Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Medicine Bow-Routt National Forests and Thunder Basin National Grassland April 2024

Biennial Monitoring Evaluation Report for the Medicine Bow-Routt National Forests and Thunder Basin National Grasslands

Fiscal years 2019-2022

For More Information Contact:

Jessica Vogt
2468 Jackson St
Laramie, Wyoming
307-745-2371

https://www.fs.usda.gov/mbr

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

Table of Contents

Table of Figures

Table of Tables

Why Monitoring Matters

There is no single correct approach to managing a forest or grassland. Each decision maker must weigh the ecological complexity of these ecosystems, the changing environmental conditions, the many different viewpoints of the public, and uncertainty about long-term consequences.

Data from monitoring can therefore be extremely useful. A robust, transparent, and meaningful monitoring program can provide information on specific resources, management impacts, and overall trends in condition – in other words, feedback on whether we are meeting our management objectives or not.

Each national forest or grassland has a land management plan or "forest or grassland plan" that balances tradeoffs among recreation, timber, water, wilderness, wildlife habitat, and other uses. The plan describes a set of desired conditions – a science-based vision for what forest or grassland conditions should be once the goals of the plan are met. The forest or grassland plan also includes a monitoring program, organized around a set of monitoring questions and indicators that are designed to track progress toward achieving the desired conditions in the plan.

Monitoring of certain resources is required by law, regulation, or directive (see box below for the required nine monitoring topics). Other monitoring occurs depending on specific needs of the national forest or grassland. Every 2 years, each forest or grassland compiles and evaluates the monitoring results and drafts a report like this one. Decision makers, such as forest and grassland supervisors, use these Biennial Monitoring Evaluation Reports to update their knowledge and assess progress toward the desired conditions in the forest or grassland plan. The public use these Biennial Monitoring Evaluation Reports to understand what's happening on the land that they depend upon and enjoy.

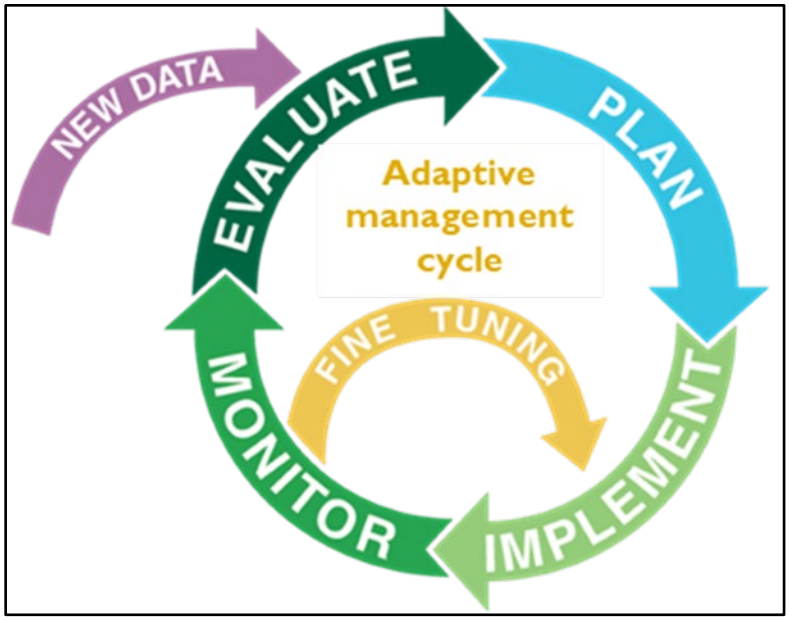

Figure 1. Adaptive Management Cycle

If the report reveals that we are not quite meeting the mark, then there's a need to change management in some way; this is adaptively managing. Monitoring data allows us to learn through management and adjust our strategies based on what we learned. Monitoring also helps us be accountable and transparent to interested and affected parties and colleagues.

Because monitoring can be expensive, time-consuming, and labor-intensive, we rely on the help of our partners and work collaboratively with them to accomplish monitoring objectives. We also rely on existing data sources such as national and regional inventory, monitoring, and research programs; federal, state, or local government agencies; scientists, partners, and members of the public; and information from Tribal communities and Alaska Native Corporations.

Biennial Monitoring Evaluation Reports, like this one, are critical to adaptive management because they tell us and the public whether the land management plan is working. ***We don't make any decisions in biennial monitoring evaluation reports; instead, we simply document and share monitoring results.***

1. Status of select watershed conditions.
2. Statues of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
3. Status of focal species to assess the ecological conditions.
4. Status of a select set of the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
5. Status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
6. Measurable changes on the plan area related to climate change and other stressors that might be affecting the plan area.
7. Progress toward meeting the desired conditions and objective in the plan, including for providing multiple use opportunities.
8. Effects of each management system to determine that they do not substantially and permanently impair the productivity of the land.
9. Status of social, economic, and cultural sustainability.

Summary Of This Report

This 2023 Biennial Monitoring Evaluation Report for the Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) documents monitoring activities that occurred during fiscal years 2019 through 2022. A Forest Service fiscal year begins on October 1st and ends September 30th of the following year. The 2018 Biennial Monitoring Evaluation Report for the Unit was signed in 2021 and reported data collected through 2018. This report includes data from 2019 through 2022. Resource specialists answered the Unit's 2016 Monitoring Plan monitoring questions to determine if current management activities are moving the Unit toward or maintaining the desired conditions or objectives. Specialists identified data gaps, considered recommending changes to our forest plans, monitoring plan, management activities, and considered if a new assessment is needed.

The detailed resource reports that were used to build this monitoring report are available in the project record upon request. For a complete listing of monitoring elements, including method of data collection, monitoring frequency, and reporting interval for each, see the 2016 Monitoring Plan. The Monitoring Plan, this Biennial Monitoring Evaluation Report, and previous monitoring reports are available at: https://www.fs.usda.gov/main/mbr/landmanagement/planning.

Of the 64 indicators examined, the Unit is meeting both plan objectives and progress towards our desired conditions in 50 indicators. To move the Unit closer to the desired condition for vegetation and habitat, intentional data for some of our indicators is required, rather than just recording incidental observations. Because of this, the remaining 14 indicators across the Unit show uncertainty and recommendations on data improvement have been made. Although the Unit doesn't have forest-specific climate monitoring data, the Carbon Assessment for the Unit in the Forest Service's Rocky Mountain Region (November 2021) provides baselines on Carbon data and trends to be monitoring for climate change.

Table 1 summarizes the results the monitoring questions evaluated in this report and shows whether changes to the forest plan, management activities, or plan monitoring program should be considered.

Table 1. Summary of recommendations for all 64 indicators

Recommendation Factors	Yes	Uncertain	No
Indicators showing progress toward desired condition objections	50	14	0
Change to forest plan recommended	0	0	64
Change to management activities recommended	0	0	64
Change to plan monitoring program recommended	44	0	20
Assessment recommended	0	0	64

In the following pages of this report, you'll read about why it's important to evaluate the monitoring results. You'll also learn details about the key results of our monitoring efforts, and the changes that we're recommending to our forest supervisor. Lastly, at the end of the report the table will summarize the progress and recommendations for each of the 64 indicators (table 12).

Forest Supervisor's Certification

This report documents the results of monitoring activities that occurred through fiscal year 2022 on the Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit). Monitoring on some topics is long-term and evaluation of those data will occur later in time.

I have evaluated the monitoring and evaluation results presented in this report. I have examined the recommended changes to the 2016 Monitoring Plan, which consolidated the monitoring of the 2003 Medicine Bow, 1997 Routt and 2001 Thunder Basin Land Management Plans, as amended. I therefore consider the 2003 Medicine Bow, 1997 Routt and 2001 Thunder Basin Land Management Plans sufficient to continue to guide land and resource management of the Medicine Bow and Routt National Forests and Thunder Basin National Grassland for the near future. I plan a deeper examination of the recommended changes through engagement with resource specialists and the public through plan revision, tentatively planned for fiscal year 2025. Information about public engagement sessions will be posted at: https://www.fs.usda.gov/mbr.

Digitally signed by Milton O. Stubbs
Date: 2024.04.15 16:31:30 -06'00'

Russell Bacon, Forest Supervisor

Date: 04/15/2024

Status Of Select Watershed Conditions

Streams recharge groundwater aquifers, provide habitat for aquatic and riparian dependent species, and supply water for a variety of human uses. The Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) is the source of many streams that contribute to larger river systems including the North Platte, South Platte, Colorado, Yampa, and Powder Rivers. We know that projects and activities on forest lands can impact water quantity and quality, thus we use native fish as an indicator of watershed conditions. Every 1-3 years, Forests and Grassland staff and partners conduct surveys for Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*); genetic purity of 90% or greater) and mountain sucker (*Catostomus platyrhynchus*), which have sensitive species status in the Forest Service Rocky Mountain Region. Presence or absence of native fish species is not currently monitored on the Thunder Basin National Grassland. These results will help us to prioritize areas in need of management attention regarding watershed conditions.

Monitoring Questions

1. What are watershed conditions and trends on the planning unit? (2016 Monitoring Plan)
    - *Indicator 1a. Condition class: Number and percent of watersheds in each condition class*
    - *Indicator 1b. Water quality: Number of streams on state threatened or impaired lists and state monitoring and evaluation lists; macroinvertebrate sampling.*
    - *Indicator 1c. Presence/absence of native fish species*
    - *Indicator 1d. Stream flows: Current versus historic flows; number of water developments with stream flow or water body level protection provisions*
    - *Indicator 1e. Watershed projects: number and acres of watershed improvement projects completed or other projects that meet watershed improvement criteria as reported in the US Forest Service (USFS) Watershed Improvement Tracking (WIT) database.*
    - *Indicator 1f. Implementation and effectiveness of best management practices to protect water quality.*

Key Results

- Indicator 1a and 1e – The Unit has 258 watersheds. Condition is assessed using the Watershed Condition Framework (USDA 2011). As of 2022, 78 watersheds are classified as Functioning Properly, which represents 30.2% of the total. 168 watersheds are classified as Functioning at Risk, which represents 65.1% of the total. Twelve watersheds are classified as Impaired Function, which represents 4.7% of the total. Watersheds within the Mullen Fire area were reevaluated in 2021 to reflect changes in condition caused by the fire.

  While watershed condition trend indicates a decrease in watershed condition across the Unit, changed condition is due to vegetation cover loss, increase in annual invasives (cheatgrass), and increase in hillslope erosion rates following the Mullen Fire (Table 2). Across the Unit, roads continue to contribute the most to degradation of watershed condition.

Table 2. Medicine Bow-Routt National Forests and Thunder Basin National Grassland Watershed Condition Classification, 2010-2022

Watershed Condition Class	2010	2013	2018	2022
Functioning Properly (Class 1)	81 watersheds; 31.4%	80 watersheds; 31.0%	80 watersheds; 31.0%	78 watersheds; 30.2%
Functioning At-Risk (Class 2)	175 watersheds; 67.8%	176 watersheds; 68.2%	176 watersheds; 68.2%	168 watersheds; 65.1%
Impaired Function (Class 3)	2 watersheds; 0.8%	2 watersheds; 0.8%	2 watersheds; 0.8%	12 watersheds; 4.7%

The Unit continues efforts to complete essential projects on select priority watersheds. Watershed Restoration Action Plans list essential projects needed to improve watershed condition classification. During 2019-2022, two new plans were signed for the priority watersheds Middle Douglas Creek and Upper Middle Crow Creek.

Essential projects completed during 2019-2022 include 44 road decommissions and stream crossings, six aquatic restorations (wetland, channel, gully rehabilitation), and three riparian plantings and protections. Partners contributed 82% of the funding needed to complete these projects.

- Indicator 1b – Trends in the Unit water quality remained stable during 2019-2022. On the Colorado and Wyoming lists of impaired and threatened waters (303(d) lists), or on waters requiring monitoring and evaluation, there have been no changes in the Unit waters listed as impaired.
- Indicator 1c – Native fish population tracking provides insight into water quality because they are responsive to changes in water quality over long time frames (3-10 years). Forest and grassland-wide plan goals and objectives regarding native fish are non-quantitative. Habitat and population restoration activities for native fish are ongoing. Current data on miles of stream occupied by Colorado River cutthroat trout and mountain sucker will be used as a baseline to assess future trends of native fish occupancy and progress toward meeting desired conditions. The Forest Service and its partners will continue to monitor these populations and document changes in their presence or absence. Details about current and past native fish restoration projects are available at: https://www.fs.usda.gov/projects/mbr/landmanagement/projects.
- Indicator 1d – The Forest streamflow trends and the influence of management actions on them is variable. The figures below show data from select United States Geological Service streamgages that collect data about streams flowing through the forests and grassland. Figure 2 and Figure 3 show annual streamflow data including peak discharge and average daily discharge for the Encampment River streamgage station in the Sierra Madre mountains and North Brush Creek streamgage in the Snowy Range mountains on the Medicine Bow National Forest. Figure 4 shows annual streamflow data for Fish Creek streamgage on the Routt National Forest. The streamgage on the Cheyenne River on the Thunder Basin National Grassland is no longer operational.

  Streamflow and water body level protections are provided by Forest Service land use authorization permits and by State instream flow protection where the States hold water rights Between 2019 and 2022, the Unit plugged nine wells no longer being put to beneficial use. These wells were formerly associated with campgrounds, livestock watering, and energy development.

  Streamflow trends on select streams in the Forest show stable conditions in the Encampment River and North Brush Creek and recent changes in low flows for Fish Creek (Table 3).

Table 3. Flow Summary for Encampment River, North Brush Creek, and Fish Creek.

Stream	National Forest	Minimum Average Daily Discharge (cubic feet per second)	Maximum Average Daily Discharge (cubic feet per second)	Minimum Peak Streamflow (cubic feet per second)	Maximum Peak Streamflow (cubic feet per second
North Brush Creek	**Medicine Bow**	2,002	2,011	2,002	2,011
Encampment River	**Medicine Bow**	2,002	2,011	2,002	2,010
Fish Creek	**Routt**	2,021	2,011	2,022	1,996

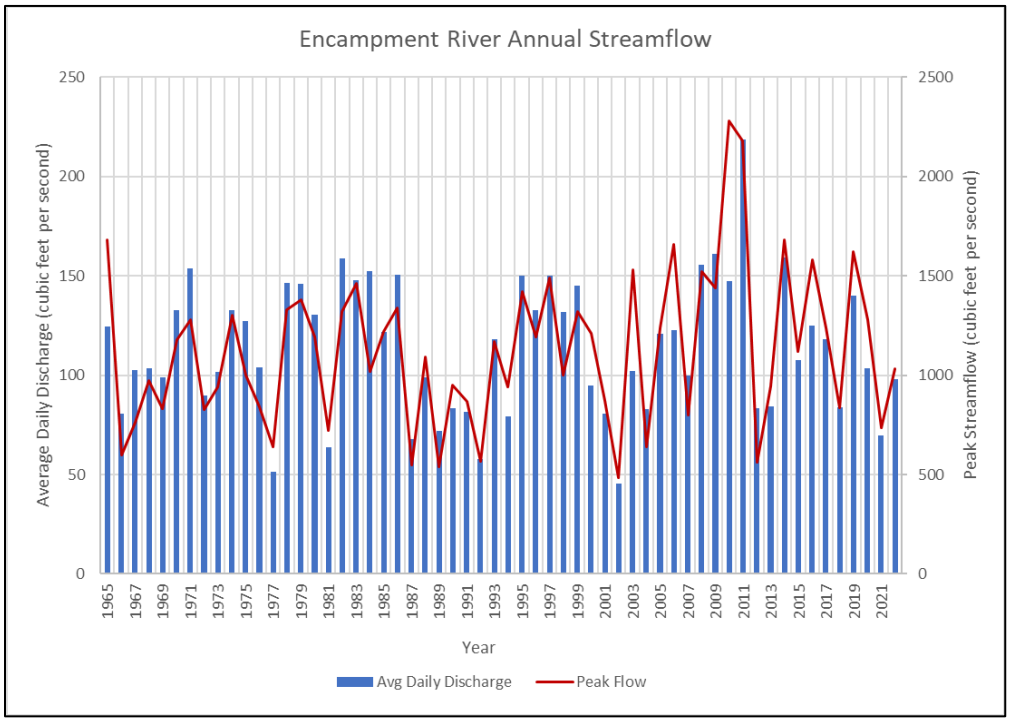

Figure 2. Annual average daily discharge and annual peak discharge at the Encampment River streamgage (USGS 06623800) on the Medicine Bow National Forest, 1965-2022.

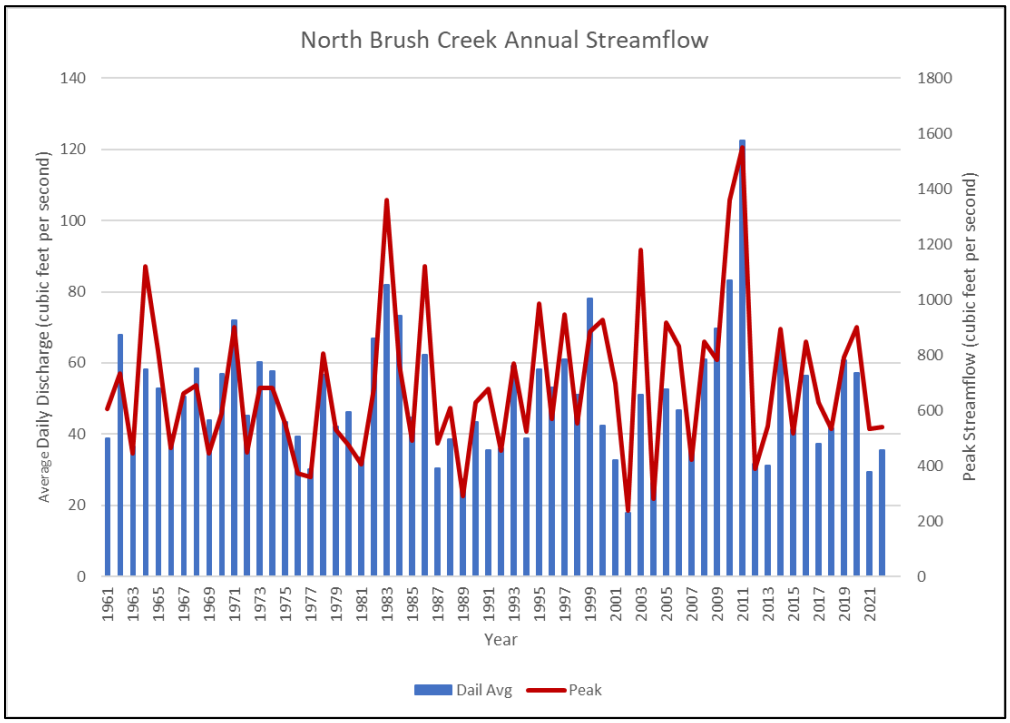

Figure 3. Annual average daily discharge and annual peak discharge at the North Brush Creek streamgage (USGS 06622700) on the Medicine Bow National Forest, 1961-2022.

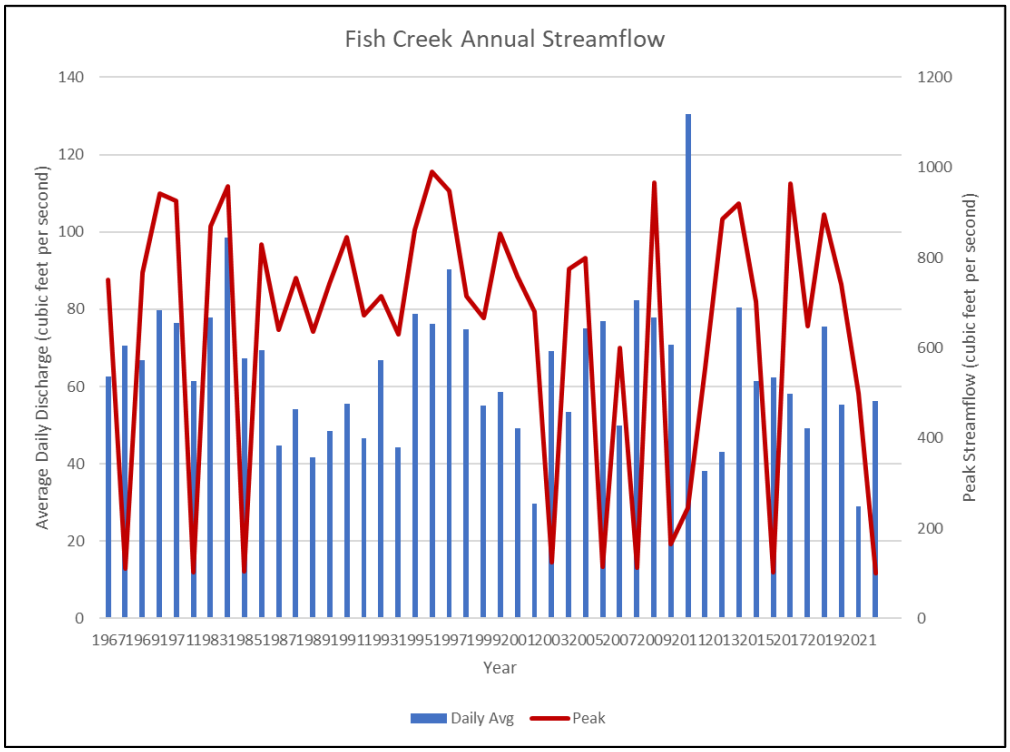

Figure 4. Annual average daily discharge and annual peak discharge at the Fish Creek streamgage (USGS 09238900) on the Routt National Forest, 1968-1972 and 1983-2012. Note the break in the horizontal axis.

- Indicator 1f – Hydrology and soils specialists report best management practices during environmental review of land use actions. These are authorized by the decision document as design features. The Unit developed a crosswalk between vegetation management decision documents and common contract language to facilitate integration of best management practices into timber sale contracts. The Unit completed four best management practices evaluations in 2019-2022 following prescribed fire, wildland fire, grazing and ground-based vegetation management. These practices ranged from fully implemented to marginally implemented and all scored as effective in protecting water quality.

  Between 2013 and 2022, the Forest conducted 42 evaluations of best management practices on a wide range of projects (Figure 5). Seven of the evaluations focused on vegetation management, while five reviewed aquatic ecosystem restoration. When fully implemented, best management practices were observed to be effective at protecting water quality primarily by stabilizing disturbed ground with slash, reseeding, and avoiding stream management zones (also known as buffers). These measures reduce erosion from bare ground and sedimentation in streams.

  Figure 6 shows implementation status of projects since 2013, with 10% of projects having no best management practices in the project decision. Figure 7 shows best management practices are primarily effective at protecting water quality when implemented.

  Land actions authorized in decisions include design features such as best management practices. To improve implementation, the Forest created a ‘crosswalk’ between best management practices in project decisions and project contract provisions. Because the number of best management practices evaluations has decreased since 2018, the success of the crosswalk remains uncertain.

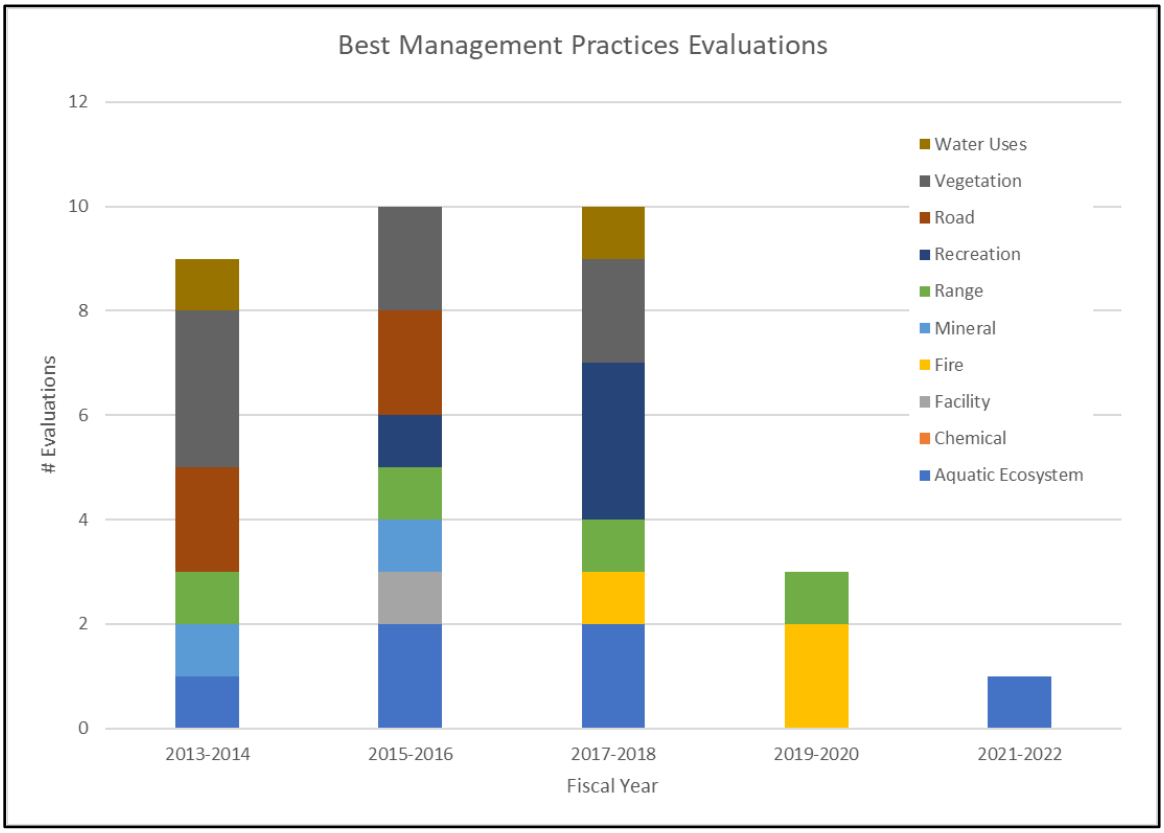

Figure 5. Best management practice evaluations conducted between 2013 and 2022 span a wide range of resource areas.

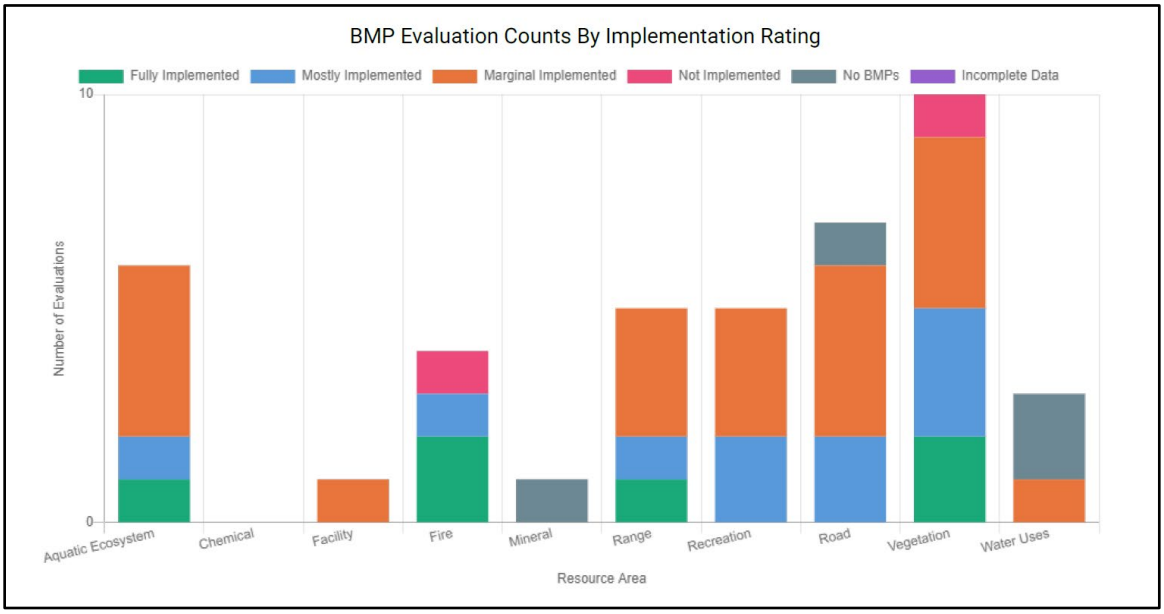

Figure 6. Best management practices evaluations.

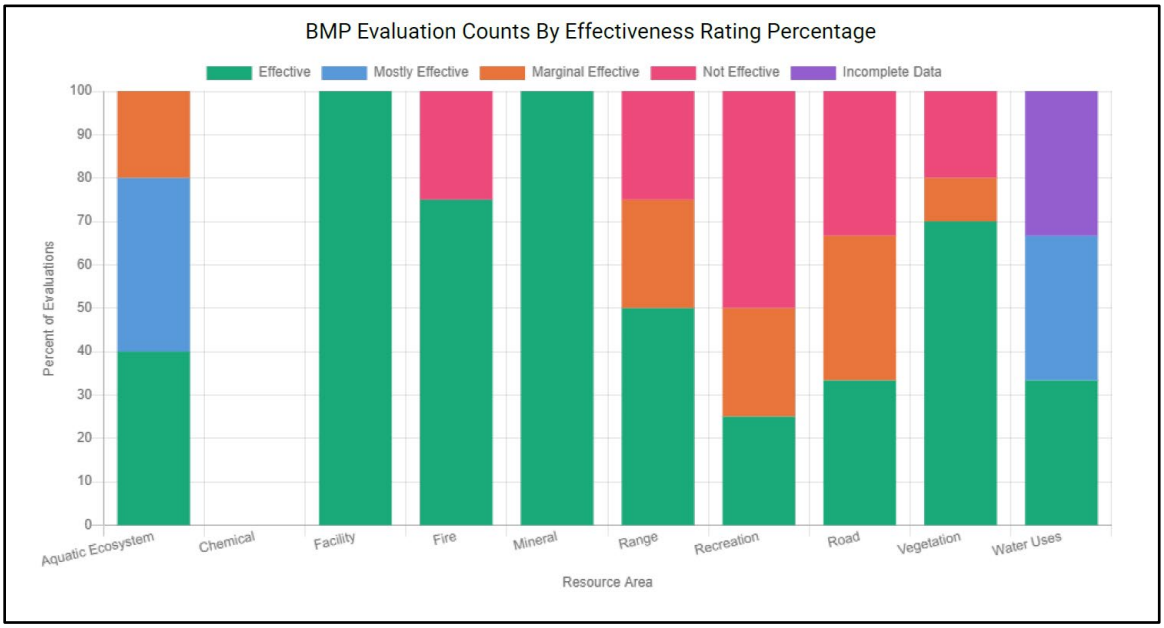

Figure 7. When implemented, best management practices are primarily effective at protecting water quality.

Recommended Changes

- *Indicator 1a and 1e* – Complete implementation of essential projects identified in the Watershed Restoration Action Plans.

  Focus future watershed restoration efforts on the critical factors having the most influence on watershed conditions.

  Prepare additional Watershed Restoration Action Plans to ensure continuous planning and implementation of essential projects necessary to restore watershed conditions.

  Continue to update and use the Watershed Condition Assessment Tracking Tool and Watershed Improvement Tracking tools to monitor watershed condition trends over time.

- *Indicator 1b* – Consider rewording this indicator to "Water quality: Number of streams on state threatened or impaired lists and state monitoring and evaluation lists; macroinvertebrate sampling or comparable indicator tracking."

- *Indicator 1c* – Explore monitoring the presence or absence of native fish species on the Thunder Basin National Grasslands.

  Coordinate with the Unit Geographic and Information Specialists and state wildlife agencies to create a consolidated geographic information system layer, available in the corporate database, that shows where the known locations of native fish occur.

- *Indicator 1f* – Expand the number and range of best management practices evaluations to 10 per year. This will meet the Region 2 assignment.

  Implement best management practices according to land action decisions.

Status Of Select Ecological Conditions

Biological diversity is critical to sustaining healthy ecosystems. The Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) support a natural diversity of species and environments. Some wildlife species depend on young forest or open conditions, while others like older forest surroundings. Consequently, we work to maintain a variety of terrestrial and aquatic habitats. Habitat on the Unit ranges from grasslands/sagebrush step to alpine cover types. Dominant forest cover types include Lodgepole pine (*Pinus contorta*), spruce-fir, Ponderosa pine (*Pinus ponderosa*), and Aspen (*Populus tremuloides*). Non-forested cover types include northern mixed grass prairie, sagebrush habitats, and low structure grasslands.

Terrestrial habitats can have a variety of tree species and may include many different types of herbaceous and shrubby plants. Herbaceous plants are characterized by non-woody stems that reach their full height and produce flowers within one year before dying back over the winter and then reappearing the following spring for a repeat performance. We also aim to maintain or improve aquatic and riparian habitats, such as areas adjacent to streams, lakes, or wetlands that contains a combination of trees, shrubs, or other perennial plants, to ensure water quality and quantity is protecting aquatic species and ecological functions.

Threats to ecosystem health include trees stands that are too dense, wildfire suppression, and the spread of invasive species, insects, and disease. Dense stands of live trees can be susceptible to insects and disease. Large acreages of beetle mortality are susceptible to large, catastrophic wildfires and subsequent spread of invasive species. Spruce beetle (*Dendroctonus rufipennis*), an insect native to North America, has been the most significant insect pest on the Unit in its effects on stand structure and species composition in the Engelmann spruce-subalpine fir ecosystem. Similarly, mountain pine beetle (*Dendroctonus ponderosae*) has been the most significant insect pest in the lodgepole pine ecosystem. The Unit is using planned, or prescribed, fire as well as silvicultural treatments to restore stands and create habitat diversity across the forest which will be more resilient to insects, disease, and fire. Silvicultural treatments are actions applied to change, accelerate change, or maintain the condition of trees and stands. For example, by applying selective herbicides after planting, a desired tree species can be given a head start in growth that allows it to out compete other vegetation. Prescribed fire treatments help us to maintain or restore fire-mediated and fire-dependent forest community types, such as ponderosa pine and aspen.

Monitoring helps us determine if we are maintaining a good balance of tree species and the right mix of old-growth forest, young forest, and permanent grassy openings. Our specific goals include maintaining old-growth forest, restoring insect and fire mortality impacted stands, and improving the resiliency of our live stands.

Monitoring Questions

2. How are major vegetation types on the planning unit changing over time?
    - *Indicator 2a. Cover type, ecological site conditions, age class, size class, structural stages of forest, shrubland, and grassland vegetation.*
3. Are riparian and wetland conditions in the planning unit meeting or moving towards desired conditions as described in the Forest and Grassland Plans?
    - *Indicator 3a. Riparian ecosystems monitoring data.*
    - *Indicator 3b. Presence/absence data for select aquatic and amphibian species.*

- *Indicator 3c. Groundwater dependent ecosystems monitoring data (i.e., springs, fens)*

4. How are environmental stressors and management activities affecting ecological function and integrity of sagebrush ecosystems on the planning unit?
    - *Indicator 4a. Reference Sage-grouse Record of Decision, Implementation Plan, and associated monitoring.*
    - *Indicator 4b. Diversity, species richness, distribution, and trends of sagebrush bird communities.*

Key Results

- Indicator 2a – Changes in forest vegetation structure and conditions are monitored through analysis of the Forest Service Field Sampled Vegetation (FSVeg) Spatial database. Habitat structural stages describe the ecological function of stands based on tree size and canopy cover and is the metric used to describe changes over time. The general trend since 2017 has been more acres moving into habitat structural stages 1 and 2 (grass-forb and seedling) and less acres in stages 3 and 4 (sapling-pole and mature, old growth) due to large catastrophic wildfire events (Table 4) and, to a much lesser degree, timber harvesting.

Table 4. Fires on the Medicine Bow-Routt National Forests since 2017

Year	Fire	Acres Burned
2021	Morgan Creek	7,586
2021	Muddy Slide	4,093
2020	Mullen	176,878
2020	East Troublesome	193,812
2020	Middle Fork	20,517
2018	Ryan	25,585
2018	Badger	21,310

Updates to the FSVeg database for these fires in Table 4 are in various stages of completion and are predicted to be complete by early 2024. The Unit is also in the process of completing the ground truthing and processing of Light Detection and Ranging (LiDAR) data in select areas on Brush Creek/Hayden, Laramie, and Hahns Peak/Bears Ears Ranger Districts. These data are expected to be available in 2024. Due to needed updates on large numbers of acres and newer data becoming available, the Unit is opting to wait for the plan revision process (tentatively planned in fiscal year 2025) to determine the status of this metric.

- Indicator 3a and 3c – Monitoring is one piece of an integrated process the Unit uses to manage riparian and wetland areas. This process includes identifying and assessing riparian and wetland resources. The monitoring effort has continued since the 2018 monitoring report. The pace and extent of riparian monitoring declined since 2009; however, the effort to inventory groundwater dependent ecosystems increased.

  During 2019-2022, the Forest assessed streams using the photo monitoring and Multiple Indicator Monitoring protocols (USDI 2011) where livestock grazing and timber land use activities occurred (Table 5), making a total of 74 surveys since 2011. Of 20 streams monitored since the 2018 report, 17 exceeded thresholds for bank stability indicating imbalances in channel forming and sedimentation/erosion processes. Three streams showed unstable greenline (linear groupings of

long-lived riparian plant species) indicating loss of riparian habitat. Both bank and greenline instability diminish energy dissipation capacity that leave these streams susceptible to unraveling during a high flow event and changing to a lower stream health classification. The Forest inventoried 6 groundwater dependent ecosystems during 2019-2022 using the USDA Groundwater-dependent Ecosystems Level 1 protocol for a total of 320 since 2015. These additional data inform extents of land use actions but are insufficient to determine trends at this time.

Table 5. Riparian monitoring results of bank stability and greenline stability between 2019 and 2022 indicate lateral instability of channel processes and reductions in riparian habitat.

Year	Total Assessments in a year	Assessments Exceeding Bank Stability	Assessments Exceeding Greenline Stability	Range Assessments	Timber Assessments
2019	9	9	3	9	0
2020	3	3	0	3	0
2021	5	2	0	5	0
2022	3	3	0	0	3
Total	20	17	3	17	3

The main sources of riparian and wetland degradation observed across the Unit include livestock grazing, elk grazing from a rise in elk herd populations since the 1950s, road and trail crossings, closely located roads and trails, fire, and illegal off-road motorized use. Riparian surveys suggest that the source contributing most to ongoing riparian degradation is livestock grazing. However, many of the existing riparian area impairments may be the legacy of past travel, timber, minerals, and rangeland management activities.

- Indicator 3b – Three Region 2 sensitive amphibian species occur on the Unit. Wood frogs (*Lithobates sylvaticus*) are relatively common on portions of three Ranger Districts and field surveys suggest that they continue to occupy most historic breeding sites. Northern leopard frogs (*Lithobates pipiens*) occur across the Unit, are less common than wood frogs, and are limited to lower elevations. The Forest Service will be working with partners like state game and fish agencies to increase monitoring addressing this species.

  Beaver dam analogs were constructed at the Falls Creek boreal toad (*Anaxyrus boreas*) breeding sites in 2022 to restore pond habitats. The Unit and Wyoming Game and Fish Department documented egg masses, tadpoles, and juvenile toads during multiple post-project monitoring visits.

- Indicator 4a – To the knowledge of the specialists, Habitat Assessment Framework surveys are no longer conducted on any of the planning units. The Colorado Parks and Wildlife department monitors greater sage-grouse (*Centrocercus urophasianus*) populations in the northwest part of the state; the Wyoming Game and Fish Department conducts statewide monitoring efforts. Population monitoring tracks male greater sage-grouse bird counts in leks. Wildlife specialist staff on the Douglas and Brush Creek/Hayden Ranger Districts conduct annual lek counts that contribute to state databases.

- Indicator 4b – Data for other sagebrush birds on the forests and grassland, such as Brewer's sparrow (*Spizella breweri*), sagebrush sparrow (*Artemisiospiza nevadensis*), and sage thrasher (*Oreoscoptes montanus*), show opportunistic observations but are insufficient to determine population trends.

Recommended Changes

Based on these results, we are considering the following possible changes:

- *Indicator 2a* – Explore opportunities to expand use of Forest Inventory and Analysis data to inform management and forest plan monitoring.

  Looking at the 2018 Biennial Monitoring Evaluation Report, habitat structural stage should continue to be used as the metric for change. Moving forward, using table 16 in the 2018 Biennial Monitoring Evaluation Report—"National Forest changes in habitat structural stage distribution since forest plan revision"—major events that have occurred on the forest since last reported could be summarized, including a statement about updates that are still occurring to the FSVeg database. This includes LiDAR data that is currently being evaluated, processed, and ground verified to assist in updating FSVeg.

- *Indicator 3a* – Riparian ecosystems monitoring data.

  Past monitoring reports have relied on project level data. A forest wide riparian and water quality monitoring program that accounts for the distribution the Forest's stream types, riparian ecotypes and wetland types as well as project-level, site-specific assessment data would provide data to detect condition trends and support project monitoring.

- *Indicator 3b* – In the upcoming Forest and Grassland plan revisions, expand monitoring efforts to better define amphibian distributions across the entire unit to assess wetland condition to be consistent with state and federal regulations.

- *Indicator 3c* – Groundwater dependent ecosystems monitoring data (i.e., springs, fens)

  Past monitoring reports have relied on project level data. A forest wide riparian and wetland monitoring program that accounts for the distribution the groundwater dependent ecosystem types as well as project-level, site-specific assessment data, would provide data to detect condition trends.

- *Indicator 4a* – Drop this indicator, as it is no longer being measured. Effects are considered at the project level through environmental analyses.

- *Indicator 4b* – Consider pursuing partnerships to conduct breeding landbird monitoring as part of the Integrated Monitoring in Bird Conservation Regions program on the Thunder Basin National Grasslands.

Status Of Focal Species

The Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) encompasses a diverse landscape with many habitats. Many of these biological areas contain rare species, some of which are federally listed as endangered or threatened. The Unit also provides habitat for a wide variety of more common terrestrial and aquatic fauna.

Consistent with our 2016 Monitoring Plan and as evaluated in our 2018 Biennial Monitoring Evaluation Report, black-tailed prairie dogs (*Cynomys ludovicianus*) are the focal species for our prairie ecosystems, red squirrel (*Tamiasciurus hudsonicus*), golden-crowned kinglet (*Regulus satrapa*), pygmy nuthatch (*Sitta pygmaea*), and common flicker(*Colaptes auratus*) are focal species for our forested ecosystems, American pika (*Ochotona princeps*), American pipit (*Anthus rubescens*), and brown-capped rosy finch (*Leucosticte australis*) for our alpine ecosystems, and our wetlands focal species include amphibian assemblages.

Monitoring Questions

5. What is the status of black-tailed prairie dog populations as an indicator for short-grass prairie ecosystem integrity?
    - *Indicator 5a. Prairie dog town extent, density, and occupancy*
    - *Indicator 5b. Current vs. historic population levels*
    - *Indicator 5c. Associated species occupancy (mountain plover, burrowing owl, swift fox, raptors)*
    - *Indicator 5d. Sylvatic plague extent/changes*
6. What do red squirrel, golden-crowned kinglet, pygmy nuthatch, and common flicker populations tell us about the extent and condition of mid to late successional forested ecosystems on the planning unit?
    - *Indicator 6a. Extent, density, and occupancy of red squirrels*
    - *Indicator 6b. Change in occupancy and density of monitored bird species.*
    - *Indicator 6c. Diversity, species richness, distribution, and trends of mid to late successional forest bird communities*
7. What is the status of American pika, American pipit, and brown-capped rosy finch populations as indicators for alpine ecosystem integrity?
    - *Indicator 7a. Extent, density, and occupancy of American pika*
    - *Indicator 7b. Change in occupancy and density of monitored bird species.*
    - *Indicator 7c. Diversity, species richness, distribution, and trends of alpine bird communities*
8. What is the status of amphibian assemblages on the planning unit?
    - *Indicator 8a. Diversity, abundance, and distribution of amphibian species*
    - *Indicator 8b. Presence/absence of chytrid fungus*

Key Results

- Indicator 5a, 5b, and 5d – Records for black-tailed prairie dog colony extent on the Thunder Basin National Grassland date back to the 1970s. Since 2016, the Forest Service has conducted colony monitoring in partnership with the Thunder Basin Grassland Prairie Ecosystem Association, which has led collation and analysis of data collected via systematic grid survey. While not all parts of the grassland are surveyed every year, colonies seldom go more than 1-3 years without detection and mapping. Grassland-wide data show general trends in colony extent, if not the true extent of colonies in any single year. Observation data indicate annual fluctuations in prairie dog populations on the grassland and that plague has become a critical driver of colony extent since 2001.
- Indicator 5c – Thunder Basin National Grassland staff typically collect observation data of at-risk species while conducting wildlife surveys across the grassland annually. While sampling for survey locations is often opportunistic or nonrandom, anecdotal observations of several species, including mountain plover (*Charadrius montanus*), burrowing owl (*Athene cunicularia*), swift fox (*Vulpes velox*), and some raptors, are associated with prairie dog colonies. Raw numbers of observations for burrowing owl, mountain plover, and swift fox have generally increased when the total extent of prairie dog colonies on the grassland has increased. Due to the resource intensive nature of raptor surveys allowing only segments of the grassland to be surveyed each year, the record for raptors on the grassland is incomplete. The University of Wyoming, Wyoming Natural Diversity Database, and Wyoming Game and Fish Department have assisted with raptor surveys.
- Indicator 6a-c – Per the guidance in the 2016 monitoring plan, the Unit partnered with The Bird Conservancy of the Rockies to monitor all four of these species. They have collected data on our unit consistently since 2009. Data can be found at http://rmbo.org/v3/avian/ExploretheData.aspx. Since crews detected few individual nuthatches and kinglets, there is no clear tie to management activities and forest extent and condition.

  Although the trend for northern flicker density has a downward slope, occupancy appears to be stable to slightly increasing; the same is true for red squirrel. Coupling this information with the vegetation data, animal species density appears to be mirroring the decrease in acreage of sapling-pole and mature, old growth forests. Large catastrophic wildfires, rather than timber harvesting, are a contributing factor.
- Indicator 7a-c – The Bird Conservancy of the Rockies also monitors all three alpine species. Additional information on pika is collected through Citizen Science partners. There were no detections of rosy finch on our unit. The pika and pipit data are inconclusive due to very low sample sizes. Based on data throughout the western United States, climate change appears to be a bigger factor in the extent, density, and occupancy of pika. Since our management actions don't affect sub alpine or alpine habitats in general, there is no meaningful correlation for any of these indicators.
- Indicator 8a – Diversity, abundance, and distribution of amphibian species

  Survey results do not indicate noticeable changes in amphibian diversity and distribution. As noted in 3b (above), wood frogs are relatively common on portions of three Ranger Districts and field surveys suggest that they continue to occupy most historic breeding sites. Northern leopard frogs occur across the Unit, but are less common than wood frog, and are limited to lower elevations.

  The Forest Service will continue to work with partners to annually sample the nine known boreal toad breeding sites on the Medicine Bow and Routt National Forests. In the last four years, one breeding site has been lost, while few changes have been observed at seven others. Limited reproduction at the Torso Creek and Ryan Park sites in 2021 and 2022 were noted. Forest Service

staff and our partners would like to increase monitoring efforts over the next two years to better understand possible changes in these populations.

The Forest Service continues to work with partners to annually resample Rocky Mountain Amphibian Project sites on the Medicine Bow National Forest. Rocky Mountain Amphibian Project sites on the Routt National Forest have not been surveyed since 2019 due to other Forest Priorities. The Forest Service and partners collaborated on a research study in 2021 to assess the impacts of the 2020 Mullen Fire on wood frog breeding sites. The findings will be published in 2024 and other information gained on improving sampling techniques for land management projects are already being implemented.

- Indicator 8b – While presence and absence of Chytrid fungus in amphibians is tested for, it is not a metric that changes our approach to plan implementation. For this reason, we have not reported on these results as we do not track them in any meaningful way with respect to forest management activities.

Recommended Changes

Based on these results, we are considering the following possible changes:

- *Indicator 5c* – Continue to engage partners to conduct breeding landbirds monitoring as part of the Integrated Monitoring in Bird Conservation Regions program on the Thunder Basin National Grasslands.
- *Indicators 6a-7c* – Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.
- *Indicators 6b and c* – As noted in the 2018 monitoring report, retaining pygmy nuthatch as a focal species does not appear to be appropriate due to lack of meaningful trend data. Given the same issues with golden crowned kinglet, both species should be removed during plan revision. Work with partners to ascertain species that better act as focal species for mid to late coniferous forests.
- *Indicators 7a-c* – Remove pika, brown capped rosy finch, and American pipit from the focal species list, since there is little management activity in this habitat type and in general our management activities do not impact them.
- *Indicator 8a* – Review the updated amphibian protocols for assessing changes in distribution and abundance. Incorporate new protocols, as needed, to ensure data collection is consistent with state and federal regulations.
- *Indicator 8b* – The presence or absence of Chytrid in amphibian assemblages is not a metric that changes our management actions. It is recommended to not include it as an indicator in the future.

Status Of Select Set of Ecological Conditions Required to Contribute to Species Recovery

We manage habitat conditions on the Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) to contribute to the survival and recovery of threatened and endangered species, allow for the return of extirpated species, contribute to the delisting of species under the Endangered Species Act, preclude the need for listing new species, improve conditions for Region 2 sensitive species, and keep native species common.

Habitat conditions provide the resiliency and redundancy necessary to maintain species diversity and metapopulations. Interconnected riparian and aquatic habitats promote the movement of wildlife, fish, and plant species, encourage genetic exchange, allow for movement of wide-ranging species, and promote natural predator-prey relationships. The Unit strives to maintain and restore terrestrial, aquatic, and riparian communities, which have been reduced in quality and quantity. Examples of such communities include ponderosa pine, aspen, willow, sagebrush, and meadows.

Monitoring Questions and Indicators

9. What is the status and trend of suitable habitat to support the recovery of the black-footed ferret on the planning unit?
    - *Indicator 9a. Prairie dog town extent, density, and occupancy*
    - *Indicator 9b. Current vs. historic population levels*
    - *Indicator 9c. Associated species occupancy (mountain plover, burrowing owl, swift fox, raptors)*
    - *Indicator 9d. Sylvatic plague extent/changes*
10. What is the availability of early successional conifer and late seral spruce-fir forests to promote recovery of Canada lynx?
    - *Indicator 10a. Extent and condition of early successional and late seral spruce-fir forests*
    - *Indicator 10b. Habitat connectivity*
    - *Indicator10c. Dense horizontal cover*

Key Results

- Indicator 9a-9d – Wild black-footed ferrets (*Mustela nigripes*) are not present on the Unit, and no reintroductions of the species are planned for the near future. For information regarding the status of suitable habitat to support black-footed ferret, which is an obligate of prairie dog colonies, see monitoring indicators 5a and 5b (Status of Focal Species).

  Indicator 10a-10c – This monitoring item addresses regulatory requirements associated with the Southern Rockies Lynx Amendment (USDA Forest Service 2008). The Southern Rockies Lynx Amendment contains several management standards intended to conserve habitat for Canada lynx (*Lynx canadensis*), a threatened species under the Endangered Species Act.

  The Southern Rockies Lynx Amendment is primarily concerned with forest actions that convert higher quality lynx habitat to lower quality habitat. The most important habitat for the recovery of Canada lynx are early successional and late seral spruce-fir forests with dense horizontal cover. Connectivity between large patches of these habitats is also important for lynx population expansion.

As required by the Southern Rockies Lynx Amendment, the Unit monitors forest actions that impact lynx habitat through vegetation management activities such as timber and fuels reduction projects. Caps are placed on the overall amount and dispersion of habitat conversions that take place to promote the recovery of Canada lynx. The Unit also monitors other actions that impact lynx habitat such as beetle outbreaks and large wildfires. These acreages are reported to our Regional Office, and the US Fish and Wildlife Service every year to ensure we remain compliant with the Southern Rockies Lynx Amendment.

Since 2019, the Unit has implemented vegetation management projects where 1,236 acres of lynx habitat was converted to a lower quality in terms of horizontal cover, habitat connectivity, and spruce-fir habitats. In 2020, the Mullen Fire burned 176,878 acres in the Snowy Range, impacting several thousand acres of lynx habitat. Despite these impacts, as of 2022 there are 974,057 acres of lynx habitat within the Unit. Since 2022, the Forest is working to implement additional vegetation management projects to conserve and protect important lynx habitat, while still meeting timber, fuels, and other restoration needs.

Recommended Changes

Based on these results, we are considering the following possible changes:

- Question 9 – Evaluate the benefit of including black footed ferret in this section. Since there are no reintroductions planned soon, consider dropping the black footed ferret aspects of this question.
- Consider adding the newly listed (endangered) northern long-eared bat (*Myotis septentrionalis*) to this section.

Visitor Use, Satisfaction, And Progress On Recreation Objectives

Recreation activities provide enjoyment for millions of national forest and grassland visitors. Recreation improves physical and mental health and helps people connect with the outdoors. Participation in recreational activities is how most of us experience our national forests and grasslands.

Through the decades, the types of recreation have changed. As of 2017 on the Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit), downhill skiing, hiking/walking, hunting, bicycling, viewing natural features, camping, fishing, snowmobiling, cross country skiing, and driving for pleasure top the list of possible recreation activities. We monitor trends in recreation use and visitor satisfaction to help us decide where and how to distribute limited resources among a broad spectrum of recreational opportunities, ranging from primitive to developed.

We also monitor the status of trail maintenance and condition, dispersed campsite conditions, developed recreation site conditions and maintenance, and visitor satisfaction. Two of our current priorities are to improve recreation facility infrastructure and maintain trails impacted by recent wildfires.

Monitoring Questions

11. What are the status and trends of visitor satisfaction for recreational visits on the planning unit?
    - *Indicator 11a. Visitor satisfaction*
    - *Indicator 11b. Number of visitors*
    - *Indicator 11c. Changes in demand*
12. What level of access to and across the planning unit is provided to the public?
    - *Indicator 12a. Change in miles of trail, by trail type*
    - *Indicator 12b. Change in miles of road, by road type*
    - *Indicator 12c. Change in number of developed recreation sites.*
    - *Indicator 12d. Change in number of sites accessible for people with disabilities.*
    - *Indicator 12e. Change in acres that are open to public access (no longer landlocked by private land) Thunder Basin National Grassland and Laramie Peak unit.*

Key Results

- Indicators 11a - 11 c – The Unit plans do not contain quantitative goals related to number of visitors, visitor satisfaction, or visitor activities. However, Forest Service priorities include providing world class recreation opportunities and will likely be included in future planning efforts on the unit.

  The Unit is generally performing well when it comes to providing high quality and sustainable recreation experiences, but more work remains to be done.

  The years since our forest plans were completed have brought some notable changes. Removing hazard trees to enhance visitor enjoyment has become a major management focus on the unit due to significant tree mortality associated with the insects and diseases, as well as wildfire. This reduces the ability to focus or defers maintenance at developed recreation sites and on trails. On top of forest health issues, the 2020 pandemic brought a huge increase in outdoor recreation users to the Unit.

- Indicators 11a - 11c – Data on visitation, visitor satisfaction, and changes in recreation demand is collected through visitor survey methods by the Forest Service National Visitor Use Monitoring Program every five years (Table 6 and Table 7). The most recent survey data available for the Routt National Forest is from 2022, and the most recent survey data available for the Medicine Bow National Forest and Thunder Basin National Grassland, which are evaluated together, is from 2018. Data from these evaluations indicate 3.3 million people visited the Forests and Grassland. In 2022 the Routt National Forest saw an increase in site visits by 700,000 visitors. Data for 2023 for the Medicine Bow National Forest and Thunder Basin National Grassland is not available currently. Without baseline data, a trend can't be determined for these indicators.

  In general, the Unit experienced an increase in the number of visitors between 2017 and 2022.

Table 6. Visitor Use 2017 and 2018

Visit Type	2018 Medicine Bow National Forest	2022 Routt National Forest	Combined Total
Total Site Visit	658,000	2,291,200	2,604,000
Day Use Developed Sites	179,000	1,402,800 (Two Ski Areas)	1,564,000
Overnight Use Developed	87,000	29,200	127,000
General Forest Areas	388,000	721,800	852,000
Designated Wilderness	4,000	137,900	61,000

Table 7. Visitor Activity and Demand

Rank	Medicine Bow National Forest	Routt National Forest
1	Hiking/Walking	Downhill Skiing
2	Hunting	Hiking / Walking
3	Viewing Natural Features	Bicycling
4	Downhill Skiing	Viewing Natural Features
5	Some other Activity	Hunting
6	Developed Camping	No Activity Reported
7	Fishing	Fishing
8	Cross Country Skiing	Snowmobiling
9	Relaxing	Developed Camping
10	Driving for Pleasure	Driving for Pleasure
12	Primitive Camping	Cross Country Skiing
13	Bicycling	Cross Country Skiing
14	Picnicking	Relaxing
15	Viewing Wildlife	Some other Activity
16	Resort Use	Motorized Trail Activity
17	No Reported Use	Viewing Wildlife
18	Motorized Trail Activity	Primitive Camping

- Indicator 12a – Annually, the Unit monitors trail conditions and trail maintenance across the forest. In 2022 trail condition surveys were completed on 67 miles of trails and trail maintenance completed on 700 miles of trails (Table 8 and Table 9). However, there is insufficient data to determine a change in this indicator.

Table 8. Unit Trails – Motorized Use

Designed Use	Miles
Motorcycle	212.7
ATV	455.3
4WD > 50 inches	30.9
Snow Machine	641
Total Motorized	1,094.3

Table 9. Unit Trails – Non-Motorized Use

Designed Use	Miles
Pedestrian (Walking/Hiking)	194.9
Pack and Saddle	835.8
Bicycle	191.8
Cross Country Ski	123.7
Snowshoe	92
Total Non-Motorized	1,328.9

- Indicator 12b – The Unit annually completed updates to the Motorized Visitor Use Map, which were made available to the public to reduce incidents of unauthorized off road vehicle use. The Unit also installed travel management signs as needed at various locations. Both efforts help to reduce off-road use. Monitoring of off-road vehicle use is done on a case-by-case basis and addressed in various planning. No single effort to collect forest wide monitoring data has been completed; therefore, a change in this indicator can't be determined.
    - Level 2 Roads (to roads open for use by high-clearance vehicles): 2,598.5 miles
    - Level 3 Roads (low speed with single lanes and turnouts): 867.9 miles
    - Level 4 Roads (paved or gravel with dust abatement): 432 miles
    - Level 5 Roads (double lane paved): 3.2 miles
- Indicator 12c – Annually the Unit produces a Recreation Enhancement Act Report that monitors the work accomplished in developed recreation sites. In 2022 the forest opened and maintained 52 fee campgrounds, 12 rental cabins, 4 fee group sites, 31-day use fee sites, and 197 non-fee day use sites. Additional sites are being considered in FY24 for new fees. Th*e total* number of recreation sites has not changed over the past 5 years.

  In 2022 the Forests and Grassland conducted a real property inventory, completed, and monitored deferred maintenance at each developed recreation site. The results of this information show that we need to focus efforts on improving infrastructure by reducing a backlog of deferred maintenance.

- Indicator 12d – Not monitored as there is no established baseline to compare to.
- Indicator 12e – There has been no change in acres that are open to public access on the Thunder Basin National Grassland and Laramie Peak unit during the timeframe covered under this report.

Recommended Changes

Based on these results, we are considering the following possible changes:

- *Indicator 11a* – Focus efforts on improving infrastructure by reducing a backlog of deferred maintenance.
- *Indicator 11c* – Consider monitoring parking areas for capacity and safety, as well as monitoring parking on highways.
- *Indicator 12d* – Establish a baseline for various indicators to be monitored in the future.
- Monitor the question "Are we managing our sites to standard?" as question 13.
    - *Indicator 13a:* Number of sites managed to standard.
    - *Indicator 13b*: Do we have appropriate capacity for the visitor use that is occurring?
    - *Indicator 13c*: Disperse camp sites. This question is being monitored and gives insight into plan direction and success and would be beneficial to include in future reports.

Climate Change and Other Stressors

Opportunities to mitigate the effects from climate change has been one of the foci of Forest Service management objectives. The Medicine Bow and Routt National Forests and Thunder Basin National Grassland (the Unit) has a two-pronged approach: determine future needs for decision support while cooperatively monitoring trends in ecosystem components. To this end, the Unit is engaged with researchers to complete a Climate Change Vulnerability Assessment, as well as collect data. Information provided by various researchers will enable the Unit resource specialists to better protect the land, resources, and the region's forests and grasslands into the future.

Monitoring Questions

13. What stressors are impacting the planning unit? Can any trends in these stressors be related to climate change?
    - *Indicator 13a. Timing, type, and amount of precipitation (rain vs. snow)*
    - *Indicator 13b. Snowpack depth and persistence*
    - *Indicator 13c. Changes in air temperature*
    - *Indicator 13d. Changes in stream/lake temperature*
    - *Indicator 13e. Extent of insect and disease outbreaks*
    - *Indicator 13f. Extent of invasive species infestations*
    - *Indicator 13g. Extent and severity of wildfires (for fires >100 acres)*
    - *Indicator 13h. Dozer fire line constructed (type/miles)*
    - *Indicator 13i. Habitat fragmentation (roads and infrastructure per square mile)*
    - *Indicator 13j. Number of visitors by activity type*
    - *Indicator 13k. Population trends*
    - *Indicator 13l. Unauthorized Off-Highway Vehicle use*

Key Results

- Indicator 13a and 13b – In terms of monitoring weather related variables, there are roughly thirty SNOwpack TELemetry (SNOTEL) sites that are either on our unit or directly adjacent to it. Using the data provided by SNOTELs, staff have in a limited fashion extrapolated future climate related trends with respect to timing, type, and amount of precipitation (rain vs. snow), snowpack depth and persistence, and changes in air temperature and have incorporated this information into project planning. However, researchers are integrating these data into the climate change vulnerability assessment being completed for our unit. These questions will be answered in that final product, due for release late spring of 2024.
- Indicator 13c and 13d – The Unit staff monitor stream and lake temperatures. These data are used to both locate areas for future habitat restoration endeavors as well as refine buffers for vegetation management projects to protect amphibians and fish habitat. They are also shared with our partners and the Rocky Mountain Research Station NorWeST stream temperate database.

  Information summarized from Chapter 5 of the Unit's draft climate change vulnerability assessment suggests air temperatures are expected to rise with corresponding increases in water temperature in streams that are surface water fed or lack riparian cover to intercept solar radiation (Arismendi et al. 2012). Changes in the timing and amount of precipitation could trigger decreased summer low flows

thereby affecting connectivity and habitat availability for aquatic species. Summer low flows are expected to become more pronounced with flows decreasing by up to 64.7% at the turn of the century. Unit staff have begun to use this information to build management strategies to enhance resilience of riparian systems in project development and will incorporate it into land resource management plan revision.

Another source of data comes from the Rocky Mountain Research Station Glacier Lakes Ecosystem Experiments Station housed on the Unit. Long-term data collected at this site provide detailed existing condition and trend data for climatic variables, which can inform analysis on the potential effects of vegetation management including carbon stocks. In 2020, a Unit employee developed a carbon white paper to use in planning efforts based in part on carbon data.

Other Glacier Lakes Ecosystem Experiments Station research explores the impacts of biotic and abiotic factors on seedling establishment at multiple scales. Seedling establishment and survival over time can be related to regional climate patterns. Unit staff continue to use this information to adjust planting strategies.

- Indicator 13e – The Forest Service Region 2 Forest Health Protection department and its partners conduct aerial surveys to map forest insect and disease across the entirety of the Unit. The "Forest Health Conditions in the Rocky Mountains" website https://www.fs.usda.gov/main/r2/forest-grasslandhealth has insect and disease condition reports dating to 1950. Results of these surveys have been the underpinning for management decisions including, but not limited to location of areas for salvage harvest and thinning for stand improvement. Although insect and disease tree mortality continue across the Unit, it has declined to a more endemic level.
- Indicator 13f – Noxious weeds

  Climate change may make existing invasive species control tools less effective, such as aquatic barriers that require minimum water flows.

  See *the Effects of Management Activities on the Productivity of the Land* section for the complete discussion of noxious weeds. Noxious weeds have established and appear to be expanding in localized areas in response to ground disturbing management activities. However, there have been no studies that address noxious weeds with respect to climate change specifically.
- Indicator 13g – Unit staff have been monitoring the number of starts and subsequent wildfire size since 1937. There has been a significant increase in both variables during this timeframe (Figure 8). It should be noted that although the fire size exhibits a large amount of variability, the basic trend appears to be that of increased fire size attributed to both changes in weather, such as drought, as well as the substantial fuel bed directly correlated to insect and disease related tree mortality.

  In 2020, the Unit began working with external cooperators on a program to address this concern. Staff have delineated Potential Operational Delineations to target vegetation management activities to aid in the efficacy of fire suppression efforts. Congress has recognized the need for action and passed laws to provide funds needed to implement these activities. Implementation of strategies to alter vegetative patterns could decrease fire size enhancing future suppression, but also help provide resilience to plant communities.
- Indicator 13h – Dozer and fire line construction as an indicator of climate change for the Unit has not been monitored because it doesn't produce quantifiable empirical data like modeling can do based on historical fire size and frequency. For example, equipment is being used more frequently in this century than any other based on production rates, fire fighter safety, increases in down large

woody debris in conjunction with sheer number and type of equipment available compared to previous centuries.

- Indicator 13i – Not monitored.
- Indicator 13j – See Table 6 and Table 7.
- Indicator 13k – Population changes across counties show a variety of growth and reductions over the last two years. See Figure 9, Figure 10, and Figure 11.
- Indicator 13l – There has been no tie made between Unauthorized Off-Highway Vehicle Use and climate change.

Recommended Changes

Based on these results, we are considering the following possible changes:

- Change the monitoring question from "What stressors are impacting the planning unit? Can any trends in these stressors be related to climate change?" to "Are trends in climate change impacting management activities?"

  With this change, recommend changing to three indicators, as follows:

  - *Indicator 13a:* Are there changes in the extent and severity of wildfire?
  - *Indicator 13b:* Is climate change effecting native plant communities? This question encompasses *Indicator 13e* - "Extent of insect and disease outbreaks" and *Indicator 13f* - "Extent of invasive species infestations" indicators found in the 2016 Forest Supervisor monitoring letter.
  - *Indicator 13c:* Are there any noticeable changes in abiotic variables? This question incorporates the indicators: timing, type, and amount of precipitation (rain vs. snow); snowpack depth and persistence; changes in air temperature; changes in stream/lake temperature found in the 2016 Forest Supervisor monitoring letter.

- Remove *Indicator 13h* – Dozer and fire line construction as an indicator of climate change doesn't produce quantifiable empirical data like modeling can based on historical fire size and frequency.
- In addition, the Unit should explore the potential use of the Resistance, Resilience, Transition framework (Millar et al. 2007) in the revised land resource management plans to incorporate strategies to address climate change into management activities including invasive species management and augmentation of resilience in riparian systems. https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/06-1715.1
- *Indicator 13i and 13l:* Develop a monitoring scheme or consider removing indicator.

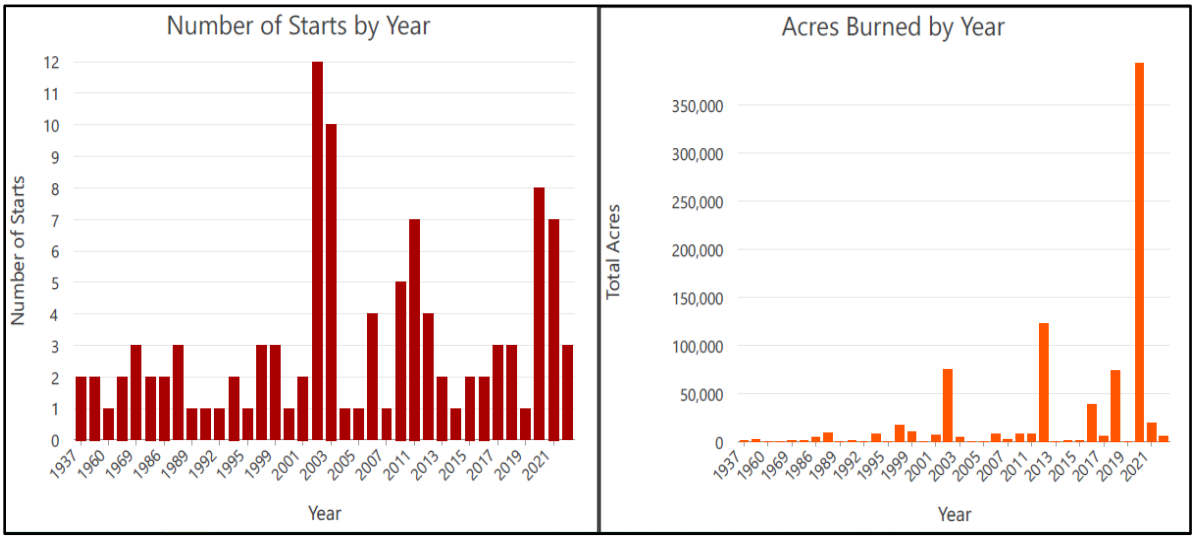

Figure 8. Number of Starts and Acres Burned from 1937 to 2021

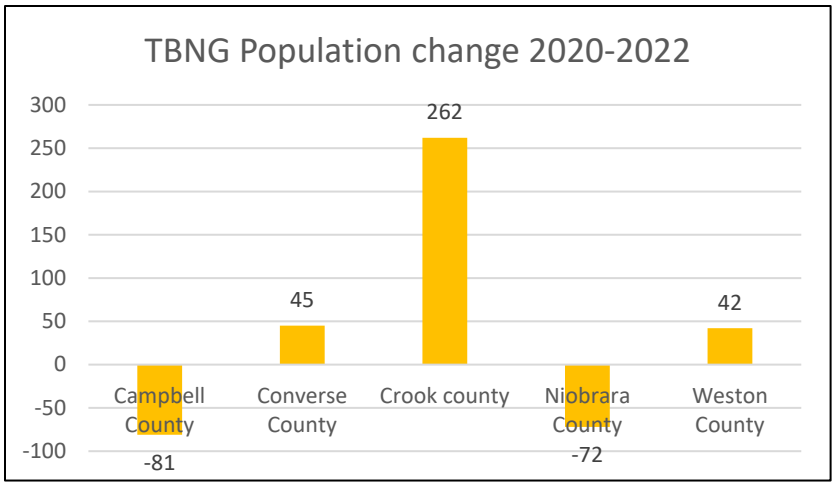

Figure 9. Thunder Basin National Grassland Population change by County. Annual Estimates of the Resident Population for Counties in Wyoming: April 2020 to July 2022; US Census Bureau, Population Division. Release March 2023

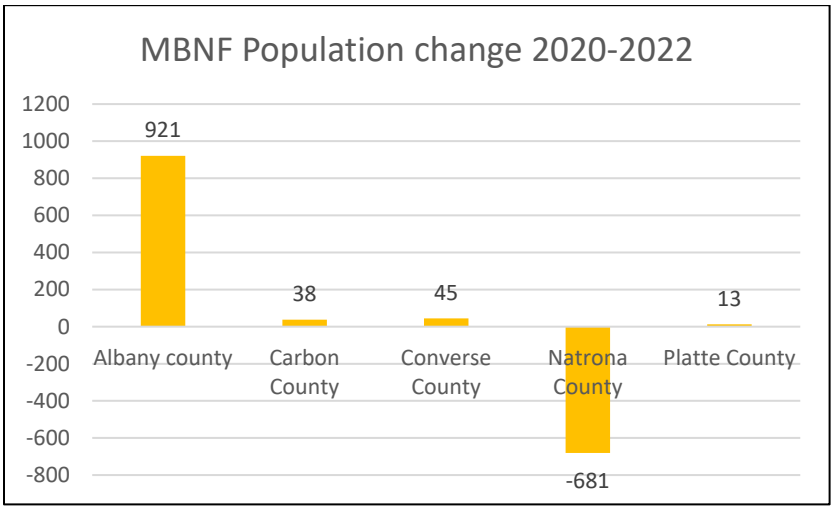

Figure 10. Medicine Bow National Forest Population change by County. Annual Estimates of the Resident Population for Counties in Wyoming: April 2020 to July 2022; US Census Bureau, Population Division. Release March 2023

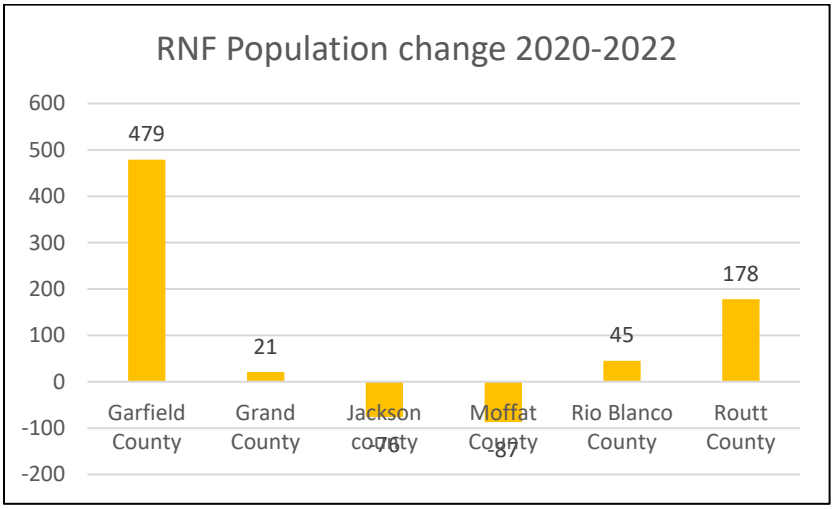

Figure 11. Routt National Forest Population change by County. Annual Estimates of the Resident Population for Counties in Colorado: April 2020 to July 2022; US Census Bureau, Population Division. Release March 2023

Progress Toward Meeting Desired Conditions and Objectives

We manage the Medicine Bow and Routt National Forests and Thunder Basin Grasslands (the Unit) such that they are healthy and diverse, with appropriate variability in tree species, sizes, and ages. This helps provide a stable and sustained flow of habitat conditions, recreational settings, and timber products. To achieve this, we need an understanding of the abundance and distribution of various ecosystem types.

Monitoring allows managers to identify forest types that are under-represented across the landscape and areas where the pace and scale of treatment does not meet the desired goals.

Monitoring Questions

14. How are management activities on the planning unit affecting local employment and income?
    - *Indicator 14a. Range contributions and effects to local employment and income*
    - *Indicator 14b. Timber contributions and effects to local employment and income*
    - *Indicator 14c. Recreation and effects to local employment and income*
    - *Indicator 14d. Minerals developments and effects to local employment and income*
15. To what extent have we managed our heritage assets?
    - *Indicator 15a. Number of stewardship activities conducted.*
    - *Indicator 15b. Monitoring of priority heritage assets*

Key Results

- Indicator 14a, c–d – There are currently no staff who track these indicators for the unit, although these topics are addressed in some project level analyses.
- Indicator 14b – From 2018 to 2022, timber harvest on the National Forests averaged 77,712 centum cubic feet annually, including 71,253 centum cubic feet of sawtimber and 6,459 centum cubic feet of non-saw. In 2022 these timber products contributed 280 jobs and approximately $10.8 million in labor income and $18 million in gross domestic product (Table 10).

  Table 10. IMPLAN software modeled employment, labor income, and gross domestic product contributions from timber harvest on the National Forests in fiscal year 2022.

Model Outputs	Employment (number of jobs)	Labor Income	Contribution to Gross Domestic Product
Direct	160	$7,500,000	$12,100,000
Indirect and Induced	120	$3,300,000	$5,900,000
Total	**280**	**$10,800,000**	**$18,000,000**

  Timber harvest was higher in 2021 by 47.65%, in 2020 by 27.48%, in 2019 by 175.44% and in 2018 by 170.56% compared to 2022 so local jobs and wages in the analysis area for those years would have been proportionally higher, all else equal.
- Indicator 15a – In 2018, the Medicine Bow Routt National Forest initiated stewardship activities in the Seedhouse Campground (5RT462), with a project to restore and rehabilitate the eligible Seedhouse Outhouse (1934-5) the only known standing Civilian Conservation Corps structure on the Routt National Forest.

In 2022, the U.S. Forest Service initiated a site stewardship activity by entering into an agreement with Historic Routt County to create a better inventory of arborglyphs associated with sites 5RT2823 and 5RT2828.

- Indicator 15b – The forest has a monitoring schedule for at least 62 priority heritage assets. Each priority asset is scheduled to be monitored every five years.

  The Laramie and Brush Creek/Hayden Ranger Districts monitored five priority heritage assets in fiscal year 2019, four in fiscal year 2020, and three in each fiscal years 2021 and 2022.

  The Hahns Peak/Bears Ears, Yampa, and Parks Ranger Districts monitored ten priority heritage assets in fiscal year 2018, three in fiscal year 2019, four in fiscal years 2020 and 2021, and ten in fiscal year 2022.

Recommended Changes

Based on these results, we are considering the following possible changes:

- *Indicator 14 a, c, and d* – Revise this indicator during plan revision working with the regional office to get new socioeconomic modeled data.
- *Indicator 15b* – Report site monitoring results to present changes in status and condition of heritage assets across the forests and grassland.
- Consider adding a Question “Are we maintaining and managing our wilderness areas for its wilderness characteristics?” utilizing wilderness scores as a metric.

Effects of Management Activities on the Productivity of the Land

Management activities can have a negative effect on the productivity of the land. It is important to monitor for any signs of degradation for habitat and watershed conditions. Silviculture practices should be mindful of maintaining site productivity and timber production should be based on sustainable levels.

We focus our management efforts on improving stream riparian areas and wetlands as well as restoring riparian function to springs. Plan direction requires that: 1) we adopt best management practices to prevent soil erosion and adverse effects to water quality; 2) avoid wetlands, springs, seasonally wet meadows, and montane meadows and soils that are unstable and highly erodible when connected to streams. We monitor the effectiveness of our best management practices for implemented projects on long-term soil productivity annually.

Reforestation is a management action to renew tree cover by establishing young trees. It is done to maintain appropriate forest cover, achieve desired ecological conditions, and restore forests for wildlife, watersheds, and recreational experiences. Reforestation includes planting, seeding, and activities that facilitate natural regeneration of forests. These activities are crucial to fulfilling legal requirements to reestablish and maintain forests.

Monitoring Questions

16. What changes in soil properties have been observed in the planning unit?
    - *Indicator 16a. Extent of soil disturbance:*
      - *i. Detrimental soil compaction*
      - *ii. Detrimental displacement*
      - *iii. Detrimental erosion*
17. To what extent has regeneration been successful following timber harvest on the planning unit?
    - *Indicator 17a. Percent of harvest areas restocked after 5 years.*
18. Are we providing adequate forage for domestic livestock, wild ungulates, and small herbivores commensurate with availability, capability, and sustainability?
    - *Indicator 18a. Animal Unit Months permitted for each allotment*
    - *Indicator 18b. Extent of invasive species infestations in capable rangelands (acres/species)*
    - *Indicator 18c. Utilization of forage*
    - *Indicator 18d. Select wildlife population trends.*
    - *Indicator 18e. Soil type, aspect, slope, precipitation, and elevation*

Key Results

- Indicator 16a - There has been no soil monitoring of detrimental soil compaction, displacement, and erosion since 2018. Soil protection design criteria for ground disturbing activities recommend detrimental soils occur over 15% or less of a project area. These conditions are qualitatively surveyed during project clearances. Best management practices evaluations indicate that when implemented, they reduce detrimental erosion (See *indicator 1f*). However, they do not provide data to determine forest wide levels of detrimental soil compaction or displacement. Lastly, the

watershed condition attributes for the soils indicator qualitatively show that 77% of watersheds have properly functioning soil productivity, soil contamination, and soil erosion.

- Indicator 17a – 91.7% of National Forest Service land units harvested from 2014 and 2017 on the Unit were adequately restocked based on stocking surveys conducted within 5 years after completion of regeneration timber harvest. The harvested acres that have not yet been certified as adequately restocked are on a single Ranger District (Hahns Peak/Bears Ears Ranger District). There were some regeneration survey scheduling oversights which can be attributed to employee turnover. The acres that have not been certified as stocked yet have been scheduled for regeneration surveys in FY24 to determine stocking levels. If regeneration surveys show they meet Forest Plan stocking standards, units will be certified as stocked. Those units below stocking standards will be scheduled for planting.
- Question 18 addresses plan components intended to ensure the sustainable use of rangelands, provide for multiple uses, and conserve wildlife species. The 2018 Biennial Monitoring Evaluation Report measured 4 different indicators for rangeland health. Upon further discussion it was decided that only two were relevant to this monitoring report: Utilization of forage, now Rangeland Health, and Noxious weeds. Regarding large ungulates and small herbivores, the forest manages for habitat quality based on rangeland health, rather than on a per species basis. Measuring or tracking animal unit months are not a direct correlation to effects on the ground.
- Indicators 18a-*e* – To determine, if there is sufficient vegetation for domestic livestock, wild ungulates, and small herbivores needs, Unit staff monitor a wide variety of resource management objectives for allotments or pastures including forage production. The monitoring techniques vary between allotments based on management objectives, intensity of livestock management, and rangeland health.

  In lieu of utilizing Animal Unit Months, range staff use Head Months which provided a more comprehensive dataset than Animal Unit Months. The number of head months indicated on the grazing bill captures the amount livestock use authorized for any given permit on an annual basis. There is a direct conversion from Animal Unit Months to head months.

  Allotment inspections are completed to ensure that Annual Operating Instructions are being implemented and livestock management is being conducted as planned. These inspections often include measurements of forage utilization, among the wide variety variables. According to inspection data, there appears to be enough forage for both domestic and wild animals.
- Indicator 18b – Noxious weeds

  Forest and grassland staff treat noxious weeds annually. Table 11 shows the number of acres treated from 2014-2022. Calculated acres count treatment areas multiple times if they received successive treatments or were treated for multiple types of weeds. All calculated acres are approximate.

Table 11. Total acres of noxious weed treatment on the Medicine Bow-Routt National Forests and Thunder Basin National Grassland, 2014 to 2022

Year	Acres
2014	1,200
2015	1,790
2016	4,430
2017	5,130

Year	Acres
2018	6,600
2019	12.442
2020	1,666
2021	29,456
2022	8,372

Noxious weed inventory is not conducted outside of treatment areas. However, long-term trend studies on the Yampa Ranger District have indicated that noxious weeds are increasing in some allotments.

Increased logging activity, recreation, climate change, and other disturbances may cause an increase in the extent of noxious weed infestations. Historically, disturbed areas such as roads, trails, logging activities, prescribed burns and wildfire have been the locations most susceptible to infestation. In the past decade, weeds have been increasing in coniferous stands that have experienced high tree mortality due to the pine beetle epidemic. The extent of invasive species infestations will depend on how quickly these stands recover and the frequency and intensity of wildfire in these stands. At this point, there appear to be only localized changes in the amount of forage available to domestic and wild animals.

Recommended Changes

Based on these results, we are considering the following possible changes:

- Indicator 16a – Design and implement a forest wide soil monitoring program that tracks the soil resource condition and trend and supports environmental review and monitoring requirements.
- Indicator 17a – Continue to measure 5th year post-harvest regeneration surveys and certify those stands as stocked in the FACTS database to ensure there are not future scheduling oversights. Mountain Pine beetle induced tree mortality is expected to reduce seed viability which in turn is expected to decrease future natural regeneration and increase planting needs.
- Add an indicator 17b that monitors progress toward reforesting severely burned areas. It is important to acknowledge the Unit has a backlog of reforestation needs of acres burned by wildfires since 2012 that needs to be addressed. These fires have created large post disturbance reforestation needs. Post fire rapid assessment of reforestation needs identify approximately 65,000 acres of forested land as potential planting needs. Actual needs will be based on results of ongoing regeneration surveys and progress will be monitored.
- Modify question 18 to read “Are rangelands meeting or moving towards desired conditions and objectives using livestock as a key management tool?” Include the indicators below to better inform the evaluation of management activities more directly related to productivity of the land.
    - Rangeland health assessments and the continuation of long-term trend monitoring.
    - Drought planning to adjust livestock management to define effects of activities on rangeland health.
    - Monitor and report effectiveness of noxious weed treatments, as well as the relationship between noxious weed and other changing ecological processes, such as climate change and wildland fire.

Social, Economic, and Cultural Sustainability

The Medicine Bow and Routt National Forests and Thunder Basin National Grassland's rugged and scenic terrain has much to offer local communities and beyond. We provide public benefits such as infrastructure, employment, timber, clean air and water, forage, energy production, and cultural connections that go back for centuries.

We also take action to protect cultural treasures. Please see the discussion in Progress Toward Meeting Desired Conditions and Objectives.

Monitoring Questions

Monitoring questions on this topic have not been specifically listed in the monitoring plan. However, several of the questions and indicators approach this topic.

13. What Stressors are impacting the planning unit? Can any trends in the stressors be related to climate change?
    - *Indicator 13k. Population trends*
14. How are management activities on the planning unit affecting local employment and income?
    - *Indicator 14a. Range contributions and effects to local employment and income*
    - *Indicator 14b. Timber contributions and effects to local employment and income*
    - *Indicator 14c. Recreation and effects to local employment and income*
    - *Indicator 14d. Minerals developments and effects to local employment and income*
15. To what extent have we managed our heritage assets?
    - *Indicator 15a. Number of stewardship activities conducted.*
    - *Indicator 15b. Monitoring of priority heritage assets*

Key Results

See Climate Change and Other Stressors for a discussion of question 13 and Progress Toward Meeting Desired Conditions and Objectives for a discussion of questions 14 and 15.

Recommended Changes

Based on these results, we are considering the following possible changes:

- Update the Monitoring Plan to include indicators specific to Social, Economic, and Cultural Sustainability.
- In future reporting, work with the regional office to model new socioeconomic reports using data provided by the Unit. A model for each year would allow for monitoring overtime and allow us to look for unusual patterns associated with events such as the 2020 pandemic.

Public Engagement Opportunities

Our Monitoring plan, guide, and reports are posted on our website (web addresses below). Any changes to monitoring questions associated with the monitoring plan will be subject to public notice and posted on our website.

Additional information is available at the following links:

Monitoring plan: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd500641.pdf

Monitoring guide: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd500640.pdf

Monitoring reports: https://www.fs.usda.gov/main/mbr/landmanagement/planning

Summary Table

The evaluation of the plan monitoring questions addressed in this report for the Medicine Bow and Routt National Forests and Thunder Basin Grasslands recommendations are summarized below. Possible types of change recommended include changes to the land management plan, changes in management activities or the monitoring program, and recommendations for a new assessment. Progress is defined as yes, uncertain, or no.

Table 12. Summary of monitoring recommendations

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
1a	**Yes:** The Forest continues efforts to complete essential projects on select priority watersheds.	• Complete implementation of essential projects identified in the Watershed Restoration Action Plans. • Focus future watershed restoration efforts on the critical factors having the most influence on watershed conditions. • Prepare additional Watershed Restoration Action Plans to ensure continuous planning and implementation of essential projects necessary to restore watershed conditions. • Continue to update and use the Watershed Condition Assessment Tracking Tool and Watershed Improvement Tracking tools to monitor watershed condition trends over time.
1b	**Yes:** Trends in Forest water quality remained stable since 2018.	• Consider rewording this indicator to "Water quality: Number of streams on state threatened or impaired lists and state monitoring and evaluation lists; macroinvertebrate sampling or comparable indicator tracking."
1c	**Yes:** Native fish are being recorded on the Medicine Bow and Routt National Forests.	• Explore monitoring the presence or absence of native fish species on the Thunder Basin National Grassland. • Coordinate with the Unit Geographic and Information Specialists and state wildlife agencies to create a consolidated geographic information system layer, available in the corporate database, that shows where the known locations of native fish occur.
1d	**Uncertain:** The Forest streamflow trends and the influence of management actions on them is variable.	• NA

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
1e	**Yes:** The Forest continues efforts to complete essential projects on select priority watersheds.	• Complete implementation of essential projects identified in the Watershed Restoration Action Plans. • Focus future watershed restoration efforts on the critical factors having the most influence on watershed conditions. • Prepare additional Watershed Restoration Action Plans to ensure continuous planning and implementation of essential projects necessary to restore watershed conditions. • Continue to update and use the Watershed Condition Assessment Tracking Tool and Watershed Improvement Tracking tools to monitor watershed condition trends over time.
1f	**Yes:** They ranged from fully implemented to marginally implemented and all scored as effective in protecting water quality.	• Increase the number and range of best management practices evaluations to 10 per year. This will meet the Region 2 assignment. • Implement best management practices according to land action decisions.
2a	**Uncertain:** We are monitoring how major vegetations types are changing over time. Many fires are not yet accounted for in our databases.	• Explore opportunities to expand use of Forest Inventory and Analysis data to inform management and forest plan monitoring.
3a	**Yes:** The Forest inventoried 182 groundwater dependent ecosystems since 2018 using the USDA Groundwater-dependent Ecosystems Level 1 protocol. These data inform extents of land use actions.	• Past monitoring reports have relied on project level data. A forest wide riparian and water quality monitoring program that accounts for the distribution the Forest's stream types, riparian ecotypes and wetland types as well as project-level, site-specific assessment data would provide data to detect condition trends and support project monitoring.
3b	**Yes:** Select aquatic and amphibian species are being recorded on the Medicine Bow and Routt National Forests.	• In the upcoming Forest and Grassland plan revisions, expand monitoring efforts to better define amphibian distributions across the entire unit to assess wetland condition to be consistent with state and federal regulations.
3c	**Uncertain:** These additional data inform extents of land use actions but are insufficient to determine trends at this time.	• Past monitoring reports have relied on project level data. A forest wide riparian and wetland monitoring program that accounts for the distribution the groundwater dependent ecosystem types as well as project-level, site-specific assessment data would provide data to detect condition trends.

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
4a	**Yes:** Habitat Assessment Framework surveys are no longer conducted on any of the planning units. Greater sage-grouse populations are monitored in northwest Colorado by Colorado Parks and Wildlife, and across the state of Wyoming, by Wyoming Game and Fish Department.	• Drop this indicator, as it is no longer being measured. Effects are considered at the project level through environmental analyses.
4b	**Uncertain:** Opportunistic observations are insufficient to determine population trends.	• Consider pursuing partnerships to conduct breeding landbird monitoring as part of the Integrated Monitoring in Bird Conservation Regions program on the Thunder Basin National Grassland.
5a	**Yes**: Colony extent data indicate annual fluctuations in prairie dog populations. Observation data for prairie dog colonies show that prairie dog colony extent fluctuates annually on the grassland and that plague has become a critical driver of colony extent since 2001.	• NA
5b	**Yes:** Colony extent data indicate annual fluctuations in prairie dog populations. Observation data for prairie dog colonies show that prairie dog colony extent fluctuates annually on the grassland and that plague has become a critical driver of colony extent since 2001.	• NA
5c	**Uncertain:** Opportunistic observations are insufficient to determine population trends.	• Continue to engage partners to conduct breeding landbirds monitoring as part of the Integrated Monitoring in Bird Conservation Regions program on the Thunder Basin National Grasslands.
5d	**Yes:** Colony extent data indicate annual fluctuations in prairie dog populations. Observation data for prairie dog colonies show that prairie dog colony extent fluctuates annually on the grassland and that plague has become a critical driver of colony extent since 2001.	• NA

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
6a	**Yes:** Although the trend for red squirrel density has a downward slope, occupancy appears to be stable to slightly increasing. Coupling this information with the vegetation data, animal species density appears to be mirroring the decrease in acreage of sapling-pole and mature, old growth forests. Large, catastrophic wildfires rather than timber harvesting are a contributing factor.	• Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.
6b	**Yes:** Trends for two species are inconclusive, however, flicker density and occupancy trends appear to mirror the condition of mid to late successional forested ecosystems.	• As noted in the 2018 monitoring report, retaining pygmy nuthatch as a focal species does not appear to be appropriate due to lack of meaningful trend data. Given the same issues, review use of all three bird species during plan revision. • Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.
6c	**Uncertain:** Coupling this information with the vegetation data, animal species density appears to be mirroring the decrease in acreage of sapling-pole and mature, old growth forests. Large, catastrophic wildfires rather than timber harvesting are a contributing factor.	• As noted in the 2018 monitoring report, retaining pygmy nuthatch as a focal species does not appear to be appropriate due to lack of meaningful trend data. Given the same issues, review use of all three bird species during plan revision. • Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.
7a	**Yes:** The pika data are monitored by Bird Conservancy of the Rockies and citizen science. Based on data throughout the western United States, climate change appears to be a bigger factor in the extent, density, and occupancy of pika. Since our management actions don't affect sub alpine or alpine habitats in general, there is no meaningful correlation for any of these indicators.	• Remove pika from the focal species list since there is little management activity in this habitat type and in general our management activities do not impact them. • Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.
7b	**Yes:** The Bird Conservancy of the Rockies monitors alpine species. There were no detections of rosy finch on our unit. Since our management actions don't affect sub alpine or alpine habitats in general, there is no meaningful correlation for any of these indicators.	• Remove rosy finch and American pipit from the focal species list since there is little management activity in this habitat type and in general our management activities do not impact them. • Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities.

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
7c	**Yes:** Integrated Monitoring in Bird Conservation Regions is a partnership in which multiple agencies and organizations pool monitoring resources to increase efficiencies, facilitating monitoring over large spatial and temporal extents.	• Review the use of density and occupancy to determine whether the Unit should continue to use them as indicators of management activities. • Work with Bird Conservancy of the Rockies to ascertain species that better act as focal species.
8a	**Yes:** Results do not indicate noticeable changes in amphibian assemblages on the forests.	• Review the updated amphibian protocols for assessing changes in distribution and abundance. Incorporate new protocols, as needed, to ensure data collection is consistent with state and federal regulations.
8b	**Uncertain:** The presence or absence of Chytrid in amphibian assemblages is not a metric that changes our management actions.	• Recommend not including it as an indicator in the future.
9a-d	**Yes:** Wild black-footed ferrets (*Mustela nigripes*) are not present on the Medicine Bow-Routt National Forests and Thunder Basin National Grassland, and no reintroductions of the species have taken place.	• Evaluate benefits of including this question and consider dropping question 9 from the monitoring plan.
Status Of Select Set of Ecological Conditions Required to Contribute to Species Recovery	**NA**	• Consider adding the newly listed (endangered) northern long-eared bat to this section.
10a-c	**Yes**: We continue to restore at least 1,000 acres of aspen every 10 years.	• NA
11a	**Yes:** The Forests are generally performing well when it comes to providing high quality and sustainable recreation experiences, but more work remains to be done.	• Focus efforts on improving infrastructure by reducing a backlog of deferred maintenance.
11b	**Yes:** In general, the Medicine Bow-Routt National Forests and Thunder Basin National Grassland experienced an increase in the number of visitors between 2017 and 2022. The five-year cycle of the National Visitor Use Monitoring program inventory continued in 2022 for the Routt National Forest and 2023 for the Medicine Bow National Forest and Thunder Basin National Grassland.	• NA

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
11c	**Yes:** The Forests are generally performing well when it comes to providing high quality and sustainable recreation experiences, but more work remains to be done.	• Consider monitoring parking areas for capacity and safety, as well as monitoring parking on highways.
Visitor Use, Satisfaction, And Progress On Recreation Objectives	**NA**	• Add a question to this section "Are we managing our sites to standard?" • Indicator a: Number of sites managed to standard. • Indicator b: do we have appropriate capacity for the visitor use that is occurring? • Indicator c: disperse camp sites numbers.
12a	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
12b	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
12c	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
12d	**Uncertain:** No baseline established to allow for effective monitoring.	• Establish a baseline for various indicators to be monitored in the future.
12e	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action

What stressors are impacting the planning unit? Can any trends in these stressors be related to climate change?	**NA**	• Change question to "are trends in climate change impacting management activities? Include the following recommended indicators.
		  • *Indicator 13a*: Are there changes in the extent and severity of wildfire?
		  • *Indicator 13b:* Is climate change effecting native plant communities? This question encompasses *Indicator 13e* - "Extent of insect and disease outbreaks" and *Indicator 13f* - "Extent of invasive species infestations" indicators found in the 2016 Forest Supervisor monitoring letter.
		  • *Indicator 13c*: Are there any noticeable changes in abiotic variables? This question incorporates the indicators: timing, type, and amount of precipitation (rain vs. snow); snowpack depth and persistence; changes in air temperature; changes in stream/lake temperature found in the 2016 Forest Supervisor monitoring letter.

13a-g	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
13h	**Yes:** Dozer/fire line constructed as an indicator of climate change doesn't produce quantifiable empirical data like modeling can do based on historical fire size and frequency.	• Remove indicator 13h. • In addition, the Unit should explore the potential use of the Resistance, Resilience, Transition framework (Millar et al. 2007) in the revised land resource management plans to incorporate strategies to address climate change into management activities including invasive species management and augmentation of resilience in riparian systems.
13i	**Uncertain:** Not monitored	• Develop a monitoring scheme or consider removing indicator.
13j-k	**Yes**: Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
13l	**Uncertain**: Not monitored	• Develop a monitoring scheme or consider removing indicator.

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action
14a	**Uncertain:** There are currently no staff who track these indicators for the unit, although these topics are addressed in project level analysis.	• Revise this indicator during plan revision working with the regional office to get new socioeconomic modeled data.
14b	**Yes:** From 2018 to 2022, timber harvest on the National Forests averaged 77,712 centum cubic feet annually, including 71,253 centum cubic feet of sawtimber and 6,459 centum cubic feet of non-saw. In 2022 these timber products contributed 280 jobs and approximately $10.8 million in labor income and $18 million in gross domestic product.	• Revise this indicator during plan revision working with the regional office to get new socioeconomic modeled data.
14c	**Uncertain:** There are currently no staff who track these indicators for the unit, although these topics are addressed at the project level.	• Revise this indicator during plan revision working with the regional office to get new socioeconomic modeled data.
14d	**Uncertain:** There are currently no staff who track these indicators for the unit, although these topics are addressed at the project level.	• Revise this indicator during plan revision working with the regional office to get new socioeconomic modeled data.
15a	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• NA
15b	**Yes**: Completing monitoring schedule.	• Report site monitoring results to present changes in status and condition of heritage assets across the forests and grassland.
Progress Toward Meeting Desired Conditions and Objectives	**NA**	• Consider adding a Question “Are we maintaining and managing our wilderness areas for its wilderness characteristics?” utilizing wilderness scores as a metric.
16a	**Uncertain:** There has been no soil monitoring of detrimental soil compaction, displacement, and erosion since 2018.	• Design and implement a forest wide soil monitoring program that tracks the soil resource condition and trend and supports environmental review and monitoring requirements.
17a	**Yes:** If regeneration surveys show they meet Forest Plan stocking standards, units will be certified as stocked. Those units below stocking standards will be scheduled for planting.	• Continue to measure 5th year post-harvest regeneration surveys and certify those stands as stocked in the FACTS database to ensure there are not future scheduling oversights. • Consider adding *indicator 17b* monitoring progress towards reforesting severely burned areas.

Indicators/Monitoring Questions	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Action

18a-e	**Yes:** Monitoring has been accomplished. Progress toward land management plan desired conditions and objects is occurring.	• Modify question 18 to read "Are rangelands meeting or moving towards desired conditions and objectives using livestock as a key management tool?" Include the indicators below to better inform the evaluation of management activities more directly related to productivity of the land.
		  • Rangeland health assessments and the continuation of long-term trend monitoring.
		  • Drought planning to adjust livestock management to define effects of activities on rangeland health.
		  • Monitor and report effectiveness of noxious weed treatments, as well as the relationship between noxious weed and other changing ecological processes, such as climate change and wildland fire.

Social, Economic, and Cultural Sustainability	**NA**	• Update the Monitoring Plan to include indicators specific to Social, Economic, and Cultural Sustainability.
Social, Economic, and Cultural Sustainability	**NA**	• In future reporting, work with the regional office to model new socioeconomic reports using data provided by the Unit. A model for each year would allow for monitoring overtime and allow us to look for unusual patterns associated with events, such as the 2020 pandemic.