.

The action alternative presented in this EA recognize the traditional cultural use of a portion of park lands for livestock grazing and trailing; the alternative would not change that traditional cultural use. Permit holders may change some aspects of their operations, such as implementing a pasture rotation system, based on the alternative; however, the grazing and trailing lifestyle would remain largely unaffected.

METHODS FOR ANALYZING FINANCIAL IMPACTS OF POTENTIALLY REDUCING

The National Park Service developed a Microsoft Excel model to assess the potential financial impacts on permittees if AUMs are reduced on park lands as an adaptive management tool in response to changing forage availability and resource conditions in the Sandy 3 allotment. The outputs from this model, which were vetted with Forest Service and NRCS staff, are explained below and are shown in Figure E.1. When reading the model output, note that the bold wording corresponds to the column titles in the model readout; the explanation that accompanies each title includes the calculation on how a number was derived and why this number is included in the model.

Max AUMs	Adjusted AUMs	Difference	$/AUM	$/Adjusted AUM	Constant AUM Cattle	$/AUM	Head	$ total for herd	Average cost $ /AUM on private lands	Cost $ to place AUM removed from CARE on a private allotment	Total cost $/AUM Reduction from CARE
410	409	1	1.87	1.87	1.2	$ 1.56	82	$ 127.78	520	$ 20.00	$ 147.78
410	408	2	1.87	3.74	1.2	$ 3.12	82	$ 255.57	520	$ 40.00	$ 295.57
410	407	3	1.87	5.61	1.2	$ 4.68	82	$ 383.35	520	$ 60.00	$ 443.35
410	406	4	1.87	7.48	1.2	$ 6.23	82	$ 511.13	520	$ 80.00	$ 591.13
410	405	5	1.87	9.35	1.2	$ 7.79	82	$ 638.92	520	$ 100.00	$ 738.92
410	404	6	1.87	11.22	1.2	$ 9.35	82	$ 766.70	520	$ 120.00	$ 886.70
410	403	7	1.87	13.09	1.2	$ 10.91	82	$ 894.48	520	$ 140.00	$ 1,034.48
410	402	8	1.87	14.96	1.2	$ 12.47	82	$ 1,022.27	520	$ 160.00	$ 1,182.27
410	401	9	1.87	16.83	1.2	$ 14.03	82	$ 1,150.05	520	$ 180.00	$ 1,330.05
410	400	10	1.87	18.7	1.2	$ 15.58	82	$ 1,277.83	520	$ 200.00	$ 1,477.83
410	399	11	1.87	20.57	1.2	$ 17.14	82	$ 1,405.62	520	$ 220.00	$ 1,625.62
410	398	12	1.87	22.44	1.2	$ 18.70	82	$ 1,533.40	520	$ 240.00	$ 1,773.40
410	397	13	1.87	24.31	1.2	$ 20.26	82	$ 1,661.18	520	$ 260.00	$ 1,921.18
410	396	14	1.87	26.18	1.2	$ 21.82	82	$ 1,788.97	520	$ 280.00	$ 2,068.97
410	395	15	1.87	28.05	1.2	$ 23.38	82	$ 1,916.75	520	$ 300.00	$ 2,216.75
410	394	16	1.87	29.92	1.2	$ 24.93	82	$ 2,044.53	520	$ 320.00	$ 2,364.53
410	393	17	1.87	31.79	1.2	$ 26.49	82	$ 2,172.32	520	$ 340.00	$ 2,512.32
410	392	18	1.87	33.66	1.2	$ 28.05	82	$ 2,300.10	520	$ 360.00	$ 2,660.10
410	391	19	1.87	35.53	1.2	$ 29.61	82	$ 2,427.88	520	$ 380.00	$ 2,807.88
410	390	20	1.87	37.4	1.2	$ 31.17	82	$ 2,555.67	520	$ 400.00	$ 2,955.67

Figure E.1. Permittee Socioeconomic Model Output Displaying Financial Impacts of Reducing AUMs for the Sandy 3 Allotment (a reduction of 20 AUMs is displayed)

Max AUMs: Maximum allowed AUMs in the Sandy 3 allotment.

Adjusted AUMs: Proposed number of AUMs under each alternative.

Difference: Max AUMs – Adjusted AUMs; this column indicates how many AUMs are removed.

$/AUM: $1.41 is the cost per AUM that the BLM established for 2018; this is constant in this model.

$/Adjusted AUM: $/AUM * difference; this is how much each AUM costs the permittee after a reduction in AUMs.

Constant AUM cattle: 1.2 is a constant, since the permittee has 1,200-pound cows. Another way to look at this number is 1.2 animal unit equivalents (AUEs).

$/AUM: $ per adjusted AUM/constant AUM cattle, this is the cost per AUM that the permittee would have to pay if AUMs are reduced.

Head: This is the number of livestock in the permittee's herd on Capitol Reef National Park and is assumed to be constant in this model.

$ total for herd: Head multiplied by $ per AUM; this is the loss in the income from reduced AUMs that the permittee would have to saturate among remaining animals using Capitol Reef National Park rangelands.

Average cost ($)/AUM on private lands: Estimated cost to lease one AUM on private land.

Cost ($) to place AUM removed from the Capitol Reef National Park on a private allotment: Average cost ($)/AUM on private lands multiplied by the difference; this is the cost to place an AUM that was excluded from Capitol Reef National Park on a privately leased pasture.

Total cost ($)/AUM Reduction from CARE: $ total for herd + cost $ to place AUM removed from Capitol Reef National Park on a private allotment; this is the total cost for the permittee to remove a certain amount of AUMs from Capitol Reef National Park and place the AUMs on private lands.

METHODOLOGY FOR CALCULATION OF THE COST OF TRUCKING (ALTERNATIVE 1) AND TRAILING (ALTERNATIVE 2)

Under Alternative 1, the former permittee of the Hartnet Allotment would truck livestock between their allotments on BLM-administered land and National Forest System land. Under Alternative 2, the operator would be granted a permit to trail through the park. This section describes the methodology for calculating the cost of trucking versus trailing in the two alternatives.

Under the No-Action Alternative, a few assumptions are made for the purpose of this analysis. First, ranch employees would earn $15/hour and 6 ranch employees would be needed to move, trail, and corral livestock. Second, since the BLM permit allows for 200 animal units (AUs), the trucking and trailing estimations would be based on having to move 200 animals to the BLM grazing allotment.

Two separate scenarios are assessed. With the first scenario, the permittee would truck 200 head of livestock from their property in Torrey, Utah, approximately 25 miles along Utah Highway 24 to the "River Ford." Livestock would be unloaded to the existing corral. The ranch employees would then move livestock 0.10 miles along the county road, across the river, and to the BLM allotment. Once on the BLM allotment, ranch staff would move some of the livestock 5 miles north to Blue Flats. The remaining animals would be moved to the north end of the BLM allotment. The northern end of the BLM allotment would be approximately a 10-mile ride, estimated to take 6 riders 1 day.

We do not know if the permittee would use a semi or a stock trailer and pickup, but if we assume a 44-foot, single deck, semi-trailer truck would be used to move 200, 1200-pound cows and each cow would occupy roughly 0.6 of a running foot (Grandin 2001), we can assume that each load can hold

approximately 26 head. To move 200 livestock with the said semi, it would be approximately 8 trips that would include diesel fuel charges (around $3.00 per gallon) and a $1–2 charge for each mile driven. Since one trip requires 50 total miles of travel (25 miles to the "River Ford" and a 25-mile return trip), 8 trips would be needed to move all 200 head. To cover 8 trips would require 200 miles to be driven that are loaded with livestock and 200 miles driven empty (return trips). Assuming that it costs $4.50 per mile for a loaded truck, we can assume that it would cost $900 to haul 200 livestock to the "River Ford" location. This analysis assumes it costs $4.00 per "empty" or unloaded mile driven (200 miles * $4.00 = $800). So the cost to truck 200 animals would be $1,700.

Additionally, it would likely take 4 days of ranch staff time (2 days to gather animals, 1 day to truck, and 1 day to trail animals to Blue Flats and the northern reaches of the BLM allotment) to complete this scenario. Six riders earning $15/hour and working a 10-hour day would cost $900 per day in wages (6 riders * $15/hour *10-hour work day = $900 *4 days = $3,600). Under this scenario, therefore, the total cost of trucking and driving livestock on horseback would be $5,300.

It is important to note that when livestock are moved via a truck, the likelihood of animal injury is high (e.g., broken legs, hips, and soft tissue injury). It is challenging to estimate how many animals might be injured and the extent of the injuries. It is also challenging to estimate the amount of animal shrink that would be observed when trucking animals to the allotment.

This estimate is highly variable and can change based on diesel prices, truck and driver availably, and the livestock commodity market, which can all influence trucking costs. Last, if the permittee owns a semi and trailer, this could reduce the cost.

Under the second scenario, the permittee would trail 200 livestock approximately 21 miles down Utah Highway 24. A temporary corral(s) would be set up to hold animals until they can trail from the temporary corral to the BLM allotment, which is approximately 4 miles. Under this scenario, trucking would not occur, so injury to animals would be avoided. This scenario would require 7 total days of ranch staff time (2 days to construct a temporary corral, 2 days to gather animals, 1 day to trail down Highway 24, 1 day to trail to the allotment and distribute animals on the allotment, and 1 day to deconstruct the temporary corral).

The permittee would also have to purchase enough panels to construct a large enough corral(s) to hold 200 cows. It is estimated this scenario would cost $12,300 ($6,300 in wages plus $6,000 to purchase livestock panels to create 1–2 temporary, 100-foot diameter round pens (40, 16-foot panels * $150.00/panel = $6,000 for a temporary corral[s]).

Alternative 2: 200 head of livestock would be trailed through the park on the Hartnet trail and/or the Lower South Desert trail. It is estimated that it would take 2 days to gather the livestock on the National Forest System land and 1–2 days to trail through Capitol Reef National Park before the cattle reach the BLM allotment. The permittees would have 1 day to trail livestock through the Upper Hartnet Draw. For the Lower South Desert trail, livestock would be moved into the Lower South Desert after trailing all day down Highway 24. Livestock would overnight in the Lower South Desert. The next day they would be trailed to the BLM allotment via the Lower South Desert Overlook trail and road.

The cost estimates were made using 6 riders to gather and trail the 200 livestock. Six riders getting paid $15/hour each, with 10-hour work days is equal to $3,600 ($15/hour wages * 10-hour days = $150/ day * 6 riders = $900/day in wages * 4 days of work = $3,600) in wages to trail 200 head of livestock from the Forest Service allotment and/or base property across the park to the BLM allotment.

It is impossible to estimate animal shrink and performance loss due to not knowing how hard the animals are pushed when trailing, which of the two routes animals would take, and the condition of the animals coming off the Forest Service summer allotment.

UNCERTAINTIES

As with grazing and trailing on all public lands, permittees operating at Capitol Reef face uncertainty as a result of the need to balance permitting of grazing and trailing with resource management mandates. Fore example, depending on a variety of factors, permittees may periodically have to adjust operations. Examples of such factors are weather, forage availability, rangeland health, and condition of other resources, including threatened and endangered species (see Chapter 2 for the types of adjustments that may occur at Capitol Reef under each alternative).

This uncertainty can adversely affect the income potential of these operations and the ability of permittees to carry out their traditional ranching lifestyle. This is because permittees would need to evaluate whether they want to invest new capital into their operations on public lands in any given year; however, such business decisions are at the discretion of the permittee, so the economic, social, and cultural impacts on the permittee associated with the business decisions that may be made to address this uncertainty cannot be reasonable predicted.

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