United States Department of Agriculture

Biennial
2020 and 2022 Monitoring Evaluation Report

White River National Forest

Trappers Lake (2020) Photo by Cary Green, UDSA Forest Service

Forest Service **White River National Forest** **May 2024**

For More Information Contact:

Cary Green
NEPA Planner/Environmental Coordinator
900 Grand Avenue
Glenwood Springs, CO 81601
970-390-3234

Table of Contents

Contents

Summary of Findings and Results

Table 1 consists of the 2020-2022 Monitoring Report summary of the findings and results. This table briefly describes for each monitoring item if the monitoring results demonstrate intended progress toward plan targets, whether changes are warranted, and where changes may be needed in the Forest Plan, management activities and/or monitoring program.

Table 1. Summary of findings.

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
1.1: Watershed Condition Framework Is the unit improving condition in priority watersheds?	2022	Yes, trend is watershed conditions maintained or improving.	No	N/A
1.2: Watershed Condition Class Is the unit maintaining or improving watershed condition class in non-priority watersheds?	2022	Uncertain (B) Watershed condition class slow to change over time. Data points every 6 years may not show trend.	No	N/A
1.3: National Best Management Practices Program Are Best Management Practices (BMPs) implemented, and are they effective at protecting water quality?	2022	Yes, trend is increased progress in effectiveness of BMPs in protecting water quality, but not at the 100% target effectiveness.	No	N/A
2.1: Air Quality What are the conditions and trends for visibility in Class I and selected Class II areas on the unit?	2021	Yes, trend is improved air quality in select Class I and II areas on the WRNF.	No	N/A

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
2.2: Forest and Grassland Health What are the status and trends of insects and disease in and around the plan area?	2022	Yes, insects and diseases are at endemic levels in all forest cover types, with exception of Douglas-fir beetle which is trending upwards.	No	N/A
2.3: Ecosystem Health How are major vegetation types on the planning unit changing over time?	2023	Yes, lodgepole pine, spruce-fir, aspen and pinyon-juniper cover types are stable. Douglas fir mature structural stage trending downward.	No	N/A
3.1: Macro-invertebrates Is Forest management contributing to conditions that maintain or improve biological stream health trends for biotic macroinvertebrate communities?	2021	Unclear. Using analysis of random samples suggests that management practices are maintaining stream health. The random sampling methods may not capture local impacts or trends	Yes	Utilize not only random sampling but also a stratified sampling method of historic problematic areas. Also move from current indices to Colorado MMI
3.2: Red Squirrel What do red squirrel populations tell us about the extent and condition of mid to late successional forested ecosystems on the planning unit?	2021	Yes, population trend is positive.	No	N/A
3.3: Pika What is the status of American pika populations as an indicator for alpine ecosystem integrity?	2021	Yes, population trend is stable.	No	N/A

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
3.4 Avian Species What are the status and trends of select avian species on the White River National Forest?	2021	Yes, population trends are positive for 5 of 8 species. Stable for other 3 species.	No	N/A
4.1: Cutthroat Trout What is the status and trend of cutthroat trout across the planning area?	2021	No	Yes	Increase bioassessment monitoring to biannually for Conservation Population Streams, to include MMI and TIV indices. Increase the priority and scope of conservation and restoration projects to maintain species viability within the planning area.
4.2 Amphibians What is the status and trend of boreal toads and northern leopard frogs being across the planning area?	2021	Uncertain (B) Unable to establish a trend with data collected.	No	N/A
4.3 Lynx Habitat What is the status and trend of early successional conifer and late seral spruce-fir forests to promote recovery of Canada lynx?	2021	Yes, decline in late successional conifer and an increase in early successional conifer due to wildfire activity	No	N/A
5.1: Visitor Satisfaction and use. What are the status and trends of visitor satisfaction for recreational visits on the planning unit?	2022	Yes, trend in visitor use is increasing and visitor satisfaction is stable	No	N/A

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
5.2: Special Uses Administration What are the number and type of Special Use Permits administered to standard?	2022	Yes, trend is stable for special use permits administered to standard.	No	N/A
5.3: Sustaining Recreation Infrastructure How is the Forest trending towards implementing a sustainable program for recreation related infrastructure?	2022	Yes, trend is stable towards implementing a sustainable program for recreation related infrastructure.	No	N/A
6.1: Snowpack and Precipitation What is the status and trends of snowpack and precipitation in the planning area?	2022	Snow Water Equivalent Uncertain (B) Precipitation slight downward trend Temperature slight warming trend	No	N/A
7.1: Economic Contributions from Specific Programs What are the contributions from the range, timber, recreation, and minerals program from the National Forest or Grassland?	2022	Yes, direct income and labor contributions from the WRNF from highest to lowest: recreation, USFS Investments, Forest Products, Livestock, Minerals.	Yes	Change economic analysis interval to coincide with MVUM, every 5 years.

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
7.2. Heritage Program Stewardship To what extent have management activities on the Forest complied with Section 110 of the National Historic Preservation Act and provided quality heritage recreational experiences?	2022	Uncertain (B) unable to determine a trend at this time with the current data points.	No	N/A
7.3 – Travel Management Implementation What are the status and trends of roads and trails in the WRNF?	2022	Yes, trend is stable for roads and trails.	No	N/A
7.4 - Wilderness What are the status and trends of the Wilderness Stewardship Performance elements?	2022	Yes, performance scores are stable or improving.	No	N/A
7.5 - Management Activity Bare Ground Recovery Are project level design criteria and mitigation measures addressing ground disturbing management activities meeting the direction to "…maintain or improve levels of soil organic matter on all lands" through bare ground rehabilitation projects?	2022	Yes, trend is stable for project level design criteria that address ground disturbing management activities.	No	N/A

Monitoring Item	Year Updated	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?[2]
8.1 - Soil Productivity Monitoring What are the status and trends of soil productivity?	2022	Yes, trend of soil productivity is stable with implementation of BMPs and design criteria.	No	N/A

[1]Interval of data collection is beyond this reporting cycle (A); or more time/data are needed to understand status or progress of the plan component (B); or methods/results are inadequate to answer monitoring question (C).
[2] see body of the report for more details regarding any specific recommendations/opportunities for change.

Introduction

Purpose

The purpose of the biennial monitoring evaluation report is to help the responsible official determine whether a change is needed in Forest Plan direction, such as plan components or other plan content that guide management of resources in the plan area. The biennial monitoring evaluation report represents one part of the Forest Service's overall monitoring program for this National Forest unit. The biennial monitoring evaluation report is not a decision document—it evaluates monitoring questions and indicators presented in the Plan Monitoring Program chapter of the Forest Plan, in relation to management actions carried out in the plan area. The White River National Forest Land and Resource Management Plan – 2002 Revision (Forest Plan) was updated in 2016 following the 2012 Planning Rule in order to replace "Chapter 4 Monitoring and Evaluation" with "White River Forest Plan: Updated Monitoring Plan (Monitoring Plan)."

Monitoring and evaluation are continuous learning tools that form the backbone of adaptive management. For this reason, our goal is to produce an evaluation report every two years. This is our second written report of this evaluation since the Monitoring Plan was adopted on May 6, 2016. This report will combine monitoring data from 2020 and 2022. This report indicates whether a change to the Forest Plan, management activities, monitoring program or Forest assessment may be needed based on the new information. This 2020-22 biennial monitoring evaluation report for the White River National Forest (WRNF) is available at https://www.fs.usda.gov/detail/whiteriver/landmanagement/?cid=fsbdev3_001228.

Objectives

There are several objectives for this report, including:

- Assess the current condition (i.e., status) and trend of selected Forest resources.
- Document implementation of the Monitoring Plan including changed conditions or status of key characteristics used to assess accomplishments and progress toward achievement of the selected Forest Plan components.

- Evaluate relevant assumptions, changed conditions, management effectiveness, and progress towards achieving the selected desired conditions, objectives, and goals described in the Forest Plan.
- Assess the status of previous recommended options for change based on previous monitoring and evaluation reports.
- Document any scheduled monitoring actions that have not been completed and the reasons and rationale why it has not.
- Present any new information not outlined in the current plan monitoring program that is relevant to the evaluation of the selected monitoring questions.

How to Use this Report

This report is a tool and a resource for the Forest Service to assess the condition of Forest resources in relation to Forest Plan direction and management actions. It is also a tool and a resource for the public to learn more about how the Forest Service is managing Forest resources.

The biennial monitoring evaluation report is designed to help the public, Tribal entities, stakeholders, and federal, state, local governments anticipate key steps in the overall monitoring program. The biennial monitoring evaluation report is also intended to help people better understand reported results in relation to past monitoring reports, future monitoring reports, and the broader-scale monitoring strategy that is issued at the Forest Service regional level.

The White River National Forest will make this report available for public review and feedback. The Forest is also interested in how members of the public feel that the Forest Supervisor should incorporate this information into decision making. The forest will accept public comments from the monitoring project page at https://www.fs.usda.gov/detail/whiteriver/landmanagement/?cid=fsbdev3_001228. Individuals and organizations are strongly encouraged to submit feedback.

The goal is to receive constructive feedback on how the Forest can utilize limited Forest Plan monitoring resources and take advantage of existing datasets and monitoring information. The monitoring program welcomes public participation per the Forest Service Handbook (FSH 1909.12_42.14) “to obtain public feedback on what the monitoring information suggests about the effectiveness of the land management plan.”

About the Forest Plan Monitoring Program

Roles and Responsibilities

The Forest Plan Monitoring Program requires a coordinated effort of many people. It includes people who collect the data, people who analyze the data and report results, people outside the Forest Service who provide feedback and assistance, and agency decision makers who apply the results. A list of contributors to this report is found in Appendix B: List of contributors.

How the Forest Plan Monitoring Program Works

Monitoring and evaluation requirements are established through the National Forest Management Act (NFMA) at 36 CFR 219. Additional direction is provided by the Forest Service in Chapter 30 – Monitoring – of the Land Management Handbook (FSH 1909.12).

Monitoring of the Forest Plan has occurred since it was adopted in 2002. For a copy of previous monitoring reports and for information about the monitoring program go to https://www.fs.usda.gov/detail/whiteriver/landmanagement/?cid=fsbdev3_001228.

This 2020-22 biennial monitoring evaluation report uses a new framework that is in line with the 2012 Planning Rule and follows the amendment to the Forest Plan made in 2016. Monitoring questions and indicators were selected to inform the management of resources on the plan area and not every plan component was determined necessary to track [36 CFR 219.12(a)(2)]. See the Plan Monitoring Program at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd500459.pdf for discussion on how the monitoring questions were selected to be consistent with the 2012 planning regulations 36 CFR 219.12. Providing timely, accurate monitoring information to the responsible official and the public is a key requirement of the plan monitoring program. This 2020-22 biennial monitoring evaluation report is the vehicle for disseminating this information.

In the context of forest planning there are three main monitoring goals:

- Implementation monitoring - Are we implementing the Forest Plan properly? Are we meeting our management targets and project guidelines?
- Effectiveness monitoring - Are we achieving our Forest Plan management goals and desired outcomes? If not, how, and why?
- Validation monitoring - Do our hypotheses testing indicate we may need to change the Forest Plan? To what extent? In what direction?

Implementation monitoring is important for tracking progress and accomplishments; however, it is effectiveness and validation monitoring that drive and support the adaptive management process. Effectiveness monitoring evaluates condition and trend relative to desired conditions. Validation monitoring tests hypotheses and provides information that might necessitate changes to desired conditions in the plan (e.g. is what we think the desired state should be accurate?).

Monitoring Evaluation

Monitoring Activities

The following sections present the most current information (data and evaluations) for all monitoring questions contained within the WRNF Monitoring Plan. The monitoring plan contains 23 questions. All twenty-three questions were updated during the current evaluation period 2020-2022 with the most recent available data and have had their associated discussions updated in the next section of this report.

This section and all its subsections describe the details of how monitoring data were collected, reported, and evaluated for the Monitoring Plan to support the recommendation options. This section displays the summary of data results compiled for each monitoring item. The organization of this section follows the organization of the monitoring program contained within the Forest Plan.

Questions in the 2016 Monitoring Plan Strategy have reporting intervals ranging from one to five years. This report includes questions scheduled for reporting after the adoption of the updated monitoring plan through 2022. Results for questions that have reporting intervals longer than two years are not included in this report, except for those that depend on periodic reports. This information

will be updated in the next biennial report. As described in the 2016 Monitoring Plan Strategy, 23 questions are spread over the eight required monitoring categories:

i. Watershed conditions
ii. Ecological conditions
iii. Focal species
iv. Ecological conditions for at-risk species
v. Visitor use, visitor satisfaction, and recreation plan objectives
vi. Climate change measures and other stressors
vii. Forest Plan desired conditions and objectives
viii. Management and productivity of land (soils)

Each monitoring item includes 1) a summary of the monitoring question and its indicators; 2) an evaluation of the monitoring results, discussion, and findings; and 3) an adaptive management finding on whether recommendation options could be considered for future changes or not.

I. The status of select watershed conditions

Monitoring Item 1.1: Watershed Condition Framework

Monitoring Question and Background

- Is the unit improving condition in priority watersheds?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Frequency of data a) collection b) reporting	Targets or thresholds
Goal 1, Objective 1a: "Improve and protect watershed conditions to provide the water quality and quantity necessary to support ecological functions and intended beneficial uses."	Completion of the number and percentage of essential projects identified in Watershed Restoration Action Plan(s).	USFS Watershed Condition Framework (WCF). Watershed Condition Assessment Tracking (WCATT) database	a) Every 6 years for WCF and annually for WCATT; b) Every 6 years for WCF and annually for WCATT;	Condition class of select watersheds is maintained or improved over the life of the Forest Plan

Monitoring Results

The US Forest Service's "Watershed Condition Framework" (WCF) is used to assess the overall watershed condition of all sub-watersheds on the Forest, prioritize restoration efforts, and track progress toward improving watershed condition on National Forest System (NFS) lands (USDA Forest Service, 2011a). Within the WCF framework, several priority watersheds are designated that require the preparation of a Watershed Restoration Action Plan (WRAP). These are programmatic documents that identify essential projects needed to improve conditions in priority watersheds. Completion of WRAPs and essential projects are used to evaluate progress toward meeting Forest Plan goals and

objectives related to maintaining and improving watershed conditions. Figure 1 shows the location of priority watersheds on the WRNF, and Table 2 summarizes WRAPs and essential projects. In Figure1, green represents watersheds in best condition (Condition Class 1 – Functioning Properly) and yellow represent watersheds in moderate condition (Condition Class 2 – Functioning at Risk). The WRNF has no watersheds in the lowest condition class (shown in red – Impaired Function). Blue stars indicate WRNF priority watersheds.

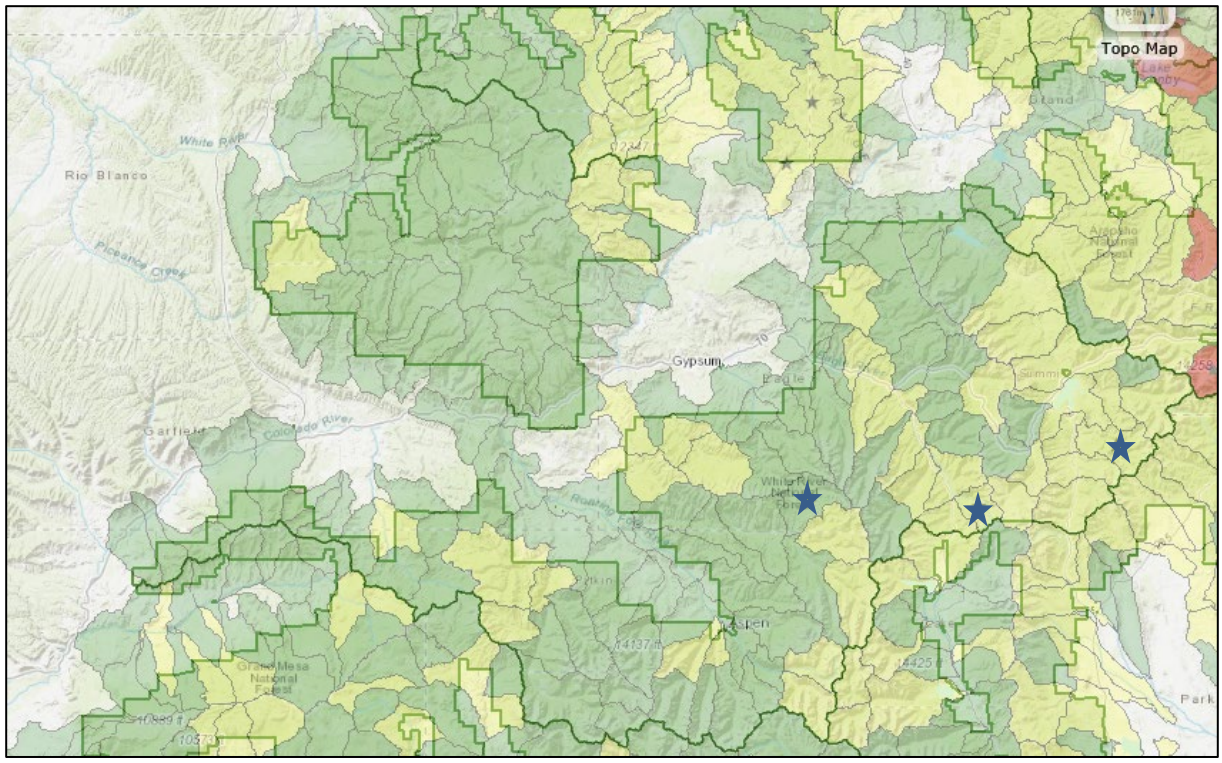


Figure 1. WRNF watershed condition classification and priority watersheds.

Green represents watersheds in best condition (Condition Class 1) and yellow represent watersheds in moderate condition (Condition Class 2). The WRNF has no watersheds in the lowest condition class (shown in red). Blue stars indicate WRNF priority watersheds.

Table 2. Summary of Watershed Restoration Action Plan implementation.

Sub-basin (HUC-8)	Sub-watershed (HUC-12)	WRAP Approval Date	Number of Essential Projects	Number of Essential Projects Completed	Estimated Completion Date of All Essential Projects
Roaring Fork	Lime Creek	24 Oct 2011	5	4	30 Sept 2024
Eagle	East Fork Eagle	01 Sept 2012	4	2	31 Oct 2028
Blue	Swan River	31 Aug 2012	3	2	31 Oct 2020
Eagle	Turkey Creek	Still in Draft	7	3	31 Oct 2028

Monitoring Discussion and Findings

The Forest has identified four priority watersheds for restoration with associated Watershed Restoration Action Plans (WRAPs) and restoration efforts are underway. Table 2 shows that significant

progress has been made on the approved WRAPs; most of the remaining projects are either very large, expensive and time consuming or are the responsibility of partner agencies, such as cutthroat trout reintroduction by Colorado Parks and Wildlife.

The USFS activities in the Lime Creek are complete, but one project remains that will be accomplished by Colorado Parks and Wildlife in 2024. Progress continues in the Swan River; funding was recently received to continue the remaining projects in 2023 and beyond. Funding for Turkey Creek projects was also received in late 2022, which will significantly increase the pace of project implementation in the next three years. Efforts in the Upper Eagle River at Camp Hale have been re-initiated with funding from the Collaborative Aquatic Landscape Restoration Program. Several issues are still outstanding. Prior to implementation asbestos cleanup by the U.S. Army Corps of Engineers is needed, while discussions continue with the State Historic Preservation Office on how to best restore aquatic conditions at Camp Hale while honoring the historical significance of the World War II military base. The recent declaration of the Camp Hale – Continental Divide National Monument (CHCDNM) should not effect the restoration.

The Forest intentionally prioritized large-scale and expensive restoration in watersheds that include Camp Hale and the historic dredge boat mining in the Swan River. This was done to bring attention to these large projects, knowing that completion would take a decade or more. While progress is slow in these watersheds, the conditions are being improved with each essential project completed, consistent with the goal of improving watershed conditions.

Adaptive Management Considerations

The monitoring shows that progress is being made to improve conditions in priority watersheds consistent with Forest Plan goals and objectives. Since the WCF is only updated every six years, it is not a particularly sensitive baseline of comparison; however, priority watersheds with associated essential projects can be designated at any time and tracked under this monitoring question. As such, no adaptive changes to the Forest Plan, WCF program or this monitoring question are anticipated at this time.

Monitoring Item 1.2: Watershed Condition Class

Monitoring Question and Background

- Is the unit maintaining or improving watershed condition class in non-priority watersheds?

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Frequency of data a) collection b) reporting	Targets, thresholds
Goal 1, Objective 1a. Strategy 1a.3 Over the life of the plan, monitor watershed condition in all watersheds. Evaluate degraded watersheds for improvement potential. Where restoration work has been applied, assess trends towards positive watershed condition."	Percentage of sub-watersheds maintained or improved.	Watershed condition framework	a) As conditions change, e.g. wildfire, floods, insect and disease outbreaks, large-scale restoration, etc. b) 6 years	Condition class of all watersheds is maintained or improved over the life of the Forest Plan

The WCF uses a suite of 12 indicators that reflect the condition of the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. These indicators include the physical aquatic metrics of water quality, water quantity and aquatic habitat; aquatic biological metrics of aquatic biota and riparian/wetland vegetation; terrestrial physical metrics related to the condition of roads, trails and soils; and terrestrial biological metrics for fire regime, forest and rangeland vegetation, invasive species and forest health. Each indicator has sub indicators which are assigned a numeric rating, all of which are summed and averaged to give a condition class rating for each watershed.

Monitoring Results

Class 1watersheds – those Functioning Properly - have an ecological structure, function, and composition that are comparable to natural wildland conditions. Class 2 watersheds are "Functioning at Risk", and Class 3 watersheds have highly Impaired Function. Figure 2, which summarizes the condition of all sub-watersheds on the Forest, shows the proportion of watersheds in Class 1 and Class 2 condition classes. There are no watersheds on the WRNF in the lowest condition class.

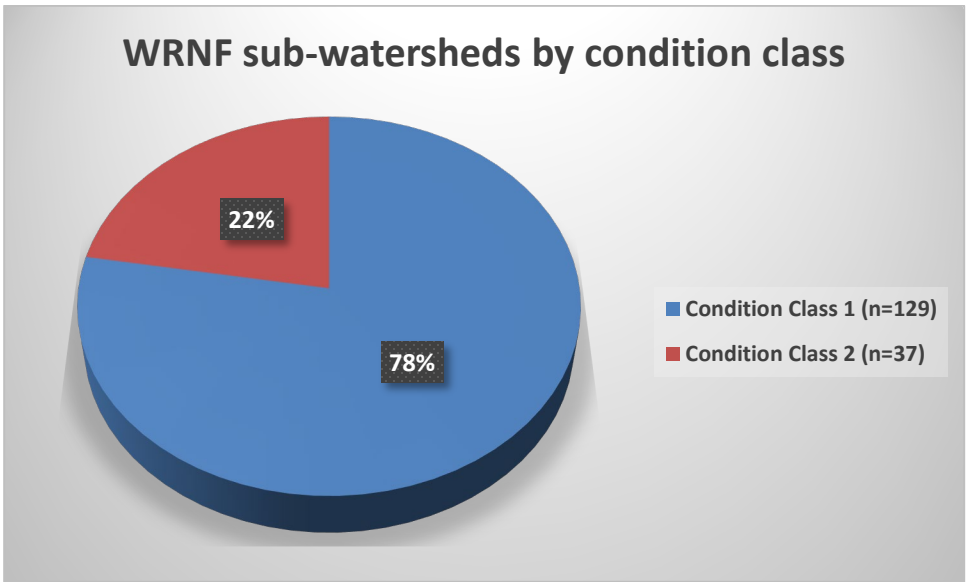


Figure 2. Proportion of WRNF HUC-12 (sub-watersheds) by condition class.

Monitoring Discussion and Findings

Watersheds in the highest Condition Class account for 78 percent of the total on the White River National Forest. Of the 22 percent of watersheds in Condition Class 2, most are impacted by roads, urbanization and/or invasive species. These current figures serve as a baseline for future biennial reporting.

Since the last monitoring period, wildfires occurred in Glenwood Canyon, Sylvan Lake Area, Ptarmigan area near Silverthorne, and near the Lake Christine Wildlife Area in Basalt, potentially affecting aquatic resources in the Colorado and Fryingpan rivers. Thunderstorms caused several post-fire debris flows that delivered significant amounts of sediment to the Colorado River, affecting Interstate 70 and closing the highway in Glenwood Canyon. The five affected sub-watersheds were Grizzly Creek, No Name Creek, Glenwood Canyon, Blue Creek-Roaring Fork River, and Mill Creek-Cattle Creek, all of which had at least 10 percent of the watershed burn. Only two watersheds had burn acreages and intensities that caused a change in ratings for Element 7.1 - Soil Productivity or Element 9.1 - Loss of Forest Cover. In both cases, the Element ratings dropped from Good to Fair, but neither

caused the overall watershed rating to change. Glenwood Canyon remained in Condition Class 1 and Mill Creek-Cattle Creek remained in Condition Class 2.

Since these were natural events and vegetation and soil conditions will slowly recover, and the river will digest and redistribute the sediment deposits, conditions are expected to recover on their own. Recovery efforts should be accelerated by the sediment removal work in the Colorado River to protect Interstate 70 and by the planned soil amendment work to promote soil and vegetation recovery.

Adaptive Management Considerations

The monitoring shows a snapshot of conditions from when the Watershed Condition Framework assessment was completed in 2010. Since overall rating changes are slow to occur, progress toward Forest Plan goals and objectives cannot be demonstrated in this biennial report. The exception is the impact from wildfire discussed previously.

Since the WCF is only updated every six years, it is not a particularly sensitive baseline of comparison to show progress toward watershed improvement goals. Ground disturbing activities and restoration work are simultaneously occurring in many watersheds across the Forest in any given year, yet the net effects of these activities are not large enough to cause a change in condition class. It can be argued that too much resolution is being requested from this national dataset. As such, to be an effective monitoring question, analysis in subsequent years may require that project level data be evaluated in affected watersheds with a determination of whether overall condition was decreased, maintained, or improved. WCF metrics may need to be updated annually to keep track of numeric or categorical changes in each watershed. As such, no adaptive changes to the Forest Plan are anticipated at this time, but elements of the WCF program and this monitoring question may need to be modified to provide meaningful results for subsequent biennial reports.

Monitoring Item 1.3: National Watershed Best Management Practices Program

Monitoring Question and Background

- Are Best Management Practices (BMPs) implemented, and are they effective at protecting water quality?

The purpose of Best Management Practices (BMPs) is to avoid, minimize, or mitigate adverse effects to soil, water, and riparian resources that may result from land management activities in or adjacent to aquatic ecosystems.

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Frequency of data a) collection b) reporting	Targets, thresholds
Goal 1, Objective 1a: "Improve and protect watershed conditions to provide the water quality and quantity necessary to support ecological functions and intended beneficial uses."	Monitoring protocol rating system categories	National Best Management Practices for Water Quality Management on National Forest System Lands (2012)	a) Annually b) 2 years	All prescribed BMPs in the National Core Technical Guide are fully implemented and effective for each evaluation

Monitoring Results

Since 2015, the WRNF has monitored the implementation and effectiveness of BMPs with nationally consistent protocols. The National BMP Program consists of four main components: 1) a set of National Core BMPs, 2) a set of standardized monitoring protocols to evaluate implementation and effectiveness of those BMPs, 3) a data management and reporting structure, and 4) corresponding national direction.

Monitoring protocols are available for Forest management activities related to aquatic restoration, chemical uses, facilities management, fire, minerals and mining, rangeland management, developed and dispersed recreation, roads management, vegetation management, and water uses. Each year the Forest completes at least ten formal monitoring evaluations, five of which are assigned by the Regional Office, the other five are selected by the Forest. Both implementation monitoring (if BMPs were implemented) and effectiveness monitoring (if BMPs were effective at protecting aquatic resources) can be evaluated for each activity. Table 3 summarizes the monitoring activities evaluated over the reporting period.

Table 3. Forest management activities monitored on WRNF in fiscal years 2019-2022.

Activity by BMP Monitoring Code	Description	Number of Evaluations
AqEco_A	Active Construction of Aquatic Ecosystem Improvements	1
Fac_D	Completed Facility Reclamation	1
Fire_A	Use of Prescribed Fire	1
Fire_B	Wildfire Management Actions	1
Min_B	Active Non-Placer Mineral Operations	1
Rec_A	Developed Recreation Sites	1
Rec_E	Motorized Vehicle Use Areas	1
Rec_H	Completed Ski Area Construction or Reconstruction	3
Road_A	Active Road or Waterbody Crossing Reconstruction	4
Road_C	Road Operation and Maintenance	1
WatUses_D	Active Construction of Diversion and Conveyances	2
	TOTAL	**17**

The results from applying the monitoring protocols are summarized below in Figure 3 for implementation monitoring and in Figure 4 for effectiveness monitoring. Figure 3 shows the extent to which required BMPs were implemented across the range of projects. Figure 4 shows how effective required BMPs were at protecting aquatic resources from a variety of land management activities.

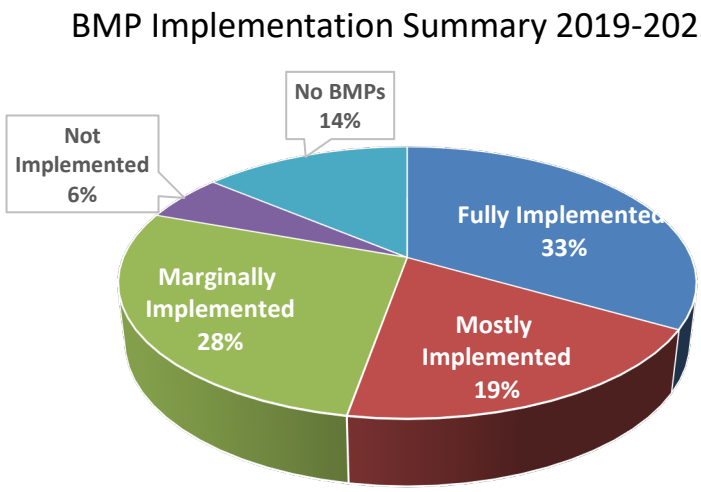


Figure 3. Results from BMP implementation monitoring sites for fiscal years 2019-2022.

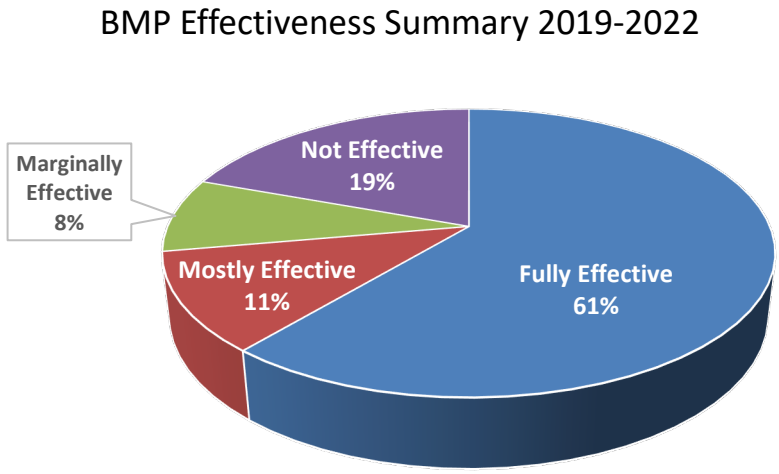


Figure 4. Results from BMP effectiveness monitoring sites for fiscal years 2019-2022.

Monitoring Discussion and Findings

The results shown in Figures 3 and 4 suggest that the implementation and effectiveness of accepted BMPs have protected aquatic resources to a degree but are falling short of complete compliance. Implementation monitoring displays room for improvement, especially in the mostly implemented category with only 19%. Effectiveness of the prescribed BMPs show that 72% of those applied were fully or mostly effective. While this is encouraging, the intent is for the practices to be 100% effective at protecting aquatic resources. More analysis is required to determine if the shortcoming is due to the efficacy of the BMP itself, or if the BMP was not precisely implemented.

Adaptive Management Considerations

The monitoring shows that progress is being made to improve and protect watershed conditions consistent with Forest Plan goals and objectives, although there is room for improvement. The data

collection methodology and monitoring question appear to be sufficiently scaled to reach meaningful conclusions about if and how well management actions are mitigated to protect aquatic resources. As such, no adaptive changes to the Forest Plan, BMP program or this monitoring question are anticipated at this time.

II. The status of select ecological conditions

Monitoring Item 2.1: Air Quality

Monitoring Question and Background

- What are the conditions and trends for visibility in Class I and selected Class II areas on the unit?

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Frequency of data a) collection b) reporting	Targets, thresholds
Physical, Air Resources, Standard 1. "Meet state and federal air quality standards and comply with local, state, and federal air quality regulations and requirements either through original project design or through mitigation for such activities…."	Haze and visibility at Ajax IMPROVE monitoring site	IMPROVE / Federal Land Manager Environmental Database	a) Weekly b) 2 years	Maintain or improve visibility in Class I areas

Monitoring Results

Visibility monitoring has been conducted on the WRNF at Ajax Ski Area in Aspen, CO since 2001 as part of the Interagency Monitoring of Protected Visual Environments program (IMPROVE). IMPROVE stations monitor concentrations of atmospheric aerosols, such as sulfates and nitrates. Visibility is calculated using the "deciview" index, which measures the degree to which light is absorbed or scattered by air pollution. A deciview value of 1 reflects a measure of change in visibility that is perceptible to the human eye. A low deciview reflects high visibility, while a high deciview number reflects low visibility. Results are shown below in Figure 5, Figure 6, and Figure 7. Annual data representing the clearest days are the average of the clearest 20 percent of samples collected in a year. Similarly, data for the haziest days are the average of the haziest 20 percent of samples over the year.

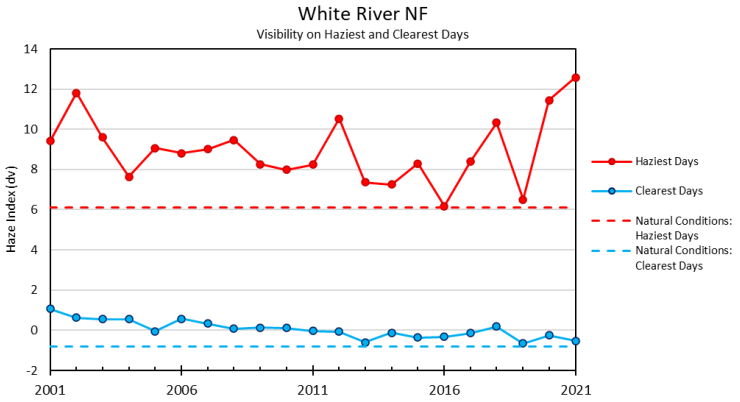


Figure 5. Trends in visibility for the haziest and clearest days on WRNF from 2001 to 2021.

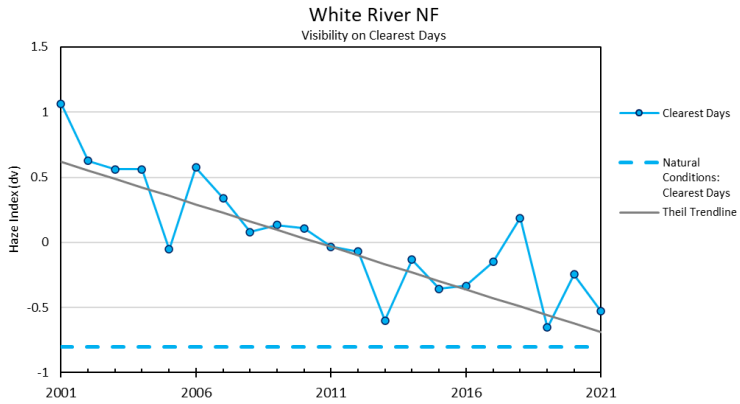


Figure 6. Visibility measurements on clearest days from 2001-2021 show a statistically significant trend of improvement.

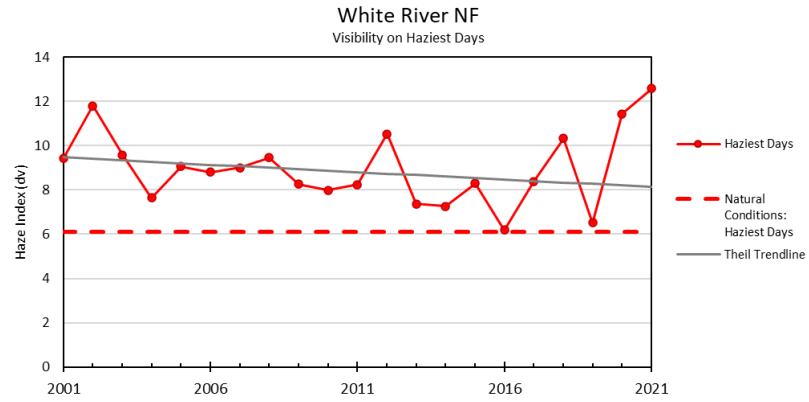


Figure 7. Visibility measurements on haziest days from 2001-2021 show a statistically significant trend of improvement.

Monitoring Discussion and Findings

IMPROVE monitoring results for both the haziest and clearest days indicate a decreasing trend in haze over time, particularly for the haziest days. The regression line for the haziest days shows a decrease in haze of -0.06 deciviews/year, while the same data for the clearest days show an improvement in visibility over time of -0.06 deciviews/year. Note that years with the most significant haze are periods of extreme drought and associated fire activity (i.e. 2002, 2012, and 2020). This long-term data set serves as the monitoring baseline going forward. It should be noted that while some Forest

management activities can affect visibility, these measured values are influenced by activities well beyond and outside the control of the WRNF.

Adaptive Management Considerations

The monitoring shows that visibility in Class 1 areas is being maintained or improved, consistent with Forest Plan goals and objectives. The data collection methodology and monitoring question provide the means to reach meaningful conclusions about trends in air quality, even though there may be no direct link between forest management activities occurring at a local scale and air quality values that assess conditions for an airshed much, much larger than the WRNF. No adaptive changes to the Forest Plan, IMPROVE program or this monitoring question are anticipated at this time.

Monitoring Item 2.2: Forest and Rangelands Health

Monitoring Question and Background

- What are the status and trends of insects and disease in and around the plan area?

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Freq. of a) data collection b) reporting	Targets, thresholds
Goal 1, Objective 1d "Increase the amount of forest and rangelands restored to or maintained in a healthy condition with reduced risk and damage from fires, insects, disease, and invasive species."	Type of Outbreak, acres and location in Canada lynx habitat (lynx analysis unit = LAU)	Maps and GIS shapefiles at http://www.fs.usda.gov/detail/r2/forest-grasslandhealth/ R2 Insect/Disease Aerial Detection Flight Data Colorado State Forest Service	a) annually b) every four years	The SRLA's Veg standard S1, LAU has no more than 30 percent of its lynx habitat in a currently unsuitable condition

Monitoring Results

Insect and disease outbreaks are monitored annually by the Region 2 Forest Health Monitoring program through aerial surveys. Insects, disease and wildfire are agents which contribute to forest and ecosystem health. These agents tend to ebb and flow over time, and are dependent upon structural and weather patterns. Figure 8 and Table 4 show the status and trends of disturbance agents from 2016-2022. Insect and disease are broadly tracked through annual aerial surveys.

Subalpine fir mortality has trended downward since 2016. Western balsam bark beetle and Armillaria root disease are the two primary agents responsible for this mortality and will continue to be present within cover types that include spruce and subalpine fir.

Western Spruce budworm activity is also trending downward, but still present in spruce-fir vegetation cover types. This agent attacks the foliation of mainly younger trees. While generally affecting tree vigor, spruce budworm causes tree mortality where heavy infestation occurs.

Aspen defoliation is trending downward from 2016 according to aerial surveys, though still present in 2022. Defoliation agents such as tent caterpillar, Marssonia leaf blight and large aspen tortrix are likely responsible for aspen defoliation observed across the Forest.

Douglas-Fir beetle is trending downward since 2016 but still active in clustered pockets in Pitkin, Eagle and Rio Blanco counties. The highest concentration of new beetle activity is between Basalt and Aspen. Douglas-fir cover type is somewhat limited to elevations in the 7500-8500 foot range and on steeper valley slopes. Douglas-fir beetle has affected a larger percentage of this cover type across the Forest in relation to the availability of the cover type.

Spruce bark beetle mortality is low, considered normal and populations are endemic. 2022 flight surveys showed an increase in new beetle activity in the Sawatch Range between Aspen and Leadville. There is an abundant spruce-fir cover type to carry an outbreak if biotic and abiotic conditions align.

Mountain pine beetle and western pine beetle activity was minimal and barely noticeable from 2016-2022.

Wildfire activity increased from 2016-2020. The Forest experienced several large fire events where fuel, topography and weather conditions aligned. Wildfire activity declined in 2022 as weather patterns normalized and an active monsoonal summer rain pattern was present.

Table 4. Major damage agents detected in aerial surveys on WRNF 2016-2022.

Agent	2016 Acres Affected	2017 Acres Affected	2020 Acres Affected	2021 Acres Affected	2022 Acres Affected
Subalpine fir mortality	37,000	20,000	3,500	6,800	9,600
Western spruce budworm	22,000	13,000	220	30	4,500
Aspen discoloration and defoliation	7,400	10,200	370	200	1,400
Douglas-fir beetle	3,800	2,300	820	1,600	1,600
Spruce beetle	230	160	160	110	210
Mountain pine beetle	-	10	-	10	20
Western pine beetle	100	-	-	-	-
Total	70,530	45,670	5,070	8,750	17,320
Wildfire	-	20,709	34,499	-	3,887

2020 only 63% of the Forest was flown with detection surveys, data limited
Wildfires: 2020 sum of wildfires from 2018-2020
Wildfires: 2022 sum of wildfires from 2021-2022

Monitoring Discussion and Findings

Insect and disease trends across the Forest for the most part are stable. Douglas-fir beetle impacts have nearly doubled since 2020 and are visible throughout the lower valley watersheds on the WRNF. Subalpine fir and aspen have also seen an increase in the amount of mortality across the landscape but are still considered at normal levels. Insects and disease are a normal function of Forest ecology and shape the structural composition of the Forest.

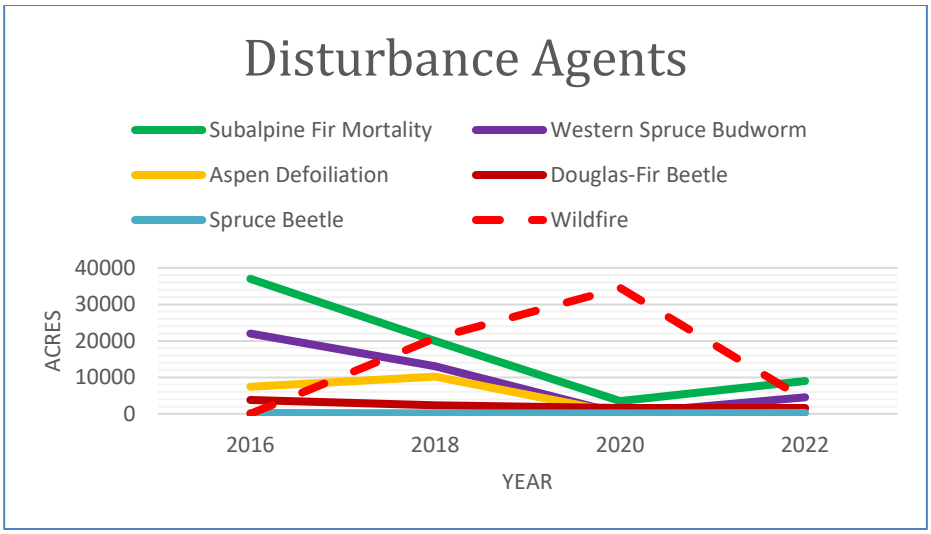


Figure 8. Insect, Disease and Wildfire activity mapped by aerial survey on WRNF 2016-2022.

There are not currently any damaging agents increasing to outbreak levels in any one forest vegetation component. Current rates of insect and disease impact are less than 30 percent on lynx analysis units (LAU) across the Forest. It has been determined that no changes to the Forest Plan or monitoring program are warranted at this time based on the current monitoring data.

Adaptive Management Considerations

Damaging agents fluctuate in their scope and intensity over time and will always be present on the forested landscape. Some agents have concentrated effects on tree mortality while other agents have a broader effects across the landscape. Forest managers consult with Gunnison Service Center forest health biologists when considering forest management actions and their probability of success to suppress damaging agents. The overall goal is to have a diverse forest structure with a variety of tree species and age classes distributed across the Forest to minimize the effects of any one damaging agent reaching outbreak levels. Silvicultural treatments using prescribed fire, timber harvest, mastication and other treatment methods can be implemented to meet desired future conditions for an identified landscape and within standards/guidelines of the 2002 Forest Plan. If any LAU has no more than 30 percent of its lynx habitat in a currently unsuitable condition, then vegetation management projects should not move additional acres into a stand initiation stage.

Monitoring Item 2.3: Ecosystem Health

Monitoring Question and Background

- How are major vegetation types on the planning unit changing over time?

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Freq. of a) data collection b) reporting	Targets, thresholds
Goal 1, Objective 1d "Increase the amount of forest and rangelands restored to or maintained in a healthy condition with	Cover type, ecological site conditions, age class, size class, and structural stages of forest,	USFS FSVeg Corporate Database USFS FACTS activities database	a) annually b) every four years	The SRLA's Veg standard S1, LAU has no more than 30 percent of its lynx habitat in a currently unsuitable condition.

reduced risk and damage from fires, insects, disease, and invasive species."	shrubland, and grassland vegetation.	Forest Health monitoring		

Monitoring Results

Forest structure, function, and composition

Monitoring data on vegetation structure, function, and composition is provided by the USFS FSVeg database program. FSVeg compiles the current state of vegetation structure base on stand exam inputs and detection change monitoring. Stand exams occur infrequently across the Forest. Detection changes in vegetation cover occur when noticeable vegetation changes occur on the landscape, most notable wildfires and insect/disease outbreaks. FSVeg will also track land management actions which may convert forest structure, such as prescribed fire and timber harvest treatments.

Figure 9 shows the FSVeg estimates for acres by forested cover type on the WRNF. Other forest cover types do exist and generally have less than 5,000 acres of forested area present. These small forest cover types include bristlecone pine, limber pine, ponderosa pine and cottonwood. The major forested cover types on the WRNF are Engelmann spruce – subalpine fir (Spruce-Fir), Aspen, Lodgepole pine, Douglas-fir and pinyon-juniper, grass/forbs and mountain shrubs.

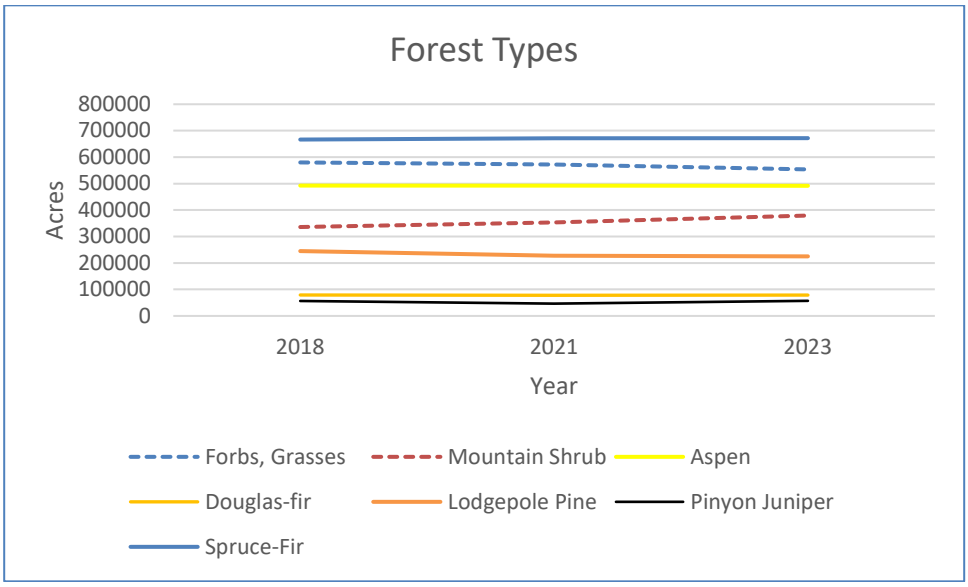


Figure 9. Area of forested acres by forest type.

FSVeg data are estimates and a snapshot of forest conditions across at the point in time when the data was extracted from the database. Forested acres are mostly stable from 2018-2022, except for a slight decline in lodgepole pine acres, likely because these are now classified as another forest type (such as spruce/fir) due to loss of lodgepole basal area. Spruce-fir did see a slight increase in forested acres over this same time period.

Forested ecosystems can be broken out into structural stage vegetative components which provides a snapshot of forest development across a landscape. Structural stages are used to assess current and desired future conditions of forested habitat at both the Forest planning level and project planning level.

Table 5. Forested Structural Stage Definitions

Structural Stage	General	Description
2T	Seedling/Sapling	Small trees, generally less than 6.0 feet in height
3A	Young forest, open canopy	Small/medium size trees, Crown cover percent <40
3B	Young forest, moderately closed canopy	Small/medium sized trees, Crown cover percent between 40 and <70
3C	Young forest, closed canopy	Small/medium sized trees, Crown cover percent >= 70
4A	Mature forest, open canopy	Large size trees, Crown cover percent <40
4B	Mature forest, moderately closed canopy	Large sized trees, Crown cover percent between 40 and <70
4C	Mature forest, closed canopy	Large sized trees, Crown cover percent >= 70

Engelmann Spruce-Subalpine fir (Spruce-fir)

Spruce-fir has the largest presence of forested cover type on the WRNF at approximately 672,000 acres (2022) and is relatively evenly split between young forest (3A-3C) and mature forest (4A-4C) composition. Seedling (2T) structural stage is generally only tracked through forest management treatments due to the uneven aged, tree size and species composition development of this forest type.

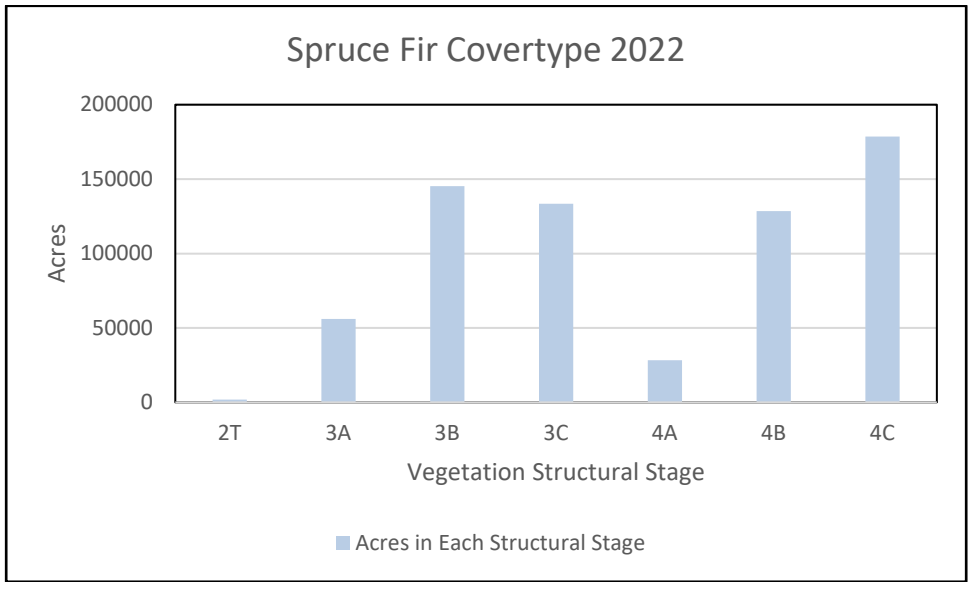


Figure 10. Existing Spruce-fir Vegetation Structural Stages (2022)

Spruce-fir forests are dynamic and long lived. Changes to this cover type are often small-scale with creation of gaps and highly variable stand structures. Large scale insect and disease outbreaks will

often times modify the structural stages of spruce-fir within stages 3A-4C. Wildfire will generally move spruce-fir into another covert type, especially if lodgepole pine and aspen are present. Figure 11 shows the structural stage changes from 2018-2022 in the Spruce-fir cover type for each structural stage. There are acreage gains in the 3A,3B, 4A and 4B structural stages and losses in the 3C and 4C structural stages. Movements in these structural stage changes are most likely due to insects/disease and wildfire disturbance.

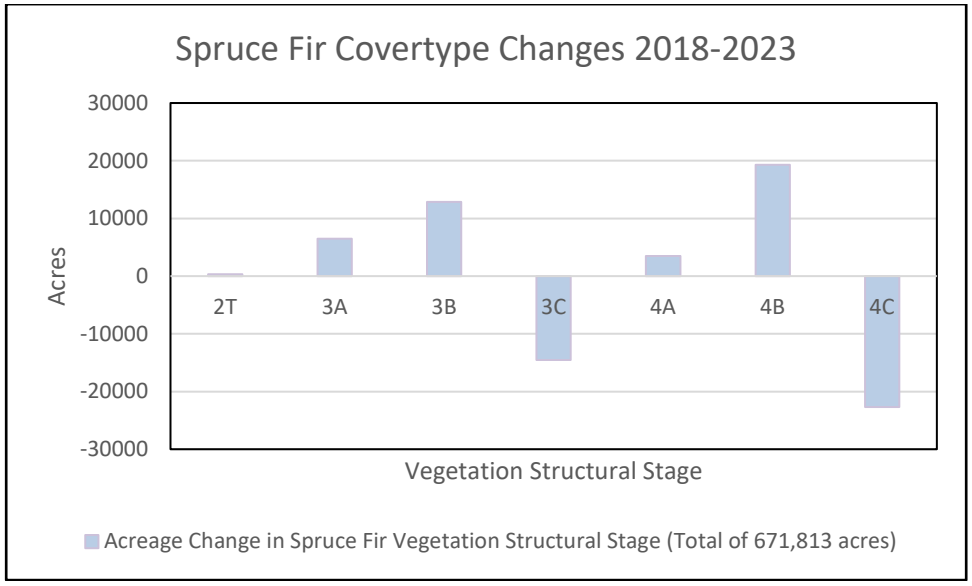


Figure 11. Spruce-fir Vegetation Structural Stage Changes.

Aspen

Aspen is the second largest forested cover type on the WRNF at approximately 492,000 acres. Figure 12 shows that the majority of aspen is in young and mature structural stages.

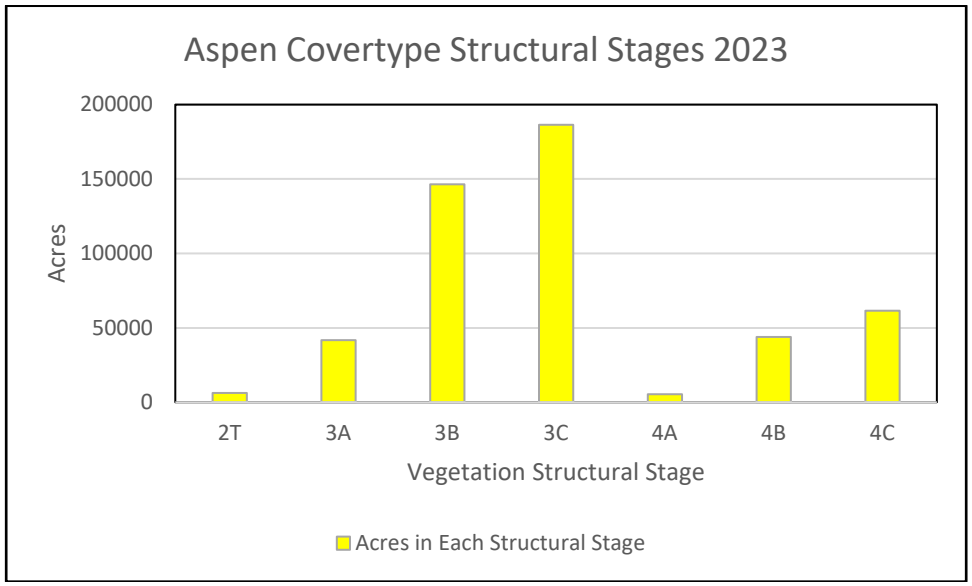


Figure 12. Existing Aspen Vegetation Structural Stages

Aspen is generally a short-lived species and generally establishes itself after a disturbance event. There are stable stands of aspen present on the Forest in the young and mature structural stages. Figure 13 shows the change in structural stages from 2018-2023. This data shows a loss of aspen in the 3B, 3C and 4C structural stages with gains in the 2T, 3A, 4A and 4B structural stages.

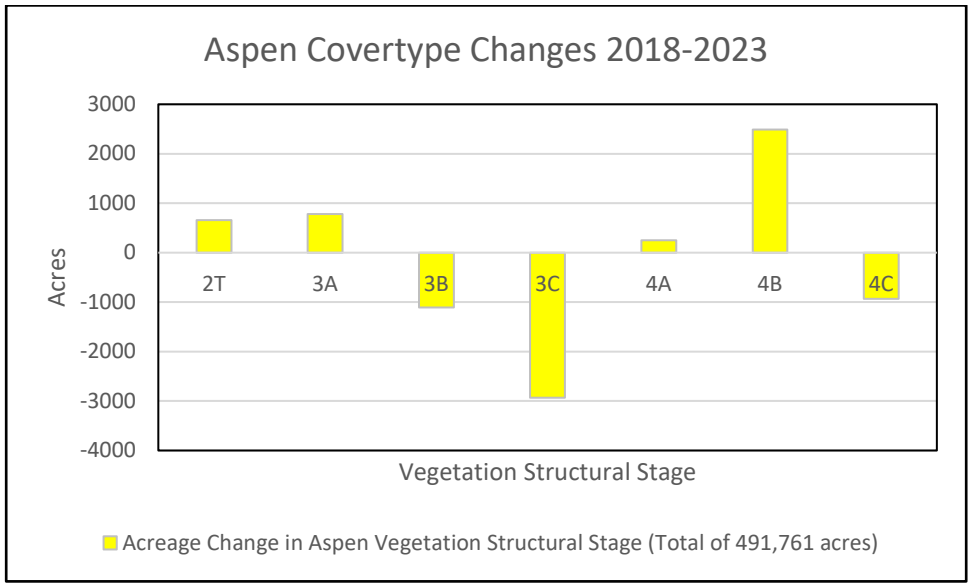


Figure 13. Aspen Vegetation Structural Stage Changes.

Changes in structural changes can be due to timber harvesting, insects/disease and development of forest structure over the 2018-2023 time period. All of these changes are normal and represent less than 0.06% of the total aspen on the Forest.

Lodgepole Pine

Lodgepole pine is the third largest forested cover type on the WRNFWRNF at approximately 271,000 acres. Figure 14 shows that the majority of lodgepole pine is in young and mature structural stages.

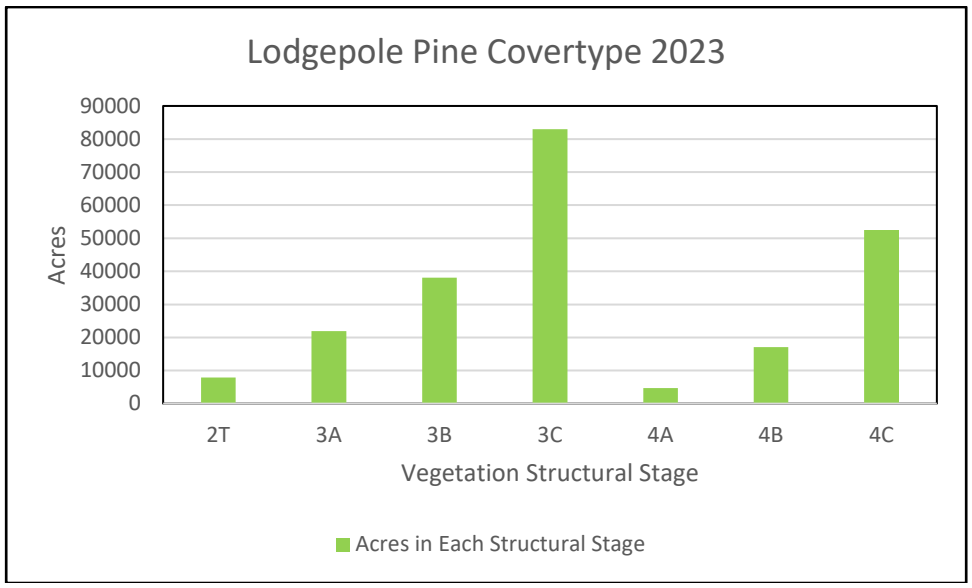


Figure 14. Lodgepole pine Structural Stages.

Lodgepole pine is a short to moderate lived species and relies on wildfire to naturally regenerate itself. Figure 15 shows the change in structural stages from 2018-2023. These data show a loss of lodgepole pine in the 3B, 3C and 4C structural stages with gains in the 2T, 3A, 4A and 4B structural stages.

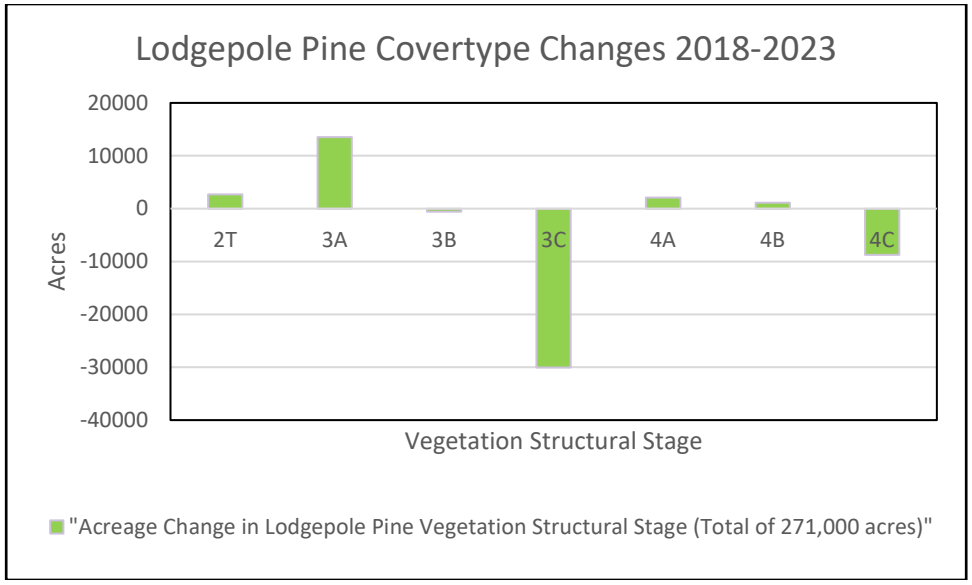


Figure 15. Lodgepole pine Vegetation Structural Stage Changes.

Changes in structural changes can be due to timber harvesting, insects/disease, wildfire and development of forest structure over the 2018-2023 time period. Structural stages 3C and 4C combined lost approximately 39,000 acres or 15% of the total lodgepole pine on the Forest. The majority of the loss was most likely due to wildfire with a minor amount of timber harvest during this time period. Mountain pine beetle had no effect on the loss of young and mature structural stage lodgepole pine. Increase in structural stage 3A acreage is most likely the result of areas hit hard with the mountain pine beetle outbreak (2004-2013) recovering with recruitment of seedling/sapling into a younger forest cohort.

Douglas-fir

Douglas-fir is the fourth largest forested cover type on the FWRNF at approximately 78,000 acres. Figure 16 shows that all Douglas-fir forest is in young and mature structural stages, with about 65% in mature forest.

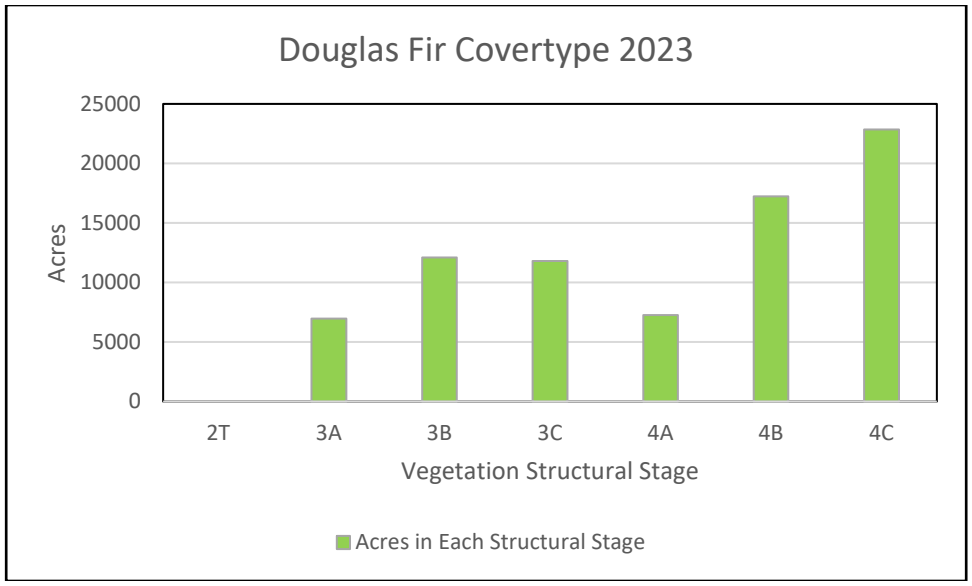


Figure 16. Douglas-fir Structural Stages.

Changes in structural changes in Douglas-fir can be due to insects/disease, wildfire and development of forest structure over the 2018-2023 time period. All structural stages, except for 2T and 4A show a loss of acreage. The combined loss was approximately 860 acres or approximately 1% of the cover type. This loss is most likely due to Douglas-fir beetle which has been consistently affecting Douglas-fir stands on the Forest.

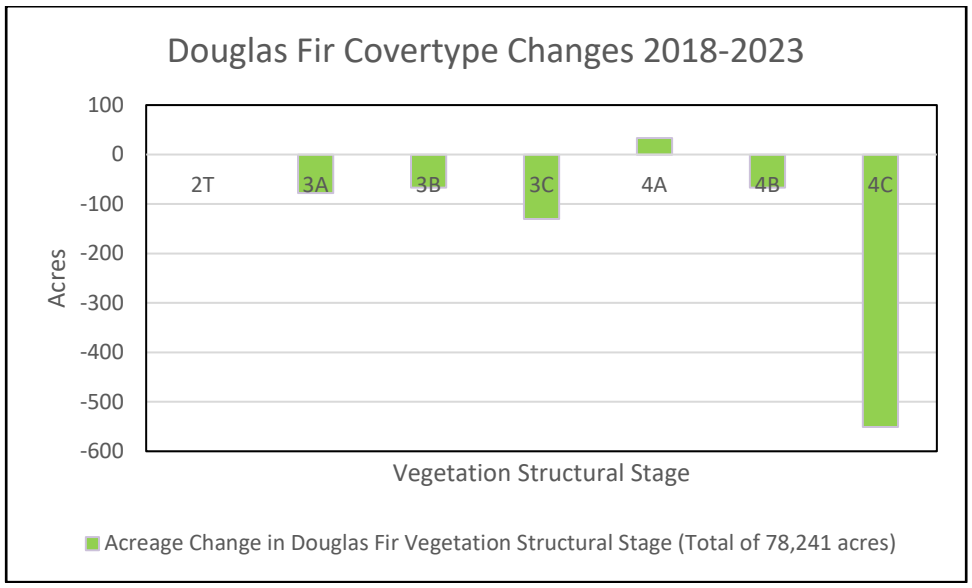


Figure 17. Douglas-fir Vegetation Structural Stage Changes.

Pinyon-Juniper

Pinyon-Juniper is the fifth largest forested cover type on the WRNF at approximately 56,000 acres. Figure 18 shows that all Pinyon-Juniper forest is predominantly in young forest structural stages, with a minor amount in mature forest.

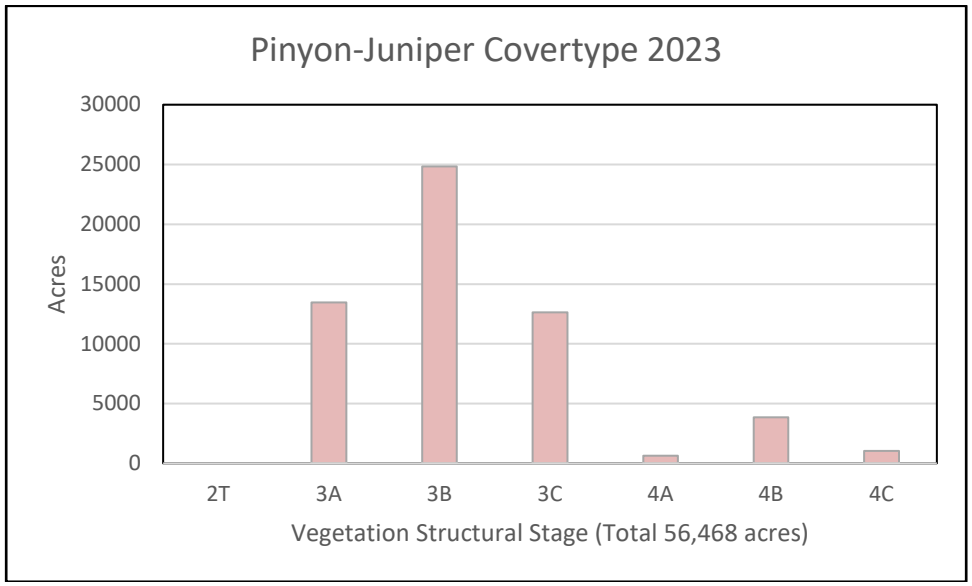


Figure 18. Pinyon-Juniper Structural Stages.

Pinyon-Juniper forests are stable. Very little change is occurring across the structural stage components of this forest cover type. From 2018-2023, data indicates less than 150 acres of pinyon-juniper habitat has declined. This represents approximately 0.002% of the habitat and within normal variability of change.

Monitoring Discussion and Findings

Spruce-fir, aspen and lodgepole pine forests are generally stable across the Forest with the majority of the Forest in younger to mature forest structure. Lodgepole pine experienced about a 15% decline in younger to mature forest structure, most likely due to wildfire events and to a minor degree timber harvest which occurred during the 2018-2022 timeframe. Lodgepole pine is slowly starting to recover from the 2004-2013 mountain pine beetle outbreak as stands of seedling/saplings begin to move into younger structural stage forest. Douglas-fir forests continue to be affected by Douglas-fir beetle. Almost all of the Douglas-fir cover type occurs on steep slopes and is not managed through timber harvest or fuels treatments. Pinyon-juniper forests are stable. Natural processes will continue to occur affecting the mature structural stage components of this forest type. Overall, all vegetation across the Forest is regenerating at acceptable levels. This is a normal progression of forest successional ecology. It has been determined that no changes to the Forest Plan or monitoring program is warranted at this time based on the current monitoring data.

Adaptive Management Considerations

Forest ecosystems on the WRNF are dynamic. Changes to forest structure generally occur slowly over time (10-50 years), except when disturbance events affect large portions of the landscape in short timeframes (1-10 years). The overall goal is to have a diverse forest structure with a variety of tree species and age classes distributed across the Forest. Having a diverse forest structure across the landscape benefits all resources across the Forest. Silvicultural treatments using prescribed fire, timber harvest, mastication and other treatment methods can be implemented to achieve forest structure desired future conditions for an identified landscape and within standards/guidelines of the 2002 Forest Plan. If any LAU has no more than 30 percent of its lynx habitat in a currently unsuitable condition, then vegetation management projects should not move additional acres into a stand initiation stage.

III. The status of focal species

Monitoring Item 3.1: Macro-invertebrates

Monitoring Question and Background

- Is forest management contributing to conditions that maintain or improve biological stream health trends for freshwater riparian macroinvertebrate communities?

Based on several long-term data sets that have indicated static or changing levels of stream health over time, this quantitative monitoring approach gives the Forest a rigorous multi-variate dataset and successfully evaluates biological stream health over time.

Forest Plan Ref./ Driver	Indicators	Data Sources / Protocols / Partners	Freq. of a) data collection b) reporting	Targets, thresholds
Goal 1, Objective 1b "Provide ecological conditions to sustain viable populations of native and desired nonnative species and to achieve objectives for Management Indicator Species (MIS) and focal species.	Aquatic macroinvertebrate richness	USFS Macro-invertebrate surveys	a) Annually b) Biannually	Presence/Absence of indicator species; CDPHE aquatic life standards

Monitoring Results

The WRNF has been sampling benthic macroinvertebrates (aquatic insects) to assess and monitor aquatic ecosystem integrity since 2003. A view of a trend at the scale of the Forest was obtained by aggregating site-level trends from sites scattered across the Forest. Metrics speak to taxa diversity, and a community's degree of tolerance for stressors including dissolved oxygen levels and heavy metals, nutrients, and fine sediment. The measure of aquatic macroinvertebrate richness equates to sustainable ecological health and can be measured by the presence or absence of indicator species.

Because of the number of metrics, the number of factors that can affect aquatic communities, and the natural variability in data collected from the field over the years, determinations were based on a plurality of evidence. If a site had one or two metrics that declined, for example, while the other metrics showed little or no change or improved, that site was considered stable, i.e. no trend one way or the other in habitat quality. If a site had three or more metrics that increased or decreased (about one-third of the metrics examined), that would be evidence to suggest that that site had either improved or deteriorated in terms of habitat quality. The fundamental assumption of this monitoring approach is that sites that "improved" or "deteriorated" are reflecting degrees of disturbance in the watershed upstream of the sampled location. A site that appears to have deteriorated in instream habitat quality thus gets a closer examination to try to determine the validity of the statistical assessment or the nature of the disturbance.

The Forest collects an average of 69 aquatic macroinvertebrate samples per year from across the Forest. Since 2003, 1,297 samples have been collected. Some samples are collected for inventory/survey purposes, others target specific streams or sites of particular interest. At the

beginning of the Multiple Indicator Species (MIS) monitoring program, 59 sites across the Forest were randomly selected for Forest Plan-scale monitoring. The random selection of these sites was vitally important to allow the generalization of information collected from these sites to the Forest as a whole. These sites are now monitored under the Focal Species monitoring program. The Forest samples about 14 of these 59 sites each year, with the aim of repeating sampling, at minimum, each site roughly every five . By 2021, 264 samples had been obtained from these 59 sites since 2003. The following discussion of site/stream status and trend relied only upon data collected from these (originally) randomly selected sites. Samples were collected in 2022, though those data were not available for summary at the time of the writing of this report.

Monitoring Discussion and Findings

Condition/Status Across the Forest.

One way to assess biological impairment of streams using macroinvertebrate data is to evaluate Shannon's Diversity Index ("Diversity" hereinafter) and the Hilsenhoff Biotic Index (HBI), metrics calculated by contractor on behalf of the Forest. The State of Colorado has established benchmarks for these two metrics for cold water streams. If a site has either metric below the benchmarks, that site/stream might be considered impaired. While this is not a perfect measure of impairment, it can be applied uniformly to our macro data over time and provides some indication of important macro community characteristics and thus the watershed conditions that they reflect.

By this measure, an average of 16% of samples collected each year could be considered to reflect "impaired" conditions by either the diversity or HBI metrics. It's important to remember that samples are collected from discrete sites, mere tens- or hundreds of feet in length, to represent generally miles of stream. There will be variation in condition between sites within particular streams, for example, which is an entirely natural phenomenon. The randomization of site selection is the means to overcome this site-specific variation as for every "poor" condition site randomly selected in an otherwise healthy stream, there will be other sites with better than average conditions and thus bias should balance out at the Forest scale. When measuring a complicated set of conditions at many sites over a large area and temporal scale, the conditions measured at every site at every time will not all be ideal, even in a high habitat quality system. This 16% might then be considered the background rate of sampling lower quality habitat conditions at any given place and time. We're also dealing with small sample sizes, so while 13% of samples from MIS sites sampled in 2013 could be considered impaired, that was only one site out of the eight samples collected that year (Figure 19). The use of other metrics including the Colorado Multi-Metric Index (MMI) to assess impairment might alter the estimated level of impaired sites, but the Forest has only recently begun to calculate this metric more widely.

Interestingly, the percentage of samples considered impaired may be increasing (Figure 20). Because observable, watershed- or stream- scale evidence of disturbance at many of these "impaired" sites is absent, it's likely that increases in the rate of impairment might reflect changes in the physical environment, temperatures, precipitation, stream discharge, and even landscape-scale nutrient cycling, more so than effects of forest management. For example, there is little data to support that forest management has altered the conditions of the East Maroon Creek watershed, and yet a site in that stream is showing up on the "impaired" list. Historic management activities associated with impairment, e.g. road development, grazing, or timber harvest are not occurring there. Consequently, at this point specific environmental mechanism(s) driving impairment is thus not clear.

Figure 19. Number of Focal Species samples collected by year and the number of samples that could be considered impaired per Colorado benchmarks for Shannon's Diversity Index and/or HBI, 2003 – 2021.

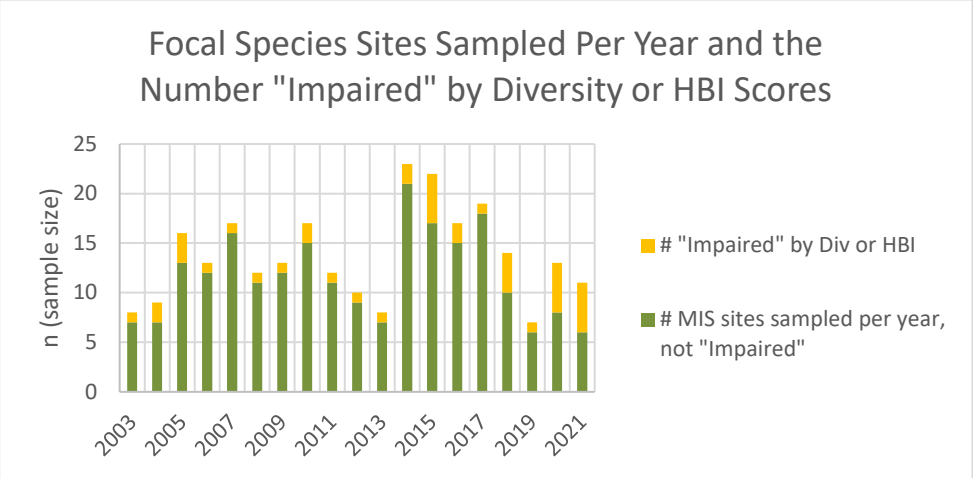
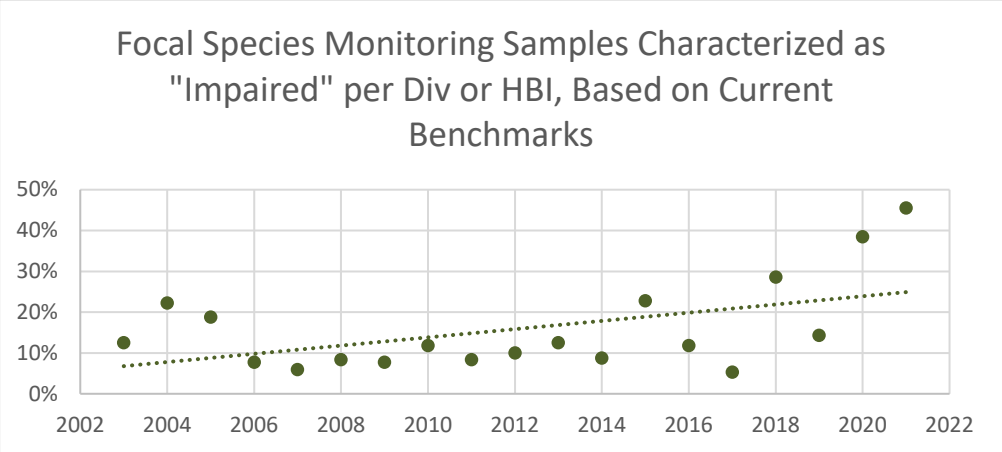


Figure 20. Percentage of samples from Focal Species sites reflecting impaired conditions per year, per Colorado benchmarks for Shannon's Diversity Index and/or HBI, 2003 – 2021.



Trend Analyses

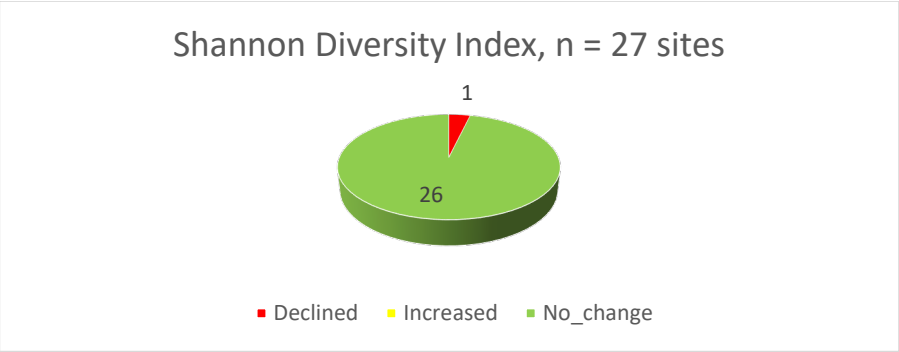
A possible trend in the percentage of "impaired" sites has already been discussed. Other trends of interest can be described by sampling the same sites repeatedly over time to see if those repeated sampling events illustrate changes in metrics that reflect changes in habitat conditions. The status or condition at each site is of less interest in this analysis than a change in those conditions, whatever their starting point. Twenty-seven Focal Species sites have been sampled at least five times over five separate years, producing 185 samples (average = 7.7 samples per site). To examine change at the Forest scale, data from these repeatedly sampled sites were aggregated by year and trends over time were examined. Site level trends examined change over time at each site to see if lumping the data masked site-level changes. Trends were considered statistically significant if the p-value for the slope was less than 0.1 .

Metric: Shannon's Diversity Index

At the Forest level, there was no trend in macroinvertebrate community diversity. That is, at these sites where at least five samples have been collected, diversity has not changed to a significant degree

between 2003 and 2021. At the site level, diversity declined at a single site (one out of 27 sites; Figure 21). A field visit to that site suggested that natural changes to site-scale habitat related to beaver activity was likely responsible for the reduction in diversity at that site.

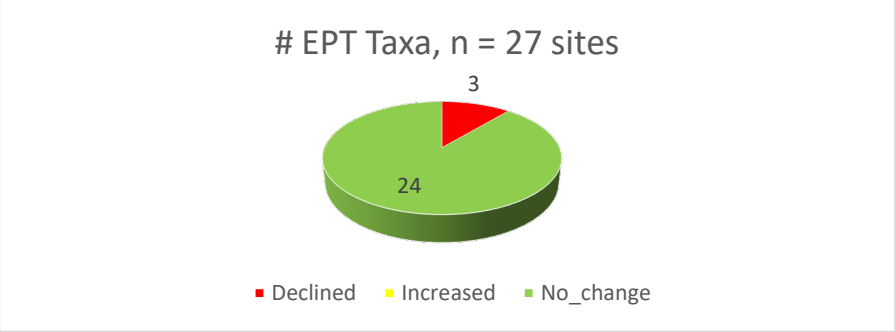
Figure 21. Shannon Diversity Index.



Metric: Number of EPT Taxa

Mayflies, stoneflies, and caddisflies (collectively termed EPT due to their scientific names: (Ephemeroptera, Plecoptera, & Tricoptera, respectively) are taxa sensitive to environmental disturbance. As disturbance increases, the prevalence of these taxa tends to decrease. At the Forest level, the number of EPT taxa did not change significantly over time. When considering the conditions at the individual site over time, the number of EPT taxa declined to a significant degree at 3 of 27 Focal Species sites. (Figure 22). As discussed above the decline at one of the sites may have been due to a response in the change of beaver activity. With only a potential shift at two individual sites, there is not enough evidence to support a need for change in forest management practices.

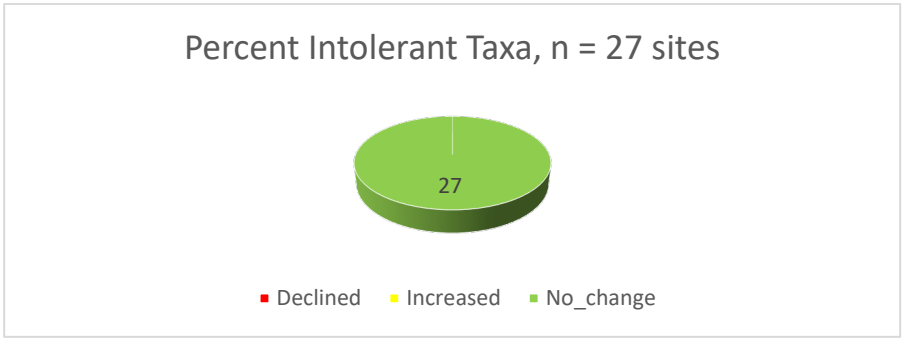
Figure 22. Number of EPT Taxa.



Metric: Percent Intolerant Taxa

The ratio of disturbance intolerant taxa to the total number of taxa sampled can be related to the prevalence of fine sediment and stream temperatures. As fine sediments and stream temperatures increase, the percentage of intolerant taxa in the community decreases. At the Forest level, the percentage of intolerant taxa has not changed over time. No changes were evident at any of the 27 sites with repeated sampling (Figure 23). Forest management practices therefore appear to be maintaining intolerant taxa in streams across the Forest.

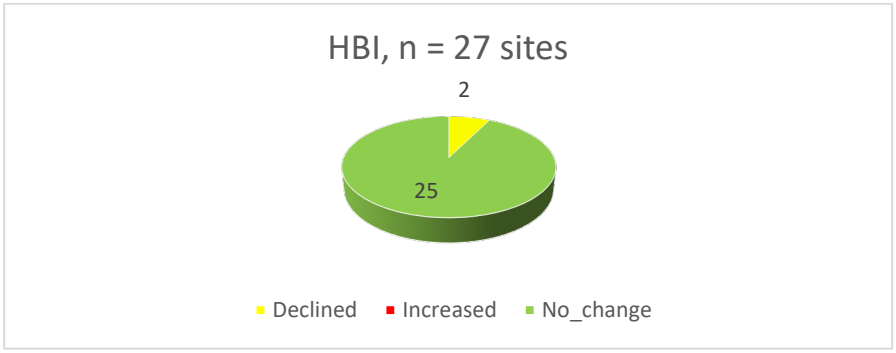
Figure 23. Percent Intolerant Taxa.



Metric: Hilsenhoff Biotic Index

The Hilsenhoff Biotic Index (HBI) reflects responses in macroinvertebrates to organic nutrient pollution. When excessive nutrients occur in a stream, more tolerant taxa of macroinvertebrates are more abundant, thereby increasing the HBI. At the Forest level, HBIs haven't changed since 2003. The HBI decreased at 2 of 27 sites on the Forest, suggesting that excess nutrients have declined at those sites since 2003 (Figure 24).

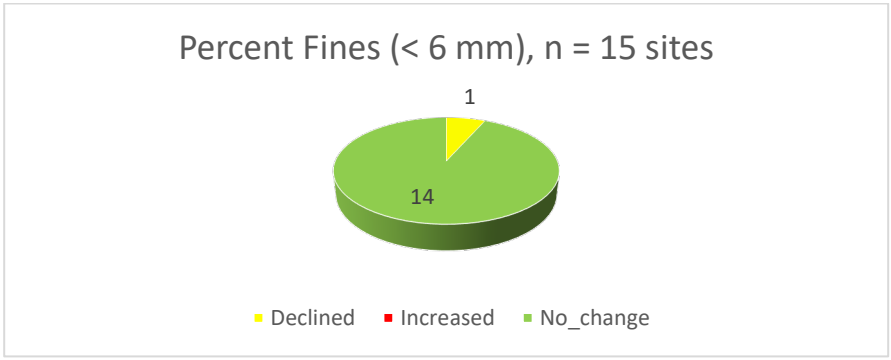
Figure 24. Hilsenhoff Biotic Index (HBI).



Metric: Percent Fines

The prevalence of fine sediment (particles less than 6 mm in diameter) in streams is an important aquatic habitat characteristic relevant to both aquatic macroinvertebrate and fish populations. Physical disturbances in a watershed, including impacts to streambanks, contributes to fine sediment levels. At the Forest level, fine sediment levels in streams haven't changed to a statistically significant degree since 2003. Fine sediment levels declined at 1 of the 15 sites with at least five repeated samples (Figure 25).

Figure 25. Percent Fines (< 6 mm).



Adaptive Management Considerations

The analysis of the randomly selected sites showing no substantive impacts suggests that no changes are needed in macroinvertebrate, bioassessment and monitoring. It should be noted however, that outside of the randomly selected sites there have been substantial changes in water quality that were first observed in macroinvertebrate monitoring (see discussion below in cutthroat trout section). Therefore, it is recommended that for future monitoring reports the macroinvertebrate, bioassement monitoring should analyze not only the random samples but also look at a stratified set of subsamples where we know there have been historic anthropogenic impacts. Furthermore if possible the Colorado MultiMetric Indices should be used to standardize the analysis.

Monitoring Item 3.2: Red Squirrel

Monitoring Question and Background

- What do red squirrel populations tell us about the extent and condition of mid- to late-successional forested ecosystems on the planning unit?

The 2012 Planning Rule requires Forests to monitor focal species that can indicate changes in key characteristics of ecological integrity (36 CFR 219.12). Red squirrels were selected as one of the focal species for forest structure and composition because they require mature conifer forests for pinecones and seeds, and in Colorado they are often found in stands with closed canopies (Scott et al. 1982).

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection b) reporting	Targets, thresholds
Goal 1, Objective 1b	Extent, density and occupancy of red squirrels	Bird Conservancy of the Rockies (BCR)	Annually; reporting every 2 years	Declining trend in extent, density, or occupancy

Monitoring Results

The Bird Conservancy of the Rockies (BCR) has monitored red squirrels on the WRNF since 2010. BCR utilizes highly trained crews and a sophisticated spatially balanced sample frame to generate estimates of occupancy and density for numerous bird species and small mammals at multiple scales. Evaluating both density and occupancy is important for understanding population trends and distribution across the landscape, and potential changes in ecological conditions (BCR, 2021). Figure 26 shows trends in density for red squirrels and Figure 27 shows occupancy.

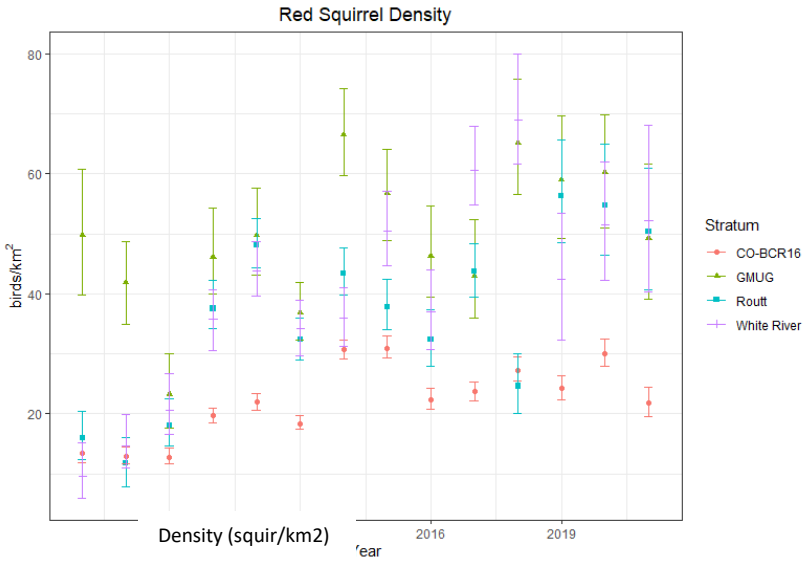


Figure 26. Density of red squirrel on the WRNF, GMUG, Routt and CO-BCR16 2010-2021

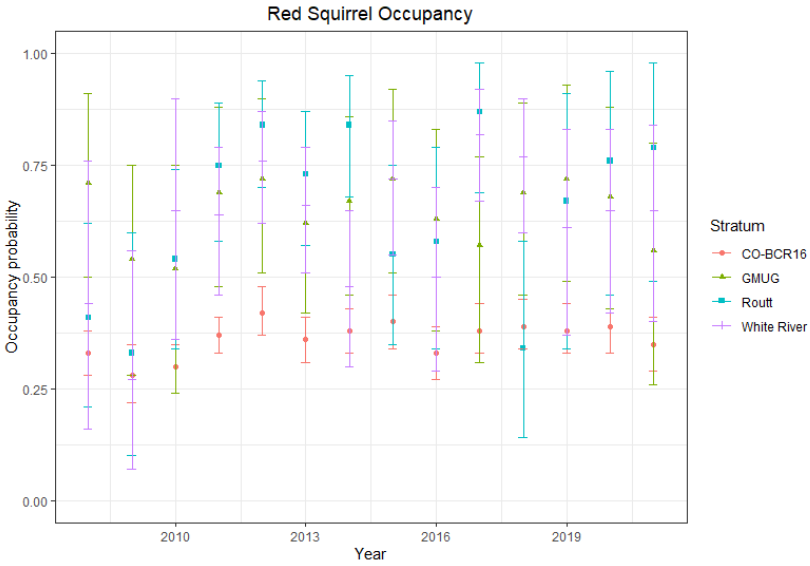


Figure 27. Occupancy of red squirrel on the WRNF, GMUG, Routt and CO-BCR16 2010-2021.

These figures also include the two neighboring forests, the Grand Mesa, Uncompagre Gunnison (GMUG) National Forest that is to the south and the Routt National Forest to the North. It also shows all of BCR 16 – which is Bird Conservation Region 16 that spans includes western Colorado, northwestern New Mexico, north Arizona and eastern Utah. Having these other data sets to compare can show more about what these species are doing on(?) a larger landscape, and if any trends are unique to the WRNF.

Population Trends

Population trend estimates from the IMBCR program across four strata from 2008-2021: CO-BCR16, GMUG National Forests, Routt National Forest, and White River National Forest. Information shown includes the median trend estimate (values <1.0 indicate a decreasing population and values >1.0

indicate an increasing population), the lower and upper 95% credible interval (LCI95 & UCI95), the coefficient of variation (CV), our confidence in the direction of the trend (f), and the number of detections used to estimate trend.

Table 6. Population trend of red squirrel

Stratum	Species		LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Red squirrel		1.05	1.10	1.16	2.49	1.00	826	Positive
GMUG	Red squirrel		1.00	1.03	1.05	1.29	0.98	596	Positive
Routt	Red squirrel		0.96	0.98	1.01	1.30	0.92	905	*
CO-BCR16	Red squirrel		1.02	1.04	1.07	1.22	1.00	5,564	Positive

* Not enough data to determine trend direction.

Monitoring Discussion and Findings

The population trend for red squirrel moving in a positive direction for the WRNF. This was also the case for the GMUG NF as well as BCR 16.

Adaptive Management Considerations

With a positive population trend for the WRNF, there are no changes recommended to this monitoring program or Forest Plan direction at this time.

Monitoring Item 3.3: Pika

Monitoring Question and Background

- What is the status of American pika populations as an indicator for alpine ecosystem integrity?

Pikas are excellent focal species for assessing alpine ecosystem integrity and climate change because they can be abundant, are active during the day and easily detectable, and are sensitive to climate change (Beever et al, 2016).

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection b) reporting	Targets, thresholds
Goal 1, Objective 1b	Extent, density and occupancy of American pika	Bird Conservancy of the Rockies (BCR) and WRNF-Rocky Mountain Wildlife Citizen Science Monitoring Project.	Annually; reporting every 2 years	Declining trend in extent, density, or occupancy

Monitoring Results

American Pika

Pika monitoring has been conducted by the Bird Conservancy of the Rockies since 2015. Table 7 shows number of detections, transects conducted, and estimated density and occupancy. (http://rmbo.org/v3/avian/ExploretheData.aspx).

Table 7. BCR pika observations

Year	Number of detections	Density (# per km2)	Number of transects	Occupancy
2015	34	5.56	5	0.147
2016	5	1.44	1	0.084
2017	56	4.33	6	0.124
2018	38	6.06	3	0.114
2019	15	4.3	2	0.116
2020	14	3.09	2	0.117
2021	8	4.3	1	0.107
2022	20	6.65	1	0.104

In addition to BCR Pika monitoring, the WRNF recently began cooperating with Rocky Mountain Wild on a collaborative project in 2018 that leveraged citizen science for long term pika monitoring.

This project mapped talus and selected 54 monitoring plots on the WRNF that represent a spatially-balanced sample of available habitat, stratified by elevation and aspect (which influence climate exposure). These plots were divided into panels with 18 to be surveyed every year, 18 in even years, and 18 in odd years). Thirty-six total plots were targeted for survey each year. Each survey plot had a 12 m radius, centered in talus, and was marked with three cairns arranged in a triangle.

The data were analyzed using methods developed by PIP to develop preliminary baseline estimates of pika occupancy for 2021 (Ψ=0.55) and 2022 (Ψ=0.47). Our previously reported estimates were revised for occupancy (based on data QA/QC) for 2019 (Ψ=0.60), and 2020 (Ψ=0.63). Rocky Mountain Wild is currently conducting an occupancy analysis to look at environmental variables that influence occupancy, and trends in occupancy. We anticipate that this analysis will be completed sometime in 2023.

There are 8 plots where surveys found old pika scat, but no evidence of recent pika presence (either in the plot or in the adjacent habitat) in surveys between 2018 and 2022. This is potential evidence that pikas were present at these sites in the past, but are no longer present. Additionally, more intensive surveys will be done at these sites in 2023 to determine whether this is the case.

Monitoring Discussion and Findings

Overall, early results indicate that pika are well-distributed, and trends are fairly stable across the WRNF. Precise occupancy estimates and trends will be analyzed when a final report is provided by Rocky Mountain Wild. We expect that this will be discussed in the next WRNF monitoring report.

Adaptive Management Considerations

There are no adaptive management actions be considered at this time.

Monitoring Item 3.4: Avian Species

Monitoring Question and Background

- What are the status and trends of select avian species on the WRNF?

Birds are excellent focal species for evaluating ecological trends and conditions because they are generally conspicuous during the breeding season, and responsive to their environment at multiple scales (Hutto, 1998).

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection b) reporting	Targets, Thresholds
Goal 1, Objective 1b	Species richness, density and occupancy of, and trends of bird communities	Bird Conservancy of the Rockies (BCR)	Annually; reporting every 2 years	Declining trend in extent, density, or occupancy

Monitoring Results

The WRNF uses a program that is implemented by Bird Conservancy of the Rockies called Integrated Monitoring in Bird Conservation Regions (IMBCR). It is a collaborative breeding bird monitoring program in which partners pool monitoring resources to create efficiencies in data collection and analysis. IMBCR is based on a spatially balanced sampling design which provides inference to avian populations at various scales, from local field offices to entire states or Bird Conservation Regions (BCR), facilitating conservation at local and national levels (Pavlacky et al. 2017). The nested design also provides a consistent and flexible framework for understanding and comparing the status and annual changes of bird populations with local and regional context. Trained observers conduct point count surveys across public and private land from the Great Basin to the Great Plains.

Bird Conservancy of the Rockies has been monitoring across private and public land in Colorado since 2008. They monitor the WRNF each year, and the Forest is divided into three substrata based on high, medium, and low elevation bands. This stratification allows biologists to adjust sampling intensity to target species of interest on the Forest. Because we monitor all other Forests and Grasslands within Colorado (and Region 2), biologists can make inferences about the status of bird populations within their management unit, and also compare to populations within other Forests or regions for context. Since 2008 within the WRNF, they have conducted 2,795 surveys, detected more than 39,000 individuals across 141 different species, and provided robust population estimates for species that are select for this report. Information on population estimates below is only presented for eight avian species, based on management interest and sufficient data available to provide meaningful results.

The WRNF initially identified American pipit (alpine), hairy woodpecker (all forest types), golden-crowned kinglet (late seral conifer), mountain bluebird (open forests), Brewer's sparrow (sagebrush), and common flicker (cavity excavator) as potential focal species. However, there is insufficient data from BCR surveys to establish a trend with any reliability for American pipit, hairy woodpecker, mountain bluebird, or Brewer's sparrow given the relative scarcity of these species, and the limited number of transects and detections. As a result, the WRNF changed the species for this monitoring to question to the dusky flycatcher and Virginia's warbler (shrub habitats); green-tailed towhee (shrub habitats and disturbed habitats); red-breasted nuthatch, red squirrel, and ruby-crowned kinglet (conifer habitats); northern flicker, warbling vireo and western wood peewee (aspen habitats) as focal species.

Population Trends

Population trend estimates from the IMBCR program across four strata in from 2008-2021: CO-BCR16, GMUG National Forests, Routt National Forest, and White River National Forest. Information shown includes the median trend estimate (values <1.0 indicate a decreasing population and values >1.0 indicate an increasing population), the lower and upper 95% credible interval (LCI95 & UCI95), the coefficient of variation (CV), our confidence in the direction of the trend (f), and the number of detections used to estimate trend. For the WRNF, there was sufficient data to determine trend for 5 out of the 8 species analyzed in this report. The results are discussed under each species in section below.

Dusky Flycatcher

Table 8. Population trend of dusky flycatcher

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Dusky flycatcher	0.94	0.98	1.03	2.37	0.79	237	*
GMUG	Dusky flycatcher	0.94	0.99	1.04	2.62	0.71	262	*
Routt	Dusky flycatcher	1.01	1.07	1.14	3.33	0.99	214	Positive
CO-BCR16	Dusky flycatcher	0.96	0.98	1.01	1.40	0.89	2,507	*

* Not enough data to determine trend direction.

Density – Figure 28: This graph shows the number of birds per square km. For the WRNF, densities were slightly higher at the beginning of the monitoring program, 2008 – 2010, but remained relatively static through 2021.
Occupancy – Figure 29: This graph shows the proportion of 1-km^2 sampling units occupied by the species. For the WRNF, similar to density, occupancy rates were slightly higher at the beginning of the monitoring program, 2008 – 2010, but remained relatively static through 2021.
Comparison of Forests: The Routt NF was the only stratum that had sufficient detections to determine a trend for this the dusky flycatcher. For this reason, there are not enough data to make a comparison among Forests or BCR 16.

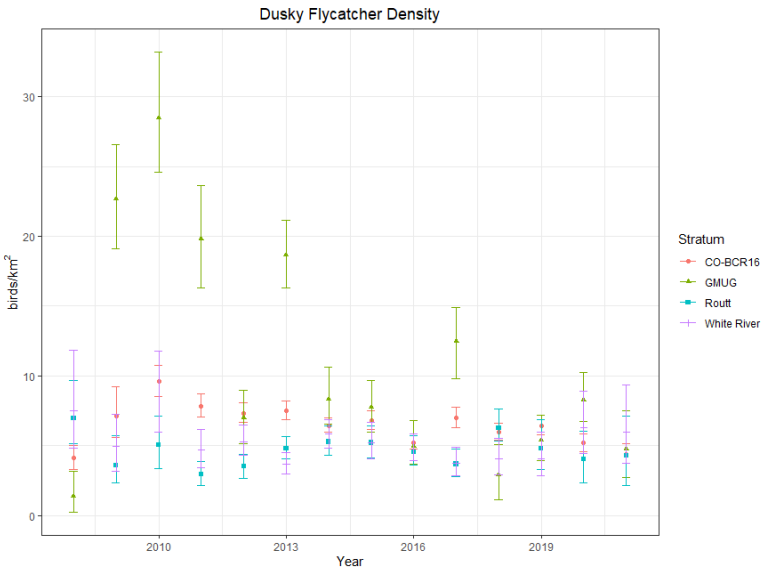


Figure 28– Dusty flycatcher density

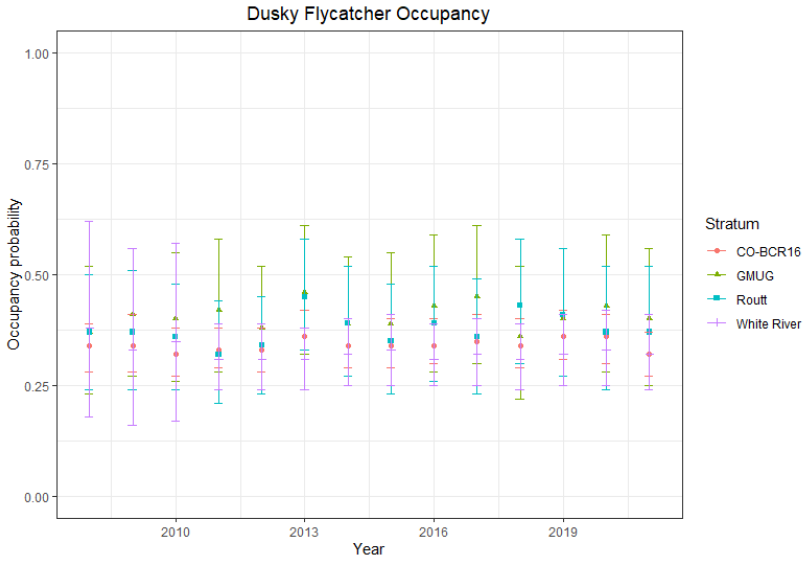


Figure 29– Dusty flycatcher occupancy.

Green-tailed Towhee

Table 9. Population trend of green-tailed towhee

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Green-tailed towhee	0.91	0.96	1.02	2.89	0.92	520	*
GMUG	Green-tailed towhee	0.99	1.03	1.07	1.93	0.92	458	*
Routt	Green-tailed towhee	1.08	1.16	1.25	4.13	1.00	200	Positive
CO-BCR16	Green-tailed towhee	0.99	1.01	1.03	0.88	0.89	6,734	*

* Not enough data to determine trend direction.

Density – Figure 30: This graph shows the number of birds per square km. For the WRNF, densities were variable throughout the monitoring period, 2008 – 2021.
Occupancy – Figure 31: This graph shows the proportion of 1-km^2 sampling units occupied by the species. For the WRNF, occupancy rates were slightly higher at the beginning of the monitoring program, 2008 – 2010, but remained relatively static through 2021.
Comparison of Forests: The Routt NF was the only stratum that had sufficient detections to determine a trend for this the green-tailed towhee. For this reason, there are not enough data to make a comparison among Forests or BCR 16.

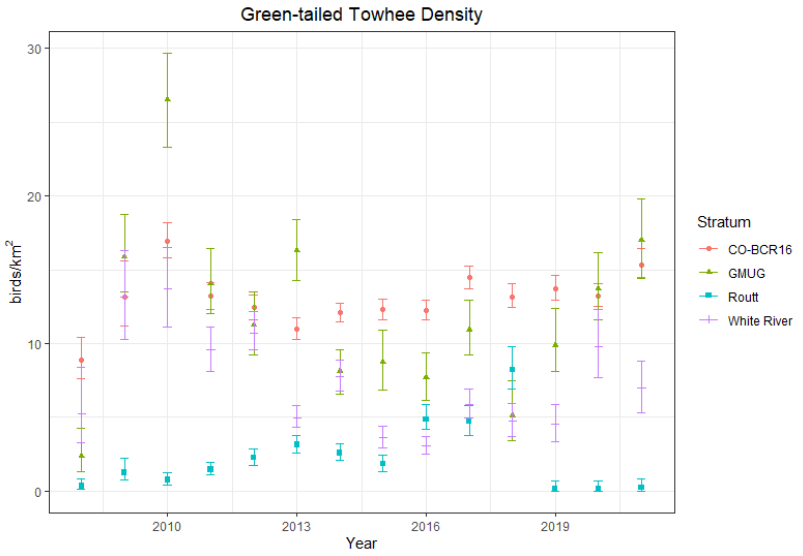


Figure 30. Green-tailed towhee density.

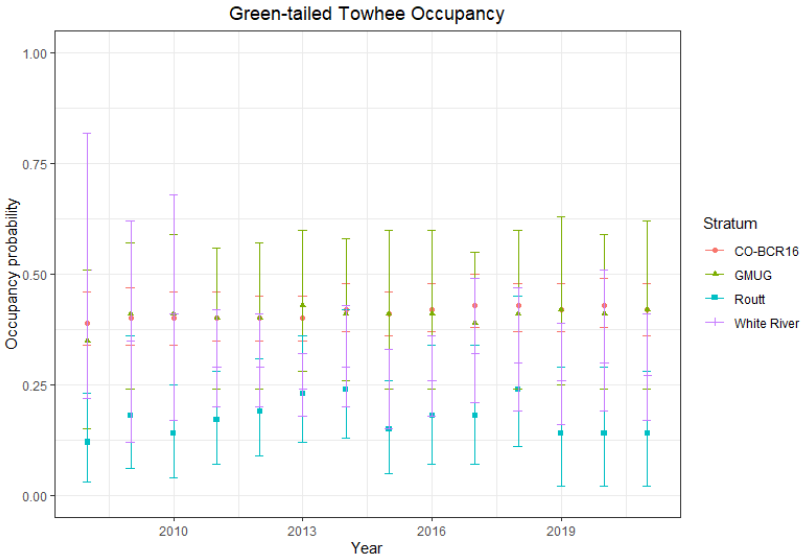


Figure 31. Green-tailed towhee occupancy rate.

Northern Flicker

Table 10. Population trend of northern flicker

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Northern flicker	0.97	1.01	1.06	2.20	0.74	285	*
GMUG	Northern flicker	0.98	1.03	1.07	2.19	0.88	253	*
Routt	Northern flicker	1.03	1.08	1.13	2.18	1.00	334	Positive
CO-BCR16	Northern flicker	1.02	1.03	1.05	0.93	1.00	3,724	Positive

* Not enough data to determine trend direction.

Density – Figure 32: This graph shows the number of birds per square km. For the WRNF, densities were variable throughout the monitoring period, 2008 – 2021. The WRNF has some of the lowest densities, compared to the other Forests and BCR 16.
Occupancy – Figure *33*: This graph shows the proportion of 1-km^2 sampling units occupied by the species. For the WRNF, occupancy rates were slightly higher towards the end of the monitoring program, 2020-2021.
Comparison of Forests: There were not enough data for the WRNF to determine population trend, for this reason, comparisons with the other Forests and BCR 16 will not be discussed.

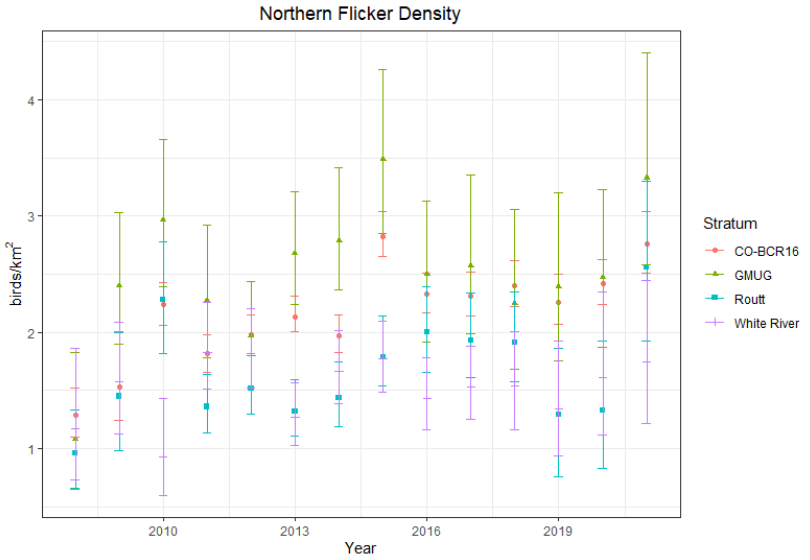


Figure 32. Northern flicker density.

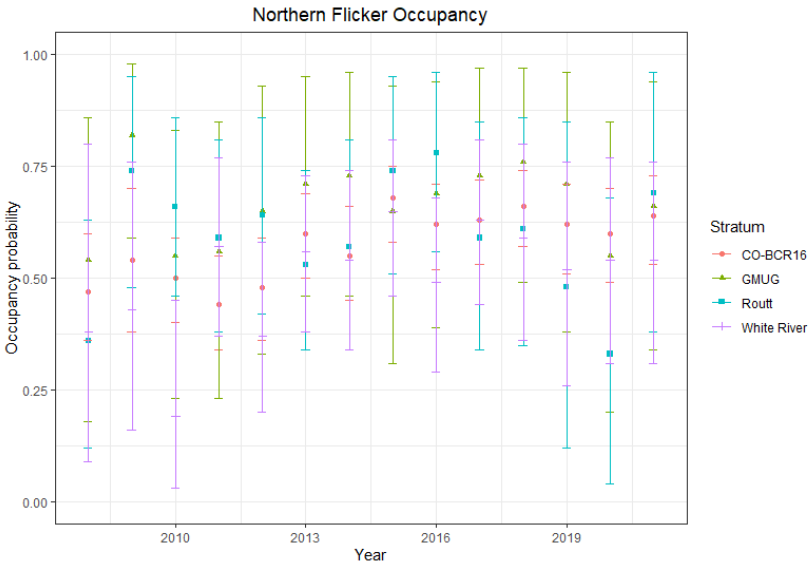


Figure 33. Northern flicker occupancy.

Red Breasted Nuthatch

Table 11. Population trend of red-breasted nuthatch

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Red-breasted nuthatch	1.00	1.04	1.09	2.14	0.98	419	Positive
GMUG	Red-breasted nuthatch	0.99	1.04	1.09	2.50	0.91	191	*
Routt	Red-breasted nuthatch	0.99	1.03	1.06	1.74	0.94	657	*
CO-BCR16	Red-breasted nuthatch	1.02	1.04	1.06	1.12	1.00	2,959	Positive

* Not enough data to determine trend direction.

Density – Figure 34: This graph shows the number of birds per square km. For the WRNF, densities were variable throughout the monitoring period, but it does appear that densities increased slightly over time.
Occupancy – Figure 35: This graph shows the proportion of 1-km^2 sampling units occupied by the species There was no strong change in occupancy rates over time, and results were variable by year on the WRNF.
Comparison of Forests: Both the WRNF and BCR 16 showed a positive population trend for the red-breasted nuthatch. This shows that the WRNF is consistent with the larger surrounding landscape.

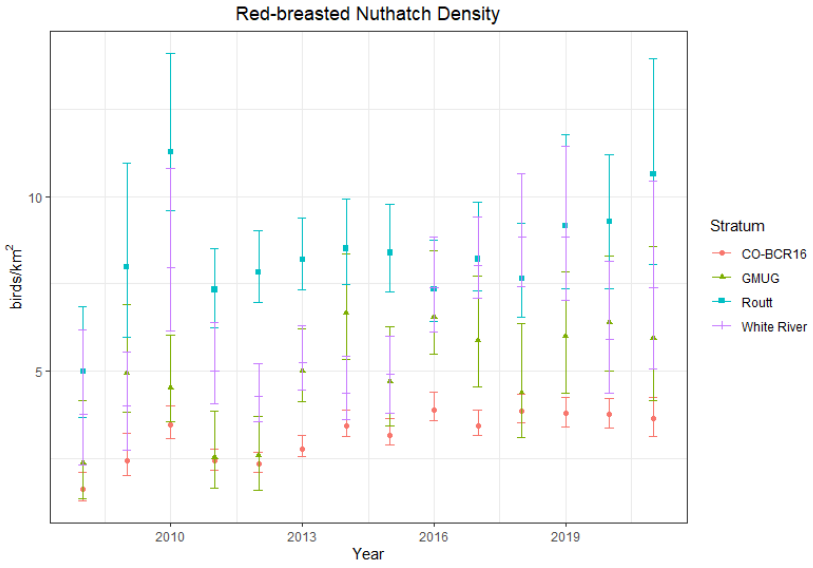


Figure 34. Red-breasted nuthatch density.

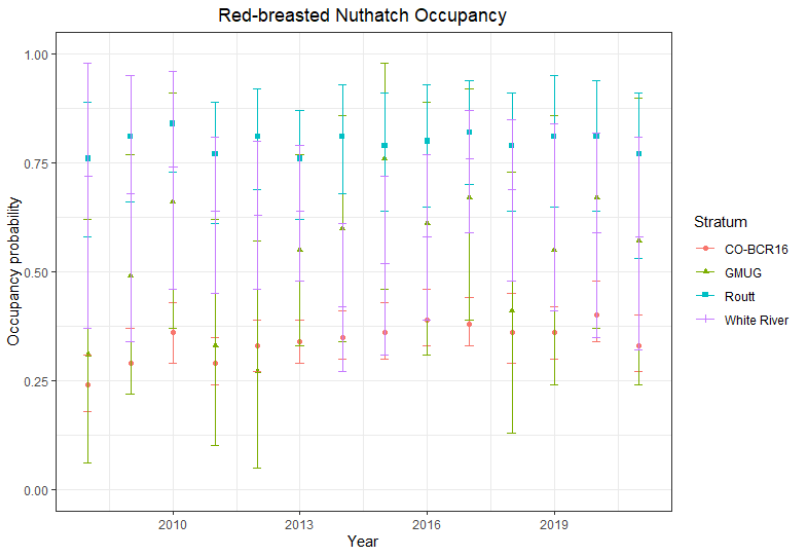


Figure 35. Red-breasted nuthatch occupancy rates.

Ruby Crowned Kinglet

Table 12. Population trend of ruby-crowned kinglet

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Ruby-crowned kinglet	0.97	1.00	1.04	1.66	0.60	1,449	Positive
GMUG	Ruby-crowned kinglet	0.97	1.00	1.02	1.26	0.52	705	Stable
Routt	Ruby-crowned kinglet	1.00	1.01	1.03	0.97	0.93	2,073	*
CO-BCR16	Ruby-crowned kinglet	1.00	1.01	1.03	0.97	0.93	2,073	Positive

* Not enough data to determine trend direction.

Density – Figure 36: This graph shows the number of birds per square km. Although there was an anomaly in 2010 on the WRNF, the graph is still showing a general increase in density over the monitoring period.
Occupancy – Figure 37: This graph shows the proportion of 1-km^2 sampling units occupied by the species On the WRNF there was very little variation or change in occupancy of birds per grid.
Comparison of Forests: Both the WRNF and BCR 16 showed a positive population trend for the ruby-crowned kinglet. This shows that the WRNF is consistent with the larger surrounding landscape.

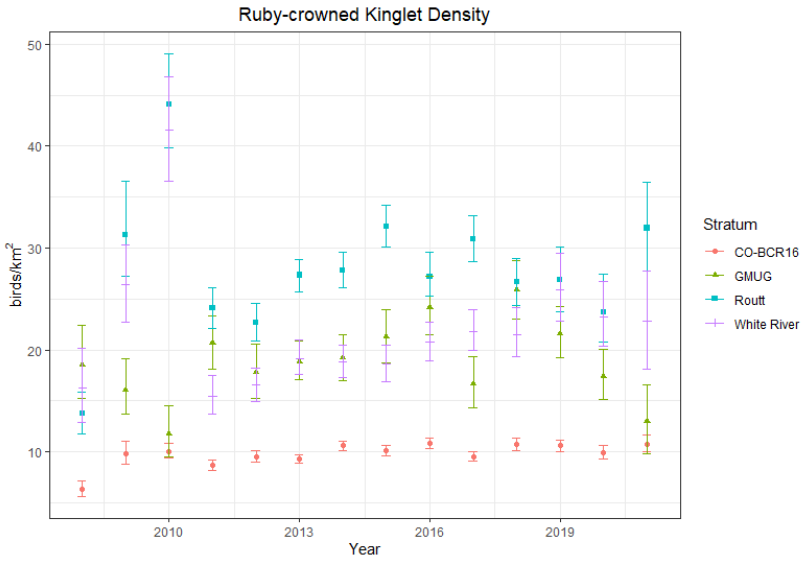


Figure 36. Ruby-crowned kinglet density.

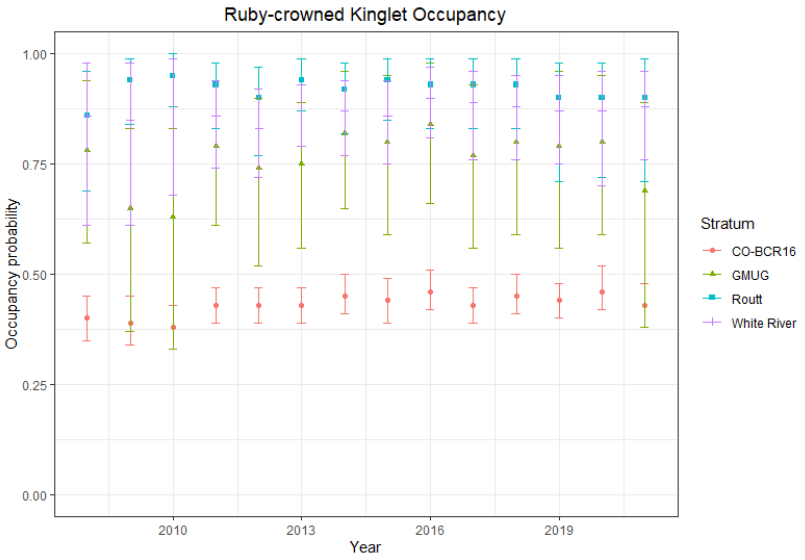


Figure 37. Ruby-crowned kinglet occupancy.

Virginia's warbler

Table 13. Population trend of Virginia's warbler

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Virginia's warbler	1.01	1.20	1.44	9.17	0.98	184	Positive
GMUG	Virginia's warbler	0.94	1.03	1.14	4.88	0.74	157	*
Routt	Virginia's warbler	0.70	1.11	1.67	22.14	0.67	8	*
CO-BCR16	Virginia's warbler	1.00	1.02	1.06	1.51	0.94	1,776	*

* Not enough data to determine trend direction.

Density – Figure 3*8*: This graph shows the number of birds per square km. The WRNF has the lowest density of Virginia's warbler compared to the other stratum.
Occupancy – Figure 3*9*: This graph shows the proportion of 1-km^2 sampling units occupied by the species. On the WRNF there was very little variation or change in occupancy of birds per grid.
Comparison of Forests: The WRNF is the only stratum that showed a positive population trend for the Virginia's warbler. Since this species was just added to the Regional Forester's sensitive species list, the Forest was encouraged to see this positive population trend.

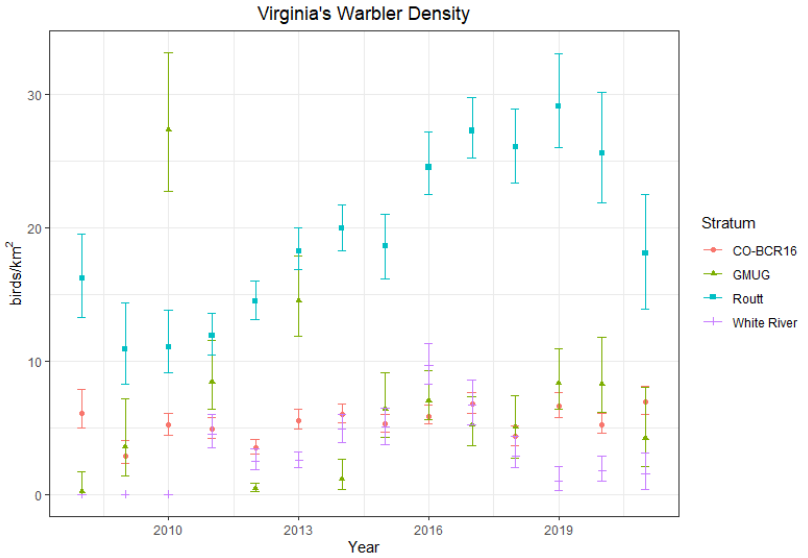


Figure 38. Virginia warbler density.

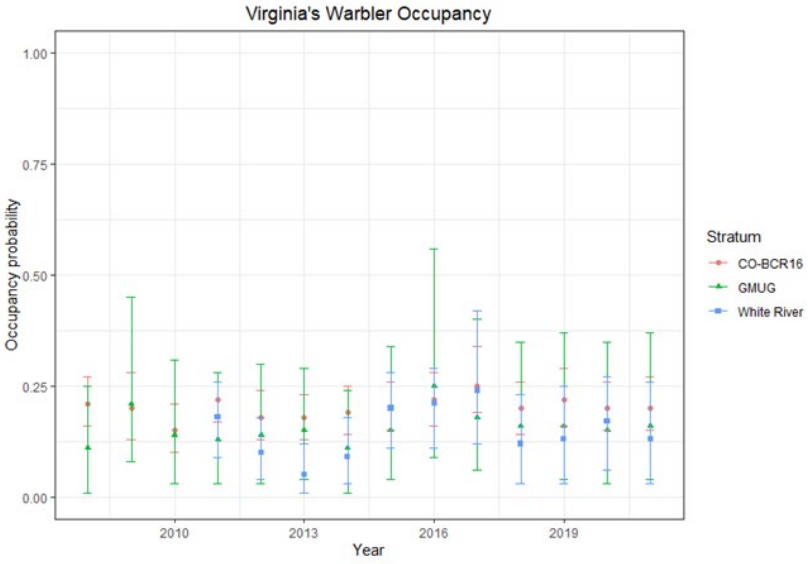


Figure 39. Virginia warbler occupancy.

Warbling Vireo

Table 14. Population trend of warbling vireo

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Warbling vireo	0.97	1.01	1.05	1.88	0.71	852	Positive
GMUG	Warbling vireo	0.95	0.97	0.99	1.15	1.00	1,054	Negative
Routt	Warbling vireo	1.04	1.07	1.10	1.59	1.00	1,199	Positive
CO-BCR16	Warbling vireo	1.02	1.04	1.05	0.87	1.00	7,311	Positive

Density – Figure 40: This graph shows the number of birds per square km. For the WRNF, densities were variable throughout the monitoring period, however it does appear that densities increased slightly over time.
Occupancy – Figure 41: This graph shows the proportion of 1-km^2 sampling units occupied by the species. On the WRNF there was very little variation or change in occupancy of birds per grid.
Comparison of Forests: Both the WRNF, Routt NF and BCR 16 all showed a positive population trend for warbling vireo. This shows that the WRNF is consistent with the larger surrounding landscape.

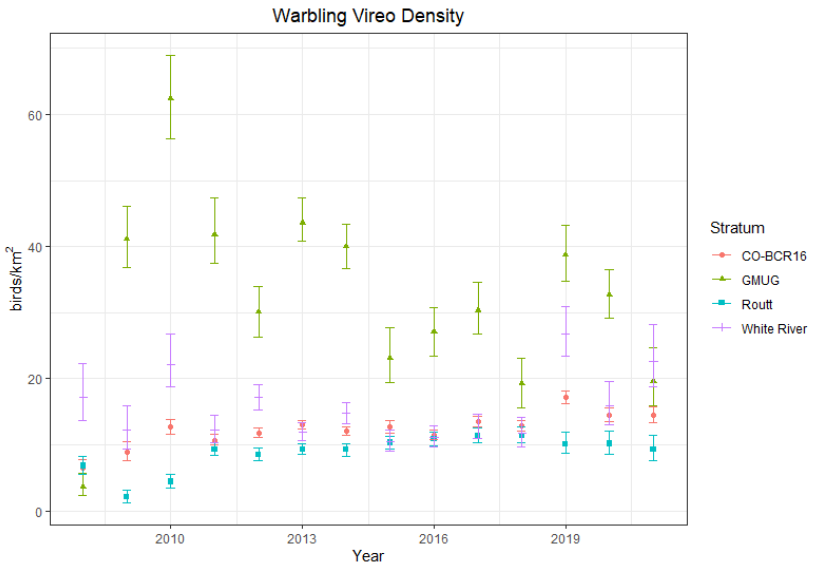


Figure 40. Warbling Vireo density.

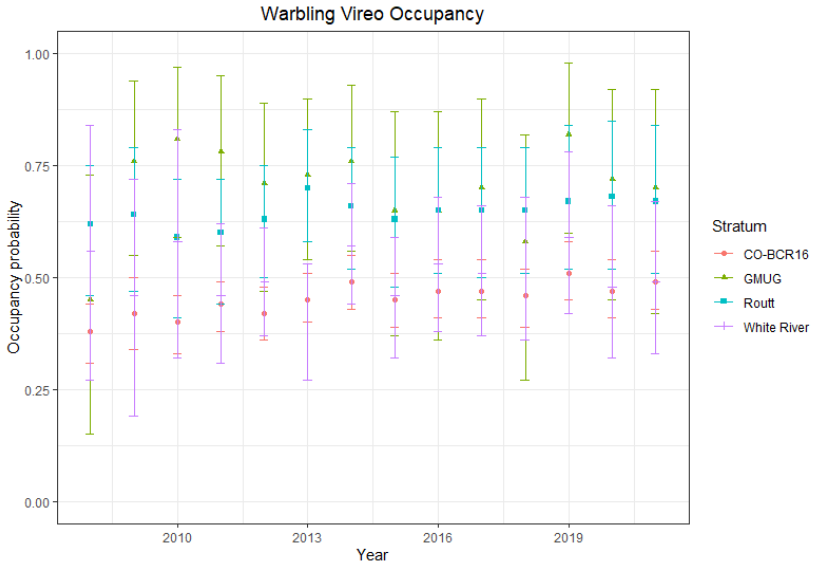


Figure 41. Warbling Vireo occupancy rate.

Western Wood-Pewee

Table 15. Population trend of western wood-pewee

Stratum	Species	LCI95	Median	UCI95	CV	f (confidence in direction of trend)	No. of detections	Trend direction
White River	Western wood-pewee	0.96	1.00	1.04	2.00	0.53	468	Stable
GMUG	Western wood-pewee	0.93	0.96	1.00	1.73	0.98	446	Negative
Routt	Western wood-pewee	0.97	0.99	1.02	1.46	0.63	1,070	Stable
CO-BCR16	Western wood-pewee	1.02	1.05	1.08	1.23	1.00	4,528	Positive

Density – Figure 42: This graph shows the number of birds per square km. On the WRNF there was very little variation or change in density of birds.
Occupancy – Figure 43: This graph shows the proportion of 1-km^2 sampling units occupied by the species. On the WRNF there was very little variation or change in occupancy of birds per grid.
Comparison of Forests: Both the WRNF and Routt NF all showed a stable population trend for the western-wood pewee.

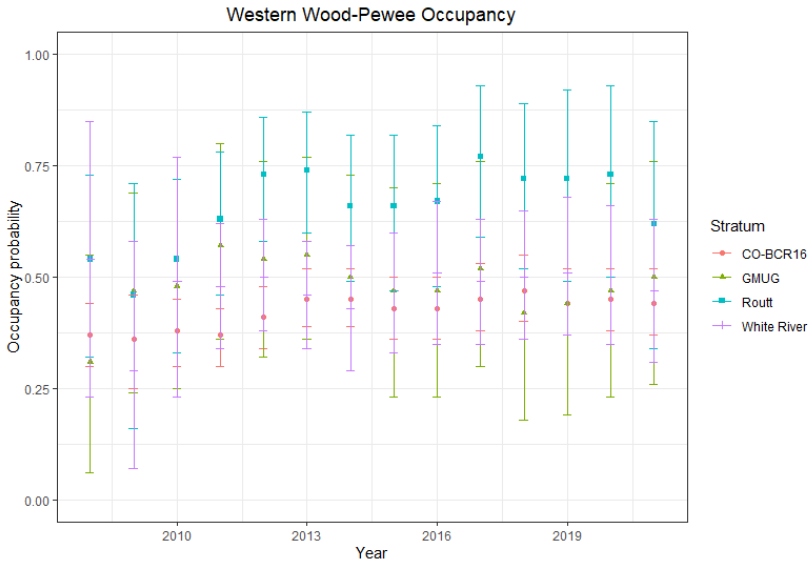


Figure 42. Western wood peewee occupancy rates.

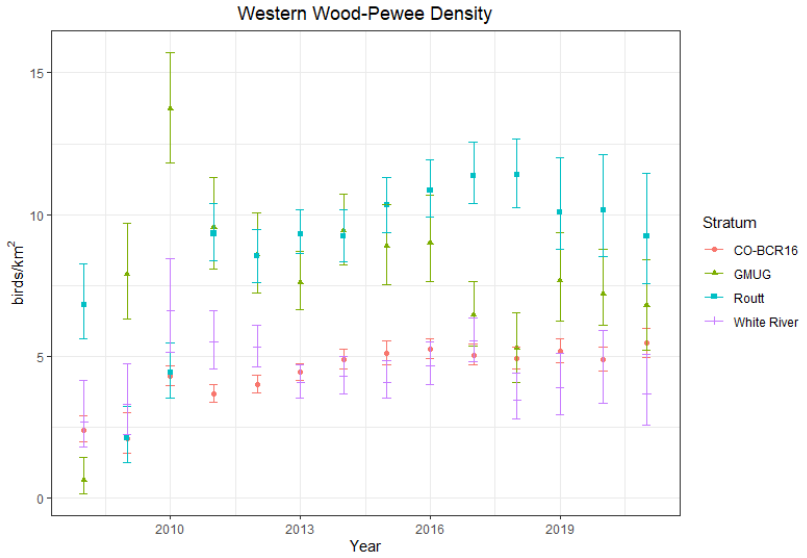


Figure 43. Western wood peewee density.

Monitoring Discussion and Findings

For avian species on the WRNF, three showed a positive population trend, two showed a stable trend, and four did not have enough data to determine a high confidence of a population trend either way. There were no species that showed a negative population trend. Both the red-breasted nuthatch and ruby crowned kinglet showed a positive population trend, and these species are generally associated with mature conifer habitat.

The WRNF is the only stratum that showed a positive population trend for the Virginia's warbler. Since this species was just added to the Regional Forester's sensitive species list, the Forest was encouraged to see this positive population trend.

The WRNF will continue to work with its partners at Bird Conservancy of the Rockies to find the best species to analyze from the vast about of bird survey data that the organization continues to collect.

Adaptive Management Considerations

Avian density, occupancy and trend will continue to be evaluated from BCR data collection efforts. The longer that this same monitoring technique is utilized, the more accurate trend data will be. If additional funding becomes available, the WRNF has the ability to have BCR increase the number of monitoring transects on the Forest. Since none of the selected species showed a negative population trend during this monitoring period, there are no changes to the monitoring program, Forest Plan direction, or management activities proposed at this time.

IV. The status of select ecological conditions for at-risk species

Monitoring Item 4.1: Colorado River Native Cutthroat Trout

Monitoring Question and Background

- What is the status and trend of cutthroat trout across the planning area?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection b) reporting	Targets, Thresholds
Goal 1, Objective 1c "Help ensure viability of species of concern for the White River National Forest"	Number of conservation populations in the planning area; Miles of occupied habitat; Presence/absence of aquatic nuisance species and/or non-native trout; Elevation, snow depth inches, and snow-water-equivalent (SWE)	USFS sensitive species monitoring data; Colorado Parks and Wildlife (CPW) cutthroat monitoring data; FWS Recovery Plan; CRCT Conservation Agreement	Annually; reporting every 2 years	Decline in any of the indicators

Monitoring Results

In the 2018 Biennial Monitoring Evaluation Report there were several threats outlined to the continued persistence of Colorado River Native (CRN – *Oncorhynchus clarkii pleuriticus*) cutthroat trout. These included the invasion of non-native trout (brook, brown, and rainbow), cross-breeding, or hybridization with non-native trout (rainbow and non-native cutthroat trout), and habitat fragmentation leading to small local population size. Non-native fishes exhibit various competitive advantages over CRN which typically leads to either headwater emigration or local extinction (extirpation) of native cutthroat trout. Hybridization with non-native trout species also eventually leads to local genetic extinction of CRN. Because the only real solution to prevent non-native invasion or hybridization is through the presence of some form of instream migration barrier, most current populations of CRN are

relegated to small, isolated sections of headwater streams above natural cascades, waterfalls or human created barriers.

Although safe from non-native invasion, fragmented, isolated, small populations that have no immigration can be at risk of extirpation due to random environmental disturbances such as drought, landslides, catastrophic wildfire, etc. (environmental stochasticity). Additionally, where local populations are isolated, genetic bottlenecking and changes in population birth and death rates, collectively known as demographic stochasticity, can also lead to extirpation. As evidenced below, isolated populations of CRN can also be subject to localized point and non-point source pollution. So, although populations that have a known migration barrier are protected from upstream invasion and hybridization from non-natives, if these streams only include small sections of occupied habitat, the very thing that protects them from non-native invasion, isolation, also leaves them at risk due to stochastic events. Consequently, native cutthroat trout in sympatry (co-habitation) with non-native trout, are in jeopardy of becoming locally extinct due to invasion, and hybridization while allopatric occurring (non-overlapping habitat) populations are at risk from localized water quality issues and stochastic events.

Populations are therefore most secure and most likely to persist when they are isolated from non-native invasion but also occupy more than 4.35 miles of stream (Roberts et al. 2013), or when multiple populations in several different streams are interconnected (metapopulation). Per the Rangewide Conservation Team Agreement, Conservation Populations of CRN are considered to have ≥90% genetic integrity and be self-sustaining. Core Conservation Populations are stable and have >97% genetic integrity.

From the previous evaluation of baseline conditions in 2018 it was estimated that of the approximate 3,342 miles of historic third order or higher stream habit available on the WRNF, Colorado River Native cutthroat trout only inhabit about 216 miles. At around 6.5% of historically inhabited streams, that was a reduction from the 8% distribution estimated by Hirsch et al. in 2006. This estimate included a total of 46 Conservation Populations, 14 (58.7 miles) of which were green lineage CRN, and 32 (157 miles) were blue lineage populations. Additionally, prior to the baseline assessment 11 miles of conservation habitat had been overtaken by non-native invasion. These included Lower Ute Creek and Main Fawn Creek in the White River drainage (Blanco Ranger District), Elliot Creek in the Blue River drainage (Dillon Ranger District) and North Fork Cattle Creek (Aspen-Sopris Ranger District).

Blue Lineage Colorado River Cutthroat Trout

Although previously thought to be inhabited by green lineage CRN, recent genetic testing has determined that Spruce Creek and McCullough Gulch (2.9 mi), in the Headwaters Blue River sub-watershed on the Dillon Ranger District, are blue lineage CRN populations. Additionally, since the 2018 baseline assessment, six other previously undetermined or unknown populations of blue lineage CRN have been verified (Figure 44). These include Battlement Creek in the Colorado Headwaters – Plateau 10-digit Hydrologic Unit (HU10) (Rifle RD), East Fork of South Fork Crystal River in the Roaring Fork HU10 (Aspen-Sopris RD), Coal Creek and South Fork White River in Upper White HU10 (Blanco RD), and Turret and Wilmor Creeks in Colorado Headwaters HU10 (Eagle-Holy Cross RD).

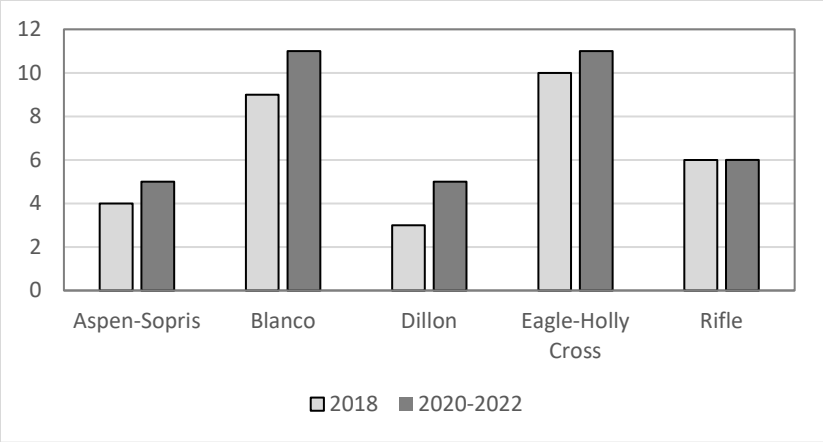


Figure 44. **A Number of Conservation Populations of blue lineage Colorado River native cutthroat trout by Ranger District, WRNF.**

These new additions are fortunate because within the same timeframe previously documented blue lineage CRN occupied stream habitat was reduced by a total of 13.19 miles. The 2018 baseline assessment stated that although Missouri Creek (1.62 mi) was counted as a Conservation Population, due to non-native invasion it would not be carried forward. Also, the undetermined populations in Cabin and Nickleson Creeks (1.5 and 0.99 mi, respectively) were found not to be Conservation Populations. Losses to extirpation due to non-native invasion included the entirety of Corral Creek (6.01 mi), and portions of North Elk Creek (0.74 mi) and North Fork Swan River (2.33 mi, Figure 45). The total number of *blue lineage* CRN Conservation Populations increased from 32 to 38, while the occupied stream habitat only increased by a total of an estimated 7.58 miles.

Figure 45. **A Summary of Conservation Populations of blue lineage Colorado River Native cutthroat trout on the White River National Forest.**

Blue Lineage CRN	2018			2020-2022			gain/loss
	# Con Pops	Miles	%	# Con Pops	Miles	%	miles
Undetermined	9.5	32.1	20.4%	10.0	33.7	20.4%	1.55
SECURE, sufficient occupied habitat & no known significant threats	3.5	23.0	14.7%	3.5	23.0	14.0%	0.00
AT RISK, stochasticity & habitat fragmentation, or risk factors not assoc. with non-native invasion &/or hybrid.	9	32.5	20.7%	13.5	39.7	24.1%	7.16
JEOPARDY, due to non-native invasion &/or hybridization	10	69.4	44.2%	11.0	68.3	41.5%	-1.13
total	32	157.0	-	38	161.6	-	7.58 (+5%)
Non-integer conservation populations signify barrier dividing population							

Green Lineage Colorado River Cutthroat Trout

Unfortunately, with no new populations documented, the situation has drastically deteriorated for green lineage Colorado River cutthroat trout. As discussed above, the 4.1 mi of Spruce Creek are now

known to be blue lineage occupied habitat. Additionally, while a landslide has extirpated 3.06 mi of green lineage waters in the upper Meadow Creek drainage, approximately 2.5 miles of main Meadow Creek and East Meadow Creek (Eagle-Holy Cross RD) have been lost to non-native invasion (Figure 46). Similarly, drought and non-native invasion has accounted for the loss of 4.7 miles of inhabited stream in the West Divide Creek watershed (Rifle RD). One positive report is that the total miles inhabited in Hunter Creek on the Aspen-Sopris Ranger District did increase by 1.86 miles

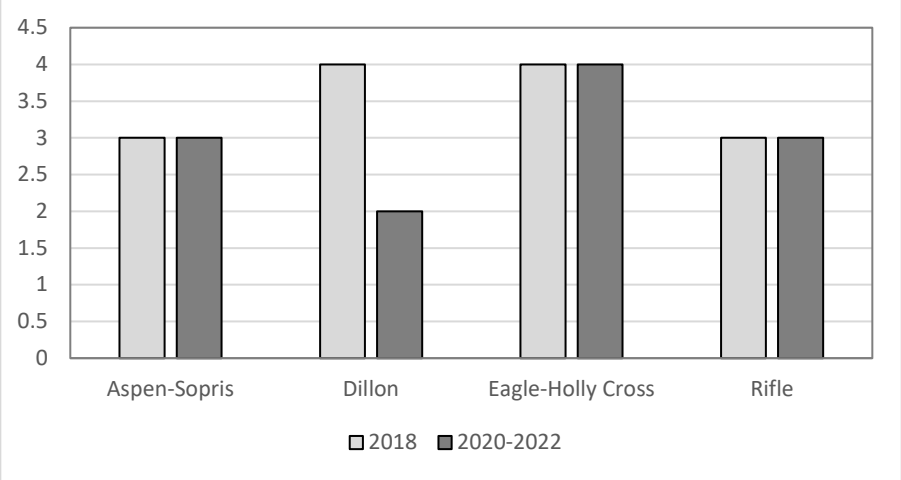


Figure 46. A Number of Conservation Populations of green lineage Colorado River native cutthroat trout by Ranger District, WRNF.

Comprising nearly half of all the green lineage Colorado River cutthroat trout occupied habitat on the Dillon Ranger District, Forest Service personnel have historically observed a robust population of CRN in Straight Creek (2.9 mi). Straight Creek flows from east to west, parallel and just to the south of Interstate 70, west of the Eisenhower-Johnson Tunnels. In 1998, due to hillslope erosion and historical use of traction sand on I-70, Colorado Department of Public Health and Environment (CDPHE) listed Straight Creek under Section 303d of the Clean Water Act (CWA) as impaired due to sediment. With the subsequent implementation of sediment total maximum daily loads (TMDLs) and numerous soil and water Best Management Practices (BMPs) Straight Creek was determined to meet the aquatic life – based sediment criteria in 2018.

As part of the BMPs to reduce sediment loading into Straight Creek a series of sediment ponds were installed and are maintained to serve as catch basins for excess sedimentation and traction sand. Around 2009 a self-sustaining population of boreal toad (BOR, *Anaxyrus borealis borealis*), also a R2 Sensitive Species, was found to be using CDOT Sediment Pond 5 as breeding and natal habitat. During the ensuing monitoring of this BOR breeding population a die off of the hydric vegetation in the adjoining wetland was documented in 2019 (Figure 47).

Figure 47. **Wetland at the outflow of CDOT Sediment Pond 5.**

The apparent sterilization of this wetland triggered concerns by CPW and Forest Service (FS)biologists, and water quality monitoring by Colorado Parks and Wildlife's Water Quality Division (WQD) was initiated for the entire Straight Creek drainage. Water chemistry data collected by WQD since 2021 has shown exceedance of dissolved heavy metals thresholds at several locations at the tow of the I-70 fill slope. Observations have been periodically high, but not exceeded aquatic life standards for heavy metals in Straight Creek itself.

The Environmental Protection Agency (EPA) has set forth specific standards concerning aquatic life for acute short-term effects (<96hr) and chronic longer-term effects (≥96hr) of numerous pollutants to include chloride. At the acute level, pollutants effect survival and growth, while chronic effects impact longer timescale functions such as reproduction and recruitment. The acute freshwater aquatic life toxicity standard for dissolved chloride is 860 µg/L (ppb, parts per billion), while the chronic toxicity threshold for the same is 230 µg/L. On multiple sampling occasions and by both Trout Unlimited and WQD, concentrations within Straight Creek have exceeded both acute and chronic thresholds for chloride established by the EPA (Table 16).

Table 16. Chloride concentrations sampled in Straight Creek

Site Code	Site	3/5/2021	4/27/21	8/16/21	10/29/21	7/6/22
TU-1	***Straight Ck*** – Town of Silverthorne	***1290****	***298***			
WQD-1	Spring Drain – downstream CDOT Pond 7			***1163***	***862.3***	***1141***
WQD-11	***Straight Ck*** – downstream dead wetland Tributary			86.35	***781.1***	63.94
WQD-7	Red Wetland – west CDOT Pond 5			***555.0***		***482.2***
WQD-4	CDOT Pond 5 Inflow			19.06	***3019***	25.94
WQD-3	CDOT Pond 5 Outlet			95.73	***7537***	95.74
WQD-8	**Straight Ck** Tributary – downstream of dead wetland			28.87	***2350***	48.17
WQD-10	***Straight Ck*** – upstream dead wetland Tributary			93.44	***645.7***	63.85
WQD-17	***Straight Ck*** – downstream CDOT Pond 1			78.24	***669.0***	54.07

Highlighted observations exceed acute toxicity level (860 µg/L), while **bold observations exceed **chronic** toxicity levels (230µg/L).

In conjunction with the initial water quality monitoring by WQD, aquatic biologists from CPW and the Forest Service conducted sampling efforts for cutthroat trout in Straight Creek. The 2021 joint effort rendered only two fish within several hundred meters of stream habitat. Given the combined results of fish sampling and water quality monitoring, it is evident that Straight Creek no longer supports a self-sustaining population of green lineage CRN cutthroat trout. Results suggest that the Core Conservation Population in Straight Creek has been extirpated.

Unfortunately, because Spruce Creek was misidentified as green lineage population of Colorado River Native cutthroat trout, two complete populations of green lineage cutthroat trout were lost since the 2018 evaluation. With additional losses due to drought and non-native invasion, a total of 15.9 miles or approximately 27%, of the total occupied green lineage CRN habitat on the White River National Forest was lost (Table 17).

Table 17. Summary of Conservation Populations of green lineage Colorado River Native cutthroat trout on the WRNF

Green Lineage CRN	2018			2020-2022			gain/loss
	# Con Pops	Miles	%	# Con Pops	Miles	%	miles
Undetermined	1.5	4.6	7.8%	2.0	3.1	7%	-1.4
SECURE, sufficient occupied habitat & no known significant threats	1.0	5.3	9.0%	1.0	5.3	12%	0.00
AT RISK, stochasticity & habitat fragmentation, or risk factors not assoc. with non-native invasion &/or hybrid.	5.5	15.6	26.6%	3.5	9.5	22%	-6.2
JEOPARDY, due to non-native invasion &/or hybridization	6.0	33.2	56.6%	5.5	24.9	58%	-8.3
total	14	58.7	-	12	42.8	-	-15.9 (-27%)

Monitoring Discussion and Findings

As discussed in the macroinvertebrate section above, bioassessment analysis of randomly selected stream sites has not evidenced decline in stream conditions. The metrics used for that analysis include the Shannon's Diversity Index (diversity) and the Hilsenhoff Biotic Index (HBI). Although these metrics are proven means of analysis, the Colorado Multi-Metric Index (MMI) is more widely used, periodically adjusted, better conceptualized, and more easily conveyed than the Diversity and HBI indices.

The Multi-Metric Index was developed as a rapid "bioassessment tool for Colorado composed of separate indices calibrated to respond to stressors affecting aquatic communities" for individually defined Biotypes (CDPHE Policy Statement 10-1, 2020). The White River National Forest almost entirely lies within the Mountain Biotype. A MMI score less than or equal to 40 indicates an aquatic life impairment, while an MMI score of 48 or greater indicates attainment of the aquatic life threshold. Similarly, Tolerance Indicator Values (TIVsed) have been established for fine sediment in Colorado mountain streams. This metric accounts for the amount of fine sediment being transported and deposited in streams and rivers. Increases in fine sediment indicate excessive erosion, and instream sedimentation which is detrimental for both aquatic macroinvertebrates and trout.

From a water quality standpoint, if a MMI score for a stream on the White River National Forest is less than 40 then the stream is considered impaired for aquatic life. If the individual score is 48 or greater, then the stream is attaining or suitable for use of aquatic life. The range between 40 and 48 indicates that although the stream may not be impaired there is likely a water quality issue that may be reducing suitability. Unfortunately, in the twenty some years that macroinvertebrate data has been collected the calculation of MMI scores is both sparse and inconsistent.

Straight Creek Site Str10582 is a bioassessment monitoring site approximately 560 feet away from the sterile wetland adjacent to CDOT Pond 5. Although bioassessment data has been collected five times since 2005, MMI scores were only established for 2006, 2007, 2020. There were respectively 86, 77 and 25. Obviously between 2006-2007 the stream was in good condition and functioning well above the aquatic life impairment threshold of 40. From the 2020 MMI score of 25 it is unknown what caused the precipitous crash in the macroinvertebrate community, but referring back to the water quality data discussed above, it seems there may be a strong correlation between contaminant concentrations and the instream impairment for aquatic life.

Adaptive Management Considerations

Assessment of the status of cutthroat trout on the White River National Forest reveals a steady decline in occupied habitat. Hirsch et al. (2006) estimated that within its native range, Colorado River cutthroat trout only occupied 8% of its historic range. The 2018 baseline assessment for CRN estimated that number to be even lower within the White River National Forest at 6.5%. In just over two years that estimate has decreased to 6.2%. These results indicate that if left unchecked, habitat loss due to non-native invasion, habitat fragmentation, and drought, will lead to the eventual local extinction of CRN on the White River National Forest.

Considering the power of bioassessments in early identification of water quality issues, we recommend that in streams containing Conservation Populations of Colorado Native Cutthroat Trout, a biennial sampling of macroinvertebrates be conducted. Furthermore, during the analysis of the macroinvertebrate samples we recommend that both the Multi-Metric Index and Tolerance Indicator Value for sediment analysis be completed and examined for change conditions.

Additionally, after reviewing the observed levels of decline, in order to maintain the species viability within the planning area, it is recommended that conservation and restoration actions for Colorado River Native Cutthroat Trout be elevated in priority and scope within the White River National Forest.

Monitoring Item 4.2: Amphibians

Monitoring Question and Background

What is the status and trend of boreal toads and northern leopard frogs across the planning area?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols	Freq. of data collection/	Last evaluation/ next evaluation	Desired conditions/ Thresholds/ Triggers
Goal 1, Objective 1c. "Help ensure viability of species of concern for the White River National Forest"	Number of active breeding populations in the panning area Presence/absence of chytrid fungus	CNHP survey data CPW survey data USFS survey data Future eDNA testing based on new research	Annually	This is the first evaluation for amphibian populations	Maintain existing populations of adult boreal toad Threshold - Loss of 50% of breeding populations

Monitoring Results

The White River National Forest Aquatics Program and our partners at Colorado Parks and Wildlife (CPW) conduct annual summer surveys for Boreal toads (*Anaxyrus boreas boreas*) on the Forest. Boreal toads are a Forest Service Region 2 Sensitive Species. Toad surveys are conducted in habitats likely to support them either as those habitats are identified or in preparation or response to specific pending or ongoing management actions. Since 1998 an average of 30 surveys a year were conducted on the Forest which could include multiple surveys of a given site in a given year.

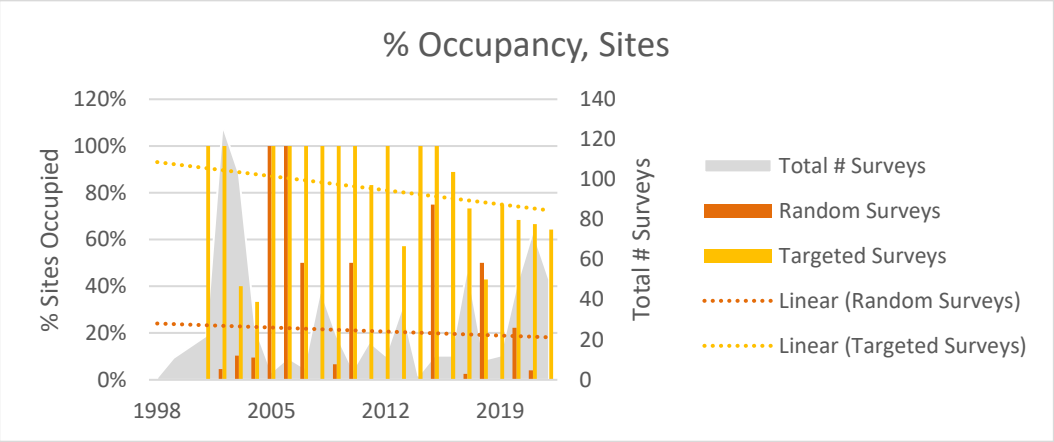
This report refers to two main types of surveys: random (occupancy) surveys and targeted (breeding) surveys. Random surveys were those conducted at habitat patches considered by professional judgement to plausibly support toads. They were "random" in the sense that the specific locations surveyed were not known to support toads, but that they could, given available habitat. These surveys help inform the Forest and CPW about the spatial distribution of toads across the Forest and provide some empirical evidence of the population size and trends. The implied assumption is that a large population will be found widely across the landscape and vice versa, and that an expanding spatial distribution implies a growing population, while a contracting distribution the opposite. Targeted surveys were those conducted at sites known to be or have been occupied by toads. These surveys provide empirical data about the size and character of the toad sub-populations that utilize these specific habitats over time which relates to the productivity of these specific habitat patches. Differentiating between these two types of surveys was required given their significant difference (whether toads were known to occupy a specific site or not).

Monitoring Discussion and Findings

The data were largely collected by Forest personnel though data for some years included those which CPW collected on the Forest. It's important to note that most of these data were collected in the post-Bd era and that the population monitored thus has been substantially reduced from its pre-Bd size and distribution.

The spatial distribution of toads across the Forest provides some indication of the size of the population and changes in that distribution could suggest that the population was expanding or contracting. Similarly, the spatial distribution of toads could reflect the availability of suitable habitat patches and changes could reflect changes in the availability or suitability of habitat. One proxy for spatial distribution is the percentage of sites visited that can be observed to be currently occupied by any life stage of toads. Random surveys are particularly helpful in this regard, as the higher percentage of surveys conducted that find toads, the larger the implied spatial distribution. Figure 48 summarizes the percentage of sites where evidence of toad occupation was found.

Figure 48. Percentage of sites surveyed that were occupied by Boreal toads.

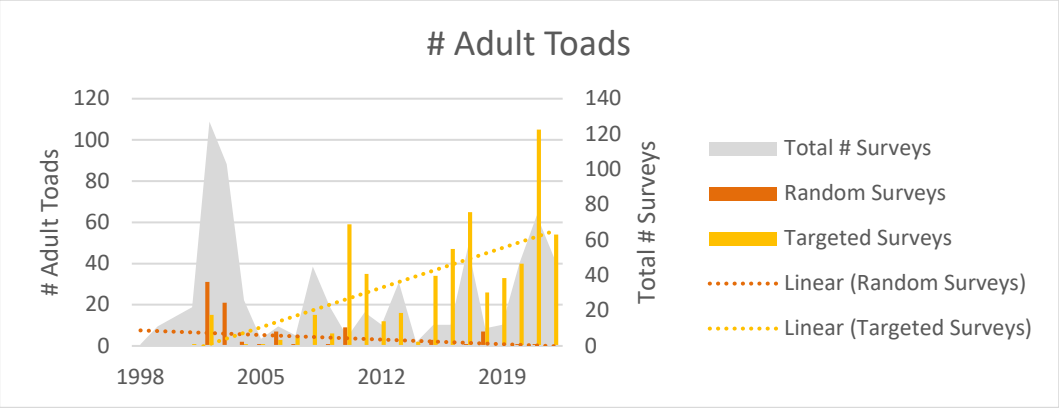


As would be expected, targeted sites were far more likely to be occupied than random sites. It was also apparent that the percentage of occupied sites was related to the number of surveys conducted in a given year (grey fill). Years with high numbers of surveys tended to have lower percentages of occupancy as more sites were surveyed, many of them inevitably unoccupied. Likewise, if only two sites were surveyed and both contained toads, occupancy was 100% which somewhat distorts the implication of a large spatial distribution. If toads were once widespread across the Forest, they are not now and therefore many plausible habitats are unoccupied, so far as our sampling has indicated. The relatively flat trendline for random surveys (green dotted line) indicated that those surveys only found about 21% of surveyed sites to be occupied and that that percentage did not appear to have changed significantly since 1998. This suggested that toads' spatial distribution is likely limited as only about one out of five plausible locations definitively hosts toads, and that status has remained essentially the same since 1998.

The visual decline in occupancy at targeted sites (yellow dotted line) was likely influenced by increased sampling effort since about 2017. Between about 2005 and 2015, generally only few surveys were conducted and those few tended to occur at the most reliably productive sites, as evidenced by the fact that targeted surveys during that period occurred at sites that were nearly all occupied. Another possible explanation is that sub-populations at known sites are blinking out, but the data do not suggest that that is the case in the HUC SPATIAL ANALYSIS.

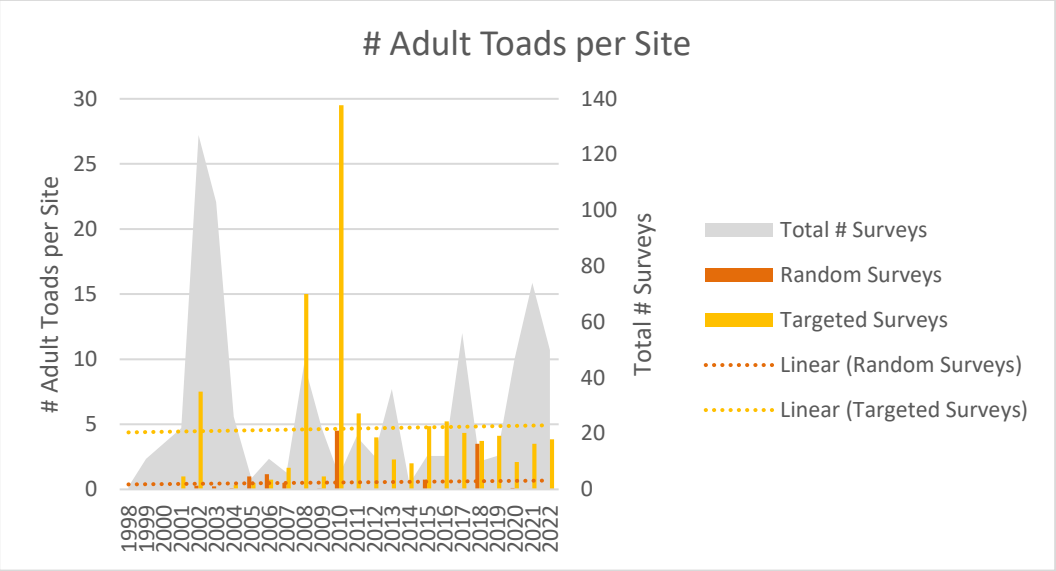
The number of adult toads observed would seem to be a reliable indicator of population size, but that number appeared to be related to the number of surveys conducted (Figure 49).

Figure 49. Number of adult toads observed.



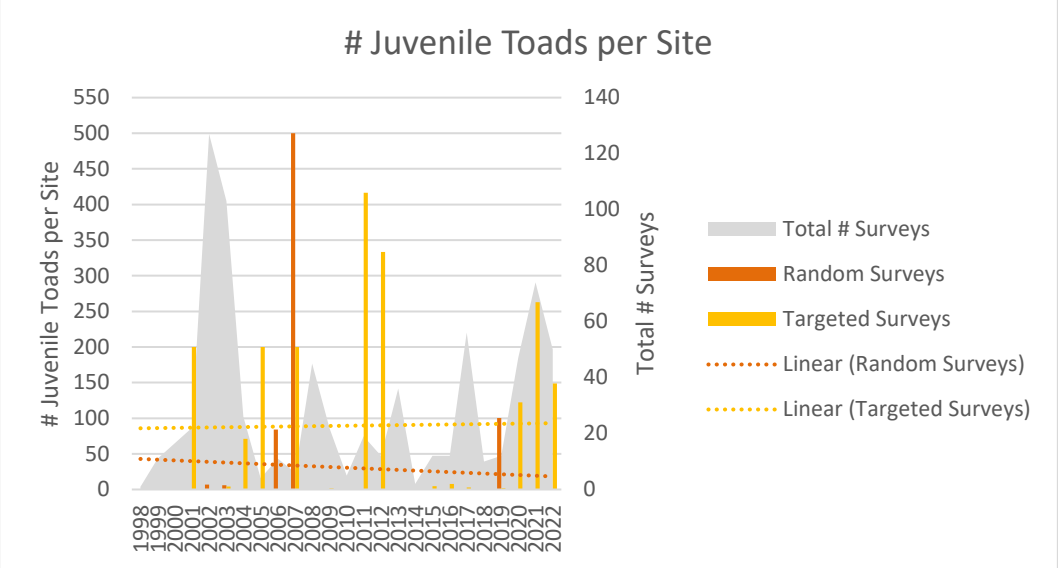
Random surveys have not counted a lot of adult toads, again suggesting that the spatial distribution of toads is sparse. Targeted surveys of known hotspots were much more productive in terms of adult toads found and the more surveys that were conducted, the more toads tended to be found. Twenty-nine percent of surveys conducted were targeted surveys and they produced 87% of the adult toads found. This suggests that where toads are still found, there may be many toads, but that there aren't many places like that known on the Forest in the current era. Also consider that once a random site that produces toads was identified, subsequent surveys became targeted surveys as they surveyed known-occupied habitat, thereby enlarging the pool of targeted surveys. Concurrently, as random surveys have targeted the most obvious potential habitat patches over the years, the random locations surveyed were progressively smaller or more isolated or potentially in less suitable habitat.
To mitigate the effect of the number of surveys conducted on the number of adult toads found, the number of adult toads per site is informative (Figure 50).

Figure 50. Number of adult toads per site.



Random sites discovered to hold toads tended to not have very many, averaging around one each, and this was what we found in some of these sites. The number of adult toads found during targeted surveys of known sites has remained more or less the same since 1998, averaging about five. This suggests that sub-populations are small and have remained small. Including counts and estimates of tadpoles and sub-adult toads, the number of juvenile toads per site varied but remained approximately the same over time (Figure 51).

Figure 51. Number of juvenile toads per site.



The factors that contribute to yearly fluctuations are not known. A known-unknown is the effect of persistent and at times acute drought on the toad population. Surveys in 2018 and 2020 for example, both very dry, early runoff years, noted desiccated wetlands at known sites where it was not clear whether reproductive efforts were successful. It's equally plausible that breeding occurred earlier in the year and was therefore missed by surveys, that breeding aggregations didn't occur at all as the

habitat was temporarily unsuitable (i.e. dry), or if eggs and tadpoles simply failed to survive (or be counted) when the habitat dried out.
The number of juveniles of any species is always higher than the number of adults as many progeny do not survive to adulthood. The number of juvenile toads at a given site can fluctuate wildly, from single digits to thousands, which makes the data hard to see given the scale. Random surveys only infrequently observed juvenile toads and generally not many of them.
The ongoing advance of Bd could be another factor.

Adaptive Management Considerations
No adaptive changes to the Forest Plan or this monitoring question are anticipated at this time.

Monitoring Item 4.3: Lynx Habitat
Monitoring Question and Background
- What is the status and trend of early successional conifer and late seral spruce-fir forests to promote recovery of Canada lynx?

This monitoring item address regulatory requirements associated with the Southern Rockies Lynx Amendment (SRLA) (USDA Forest Service 2008). The SRLA contains several management standards intended to conserve habitat for lynx, a threatened species under the Endangered Species Act.

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols	Freq. of data collection/	Last evaluation/ next evaluation	Desired conditions/ Thresholds/ Triggers
Goal 1, Objective 1c. **Southern Rockies Lynx Amendment**	Extent and condition of early successional and late seral spruce-fir forests; Habitat connectivity; and Dense horizontal cover	FS Veg Spatial Project impacts or mitigation Habitat improvements USFWS Future FWS Recovery plan WRNF lynx habitat map layer.	Annually	The lynx habitat on WRNF was re-mapped in 2017. In 2018 there were 3 large fires on WRNF– the change in habitat will be evaluated and mapped in 2019.	3% lynx habitat treated (VegS1, S2, S5, S6) WUI exemption 1% precommercial thinning exception (VegS5) .5% pre-commercial thinning or multi-story management (VegS5, S6 Exception)

Monitoring Results
The SRLA's Veg standard S1 states that if a lynx analysis unit (LAU) (an area approximating the size of the home range of a female lynx) has more than 30 percent of its lynx habitat in a currently unsuitable condition, then vegetation management projects should not move additional acres into a stand initiation stage. However, the SRLA provides exceptions for different types of management in LAUs with >30% unsuitable condition as long as acres treated remains below a threshold or cap: 3% of lynx habitat on each administrative Forest for fuel management treatments (wildland urban interface [WUI] exemption); 1% of lynx habitat for pre-commercial timber harvesting; and .5% for pre-

commercial and multi-story management. Monitoring of habitat conditions and activities is needed to ensure these caps are maintained.

The WRNF recently re-mapped Canada lynx (hereafter lynx) habitat in FSVeg, the USFS corporate geodatabase, to capture changes to forest structure resulting from fire, bark beetle, and other disturbances. The previous lynx mapping version (2011) overpredicted the amount of dead lodgepole pine. The 2017 mapping update shows no LAUs exceeding Veg S1 standard, although there are a few LAUs that are approaching the 30% unsuitable condition on the east side of the Forest where mountain pine beetle activity was the highest. Activity tracking in LAUs is collected and reported annually to the U.S. Fish and Wildlife Service. The following calculations (Table 19) include all project acres accounted for under the 3%, 1%, and 0.5% and the respective standards for exemptions and exceptions under the SRLA (USDA Forest Service 2008):

Table 18. SRLA thresholds and acres treated

SRLA standards with exemptions and exceptions	cap (%) under exemption	2011 mapping (allowable acres under cap)	2017 mapping (allowable acres under cap)	SRLA acres treated since 2008
VegS1, S2, S5, S6 WUI Exemption	3%	34,284	41,431	560
VegS5 Exception 5	1%	11,427	13,810	254
VegS5, S6 Exception	0.50%	5,714	6,905	1135

Monitoring Discussion and Findings

Mapping and activity tracking indicate that the WRNF is in full compliance with the SRLA. For each exemption and exception, the WRNF has stayed well below the management thresholds set out in the SRLA. The WRNF is meeting the vegetation standards and the respective caps for treatments under the WUI cap of 3%, pre-commercial thinning cap of 1%, and the remaining 0.5% for projects that may occur under pre-commercial thinning or multi-story management. The total acres for these caps did increase somewhat from 2011 to the new mapping for 2017.

Since 2018, the WRNF has had several large wildfires. The following table lists the fires, the number of acres of lynx habitat affected by the fires, and the resulting about of unsuitable lynx habitat resulting in the corresponding LAUs.

Table 19. Effects of wildfires on lynx habitat 2018-2020

Fire Name	Year of Fire	Number of Acres of Lynx Habitat Affected	Lynx Analysis Unit Affected	Amount of Currently Unsuitable Lynx Habitat in LAU	Percent of LAU in an Unsuitable Condition
Cabin Lake Fire	2018	4,000	Bar HL	5,084	9%
Lake Christine Fire	2018	5,519	Red Table	7,594	14%
Cache Creek Fire	2020	619	Battlement	655	4%
Sylvan Fire	2020	4,000	Brush Creek	7,882	12%
Grizzly Fire	2020	10,500	Quartzite	11,074	25%

The wildfires on the Forest that burned between 2018 and 2020 affected a total of 24,638 acres of lynx habitat. The largest fire was the Grizzly Fire in 2020. Twenty-five percent of the Quartzite LAU is currently in unsuitable condition due to the Grizzly Fire. Additional field work is still needed to verify the condition of some of these acres, as well as assess natural vegetation regeneration.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

V. Visitor use, visitor satisfaction, and progress toward meeting recreation objectives

Monitoring item 5.1: Visitor satisfaction and use

Monitoring Question and Background

- What are the status and trends of visitor satisfaction for recreational visits on the planning unit?

This monitoring question address WRNF plan goals and objectives associated with recreation and visitor use.

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 2 "Multiple Benefits to People", Objective 2a "Improve the capability of the National Forests and grasslands to provide diverse, high quality recreation opportunities."	Visitor satisfaction; Number of visitors; Demand within the Forests niche	National Visitor Use Monitoring Program	a) 5 Years; b) 5 years	N/A

Monitoring Results

Data on visitation, visitor satisfaction and changes in recreation demand is collected through survey methods by the USFS National Visitor Use Monitoring (NVUM) Program every five years. NVUM visitation surveys estimate both National Forest visits and Site Visits (Figure 52). A Site Visit is the entry of one person onto a National Forest site or area to participate in recreation activities for an unspecified period. A National Forest Visit is defined as the entry of one person upon a National Forest to participate in recreation activities for an unspecified period. A National Forest Visit can be composed of multiple Site Visits.

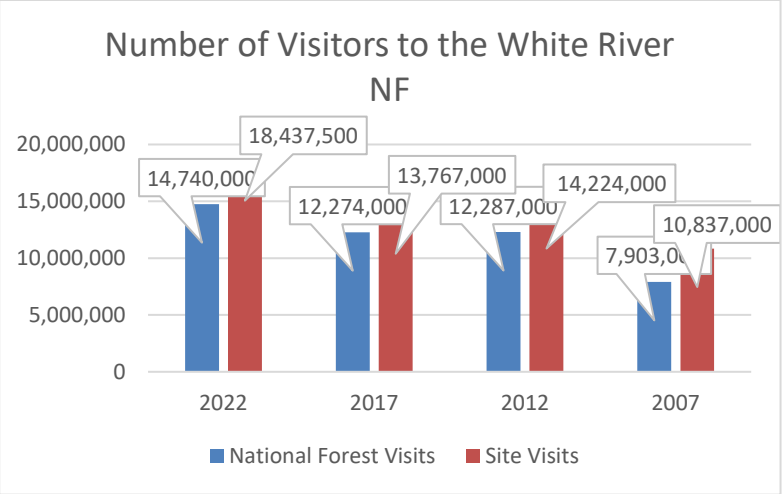


Figure 52. Number of visitors to the WRNF, 2007-2022.

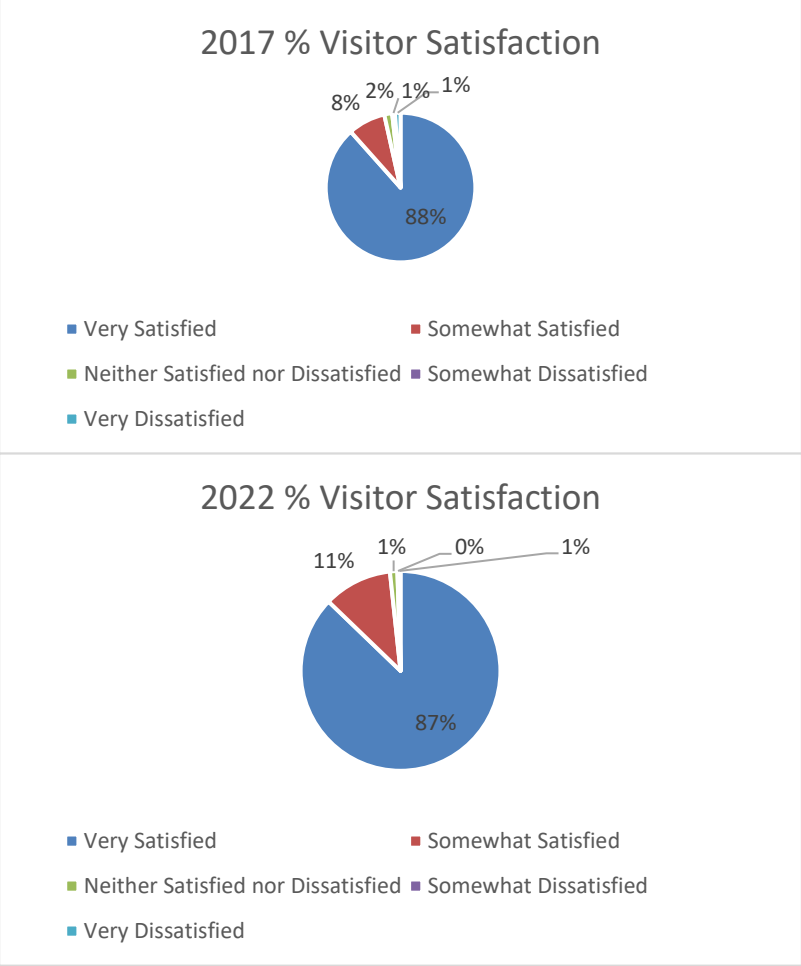


Figure 53. Trends in visitor satisfaction 2017 - 2022.

Table 20. Changes in visitor activity and demand 2017 – 2022.

2017 top 10 activities by participation	2017 % Participation	2007 % Main Activity	2022 top 10 activities by participation	2022 % Participation	2022 % Main Activity
Downhill Skiing	56.8	54.1	Downhill Skiing	53.6	52.5
Hiking / Walking	33.2	21.7	Hiking / Walking	26.2	22.2
Viewing Natural Features	31.3	6.1	Relaxing	22.7	1.0
Viewing Wildlife	21.9	0.4	Bicycling	14.7	3.4
Relaxing	20.5	3.0	Some Other Activity	12.8	12.2
Driving for Pleasure	6.0	0.4	Other Non-Motorized	12.0	0.0
Nature Study	3.8	0.0	Viewing Natural Features	12.0	0.9
Bicycling	3.8	2.2	Viewing Wildlife	5.9	0.0
Cross Country Skiing	3.0	4.1	Cross Country Skiing	3.8	2.3
Some Other Activity	2.9	1.0	Driving for Pleasure	3.0	1.1

Monitoring Discussion and Findings

National Visitor Use Monitoring is the standardized protocol across all Forest units within the National Forest System. While survey methods do not capture 100% of visitation, they provide a statistically valid representation of visitation. General consistencies from 2017 and 2022 are indicated, leading to the conclusion that surveys methods are accurate.

Visitation continues to grow dramatically. In 2022, the White River National Forest was by far the most visited Forest in the National Forest System, and is a popular international travel destination. Opportunities for outdoor recreation within the White River National Forest are seemingly endless, visitation continues to rise, and visitor satisfaction is generally high.

Downhill skiing accounts for the majority of White River National Forest Visits and hiking/walking is the second most popular activity. Other main purposes of visits have shifted slightly over time; relaxing, bicycling, some other activity, other non-motorized and viewing natural features are the only other activities with greater than 10% participation. Overall data indicate that the Forest should continue to manage for high-use and increasing demand for year-round recreation opportunities,

including managing the facilities that support these visits such as trails, roads, trailheads, and developed recreation sites.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

Monitoring item 5.2: Recreation Special Uses Administration

Monitoring Question and Background

- What are the number and type of Recreation Special Use Permits administered to standard?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 2, Objective 2c "Improve the capability of National Forests and rangelands to sustain desired uses, values, products, and services."	Permits administered to standard, number of service days permitted, type of permit.	INFRA, Administering Recreation Special Use Permits to Standard Best Practices; SUDS	Annually	All permits administered to standard set by Region for permit type

Special use permits provide the public high-quality recreational opportunities on the WRNF and support the local economy. Administering these permits to standard is key to maintaining these experiences.

The national target established to ensure delivery of a quality special uses program on behalf of the Forest Service is the number of permits administered to standard. At the end of each fiscal year, all active special use authorizations are evaluated within the Special Uses Data System (SUDS). Depending on the type of authorization, various measurement elements are considered when determining whether the permit has been administered to standard for that fiscal year. In order to be rated as "administered to standard" for the current fiscal year, the special use authorization being evaluated must receive a "Yes" determination for all applicable measurement elements. Any "No" determinations, will result in a determination of "Not Administered to Standard". Measurement elements have been identified at a national level as critical for maintaining a quality special uses program, delivering quality experiences and opportunities to the public, providing adequate natural resource protections, and for ensuring Forest Service compliance with applicable law, regulation and policy.

ATS Measurement Element Relation to the WRNF Forest Plan Goal and Objective for Special Uses Administration:

Authorization Document Current- All special use permits must be current and up to date.

Rental Fees Documented- Land use fees are determined in accordance with applicable law, regulation, policy, and permit terms and conditions. 36 CFR 251.57 requires all special use permits to have an advance fee paid unless otherwise stated in law, regulation or policy.

Bill Issued or Rent Fully Waived- 36 CFR 251.57 states: *"(a) Except as otherwise provided in this part or when specifically authorized by the Secretary of Agriculture, special use authorizations shall require the payment in advance of an annual rental fee as determined by the authorized officer."* Most fees are returned to the U.S. Treasury; however, in unique cases like outfitting and guiding, recreation events, and filming, the majority of the land use fees are returned to the Forest on which they were collected. Those fees are intended for continuation and enhancement of those specific programs and opportunities. The WRNF, its permit holders, and the public benefit greatly from the Forest's ability to reinvest those fees into those specific programs and by extension allow us to meet the Forest Plan objective of "Improv[ing] the capability of national Forests and rangelands to sustain desired uses, values, products, and services."

Document Current and Adequate Insurance- FSM 2713 states that the Forest Service must require insurance for concessionaire uses and should require other holders to carry liability insurance depending on the likelihood and potential severity of injury.

Document Inspections and Take Actions for Non-Compliance- Inspection of special uses permits is an integral process for ensuring the holders' compliance with the terms and conditions of their special use permit and help the Forest maintain high quality public services on NFS lands.

Document Performance Evaluations and Take Action for Non-Compliance- Similar to inspections, it is necessary for the Forest Service to be familiar with the holders' operations and ensure compliance with the permit terms and conditions and operation and maintenance plan. Performance reviews also allow for verification of public satisfaction with the permit holders' operation.

Monitoring Discussion and Findings

In past years, Administered to Standard has been identified as an accomplishment target for Regions and Forests as part of the annual National Budget Direction. Table 21 below identifies the specific program administered by WRNF from FY2020-FY2022 including the number of permits, diversity of uses authorized, regional target accomplishment, as well as number of permits administered to standard.

Table 21. WRNF administered to standard data for recreation special uses from fiscal year 2015- 2022.

Recreation	FY2015	FY2016	FY2017	FY2020	FY2021	FY2022
Total Permits	415	375	418	359	371	384
Total Use Types Authorized	12	14	15	12	19	15
Total ATS for FY	306	333	324	228	312	284
R2 Assigned Target for FY	126	162	207	*	*	*
# Over Target	180	171	117	*	*	*

*Region 2 no longer assigns fiscal year targets for special use permits

White River National Forest- Meeting Forest Plan Goal and Objective for Recreation Special Uses Administration:

With the exception of number of service days authorized, the table above provides information on the indicators identified in the Forest Plan Monitoring Plan for Special Uses Administration- Permits Administered to Standard, and Types of Permits. Findings with respect to each of these indicators are listed below.

Number of Permits Administered to Standard- The number of permits administered to standard alone does not supply much information for use to assess the Forest's program delivery or its success in meeting the Forest Plan goal and objective; however, when we allow for the regional target to act as a proxy for that assessment, we can better assess the Forest's program. From 2020-2022 the WRNF exceeded the annual target provided by the Regional Office for recreation special uses. This is a good indicator that the WRNF has prioritized this accomplishment and is aware of how this accomplishment contributes to the Forest's ability to meet the Forest Plan goal and objective for special uses administration.

Service Days Authorized- At this time, WRNF does not maintain a database for gathering or tracking the total amount of service days authorized; however, NVUM data show that the WRNF is the most highly visited Forest in the country with an estimated 18 million Forest visits. A good portion of these visits occur at the Forest's ski areas that are authorized under a special use permit but those visitors leave the ski areas and enjoy the National Forest either on their own or participating in events or hiring an outfitter guide to enhance their Forest experience. SUDS data show that the WRNF administers one of the largest outfitter and guide and recreation event programs in the Rocky Mountain Region. The WRNF has not only a great number of service days authorized for outfitting and guiding use, but also supports a great number of visitor opportunities through its recreation event and ski area programs.

Types of Permits- With respect to recreation and lands uses, the WRNF demonstrates a wide variety of special use authorizations. They include outfitter guides, recreation events, recreation residences, resorts, concession, winter recreation area, shelters, and snow play to name a few. Furthermore, the Forest has maintained that variety of uses for many years, indicating a willingness to continue providing those opportunities into the future.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

Monitoring item 5.3: Sustaining Recreation Infrastructure

Monitoring Question and Background

- How is the Forest trending towards implementing a sustainable program for recreation related infrastructure?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 2 Objective 2a	Site Condition	INFRA corporate database; Site Condition Surveys	Once every 5 years	Site conditions improving Deferred maintenance backlog reduced

Monitoring Results

Site Condition Surveys are completed a minimum of once every five years for all developed recreation sites, including trailheads. Table 22 shows the number and type of sites permanently taken out of service (decommissioned) since 2003, the number currently closed, and the number of sites currently open as of 2003. Current data will serve as a baseline to evaluate changes in the future.

Table 22. Recreation sites closed or opened since 2003, as of 2022.

Recreation Site Type	Currently closed	Currently Open
BOATING SITE		5
CAMPGROUND	9	54
CAMPING AREA		1
CLIMBING AREA		1
DAY USE AREA	2	4
DOCUMENTARY SITE		4
FISHING SITE	2	3
GROUP CAMPGROUND	1	5
GROUP PICNIC SITE		2
HORSE CAMP		2
HOTEL, LODGE, RESORT		23
INFO SITE/FEE STATION		2
INTERPRETIVE SITE		3
INTERPRETIVE VISITOR CENTER (MINOR)		2
LOOKOUT/CABIN		1
OBSERVATION SITE		3
PICNIC SITE	3	13
RECREATION RESIDENCE	1	15
SKI AREA ALPINE		11
SKI AREA NORDIC		2
TARGET RANGE		1
TRAILHEAD	2	162
Grand Total	**20**	**319**

Monitoring Discussion and Findings

The White River National Forest manages developed recreation sites through a combination of concessionaires (private companies) and force-account (Forest Service employees), and through both fee and non-fee sites. Site condition surveys document and track a recreation site being “managed to standard,” annual operations and maintenance, and help with future planning of replacements of developed recreation sites features and amenities. These are also useful to understanding the amount of

deferred maintenance, where recreation fees may or may not provide enough funding to address deferred maintenance.

The findings disclosed in Table 22 provide a baseline for future evaluations, and shows that 6 % (20 of 339) recreation sites on the WRNF are permanently closed. The permanent recreation site closures reduce the amount of overall developed recreation infrastructure and focus concessionaire and force-account capacity on supporting a sustainable recreation program.

Another tool to implementing a sustainable program for recreation related infrastructure is through Recreation Site Analysis (RSA). RSA looks at the totality of operating and maintaining sites and deferred maintenance, but also broadens the goals to consider how recreation sites contribute to social stability, environmental integrity, and economic viability for the Forest and its communities. This is a tool that provides future prioritization, including a range of options including expansion and/or reductions in services of recreation sites, closing sites, shifting operational responsibility to other stakeholders, etc.

Adaptive Management Considerations

The WRNF has performed two rounds of Recreation Site Analysis. The Forest has implemented many of the management actions to reach a sustainable developed recreation program. The Forest is currently embarking on a 2022 Forest-wide concession prospectus that will offer 69 developed sites out for private concession management. This prospectus added five new sites into the offering to allow for sustainable management; three sites were made optional offerings. We do not foresee any changes to the monitoring program, Forest Plan direction or management activities proposed at this time.

VI: Status of climate change measures and other stressors

Monitoring Item 6.1: Snowpack and Precipitation

Monitoring Question and Background

- What are the status and trends of snowpack and precipitation in the planning area?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Frequency of data a) collection b) reporting	Targets, Thresholds
Goal 1, Objective 1e "Work cooperatively with individuals, organizations, local, state, tribal, and other federal agencies to promote ecosystem health and sustainability across landscapes."	Snow water equivalent (SWE), annual precipitation and average temperature	Natural Resource Conservation Service SNOTEL DRI/University of Idaho Google Earth Engine	a) Daily b) 2 years.	Declining snow-water equivalent trends Declining trends in climatic measures of precipitation and temperature over time

Monitoring Results

Snowpack

Snowpack monitoring on WRNF is conducted by the Natural Resources Conservation Service at automated SNOTEL monitoring sites. Data from multiple SNOTEL sites are used to assess trends in the snow-water equivalent (SWE) (i.e. the amount of water in snow snowpack) across the upper Colorado River Basin, a watershed that encompasses most WRNF (Figure 54).

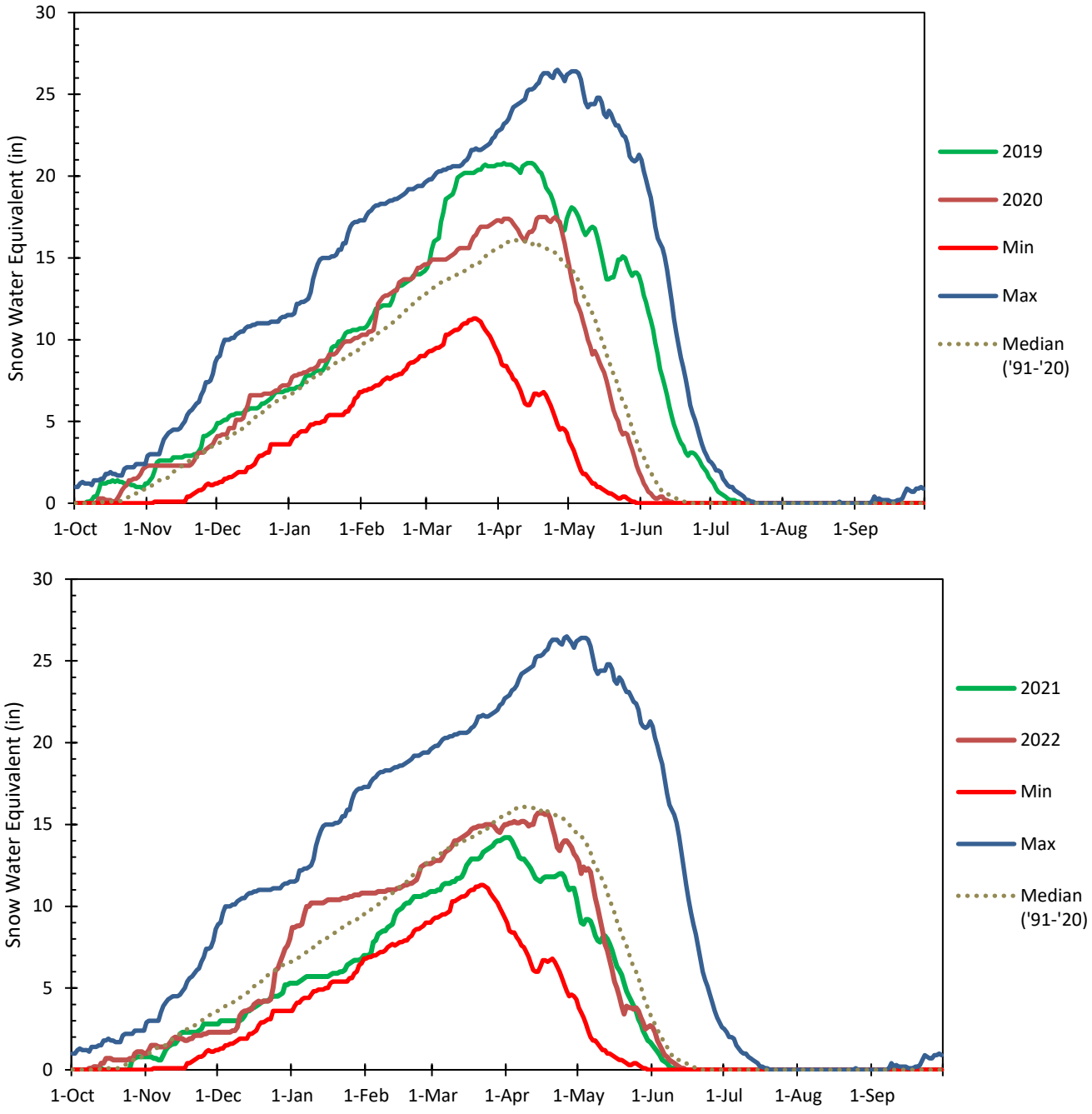


Figure 54. Snow Water Equivalent trends for the Upper Colorado River Basin. Maximum, minimum and median are 30-year averages for the 31 SNOTEL sites in the basin.

Recent annual trends for the WRNF plan area are also evident in area averaged estimates of snow water equivalent derived from NOAA's SNODAS product, summarized here using the Desert Research Institute and University of Idaho's **Climate Engine**. See Figure 55.

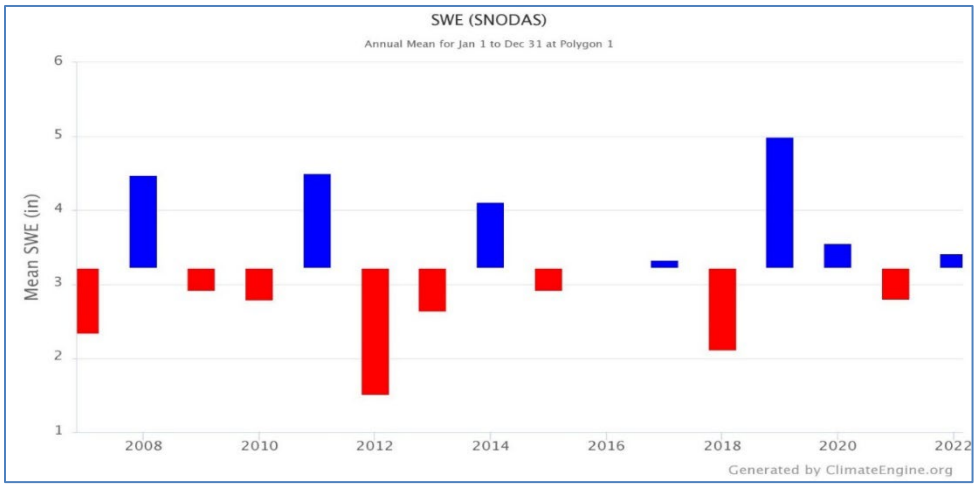


Figure 55. Mean Area Snow Water Equivalent deviations from the mean (3.22 inches) for the White River National Forest planning unit, 2004-2022

Precipitation and temperature

Annual precipitation and temperature trends for the WRNF planning area were also calculated from gridded datasets (i.e. GRIDMET) in the Climate Engine. Results are shown below in Figure 56 and Figure 57.

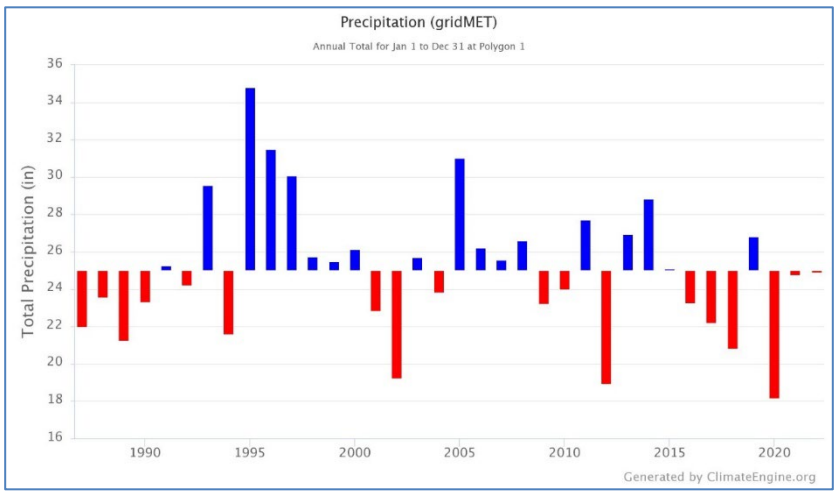


Figure 56. Precipitation total deviation from the precipitation mean (25.03 inches) from 1987-2022 for the White River National Forest

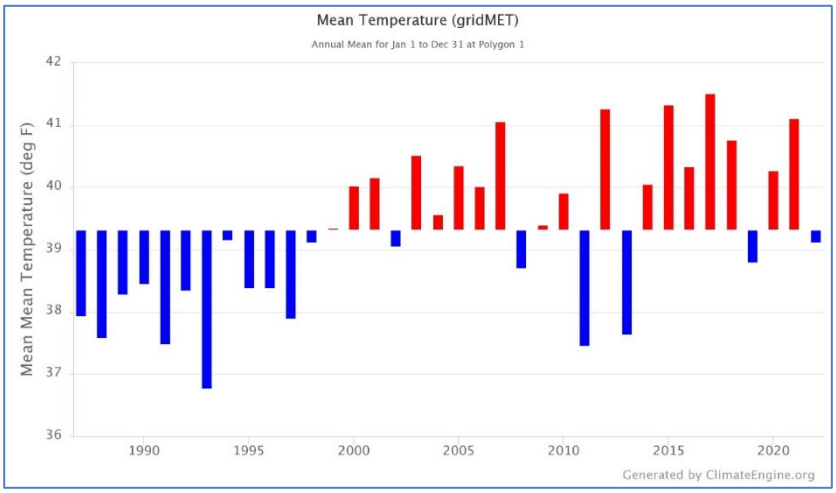


Figure 57. Mean temperature deviation from the temperature mean (39.32 F) from 1987-2022 for the White River National Forest.

Monitoring Discussion and Findings

Snow water equivalent values for 2019 through 2022 are higher than the mean, with the exception of 2021 (Figure 55). There is variation between mean annual values, but there is no significant trend between 2007 to 2022. Precipitation trends show a slight downtrend below the mean, although this may be attributed to annual variations (Figure 56). There is a clear warming temperature trend shown in Figure 57. These data will be used as a baseline for subsequent monitoring studies.

Adaptive Management Considerations

These climate datasets are collected continuously and reported over various time increments useful for these analyses. Although Forest management activities will typically not have a direct and measurable influence on these climate parameters, the trends described can provide a context for evaluating other fine-scale monitoring results and trends on the Forest. As such, no adaptive changes to the Forest Plan or this monitoring question are anticipated at this time.

VII. Progress toward meeting Forest Plan desired conditions and objectives

Monitoring Item 7.1: Economic Contributions from Specific Programs

Monitoring Question and Background

- What are the contributions from the range, timber, recreation, and minerals programs to the National Forest?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 5, Objective 5a "Work cooperatively with individuals and organizations, local, state, tribal, and federal governments to promote ecological, economic, and social health and sustainability across landscapes."	**Indicator 1:** Range, timber, recreation, and minerals contributions to local employment and income	IMPLAN	a) Annually; b) 2 years.	Maintain economic contributions

National Forests and Grasslands provide multiple benefits to the American people and to local communities. They provide clean air and water, preserve cultural resources, and conserve lands for the enjoyment of present and future generations. They also support local economies through recreation, timber, energy, minerals, and livestock grazing. In addition, counties with National Forests or grasslands receive funds to support schools, road maintenance, and stewardship projects. The Forest Service also invests in such things as the construction and maintenance of infrastructure, environmental restoration, and forest health, in addition to providing salaries to its employees and contractors. In 2022, the sum of these activities on the White River National Forest (WRNF) supported between 25,000 and 29,000 local jobs and between $1.24 and 1.43 billion dollars in local labor income.

To derive these figures, a model of the local economy that simulates how its different pieces interact—an "Input-Output" model—was run using a software and data package called IMPLAN (www.implan.com). Forest Service data for program outputs from the WRNF were added into the model, including recreation visitation and expenditure patterns, livestock grazing, Forest products, minerals and energy extraction, payments to states and counties, and Forest Service salary and non-salary expenditures. The IMPLAN model then estimated the economic links between natural resource management on the WRNF and local jobs and income, also known as economic contributions. The modeled outputs for jobs and income are reported in Tables A and B below.

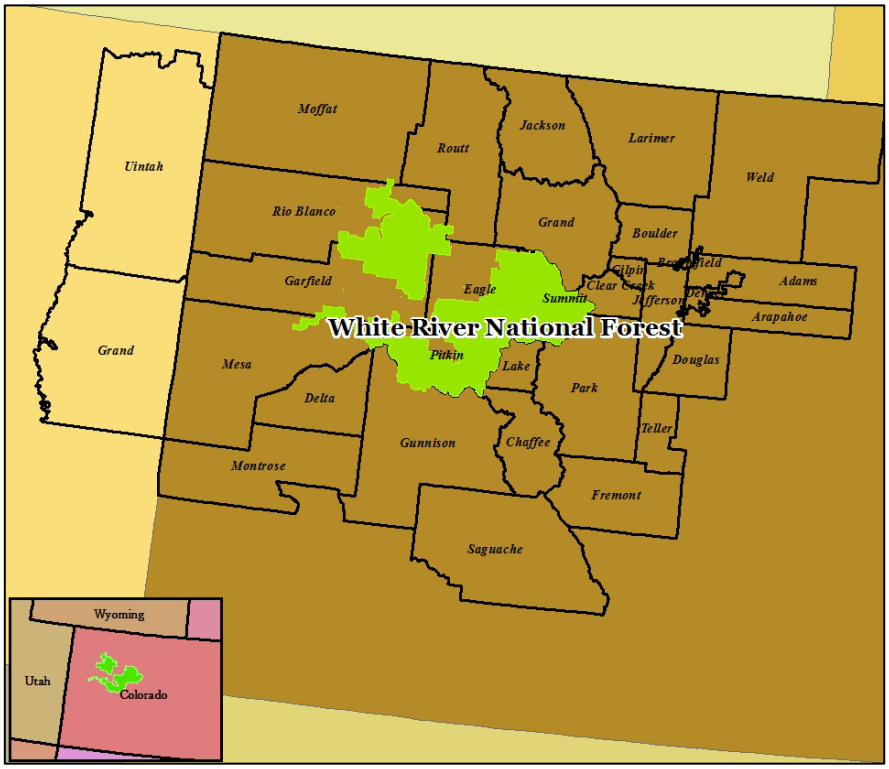


Figure 58. Counties in Colorado and Utah that comprise the "Economic Area of Influence" of the White River NF for the purposes of this analysis.

The economic contributions from the WRNF have a wide geographic reach (Fig 58). For the purpose of this analysis, the "economic area of influence" includes the following 32 counties: Adams, Arapahoe, Boulder, Broomfield, Chaffee, Clear Creek, Delta, Denver, Douglas, Eagle, Fremont, Garfield, Gilpin, Grand, Gunnison, Jackson, Jefferson, Lake, Larimer, Mesa, Moffat, Montrose, Park, Pitkin, Rio Blanco, Routt, Saguache, Summit, Teller, and Weld Counties in Colorado; and Grand and Uintah Counties in Utah. The counties selected to form the WRNF's economic area of influence were chosen based on where Forest Service management decisions have a direct effect on economic activity. The map in Fig. 1 shows where Forest Service-related direct expenditures occur, including recreation and wildlife visitor spending, the location of grazing permit holders, the location of logging and restoration firms, mills processing Forest Service wood products, the counties receiving returns to states funds and payments in lieu of taxes, the location of Forest Service budget expenditures, and the salary spending by Forest Service employees.

Monitoring Results, Discussion and Findings

Modeled Contributions to Local Jobs in 2022

Jobs supported by National Forests and Grasslands are often in small, rural communities and therefore make an important contribution to economic and social sustainability. Employment is the estimate of average annual full-time, part-time, temporary, and seasonal jobs. "Direct" job contributions come from economic activity immediately associated with a Forest Service program. "Secondary" job contributions are the ripples in the labor pool that are stimulated by the direct economic activity—for instance, hiring by firms that support the programs indirectly, or hiring that is enabled by workers spending their earnings on goods and services in the local area. Total job contributions are the sum of direct and secondary contributions.

Table 23 shows the annual jobs supported by WRNF programs in 2022. Note that the recreation-related job contributions are expressed as a range rather than a single estimate. This is to capture the uncertainty and variation in the economic behavior of Forest visitors. The lower bound represents the economic contributions if each recreation visitor behaved according to an "average spending profile", while the upper bound attributes a "high spending profile" to each visitor (see White 2017).

Except when the values were less than ten, values have been rounded to the nearest ten jobs. Rows and columns may not sum exactly due to rounding.

Table 23. Direct, Indirect & Induced, and Total Jobs supported by WRNF in 2022, by program

Program	Direct Jobs (average annual)	Secondary Jobs (average annual)	Total Jobs (average annual)
Recreation by Local Visitors	1,440 — 1,670	520 — 610	1,970 — 2,280
Recreation by Non-Local Visitors	16,110 — 18,470	5,980 — 6,940	22,090 — 25,410
Minerals and Energy	2	13	15
Forest Products	250	300	550
Livestock Grazing	190	110	310
USFS Resource Management Investments	220	90	310
Payments to States/Counties	6	4	10
TOTAL	**18,220 — 20,810**	**7,020 — 8,070**	**25,240 — 28,880**

Recreation is divided into "local" and "non-local" visitors because of their distinct economic impacts. Non-local recreation visitors bring new money into the economy, while local recreationists spend money that is already counted in the economic statistics for the area, so they are tracked independently. The "Forest Service Resource Management Investments" category captures the spending of the WRNF's budget on such things as infrastructure construction and maintenance, ecosystem restoration, fuels treatments, and salaries. The "Payments to States/Counties" category estimates the jobs supported by local government investment in such things as roads and schools via funding from programs like the 25% Fund, Payments in Lieu of Taxes, and minerals royalties.

Modeled Contributions to Labor Income in 2022

Labor income is the value of wages, salaries, and benefits for wage earners plus income to local business owners. Table 24 shows direct, secondary, and total labor income supported by WRNF programs in 2022. Note that the unit for the table entries is "thousands of USD", so a value of "$300" means "$300,000". Values have been rounded to the nearest thousand dollars. Rows and columns may not sum exactly due to rounding.

As above, recreation-related income is expressed as a range, where the lower bound attributes an "average spending profile" to each visitor and the upper bound attributes a "high spending profile" to each recreation visitor (White 2017).

Table 24. Direct, Secondary, and Total Labor Income supported by WRNF in 2022, by program

Program	Direct Labor Income (annual, $1000s)	Secondary Labor Income (annual, $1000s)	Total Labor Income (annual, $1000s)
Recreation by Local Visitors	$58,208 — 67,940	$37,484 — 43,532	$95,692 — 111,473
Recreation by Non-Local Visitors	$674,848 — 778,449	$417,524 — 484,751	$1,092,372 — 1,263,200
Minerals and Energy	$1,078	$1,153	$2,231
Forest Products	$10,494	$8,946	$19,441
Livestock Grazing	$2,556	$4,566	$7,122

Program	Direct Labor Income (annual, $1000s)	Secondary Labor Income (annual, $1000s)	Total Labor Income (annual, $1000s)
USFS Resource Management Investments	$17,074	$6,170	$23,244
Payments to States/Counties	$417	$300	$718
TOTAL	**$764,675 — 878,008**	**$476,143 — 549,418**	**$1,240,818 — 1,427,429**

Economic Inputs from the White River, 2016 through 2022

Management decisions by the Forest Service aren't the sole or even major determinant of the "economic contributions" reported above. The final economic contributions values (Tables 23 and 24) are heavily affected by actual use of natural resources from the Forest (i.e., demand) and other local, national, and global economic conditions (e.g., prices, trade patterns, population change, etc.) that are beyond the scope of Forest Service control. Our sphere of influence is limited to the supply of certain material inputs through Forest planning and budget allocations.

The modeled estimates from IMPLAN in Tables 23 and 24 provide a snapshot of the *outcome* of Forest resource uses, and validate the important role the Forest plays in the local economy. They are not for use in isolation, nor should they be treated as monitoring "data". It is inadvisable to draw year-on-year inferences from model outputs through time series analysis. Due to advancements in modelling approaches, changes in the underlying economy, as well as differences in data collection across years, these results should not be used to identify trends or make assumptions about changing economic contributions. Therefore, it is not appropriate to rely on these findings as a metric in Biennial Monitoring Evaluation Reports.

Furthermore, results for future two-year periods will not capture economic contributions in their entirety due to the mismatch in reporting cycle of recreation visitation. The National Visitor Use Monitoring (NVUM) program, which supplies recreation visitation data, samples every National Forest on a five-year cycle. The WRNF was sampled in 2017 and again in 2022. Not until 2027 will "fresh" recreation data be available again. Given that the WRNF is one of the most highly visited Forests in the nation and that recreation spending plays an outsized role in supporting local jobs and labor income, biennial reporting of IMPLAN estimates will frequently miss a key component of the Forest's overall economic contributions. Consideration should be given to align the economic activity report on the same five-year timeframe as recreational visitors use data within the WRNF monitoring program.

A more appropriate data set for tracking the Forest Service's influence on the economic sustainability of the region over time is the collective *program outputs* that serve as the raw data for the IMPLAN model. Number of visitors, barrels of oil, volume of Forest products, dollars spent on Forest Service salaries, etc. – these indicators are more directly under the control of the Forest Service and can be compared year by year to track our changing contributions to the local economy.

Tables 25 through 31 below show the program outputs that were used to estimate the tie between management actions and economic activity in communities in and around the White River National Forest. Where possible, data are presented for 2016, 2018, 2020, and 2022.

Recreation

Table 25. Recreation visitation to the White River National Forest in 2017 and 2022, broken down into three categories based on "Main Recreation Activity".

	2017		2022	
Total Visitation, Estimated	**12,274,000**		**14,738,600**	
Type of Main Recreation Visit	Percentage (2017)	Number of Visits (2017)	Percentage (2022)	Number of Visits (2022)
Non-Wildlife, Non-Downhill Skiing	44.8%	5,498,752	46.7%	6,882,926
Downhill Skiing-Related	54.1%	6,640,234	52.5%	7,737,765
Wildlife-Related	1.1%	135,014	0.8%	117,909
Non-Wildlife Related Visitation (by trip type)	Proportion of Visitors (2017)	Total Number of Visitors (2017)	Proportion of Visitors (2022)	Total Number of Visitors (2022)
Non-Local (NL) Day Trips	6%	329,925	6%	412,976
NL Overnight (OVN) on the NF	3%	164,963	4%	275,317
NL-OVN off the NF	23%	1,264,713	26%	1,789,561
Local (L) Day Trips	35%	1,924,563	27%	1,858,390
L OVN on the NF	1%	54,988	1%	68,829
L OVN off the NF	0%	-	2%	137,659
NL Not Primary	32%	1,759,601	34%	2,340,195
Downhill Skiing-Related Visitation	Proportion of Visitors (2017)	Total Number of Visitors (2017)	Proportion of Visitors (2022)	Total Number of Visitors (2022)
NL Day Trips	19%	1,261,644	35%	2,708,218
NL Overnight	67%	4,448,957	31%	2,398,707
L Day Trips	11%	730,426	29%	2,243,952
L Overnight	1%	66,402	2%	154,755
NL Not Primary	2%	132,805	3%	232,133
Wildlife-Related Visitation	Proportion of Visitors (2017)	Total Number of Visitors (2017)	Proportion of Visitors (2022)	Total Number of Visitors (2022)
NL Day Trips	12%	16,202	9%	10,612
NL OVN on the NF	18%	24,303	16%	18,865
NL OVN off the NF	31%	41,854	20%	23,582
L Day Trips	12%	16,202	38%	44,805
L OVN on the NF	16%	21,602	0%	-
L OVN off the NF	0%	-	0%	-

	2017		2022	
NL Not Primary	11%	14,852	17%	20,045

Source: National Visitor Use Monitoring Program

The WRNF hosted an estimated 12.3 million visitors in 2017. By 2022, visitation to the WRNF had increased by 20 percent to 14.7 million. In both years, the majority of visitors reported "Downhill Skiing" as their main activity (although many of these visitors also engaged in other activities while on the Forest, such as hiking, viewing natural features, or cross-country skiing). In 2022, a far greater proportion of the downhill skiers (29% vs 11%) were local visitors on day trips, while the proportion of nonlocal skiers who stayed overnight dropped from 67 to 31 percent. ("Local" visitors are defined as those who travel less than 50 road miles from their home to the recreation site). More information and insight can be found using the NVUM Results application (https://www.fs.usda.gov/about-agency/nvum).

Minerals and Energy

Table 26. Minerals produced on the WRNF in alternating years between 2016 and 2022.

Mineral	2016	2018	2020	2022
Carbon Dioxide (M Cubic Feet)	-	-	-	-
Coal Mining (Short Tons)	-	-	-	-
Construction Sand and Gravel (Short Tons)	-	-	-	-
Copper (Short Tons)	-	-	-	-
Crude Oil (Barrels)	6,833	7,614	4,694	5,514
Crushed Stone (Common Variety) (Short Tons)	-	2	3	-
Crushed Stone (High-Purity) (Short Tons)	-	-	-	2,548
Dimension Stone (Short Tons)	-	-	-	-
Gold (Troy Ounces)	-	-	-	-
Hot Water (kWh)	-	-	-	-
Lead (Short Tons)	-	-	-	-
Natural Gas (M Cubic Feet)	1,104,920	727,613	783,926	681,037
Natural Gas Liquids (Gallons)	1,952,875	1,382,135	1,655,793	1,377,170
Nitrogen (M Cubic Feet)	-	-	-	-
Other Clay Ceramic Refractory Mining (Short Tons)	-	-	-	-
Palladium (Troy Ounces)	-	-	-	-
Phosphate (Short Tons)	-	-	-	-
Platinum (Troy Ounces)	-	-	-	-
Pumice (Short Tons)	-	-	-	-
Quartz Crystals (Pounds)	-	-	-	-
Silver (Troy Ounces)	-	-	-	-
Specialty Mineral Materials (Short Tons)	-	-	-	-

Mineral	2016	2018	2020	2022
Zinc (Short Tons)	-	-	-	-

Source: DOI Office of Natural Resources Revenue

The primary minerals and energy resources produced by the WRNF are crude oil, natural gas, and natural gas liquids. Production of each of these three resources has fluctuated and fallen since 2016, with the 2022 values lower than the 2016 values by 19.3 percent (crude oil), 38.4 percent (natural gas), and 29.5 percent (natural gas liquids). The number of jobs supported by these commodities are low relative to other resources on the WRNF, amounting to 15 jobs in 2022.

Forest Products

Table 27. Volume of Forest products harvested on the WRNF in alternating years between 2016 and 2022.

Type of Forest Product	2016	2018	2020	2022
Softwood Sawtimber (Hundred Cubic Feet, CCF)	10,107	8,706	1,767	27,146
Softwood Pulp (CCF)	-	-	-	-
Hardwood Sawtimber (CCF)	-	-	-	-
Hardwood Pulp (CCF)	-	-	-	-
Posts & Poles (CCF)	1,447	2,468	980	6
Fuelwood (CCF)	2,301	2,715	1,718	1,769
All Other (CCF)	5,095	15,398	22,178	23,270
TOTAL	**18,950**	**29,287**	**26,643**	**52,191**

Source: US Forest Service, Forest Products Cut and Sold Report (CUTS203f)

Softwood sawtimber harvest volumes vary widely from year to year, with 2022 being an exceptionally high year for timber volume removed due to task orders within the long-term stewardship contract nearing termination and the contractor increasing capacity in order to meet termination timelines. There is no hardwood harvesting on the WRNF. The fuelwood volumes reported here are not included in the economic contribution values in Tables 23 and 24 because the firewood is gathered for personal (not commercial) use. The material in the "All Other" category, consists mostly of biomass Forest products utilized by the bioenergy plant in Gypsum, Colorado. Biomass feedstock has grown steadily since 2016 due to annual awards of long-term stewardship task orders.

Livestock Grazing

Table 28. Livestock grazing values in "Animal Unit Months" (AUMs) for the WRNF in alternative years between 2016 and 2022.

Livestock	2016	2018	2020	2022
Cattle and Horses (AUMs)	67,511	76,181	66,325	73,144
Sheep and Goats (AUMs)	27,833	31,608	27,813	29,667
Total AUMs	**95,344**	**107,789**	**94,138**	**102,811**

Source: US Forest Service Rangeland Management Report (RNGR310P)

Grazing on the WRNF has been steady or growing for the past six years. Between 2016 and 2022, the number of cattle and horses grazing on the Forest as measured in Animal Unit Months (a standard unit

referring to the forage necessary to sustain a 1000-pound animal for one month) increased by 8.3 percent. Over the same period, grazing by sheep and goats increased by 6.6 percent.

Forest Service Expenditures

Table 29. Expenditures by the White River National Forest on Salary and Non-Salary in alternating years between 2016 and 2022. Reported in units of 1000s of USD.

Expenditure	2016	2018	2020	2022
Forest Service – Salary ($1000s)	$12,608.97	$11,987.41	$12,113.86	$11,555.84
Forest Service – Non-Salary ($1000s)	$9,990.44	$19,838.73	$32,369.49	$11,631.61
Total	**$22,599.42**	**$31,826.14**	**$44,483.35**	**$23,187.44**

Source: Data from Lead Budget Analyst Michael Jacobs.

Table 30. Number of Full Time Employees (FTEs) in service to the WRNF in alternating years between 2016 and 2022.

Workforce	2016	2018	2020	2022
Permanent Full Time Employees (FTEs)	106	103	120	120
Other than Permanent FTEs	112	117	44	31
Total FTEs	**218**	**220**	**164**	**151**

Source: FMMI Regional Payroll Summary Report, "FTEs by HR Org Code"

Total expenditures by the WRNF have fluctuated over the last six years with a sharp rise in 2018 and 2020, and a return to near 2016 levels in 2022. This has primarily been due to variability in Non-Salary expenses, since Salary expenditures have been nearly flat for the entire period. The number of Permanent Full Time Employees (FTEs) has grown by 13.2 percent since 2016, while the number of "Other than Permanent" FTEs has decreased significantly in recent years from a high of 117 in 2018 to a low of 31 in 2022. "Other than Permanent" FTEs trending downward can be attributed to low unemployment rate, high cost of living on the WRNF and flat budgets with higher inflation. The WRNF had a difficult time recruiting "Other than Permanent" FTEs in 2020 and 2022.

Payments to States and Counties

Table 31. Payments to States and Counties by the WRNF since 2016.

	2016	2019[1]	2020	2022
Payments to Counties: Total Secure Rural Schools Act (SRS) and 25% Fund Payments ($1000s)	$30	*N/A*	$1,997.07	$2,126.55
Minerals Royalties	$0	*N/A*	$15.51	$63.92
Payments in Lieu of Taxes (PILT)	$4,859	*N/A*	$5,249	$5,496
Total Payments to States and Counties	**$4,889**	**$7,155**	**$7,262**	**$7,623**

Sources: Secure Rural Schools Program; Office of Natural Resources Revenue; DOI Payment in Lieu of Taxes Website

The Secure Rural Schools program provides critical funding for schools, roads, and other municipal services to more than 700 counties across the U.S. and Puerto Rico;however, 73 counties have elected

[1] When this report was being compiled, data were not immediately available for 2018, so 2019 data were included instead. However, only the Total value for 2019 was readily available, not the line-by-line breakdown.

not to receive Secure Rural Schools payments and instead to receive 1908 Act (amended) 25% payments, in which 25% of gross receipts generated on Forest Service lands during the fiscal year are distributed to counties. The White River contains both kinds of counties, and so disburses both types of payments annually. (See the Secure Rural Schools Payments page for more information on the two types of payments and the selection process).

All segments of Payments to States and Counties have increased over time. Compared to 2016, the jump is particularly notable in Secure Rural Schools Act (SRS) and 25% Fund Payments, although the increase in Payments in Lieu of Taxes have been substantial as well (+56% growth).

Adaptive Management Considerations At this time, there are no adaptive management considerations to consider for economic contributions to WRNF.

Monitoring Item 7.2: Heritage Program

Monitoring Question and Background

- To what extent have management activities on the Forest complied with Section 110 of the National Historic Preservation Act and provided quality heritage recreational experiences?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Heritage Program Standard 1: Conduct all land management activities in such a manner as to comply with all applicable federal, state and local regulations. Many heritage resources values can be protected effectively through application of the provisions of these regulations:	**Indicator 1:** Number of heritage stewardship actions taken, including preservation, stabilization, research, interpretation, partnerships, volunteer opportunities, and other forms of public outreach.	National Resource Manager Database, Heritage Program reports	a) Annually; b) 10 years.	45 total points from Heritage Program Managed to Standard targets is the annual target for Forests.

The USFS's Heritage Program Managed to Standard program is how each Forest documents monitoring of Cultural Resources and heritage stewardship actions. This is based on Section 110 of the National Historic Preservation Act; Section 110 of the Act calls on all federal agencies to establish—in conjunction with the Secretary of the Interior—their own historic preservation programs for the identification, evaluation, and protection of historic properties.

Monitoring Results

Table 32. Heritage Program Managed to Standard Target Accomplishments.

FY22 WRNF Heritage Program Managed to Standard Target Accomplishments			
Measures	**YTD Points**	**Max Points**	**Description**
Heritage Program Planning		10 total	
Heritage Program Plan	0	10	Comprehensive Plan – all categories
Cultural Resource Overview	0	2	Synthesis of WRNF known cultural resources
Predictive Model	0	2	Site probability model
Monitoring Plan	1	1	Current
NAGPRA Protocol	0	1	Legacy plan – needs update
Looting & Vandalism Protocol	0	1	Legacy plan – needs update
Emergency Response Protocol	0	1	Legacy plan – needs update
Field Survey	0	10	1 pt per 20 acres up to 200 acres total
Legacy Evaluations/Nominations	10	10	0.5 pt per NRHP evaluation 10 pts per nom
Condition Assessment on PHAs	2	10	1 pt per current (5 yrs.) condition assessment
Stewardship Activities	2.5	10	2.5 pts per Stewardship project
Study/Public Use	10	10	2 pts per outreach project
Volunteers	10	10	0.025 pt per volunteer hours. 400 hrs+ = 10pts
Yearly Total Target		70	
Totals	35.5		

Monitoring Discussion and Findings

The Heritage Program Plan was in progress, along with a Predictive Model. No Section 110 field survey was completed due to only having two people in the Heritage Department and the additional duties of working on the proclamation for the new National Monument, Sweetwater Lake property acquisition, and Hanging Lake trail rebuild projects. Being able to complete survey work alone would have brought us over 45 points.

Adaptive Management Considerations

There has been an emphasis on completing Section 106 compliance in the WRNF Heritage Department for years, Section 110 work has been on the back burner while Forest project work comes first. Most of our Heritage Program Managed to Standard targets have been met by our partner's contributions - Aspen Historic Society, Breckenridge History, Cayton Ranger Station Foundation, Vail Resorts (Keystone), and Walking Mountains Science Center.

With the addition of two more people in the Heritage Department in 2023, more opportunity for improving our Heritage Managed to Standard was thought to be possible, but we were essentially

limited to two field going staff for the field season. Maintaining a constant staffing level of at least four people is essential for being able to meet our targets.

Adaptive Management Considerations can be limited due to lack of funding. But there are options such as using the Enterprise team for completing measures, as they have been working on a Predictive Model for the WRNF without a cost to us, or having volunteers assist us with PIT projects like survey work.

Monitoring Item 7.3 - Travel Management Implementation

Monitoring Question and Background

- What are the status and trends of roads and trails on WRNF*?*

Forest Plan Ref./ Driver	Indicators	Data Sources, Protocols, Partners	Freq. of a) data collection and b) reporting	Desired Conditions, Targets, Thresholds
Goal 4, Objective 4a **2011 Travel Management Plan**	Miles of Roads Managed to Standard, Miles of Trails managed to Standard, Miles of Routes (Roads/Trails) Decommissioned, Number of Kiosks and Information Panels installed	USFS Infrastructure (INFRA) database	a) Annually; b) 2 years.	14 miles of road decommissioned per year Number of miles of trails maintained to USFS standard

Monitoring Results

Since the signed record of decision of the 2011 Travel Management Plan (TMP), WRNF recreation staff has been implementing management actions in accordance with decisions related to motorized and non-motorized trails and recreation visitors for both summer and winter seasons. The 2011 TMP Record of Decision requires a substantial amount of planning and coordination every year between WRNF staff, public and private organizations, volunteer and partner organizations, as well as state and local government agencies. Every year the Forest completes updates, produces and makes available to the public Motor Vehicle Use Maps (MVUMs) for both summer and winter seasons.

Roads

Forest Service classifies maintenance of National Forest System roads by five levels: 1, 2, 3, 4, and 5. Maintenance level 1 roads are closed to motor vehicle use. Maintenance level 2 roads are maintained for high-clearance vehicles. Maintenance level 3, 4, and 5 roads are maintained for passage by standard passenger cars during the normal season of use. The status and trend of roads within the WRNF is summarized in Table 33. These data were prepared from the natural resource manager (NRM) corporate database's road accomplishment reporting (RAR) module. The quantity of system road miles in the WRNF NRM report differs greatly from the quantity of system road miles shown in 2011 TMP (Table 34). This large difference in mileage is because the total mileage of system roads identified the 2011 TMP as "decommissioned", or "not needed" is not included in the TMP road mileage. WRNF engineering has worked with the USFS enterprise team through an agreement and other resource specialists to make the proper corrections to our databases. Current figures will serve as a baseline for future biennial reporting.

The TMP identified 1,551 miles of system and non-system roads for decommissioning, and a target of 14 miles of road decommissioned each year. Figure 59 shows miles of road decommissioned each year

versus the target. Figures 59 and 60 were populated with a variety of reports, ranging from force account to recreation staff cooperative agreement accomplishments, and contract reports. Since the March 2011 Record of Decision for the TMP, and through 2022, approximately 239 miles of road have been physically closed and decommissioned with heavy equipment. Another 14 miles (approximately) are anticipated to be completed in 2023. This totals approximately 16 percent of the decommissioning identified in the TMP. A substantial portion, perhaps one-third or more, of the remaining identified road decommissioning mileage has become effectively closed to traffic and become stabilized through natural processes. This will remain a rough estimate until project level planning efforts are able to identify decommissioning treatments needed for specific roads.

Table 33. WRNF roads by maintenance level operated at or above plan objectives.

Objective Maintenance Level	Mileage Operated Above Objective	Mileage Operated Equal To Objective	Mileage Operated Below Objective	Total System Miles	% of Mileage Operated At Or Above Objective
5	0.0000	19.1790	1.5840	20.7630	92.4
4	0.0000	45.0730	39.0700	84.1430	53.6
3	0.3490	309.4242	75.9720	385.7452	80.3
2	28.9600	1,264.2303	27.7140	1,320.9043	97.9
1	57.2200	282.5900	0.0000	339.8100	100.0
C	12.7070	0.0000	0.0000	12.7070	100.0
D	1.4000	0.0000	0.0000	1.4000	100.0
Total:	**100.6360**	**1,920.4965**	**144.3400**	**2,165.4725**	**93.3**

Table 34. 2011 TMP data and 2015 Subpart A report.

Roads	Miles
Maintenance Level 5	14
Maintenance Level 4	48
Maintenance Level 3	325
Maintenance Level 2	1,029
Maintenance Level 1	4
Total System Roads	1,420

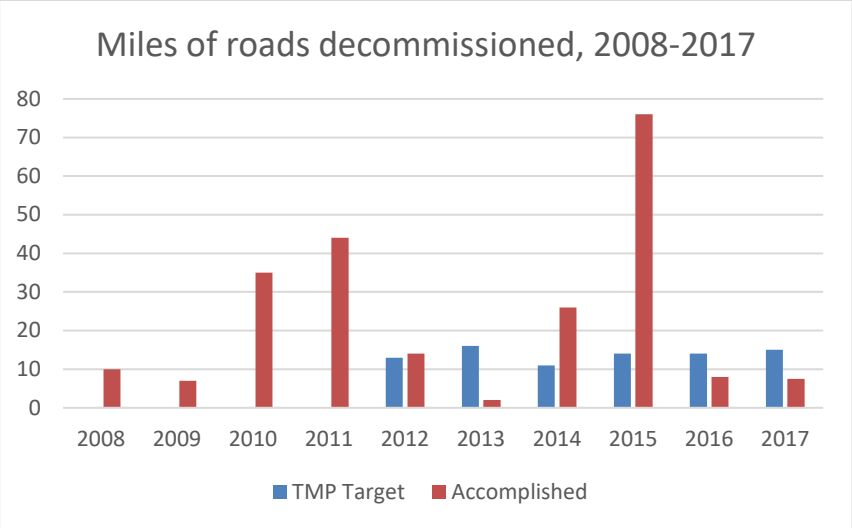


Figure 59. Miles of road decommissioned 2008-2017.

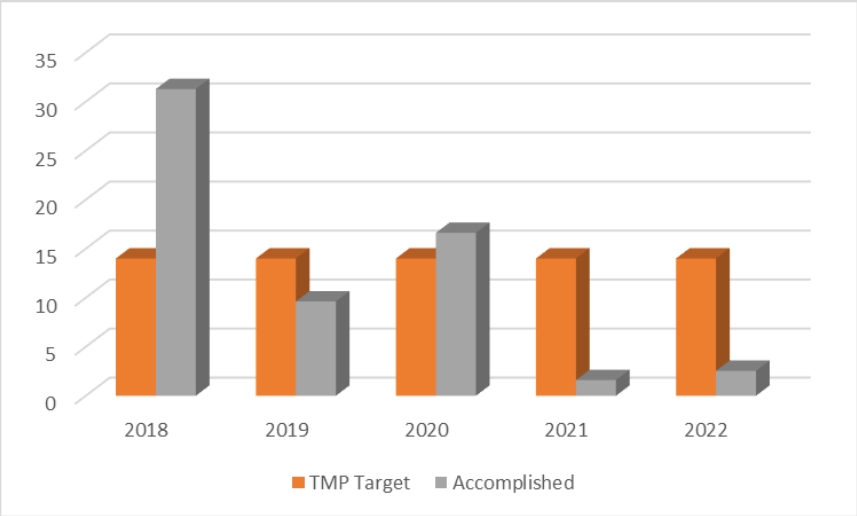


Figure 60. Miles of road decommissioned 2008-2017.

Trails

The TMP Implementation Plan identified management actions related to Recreation and Trails under four separate emphasis areas: Education, Enforcement, Engineering, and Evaluation (addressed within Monitoring Discussion and Findings). All trails designated through the TMP are to be maintained to standard, routes not designated will be decommissioned. This made Travel Management Implementation a priority for five years and continues to earmark monies for education, informational and regulatory signing across the Forest.

Education: As part of the education and information component of the TMP, the WRNF sign program has been an integral part of getting travel and access information out to Forest visitors. The sign program started in 2005 in an effort to provide consistent and high-quality signage across the Forest. As part of TMP implementation the sign plan identified kiosk locations across the Forest that would house TMP information for roads and trails. As part of that effort, the Forest entered into an agreement in 2012 with Colorado Corrections Industry (CCI) in Buena Vista to construct kiosks. The Forest

budgeted approximately $22k for kiosk materials annually from 2012 thru 2021. Over that ten-year period, CCI constructed on average 36 kiosks per year. From 2011 thru 2017 the Forest installed kiosks at approximately 166 locations across the Forest. From 2018 thru 2022 the Forest installed kiosks at approximately 93 locations across the Forest. Currently, the Forest is approximately 82% complete given the originally planned 313 kiosk locations. Planned kiosk and sign locations includes TMP "Portals", Ranger Districts, trailheads and campgrounds. WRNF recreation continues to work with the USFS Enterprise Team for the design and production of trailhead sign panels in accordance with our sign and kiosk plan.

Enforcement: Enforcement has been underway from the beginning; however, information and education were the focus for the first three years. A key part of enforcement was the production and distribution of the MVUMs. MVUMs have been available and free to the public since 2012. On average the WRNF spends $16,000 a year to print MVUMs.

Engineering: The TMP identified 2,608 miles of system trails on WRNF. As of 2017, all system routes have been signed and continue to be maintained in accordance with USFS signing standards. Sign procurement on the WRNF has been supplemented $7,500 each year from "Stay the Trail Colorado" which is funded from Colorado Parks and Wildlife. The Forest currently has three "Good Management" OHV Crews that are also funded by CPW through the States OHV sticker fund. These OHV crews play a key role in providing public information, planning, management, and maintenance for motorized routes on WRNF.

Monitoring Discussion and Findings

While there is significant variation in miles of road decommissioned each year based on available funding and priorities, the WRNF has been averaging above target for road decommissioning for the lifetime of the TMP.

On average over the last 5 years, the WRNF is assigned and has met the following trails accomplishments/targets each year. "Trails maintained to standard" =478 miles; and "Trails Improved to Standard" = 12 miles. Non-system trails continue to be decommissioned or closed as recreation staff comes upon unauthorized trails.

WRNF continues to focus maintenance on existing system roads and trails that are important for access to all resource areas and key to our community's sense of place. Road maintenance on the WRNF is performed through various mechanisms, including Force Account (Road Crew), Contracts, Agreements, and Partnerships with County Cooperators. Trail maintenance on WRNF is and has been predominately done with youth corps, partner, non-profit and volunteer organizations. The WRNF continues to work on validating road and trail data to provide the public with the most accurate data.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

Monitoring Item 7.4 - Wilderness

Monitoring Question and Background

- What are the status and trends of the Wilderness Stewardship Performance elements?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 2, Objective 2b	Wilderness Stewardship Performance (WSP) Elements	*NRM- "WSP Accomplishment Report Summary" (12.7.2023)*	A) Annual B) Annual	Target: 5-point increase per selected element each year in every wilderness until all meet or are above "Standard Performance level = 60-69 points".

Wilderness Stewardship Performance (WSP) is a framework to track how well the USFS is meeting our primary responsibility under the Wilderness Act—which is to preserve wilderness character. This new performance allows the flexibility in the selection of individual elements for each wilderness area to reflect local wilderness stewardship priorities, while also correcting other long-acknowledged short-coming. It seeks to foster improved integration and communication between program areas, to accurately reflect the collaboration required to steward our wilderness resources. Wilderness Stewardship Performance will track the number of wildernesses meeting baseline performance for preserving wilderness character. For complete information on WSP: https://www.wilderness.net/NWPS/documents/FS/WSP-Guidebook_v2017.2.pdf

Ten elements are selected for each wilderness and will be reported upon annually. The WRNF convened several full interdisciplinary team (IDT) meetings to select six elements that matched local stewardship priorities for each wilderness. There are four mandatory elements: Agency Management Actions, Workforce Capacity, Education, and Wilderness Character Baseline. A wilderness scoring 60 points or higher equates to "Wilderness meeting baseline performance for preserving wilderness character". Scoring and deliverables is unique to each element.

Wilderness Character Monitoring (WCM): The framework for WCM is woven into the overall format of the new performance measure and is also included as a stand-alone required element.

Monitoring Results, Discussion and Findings

Performance measure upward reporting began in FY 2016, with targets based on the initial WSP scores submitted in FY 2015 that began the new WSP process. Annual performance assumes slow-but-steady incremental improvement in scores, estimated at a 5-point increase per year. This progression of scores also assumes the continued support of national funding.

2016 WRNF was successful in WSP project submissions in the initial rollout of WO internal funding for projects for the following: $47k for "*Indigenous Cutthroat Trout Conservation Monitoring and Invasive Species Removal*" as well as $39.5k for "*Flat Tops Wilderness Recreation Site and Solitude Monitoring Project"*. Both projects elevated WSP scores in the Flat Tops and Holy Cross Wilderness Areas respectively.

Overall, scoring improved in 2016 from the initial 2015 scores for all wilderness areas with exception for the Maroon Bells-Snowmass Wilderness (MBSW) which dropped two points due to limited workforce capacity and issues related to high use challenges in this wilderness area. Ptarmigan Peak and Eagles Nest continue to be "Well Below Standard Performance= < 30 points".

2017 WRNF was once again successful in WSP project submissions for 37.7k for "*Holy Cross Wilderness Solitude and Recreation Site Inventory".* It is expected that this project will further elevate Holy Cross Wilderness area scoring in both the solitude and recreation site elements.

The overall scoring improved for all wilderness areas except for the MBSW and the Hunter Frying Pan which both remained the same as in 2016. Holy Cross scores increased from a 42 to a "60" in 2017 which brought this wilderness area up to meeting baseline performance or "at or above standard performance = 60-69 points". The only WRNF wilderness area that remains at "Well Below Standard Performance= < 30 points" in 2017 is Ptarmigan Peak.

2018 WRNF was successful in a WSP project submission for $38.9 k for "*Eagles Nest Wilderness Solitude Monitoring & Trail Assessment*". At the time of this report, 2018 WSP upward reporting had not been finalized. It is expected that overall scores will continue to increase and that the WSP project work will continue to elevate the Eagles Nest Above the current "Below Standard Performance = 30- 49 points".

2022 WSP scores have been mostly flat or slightly declining for the last two years as there has been a lack of National funding for WSP projects along with post-pandemic increases in wilderness visitation and. The Flat Tops Wilderness is the only wilderness on the Forest "At or Above Standard Performance" with a score of 60 as the Holy Cross has dropped back to a score of 58 which matches the score of the Maroon Bells-Snowmass. The Hunter-Fryingpan (score of 44) and Ptarmigan Peak (score of 36) both continue to be "Below Standard Performance".

Adaptive Management Considerations

Wilderness performance measures are generally not increasing at this time; however, we anticipate that scores will begin to slowly increase again with focused funding and effort and there are no changes recommended to the monitoring program or to Forest Plan direction at this time.

Monitoring Item 7.5 - Status of Bare Ground Recovery

Monitoring Question and Background

- Are management projects designed to address ground disturbing management activities meeting the direction to "…maintain or improve levels of soil organic matter on all lands" through bare ground rehabilitation projects?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Targets, Thresholds
Goal 2; *"*Multiple Benefits to People*",* Objective 2c "Improve the capability of National Forests and rangelands to sustain desired uses, values, products, and services."	Field/ground-truthed soil organic matter transects coupled with a comparison of time-stamped, remotely-sensed data of bare ground rehabilitation areas prior to and following mitigation.	Soil Organic Matter transects Remote sensing products, i.e. Climate Engine	a) Annually; b) 2 years.	14 miles of road decommissioned per year

Monitoring Results, Discussion and Findings

Bare ground data has been collected by contractors that supply's the base imagery for a visual comparison of vegetation ground cover at several ski areas. These bare ground data have been utilized to compare before and after implementation to determine if projects are maintaining or improving levels of soil organic matter. Soil organic transects data on ski area projects have been collected by Forest Service personnel and contractors to document depth of soil O and/or A horizons prior to ground disturbance activities. After ground disturbance, soil organic transects where collected and we determined that soil organic matter was less than at prior implementation levels so mitigation measures and design criteria will be utilized to go back to long-term soil organic matter levels. Bare ground on timber projects has been observed on landings, multiple pass skid trails and temporary roads that have not been closed – these bare ground areas do not exceed 15% of the project areas, but efforts to rehabilitate the bare ground remain active. There was no quantitative analysis to determine total bare ground on the WRNF, but it is known to exist in more actively managed project areas, in particular ski resorts and timber sales. Adherence to design criteria and best management practices should keep soil erosion and bare ground to minimal levels that fall within tolerances for acceptable loss.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

VIII. Status of land productivity (soils)

Monitoring Item 8.1 - Soil Productivity Monitoring

Monitoring Question and Background

- What are the status and trends of soil productivity?

Forest Plan Ref./ Driver	Indicators	Data Sources/ Protocols/ Partners	Freq. of a) data collection and b) reporting	Target or Threshold
Goal 2; Objective 2c	Type, degree, and extent of soil disturbances to determine effects on soil productivity and hydrologic function.	National Forest Soil Disturbance Monitoring Protocol; Results from best management practices reviews in timber, recreation, roads, range, etc.	a) Annually; b) 2 years.	Extent of detrimental soil disturbance must be less than 15% of activity area

Monitoring Results, Discussion and Findings

Soil disturbance monitoring guidelines provide reliable monitoring methods that are repeatable and used to evaluate soil conditions across the Forest. These methods should be regularly reviewed to ensure adaptive management considerations are met. These evaluations are used to identify detrimental compaction, displacement, puddling, erosion, effective ground cover, and overall soil

quality as well as identifying and predicting soils that are susceptible to disturbances. Continued monitoring also identifies project sites with significant disturbance needing restoration to reestablish soil productivity. Finally, continued monitoring of sites where soil restoration has occurred will improve continued decision making for future monitoring and restoration.

Timber

A variety of timber projects were implemented throughout the Forest between 2019 and 2022 on the WRNF. They include salvage, sales, ski area settlement, fuelwood, and fuel reduction. Some of these timber projects had little to no impact on the soil resource due to helicopter logging on ski resort special use permit areas. However, most of the ski area settle projects used conventional logging treatments that have a local impact on soils via skid trails and landings.

Conventional timber treatments can leave some compaction, displacement, and removal of ground cover, and increased potential for erosion; however, the area of the designated landings and ski-trails for each of the timber sales do not reach greater than 15% of the activity area. These effects to soils are short-term because they are mitigated through restoration activities such as de-compaction, lopping and scattering, as well as slash and seeding. Other timber projects include salvage treatments from mountain pine beetle-killed trees and hand treatments which do not cause much ground disturbance nor effect to soil productivity. Overall, the timber harvest activities during the monitoring period did not substantially and permanently impair the productivity of the lands on the WRNF.

Ski Resorts

The WRNF has eleven ski areas that are developed and operated by the private sector to provide opportunities for intensively managed outdoor recreation activities during all seasons of the year. Construction activities to build facilities, summer use recreation, and winter recreation infrastructure has occurred on the majority of ski resorts on WRNF between 2019 and 2022. Ground disturbance occurs in a greater scale with ski area development through activities such as vegetation clearing and grading which results in temporary and permanent impairment of the productivity of soils. Implementation of soil management requirements and project design criteria minimalizes erosion and loss of soil organic material from ski area projects. The footprint from past management activities on the ski areas does exist, as there is an array of unintentional bare ground still remaining. As new intentional bare ground is being created, mitigation of existing bare ground would occur through revegetation and rehabilitation. Soil productivity in the Management Area 8.25 (Ski areas) is maintained through following project design criteria and Forest Service Handbook direction.

Other Management Activities

Range developments and livestock grazing has continued to occur through 2019 – 2022; however, no additional projects are currently proposed. Impacts from livestock grazing to soils has been minimal due to the spread-out impacts that livestock have on the landscape; however, when there are impacts local to streams and waterbodies, there have been documented instances where soil erosion has occurred rapidly.

Oil and gas developments and their impacts on soil have not been monitored during the monitoring period.

Adaptive Management Considerations

There are no changes recommended to the monitoring program or to Forest Plan direction at this time.

Conclusion

Progressing trends

The following monitoring items and associated resources have been determined to be progressing and/or trending toward Forest Plan targets.

1.1: Watershed Condition Framework
1.3: National Best Management Practices Program
2.1: Air Quality
2.2: Forest and Grassland Health
2.3: Ecosystem Health
3.2: Red Squirrel
3.3: Pika
3.4: Avian Species
4.3: Lynx Habitat
5.1: Visitor Satisfaction and use
5.2: Special uses Administration
5.3: Sustaining Recreation Infrastructure
6.1: Snowpack and Precipitation
7.1 Economic Contributions from Specific Programs
7.2: Heritage Program Stewardship
7.3: Travel Management Implementation
7.4: Wilderness
7.5: Management Activity Bare Ground Recovery
8.1: Soil Productivity Monitoring

Uncertain trends

The following monitoring items and associated resources have uncertainties in progressing and/or trending toward Forest Plan targets.

1.2: Watershed Condition Class

Watershed Condition Framework (WCF) data are updated every six years and are a snapshot of the watershed condition at that time; they are not a particularly sensitive baseline comparison. WCF metrics may need to be updated annually to better track numeric or categorical changes in each watershed to better determine that non-priority watersheds are in a maintained or improving watershed condition class.

3.1: Macro-invertebrates

Using analysis of random samples suggests that management practices are maintaining stream health. The random sampling methods may not capture local impacts or trends.

4.1: Cutthroat Trout
There are currently uncertainties in comparing monitoring data for Colorado River Native Cutthroat trout prior to 2016 and data collected during this monitoring period. Forest biologists will use the current monitoring data collected for inventory and monitoring of Colorado River Native Cutthroat trout throughout the life of the Forest Plan. As additional data are collected in future monitoring periods, the status and trend of Colorado River Native Cutthroat trout can be determined across the planning area.

4.2: Amphibians
More sampling is needed to determine trends across the Forest. Sampling generally has focused where amphibians have been found in past surveys noting their presence.

6.1: Snowpack and Precipitation
Snow Water Equivalent: More time/data is needed to understand status or progress of the plan component.

7.2: Heritage
2022 was the first monitoring year data were analyzed. Previous years were not accounted for due to lack of staffing. Staffing increased, as did the Heritage Program accomplishments, but still fell short of standards. With increased staffing, expectations are that heritage survey requirements will be brought up to standard.

Not yet evaluated

The following monitoring items and associated resources were not evaluated during this monitoring period, and therefore a determination whether these resources are progressing and/or trending toward Forest Plan targets and/or thresholds have not been made.

None

Not determined

The following monitoring items and associated resources findings were not determined in this monitoring report.

Appendix A: Monitoring Items Not Evaluated in Detail

This appendix highlights the monitoring questions that were not evaluated this reporting period. All resources were evaluated in detail during this evaluation reporting period.

Appendix B: List of contributors

Responsible Official
Scott Fitzwilliams, Forest Supervisor

Monitoring and Evaluation Team
Cole Green Smith, Hydrology
Jessica Sanow, Hydrology
Mark Weinhold, Hydrology
Melvin Woody, Hydrology and Fisheries
Robert Ramey, Fisheries
Dan Woolley, Forest Engineer
Bret Conant, Forest Engineer
Sam Massman, Recreation Program Manager
Cary Green, Forest Planner and Forest Health
Henry Eichman, Washington Office Economist
Brian Ratcliff, Region 2 Social Scientist and Economist
Tom Fuller, Forest Archaeologist
Natasha Goedert, Wildlife Program Manager
Chuck Burley, Renewable Resources & Planning Staff Officer
Paula Peterson, Recreation Special Uses Program Manager
Scott Woodall, Range Program Manager
Ryan Sparhawk, Soils Scientist

Partners
The Forest gratefully acknowledges the partnership and assistance of the following organizations:

Bird Conservancy of the Rockies
Colorado Division of Parks and Wildlife
USDA-Rocky Mountain Research Station
Colorado State Forest Service
Wilderness Workshop