USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

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Biennial Monitoring and Evaluation Report

Fiscal Years 2023 – 2024

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Cover: Male ringed emerald dragonfly (*Somatochlora albicincta*) basking on vegetation adjacent to a high-elevation pond – White Mountain National Forest photo.

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Forest Supervisor's Note

It is a pleasure to share the 2025 White Mountain National Forest (WMNF; Forest) Biennial Monitoring and Evaluation Report. Updates in this report are based on monitoring completed in 2023 and 2024. Long-term monitoring and evaluation are valuable tools for assessing implementation of the 2005 WMNF Land and Resource Management Plan (Forest Plan). These tools help determine whether the Forest Plan and its components remain as valid today as when revised or if adjustments are necessary. In this report, management effects on natural, cultural, and social resources are considered as well as how those resources are affected by other factors. We remain committed to identifying successes and areas to improve, sharing the results, and learning from the findings.

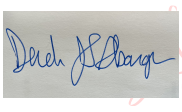
The evaluation of monitoring efforts presented in this report shows implementation of the Forest Plan is progressing as written and intended. Among many other things, monitoring efforts help evaluate:

- whether rare and unique features, including alpine, cliff, and other rare plant and animal communities are adequately protected;
- whether threatened, endangered, and Regional Forester Sensitive Species (RFSS) populations are stable, increasing, or declining;
- whether prescribed fires and naturally ignited fires managed for resource benefit are effective at enhancing ecosystem resiliency and reducing hazardous fuel loads;
- whether vegetation management objectives are being met for forest regeneration and wildlife habitat; and
- the extent of non-native invasive plant and insect infestations and the effectiveness of control efforts.

This report presents recommendations for improving our management and monitoring efforts to better steward these public lands. The summary for each monitoring question indicates when it was last reported. Updated summaries are added when appropriate based on when sufficient data is available and the timing of their last update as well as when budget constraints, staffing levels, and other Forest priorities allow.

We consistently work with local, state, and federal agencies along with many other valuable partners to manage resources and lead stewardship efforts on the WMNF. We do this in an integrated way to ensure meeting objectives in one area does not adversely affect another. The WMNF team is proud of our successes in meeting the requirements of the Forest Plan and committed to finding solutions where monitoring shows a new approach is needed. The contents of this biennial monitoring report show that we are meeting the intent of the Forest's Monitoring Plan. The monitoring results do not indicate a need to amend the Forest Plan.

I appreciate your interest and ongoing commitment to the WMNF and look forward to working with you in the future.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Derek J.S. Ibarguen,
Forest Supervisor

Summary of Findings and Recommendations

Effective monitoring and evaluation enable the USDA Forest Service and the public to assess how well our Forest Plan is being implemented, whether implementation is achieving desired outcomes, and whether assumptions made in the planning process are valid. It helps us adapt our management approaches and determine when we need to adjust desired conditions, goals, objectives, standards, and guidelines. The evaluation of monitoring presented in this report indicates the Forest Plan is being effectively implemented, desired outcomes largely are being achieved, and the assumptions made during the planning process are still valid.

Information in this report illustrates the continued importance of the Forest Plan goals. For example, impacts from destructive insects, such as emerald ash borer and hemlock woolly adelgid, and diseases, such as beech leaf disease, are a major concern for the Forest and monitoring is an important tool for early detection and response. The increasing risk highlights the need to manage for increased resiliency of forest stands through silvicultural prescriptions that sustain a healthy forest. A healthy forest also enables us to support the local economy through recreation, the sustainable contribution of high-quality timber products, and other Forest offerings.

The commitment of employees to stewarding the Forest in a sustainable manner by following Forest Plan direction during project implementation, identifying issues early, and adapting management as needed is well documented in this biennial monitoring report. For example, monitoring results for implementation of Best Management Practices (BMPs; 5.16.7) indicate that, in general, BMPs have been implemented as planned; they are being adequately included in planning documents and contracts; and they have mostly been effective at minimizing effects to water, aquatic, and riparian resources due to erosion and sedimentation. Issues in BMP implementation were generally caused by the contractor not following the operating plan or contracts. If contractors failed to properly implement BMPs, the issues were normally identified during implementation and corrective actions taken to protect resources. Where BMPs were not adhered to, recommendations for improving compliance or adapting management to best protect resources are provided. These recommendations will be incorporated into projects going into the future.

Our evaluation of monitoring data resulted in many recommendations to improve our management and monitoring efforts, including the following:

- Maintain the Interagency Monitoring of Protected Visual Environments (IMPROVE) site at Camp Dodge, or similar substitute technology, to monitor air quality in Class I Wilderness areas on the WMNF (5.1.1).
- Provide additional assessments of how monitoring data on vegetation, wildlife, recreation, and other resources are related to climate change and incorporate a summary of impacts to resources resulting from climate change effects in the biennial monitoring report (5.4.1).
- Continue to manage wildland fires for resource benefits and continue to improve communications with WMNF staff, state and local fire resources, and the public on the role of fire in the northeastern landscape (5.5.2).
- Continue aerial detection and ground surveys of insects and diseases to improve the chances of early detection and eradication of pests. Implement silvicultural prescriptions that promote healthy and resilient forested stands and encourage a diversity of age classes and species (5.7.1).

- Ensure that Geographic Information System (GIS) and Field Sampled Vegetation (FSVeg) databases are updated to provide accurate information for project planning and implementation (5.7.3 and 5.9.2).
- Improve coordination between Heritage Program staff and other Forest staff to ensure heritage resources are protected (5.9.1 and 5.9.2).
- Maintain or increase on-the-ground presence of Forest staff in mineral collecting areas (5.10.1).
- Revisit scenery analyses if substantial changes to stand boundaries are made during sale layout (5.13.1 and 5.13.2).
- Continue to sample soils and analyze data from long-term sites to better understand changes in soil chemistry and productivity over time and how soil properties affect forest health (5.15.2).
- Take care to adhere to strict protection distances in riparian guidelines, especially at higher magnitudes of harvesting (5.16.3).
- Focus future monitoring efforts in riparian areas that may be more at risk of disturbances to forest canopy or hyporheic zones (5.16.3).
- Stream reaches in low gradient valleys, which have the potential to migrate from accumulating wood and sediment and developing side channels, should be identified and considered for wider no-cut zones, especially in drainages of higher average temperature (5.16.3).
- Map real riparian boundaries and management zones to build public trust earlier in the project planning process and improve riparian protections (5.16.3).
- Conduct intensive mark-recapture surveys for wood turtles at three sites every 5 to 10 years to analyze trends in population size to help ensure that wood turtles continue to persist on the WMNF (5.19.6).
- Place floating loon rafts in more waterbodies on the Maine portion of the WMNF and survey often for presence and absence of common loons on smaller, more remote waterbodies (5.19.9).

1.0 – Introduction

Our monitoring and evaluation efforts provide the Forest Service and the public opportunities to assess how well the Forest Plan is being implemented, whether Forest Plan implementation is achieving desired outcomes, and whether assumptions made in the planning process are valid. It helps us adapt our management approaches and determine when we need to adjust desired conditions, goals, objectives, standards, and guidelines.

The WMNF's Monitoring Plan (Chapter 4 of the Forest Plan) describes what we will monitor and what we expect to learn from that monitoring. The Monitoring Plan identifies several types of required monitoring, including sustainability, outputs, services, costs, management indicator species, objective attainment, standard and guideline implementation, and effects of management practices. Our Monitoring Plan also identifies the need to conduct monitoring on a variety of topics or resources to evaluate resource conditions and ecosystem health, and help answer the question "Are we accomplishing the overall goals of the Forest Plan?"

Monitoring is not performed on every activity, nor is most of it expected to meet the statistical rigor of formal research. Some monitoring is done as an integral part of daily activities, such as construction and timber sale contract administration. Monitoring actions are conducted in various timeframes, which

include weekly or annually, at longer intervals to track changes over time, or when funds and staffing are available.

The biennial monitoring report summarizes and, at scheduled intervals, evaluates monitoring results. It also provides the public and Forest personnel with updated information about Forest Plan and project implementation. Some monitoring leads to immediate conclusions, while other topics require a decade or more of data collection to produce informative results. As a result, our biennial monitoring report has changed every year, and the level of detail provided varies by topic.

Monitoring remains an important part of our annual program of work. We will continue monitoring required items and as many high-priority items as our capacity allows. We are fortunate to have many partners willing to help develop, plan, and implement projects including maintaining our roads, trails, and facilities, and to monitor the status of our resources and effectiveness of our management. In some areas, however, our capacity is not keeping pace with resource requirements or public expectations. An example of this is increasing needs for road and trail maintenance that require new approaches to ensure safe and sustainable access. We look forward to working with our current partners and developing new relationships in the coming years to address issues and opportunities.

2.0 – Monitoring and Evaluation Requirements

Minimum monitoring and evaluation requirements have been established through the National Forest Management Act (NFMA) and 36 CFR 219. Some requirements provide guidance for the development of a monitoring program, while others include specific compliance requirements.

Monitoring and evaluation are separate, sequential activities required by NFMA regulations. Monitoring involves repeatedly collecting data by observation or measurement. Evaluation involves analyzing and interpreting monitoring data. The information gained from monitoring and evaluation is used to determine how well the desired conditions, goals, objectives, and outcomes of the Forest Plan are being met. Monitoring and evaluation are critical steps in the process of keeping the Forest Plan responsive to changing conditions, thereby providing the feedback mechanism for an adaptive management framework. The results are used to identify when changes are needed to the Forest Plan or the way it is implemented.

The Monitoring Plan included in the Forest Plan has three major components: the Monitoring Program (contained within the Forest Plan), the Monitoring and Evaluation Guide (Monitoring Guide), and the Biennial Monitoring and Evaluation Report (Biennial Report). Each are described below.

2.1 – Monitoring Program

The monitoring program contained within the Forest Plan is strategic in nature and provides programmatic direction for monitoring and evaluating Forest Plan implementation. The monitoring program addresses several types of monitoring. These requirements fall into four broad categories:

Category 1: Required monitoring items in 36 CFR 219.12
Category 2: Attainment of objectives
Category 3: Implementation of standards and guidelines
Category 4: Effects of prescriptions and management practices

Category 1 monitoring items are mandatory components of every forest plan, whereas Category 2 through Category 4 monitoring items are more flexible and tailored to address issues raised through

public scoping and interdisciplinary team review. See Chapter 4 of the Forest Plan for more information about monitoring and evaluation on the WMNF.

Budgetary constraints may affect the level of monitoring that can be done in a particular fiscal year. If budget levels limit the Forest's ability to perform all monitoring tasks, then those items specifically required by law are given the highest priority.

2.2 – Monitoring and Evaluation Guide

The Monitoring Guide is part of the overall monitoring framework for the WMNF. While Chapter 4 (Monitoring and Evaluation) of the Forest Plan is strategic in nature and provides programmatic direction for monitoring and evaluating Forest Plan implementation, the Monitoring Guide provides direction that is more specific to implement the monitoring strategy outlined in the Forest Plan. The Monitoring Guide details the methodologies and protocols used to conduct monitoring and evaluation tasks identified in the Forest Plan. The Monitoring Guide also assigns responsibilities for monitoring and evaluation tasks and defines where monitoring data is to be stored.

The Monitoring Guide is flexible and may be changed as new methodologies and techniques are developed. It allows the principles of adaptive management to be applied so that as monitoring techniques are implemented, they can be evaluated for their effectiveness and efficiency, and they can be revised as needed.

2.3 – Biennial Monitoring and Evaluation Report

Providing timely, accurate monitoring information to the decision makers and the public is a key requirement of the monitoring and evaluation strategy. The Biennial Report, which provides the analysis and summary of the monitoring results, is the vehicle for disseminating this information. As stated on page 4-12 of the Forest Plan, this report, "…will assess how well the outputs, goals and objectives of the Forest Plan have been met, and how closely management standards and guidelines have been applied".

Monitoring is described on page 4-3 of the Forest Plan as, "the systematic collection of information about resource conditions, management actions, and emerging issues in a way that will reflect changes in conditions and relationships over time and space". The information collected through monitoring is then evaluated. Also defined in Chapter 4 of the Forest Plan, evaluation is "the interpretation or judging of the information collected during the monitoring phase". The results of evaluation are then used to answer set monitoring questions and to decide if revision or amendment of management plans is required. Evaluation results are used to answer the monitoring questions, determine the need to revise or amend management plans, or determine how these plans are implemented. This way, the management of national forests can be adaptively managed to achieve desired conditions despite changing actions, conditions, and relationships over time and space. Evaluation describes movement from a known point (baseline or reference condition) either toward or away from a desired condition. The desired conditions may or may not ever be fully achieved, but it is important to know if management activities are heading in the right direction. Evaluation produces information that is used to infer outcomes and trends. Conclusions will be drawn from an interpretation of evidence. These conclusions are documented in the Biennial Report.

The Biennial Report is intended to be a comprehensive compilation of all the monitoring and evaluation tasks described in the plan. This report will provide summaries of data collected, and complete evaluations of the data. The evaluation process determines whether the observed changes are consistent with the Forest Plan desired conditions, goals, and objectives and identifies adjustments that

may be needed. Continuous updating and evaluation of monitoring data provides a means to track management effectiveness from year-to-year and to show the changes that have been made or are still needed.

Key information displayed in the Biennial Report includes:

- Forest accomplishments toward achieving multiple-use objectives for providing goods and services.
- The degree to which on-the-ground management is maintaining or making progress toward the desired conditions and objectives described in the Forest Plan.
- The effects of the various resource management activities within the plan area on the productivity of the land.
- Conclusions and recommendations regarding the need to adjust monitoring or change the Forest Plan.
- Status of other agency and institution cooperative monitoring.
- Documentation of any monitoring that has not been completed and the reasons and rationale (budget or staffing limitations or unexpected conditions, such as a severe fire season).

3.0 – History of Monitoring on the White Mountain National Forest

Monitoring of Forest Plan implementation began with the WMNF's 1986 Forest Plan. A Monitoring Report was released annually from 1987 to 2000. A 10-year evaluation of this information was summarized in the 1996 report. No reports were published between 2001 and 2005 during Forest Plan revision.

The current Forest Plan was revised under the 2005 Planning Rule (as permitted by 36 CFR 219.14(e) (2005)), which allowed the use of 1982 Planning Rule regulations during the revision process). As part of this process, the Monitoring Program was also updated to reflect new Forest Plan direction. The Forest Plan became effective in September 2005, and the first monitoring report was published in 2006. Monitoring reports were subsequently released annually from 2007 to 2014. The regulations of the 2012 Planning Rule became effective in May 2012. This established new requirements for monitoring. Implementing direction for the Planning Rule was released in January 2013. To be compliant with the 2012 Planning Rule, eight monitoring items (per 36 CFR 219.12(5)) were required to be incorporated into the WMNF's Monitoring Program. An administrative change to the Forest Plan was completed in April 2016, which incorporated these monitoring requirements as well as other changes into the Monitoring Program. Section 5.0 presents a comprehensive list of the 64 monitoring questions currently included in the new Monitoring Program and the most current information (data and evaluations) for each monitoring question.

4.0 – Monitoring Activities during Fiscal Years 2023–2024

This report covers the period from October 1, 2023, to September 30, 2024 (fiscal year (FY) 2023–2024). Section 5.0 presents the most current information (data and evaluations) for each monitoring question contained within the Forest Plan. One new monitoring question on dragonflies is included in this biennial monitoring report in section 5.19.12. Summaries were not updated for all monitoring in this biennial monitoring report. Summaries for some questions were not due to be updated based on the timing of their last update and required monitoring frequency. Summaries on other questions were not updated due to budget constraints, staffing levels, or other Forest Priorities. The most recent Summaries

for each question are presented in Section 5.0. The questions with summaries updated in 2025 are marked with an asterisk (*). Summaries on the remaining questions will be updated in future biennial monitoring reports, as information becomes available and funding, staffing, and Forest priorities permit.

5.0 – Monitoring Results

The following is the list of questions included in the 2016 Monitoring Guide. Questions that are evaluated in this report are identified with an asterisk (*).

5.1 – Air

The WMNF lies within an area characterized as having some of the best air quality in the eastern part of the country. Many visitors to national forests value pristine areas with magnificent vistas; trends showing reduced levels of haze on the WMNF allow visitors to see farther into the distance and can increase the level of their enjoyment in and around the WMNF.

Air quality is monitored by the WMNF at the Camp Dodge Interagency Monitoring of Protected Visual Environments (IMPROVE) site, in Greens Grant, New Hampshire, as part of the national network to document air quality improvements. Data from this site show that visibility has dramatically improved since 2001. This is discussed in more detail below. The WMNF manages two Class I areas: the Great Gulf and the Presidential Range-Dry River Wilderness areas. These areas were designated as Class I areas under the Clean Air Act and are afforded the highest level of protection from air pollutants. The IMPROVE monitoring site data is used to document improved visibility in these Class I areas, as required by the Clean Air Act.

Surface water quality is being monitored in the WMNF Class I areas. This has been continuing for over two decades and is discussed below.

The WMNF completed baseline lichen monitoring that will be useful in long-term monitoring of effects and recovery from air pollution and acid deposition. This baseline lichen monitoring was discussed in a previous monitoring report. Although the most recent lichen monitoring occurred in 2022, and the analyses have been completed, the data is not yet available.

Smoke monitoring from prescribed fires occurred on the WMNF in 2023 and is discussed below.

*5.1.1 – Are Air Quality Related Values (AQRVs) being impacted by air pollution, especially in Class I areas? Are the IMPROVE protocols or similar technology being implemented? How are trends in air quality emissions affecting surface water quality in the WMNF?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Visibility and water quality measurements (e.g., pH, cations, sulfate, and nitrate anions)

Monitoring Frequency

Annual.

Background and Driver(s)

Air chemistry is measured at Camp Dodge using the IMPROVE protocol. The IMPROVE monitor collects aerosol samples that may impact air quality related values (AQRVs), such as water quality, scenic values, and visibility. These aerosol samples are analyzed to obtain a chemical profile of the airborne particles. Use of the IMPROVE site is an objective in the Forest Plan, and an air quality guideline for the designated Wilderness areas on the WMNF. States utilize the IMPROVE data to develop plans to reduce the identified pollutants, which impair Class I area AQRVs.

Water quality can be affected by air quality through acid deposition. Monitoring water quality trends in the Class I areas can assist in determining if the streams have recovered from decades of acid deposition. Water samples in Class I areas are collected through an agreement with the Appalachian Mountain Club (AMC) using standard scientific methods for water sample collections and analyses.

Monitoring Indicator 1

The IMPROVE air quality monitoring station at Camp Dodge continues to operate following established protocols (sampling occurs for a 24-hour period every third day). Data reports for visibility are current through calendar year 2023; calendar year 2024 data are being reviewed.

Results

IMPROVE aerosol data are shown in Figure 1. Since 2001, there have been dramatic reductions in emissions from electric generating units (U.S. Environmental Protection Agency 2021) and this has resulted in increased visibility in Class I areas on the WMNF, as measured at the Camp Dodge IMPROVE monitoring station. The visual range on the most impaired air quality days has increased throughout the 2001 to 2023 monitoring period. The visual range from 2001 to 2005 was approximately 27 miles, while the visual range from 2019 to 2023 was approximately 81 miles, indicating that the visual range has tripled since 2005. Insufficient data was collected in 2009 and 2010 due to a long-term power outage at the monitoring site, no data are available for those years.

Figure 1. Improvements in visibility, shown here as visual range (how far a person can see) on the most impaired air quality days, at Camp Dodge from 2001 to 2023 (FED 2025).

Discussion

The IMPROVE site collects data that provides a regional perspective on air quality trends and the effectiveness of Regional Haze Program State Implementation Plans. Data from this monitoring site show that visibility has been improving at a rate of approximately 3 percent per year since 2001. One of the most noticeable forms of air pollution is haze, a veil of smog-like pollution that can blur the view of many urban and rural areas. As part of the Clean Air Act, Congress established a goal to prevent future, and remedy existing, visibility impairment in 156 protected national parks and designated wilderness areas, known as Class I areas. Federal rules require state and federal agencies to work together to improve visibility in these areas so that natural background conditions are achieved by the year 2064. The two Class I areas within the WMNF—the Great Gulf Wilderness and the Presidential Range-Dry River Wilderness—are covered under this rule.

Sulfates, in the form of ammonium sulfate, are the largest individual contributor to haze or visibility impairment. The primary sulfate sources are coal-fired power plants, diesel engines, industrial boilers, and volcanoes. Man-made sulfate emissions are being reduced through the installation of pollution control technology, increased usage of cleaner diesel fuel, and increased use of fuels other than coal.

Due to reduced pollution, haze, and smog, visibility has increased three-fold from 2005 to 2023, on the most impaired air quality days. So, on the most impaired air quality days from 2019 to 2023, a person could see three times as far as on the most impaired air quality days from 2001 to 2005.

Monitoring Indicator 2

Water samples in Class I Areas are currently collected multiple times each year. Data analysis for water sampling is current through calendar year 2023.

Results

Average acidity, as measured in pH units, for high-elevation stream sites in the Great Gulf Wilderness and the Presidential Range-Dry River Wilderness Class I areas, from 1995 to 2023, does not show any trends over time, with most data points between pH units of 5 and 6 (Murray et al. 2023)**.** Average base cations have been declining over this period, as have sulfate plus nitrate anions (Murray et al. 2023). For the Great Gulf Wilderness high-elevation stream sampling site, the slope of cation reductions over this time was -2.40, the slope of sulfate reductions was -0.81, and the slope of nitrate reductions was -1.10 (Murray et al. 2023). For the Presidential Range-Dry River Wilderness high-elevation stream sampling site, the slope of cation reductions over this time was -0.83, the slope of sulfate reductions was -0.85, and the slope of nitrate reductions was -0.11 (Murray et al. 2023). The data represent spring and summer sampling. Data were not collected during some years due to lack of funding.

Discussion

Long-term water quality samples have been taken in the spring and summer for high-elevation sites in the Great Gulf Wilderness and Presidential Range-Dry River Wilderness Class I areas intermittently from 1995 to 2023 (Murray et al. 2023). No trend is apparent for pH at either of the high-elevation Class I area sites. This may be due to pH being strongly affected by the time of year, and there has been variance in the timing of sampling over the years (Murray et al. 2023).

The data show declining concentrations of average base cations and sulfate plus nitrate anions for the Class I area high-elevation sites; however, the coefficient of determination (R^2) value is more robust for the Great Gulf Wilderness site regressions (Murray et al. 2023). A more robust R^2 value generally means the data is better able to predict future results, while a less robust R^2 value generally means the data is less likely to be able to predict future results. Another difference is the faster rate of cation decline in the Great Gulf Wilderness site (2.4 microequivalents per liter per year) than in the Presidential Range-Dry River Wilderness site (0.8 microequivalents per liter per year). Sample months and number of samples varied from year to year, which could explain some of this difference, but that is not certain. Lastly, declines "in major anions and cations do appear to be flattening with little change in these variables over the past 5 to 10 years" (Murray et al. 2023).

While the pH data do not show an apparent trend, the trends for base cations and anions suggest that the streams at these sampling sites should be in recovery due to the decline in acid deposition. It will be important to continue these measurements to document if these trends continue, and if they do, at what point could this become disruptive to the aquatic biota (Murray et al. 2023). This apparent recovery will be important to document to determine how this may affect the Class I areas.

Recommendations

Data collection should continue to determine if the Forest Plan's air quality guideline is being met. This guideline states that AQRVs, such as aquatic biota, vegetation, and water quality, should be protected to the extent possible from adverse impacts related to air quality within the WMNF (p. 2.-4). Furthermore, air quality guideline G-1 for Wilderness areas states that the Great Gulf Wilderness and Presidential Range-Dry River Wilderness Class I Airsheds should be managed to protect AQRVs such as visibility, vegetation, and water quality (p. 3-12). For this report, long-term trends are variable depending on the ecosystem components being measured. A more extensive analysis accounting for seasonal variation, or other variables, would assist in determining why continuing changes in acid deposition have not contributed to trend changes of stream acidity.

The air quality guideline G-2 for Wilderness areas states that the IMPROVE site at Camp Dodge, or similar substitute technology, should be maintained to monitor air quality in Class I Wilderness Areas in the WMNF (p. 3-12). To assist with long-term monitoring reports, this site should be maintained to demonstrate to upwind states that emissions reductions in their states are having a positive impact on increased visibility in the WMNF Class I areas.

References

Federal Land Manager Environmental (FED) Database. 2025. Interactive Data Explore [Web page]. Located at: https://views.cira.colostate.edu/fed/Sites/?appkey=SBA_AqrvVisibility [Accessed 2025 February 12].

Murray, G., L. von Huene, M. Shyevitch, and M. Ritchie 2023. Water chemistry monitoring report, Class I and II Wilderness watersheds. AMC Report to the WMNF under Cost Share Agreement 21-CS-11092200-024.

U.S. Environmental Protection Agency. 2021. Progress reports [Web Page]. Located at: https://www3.epa.gov/airmarkets/progress/reports/emissions_reductions.html [Accessed 2025 February 12].

5.1.2 – Are lichens being impacted by air pollution, especially in Class I wilderness areas?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

- Lichen species, condition, and changes

Monitoring Frequency

Every 10 years.

Background and Driver(s)

Lichens are another AQRV for Class I areas because air pollutants can affect lichens at moderate and high concentrations (Dibble et al. 2016). Future monitoring would help determine the extent of, and trends in, those impacts and inform regional and national actions to improve air quality in the Northeast.

Results

Two WMNF sites were visited in FY 2022 for the purpose of lichen monitoring. The data from these two site visits are not yet available.

Discussion

The FY 2022 data is not yet available.

Recommendations

We recommend completing the data analysis and synthesis report so this information can be included in the next biennial monitoring report. Lichen monitoring should be continued at least once every 10 years to determine the health of lichens in wilderness areas. This data can be used to document the reduction in atmospheric pollutants being deposited (e.g., rain, snow, and dust particles) in the WMNF and can also be used to discuss lichens as an air quality related value for wilderness stewardship monitoring.

References

Dibble, A.C., J.W. Hinds, R. Perron, N. Cleavitt, R. L. Poirot, and L. H. Pardo. 2016. Monitoring air quality in Class I Wilderness areas of the Northeast United States using lichens and bryophytes. Gen. Tec. Rep. NRS-165.

***5.1.3 – Are emissions from Forest prescribed fire activities negatively affecting sensitive receptors?**

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Particulate matter concentration and dispersal

Monitoring Frequency

Every 2 years based on resource availability and weather.

Background and Driver(s)

Portable smoke monitors are used to record particulate matter during prescribed fire events. Selected prescribed fires are monitored for air quality parameters, such as particulate matter. Frequency of monitoring and number of fires monitored depend on availability of agency personnel and smoke monitoring equipment during burn windows as the smoke monitor is shared with other national forests. Photographic documentation during prescribed fires is used to document how the smoke is dispersing.

Results

Photographic documentation was used during a prescribed burn in two Moat Mountain Wildlife Opening Units on May 30, 2023. This was an understory burn in an oak/pine forest, approximately 70 acres in size. The photograph shown in Figure 2 was taken from Cathedral Ledge, approximately 2.5 miles north of the burn unit, at 3:53 pm on May 30, 2023. The smoke from this prescribed fire generally dispersed vertically and to the northwest.

Figure 2. Smoke can be seen rising from the Moat prescribed fire on May 30, 2023. The smoke is dispersing vertically and to the northwest. WMNF photo.

Discussion

Monitoring fine particulate matter with a smoke monitor and taking photographs during a prescribed burn are both methods to determine where the smoke is going and how it is being transported in the atmosphere. For this prescribed fire, the smoke dispersed vertically and to the northwest as can be seen in Figure 2.

Recommendations

Continued use of the smoke monitor and/or use of photographic documentation would assist in determining whether smoke from prescribed fires is negatively affecting sensitive receptors.

References

Not applicable.

5.2 – Botany

The WMNF has many rare and unique features, including alpine, cliff, and other rare plant communities, as well as many rare and sensitive plant species, including the endangered small whorled pogonia. These monitoring questions pertain to the effects of recreation use on alpine and cliff communities; the status of threatened, endangered, and sensitive plants on the WMNF; and the effect of vegetation management practices on herbaceous understory species.

5.2.1 – What are the effects of various recreation use levels on alpine plant communities?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Recreation use levels
- Area of trampling and condition of plants or community patches
- Permanent photo and plot records of strategic or important locations

Monitoring Frequency

Varies (every 5-10+ years, depending on component).

Background and Driver(s)

The WMNF contains the largest and most biologically diverse alpine ecosystems in the eastern United States, including species that occur only or mostly in the alpine zone on the Forest. Alpine areas are also greatly valued for many recreational opportunities and cultural and historical heritage, and these areas are designated as their own Alpine Zone Management Area (MA) 8.1. The purpose of MA 8.1 is to recognize, conserve, and interpret the alpine and subalpine zone for biological, aesthetic, recreational, cultural, research, and monitoring values. The Forest Plan goals and objectives for Rare and Unique Features specifies that (1) alpine and subalpine communities (within and outside of mapped MA 8.1 boundaries) will be conserved; and (2) the WMNF will contribute to the conservation and recovery of viable populations of all Federally threatened, endangered, and sensitive species and their habitats, including the more than two dozen sensitive species that occur in MA 8.1. S-1 of the general standards and guidelines for MA 8.1 states "If monitoring indicates declines in alpine communities because of human use, mitigation action must be taken." (Forest Plan, Forest Plan General Standard S-1 for MA 8.1, p. 3-37). Monitoring question 5.2.1 reflects the various scales and approaches of inquiry necessary to determine if conservation and management approaches reflected in the broader Forest Plan are effective in protecting alpine resources.

Results

There is a long history of vegetation studies and management efforts in the alpine zone of Franconia Ridge. Most recently, the WMNF partnered with Beyond Ktaadn to revisit historical studies and documentation from Franconia Ridge. The resulting report "Vegetation of Franconia Ridge, New Hampshire: Evaluation of 42 years of Trail Management and Vegetation Change" (Cogbill 2017) integrates aspects of all of the indicators of this question, and it reveals a complex story of both successes and failures of management efforts over the course of decades, with the backdrop of increasing hiker visitation. Cogbill (2017) builds on previous studies and documentation from Franconia Ridge from the 1970s to 1993 (see Cogbill 1994 for complete list of research), and historical photographs and records as far back as the late 1800s. The previous studies experimented with different techniques to promote revegetation of damaged trailside areas. Cogbill (2017) incorporates follow-up sampling of previous studies in the form of (1) 10 site-specific case studies along the ridge, (2) a series of vegetation

transects extending across trails and in undisturbed alpine reference areas, and (3) a gallery of repeat photographs along the ridge from the 1970s to 2016 (as well as several older repeat photos) (Figure 3 Figure 4, Figure 5, Figure 6, and Figure 7).

Some key conclusions from the various lines of evidence along Franconia Ridge:

- Some management efforts (e.g., scree walls) have resulted in successful revegetation or reversals in decline of vegetative cover (i.e., recovery of rerouted or abandoned trail segments), but results depend greatly on-site conditions, techniques, and subsequent degree of control of hiker traffic.
- Active manipulation experiments to enhance recovery of alpine vegetation from the 1970s to early 1990s such as terracing, transplanting, brush cover, native seeding, alien seeding, and fertilization in severely damaged areas has mostly not worked or not enhanced recovery over background recovery rates, with the exception that Bigelow sedge (*Carex bigelowii*) can expand into unoccupied areas from transplant plugs under the right conditions.
- Full recovery of damaged alpine vegetation takes decades to a century or more to occur, averaging 1 to 2 percent gains in vegetative cover per year in the absence of active disturbance. However, gains made over the course of decades can be lost very rapidly with the return of foot traffic and soil erosion.
- Gravelly or rocky and heavily trampled or eroded areas that have lost original organic soil material either do not recover at all or recover very slowly regardless of technique. Many intractably damaged sites (e.g., summit zones eroded down to bedrock) originated many decades or a century or more ago from initial recreation use, whereas some have originated more recently (within the last 20 years).
- Overall vegetation on the ridge is stable at a broad scale (alpine meadows), but dynamic and changing at a fine scale (percent cover of specific species).
- Examples of fine-scale changes: Cover of Bigelow's sedge (a key component of alpine meadows) has declined in many permanent plots, accompanied by a corresponding increase in the cover of heath shrubs. Overall, there has been a substantial increase in total vegetation cover across most permanent plots over more than 23 years. Krummholz has expanded in places on Franconia Ridge (Figure 3). These are background changes unrelated to recreational use, per say, with uncertain driving mechanisms for the change.
- Eight rare species were extirpated from one or both mountains on Franconia Ridge more than 100 years ago due to human impacts in the summit areas.

The overall floristic composition of the Ridge over the last 70 years has remained stable (no species have been eliminated from Franconia Ridge during this time); however, declines and local extirpations of rare or sensitive species have been documented within the past 20 years in specific areas (USDA Forest Service 2017), only one of which appears to be related to foot traffic along the trail.

Figure 3. Series of images from 1909 to 1991 of Franconia Ridge taken from Haystack Ridge. Note the expansion of krummholz toward the ridgeline. Krummholz has expanded in some areas but is remarkably stable in others. Photos courtesy of N. Goodrich (upper left), AMC Archives (upper right), and WMNF (bottom left and right).

Figure 4. Regrowth of vegetation occurred outside of scree walls built after the 1975 photo. Vegetation gains were largely maintained on this section of trail in 2016 (bottom left), with the exception of one area where braiding developed (bottom right). WMNF photos.

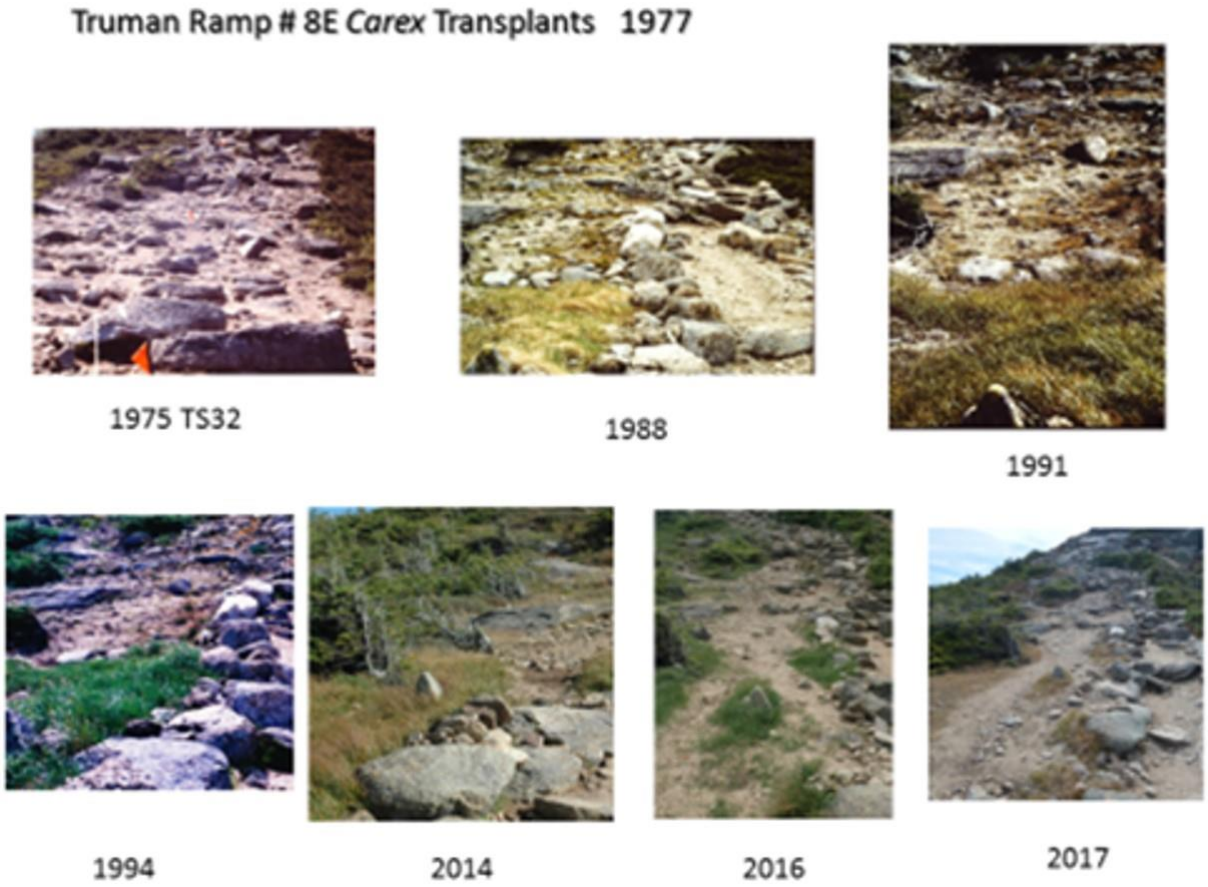

Figure 5. Successful expansion of Bigelow's sedge that was planted in 1977 can be seen along Truman Ramp from 1988 through 2014, followed by sudden erosion and trampling from off-trail traffic reversing revegetation success in subsequent years. Planting and seeding of other native and non-native species were ineffective. WMNF photos.

Figure 6. Series of photos taken from about 1860 to 2016 on the west side of Mount Lafayette summit in the area of an old horse path (shown in the foreground). Note the location of the split rock in each picture and the expansion of vegetation cover following abandonment of the horse path.

Figure 7. Series of photos of an abandoned trail segment around the summit of Mount Truman (subsidiary summit between Mount Lafayette and Mount Lincoln). Note increased vegetation cover between 1975, 1989, and 1993, then subsequent re-establishment of the bootleg trail in 2016 and 2017.

Discussion

The monitoring results reveal the complexity of protecting alpine vegetation and resources in high-use areas. They indicate some substantive conclusions about efficacy of specific trail management strategies and revegetation techniques — what works and what does not and under what circumstances. Primarily, any passive or active technique (e.g., appropriate trail construction and ongoing maintenance, education, stewardship, and signage) that eliminates or greatly limits foot traffic off-trail will prevent vegetation damage or allow natural recovery of vegetation over the long term in all but the most severely damaged areas. Conversely, reversals in revegetation or new devegetation can occur rapidly if foot traffic increases substantially in previously untrafficked areas. The challenge of keeping people on trails is multi-dimensional, including trail design, maintenance, education, and social components, and the apparent substantial increase in hiker visitation on Franconia Ridge over the last 10 to 15 years, and more broadly in alpine areas across the Northeast, only heightens the challenge.

Several pre-existing and new initiatives seek to mitigate and remedy vegetation and other impacts along the Franconia Ridge. The WMNF has strong, award-winning Trailhead Steward and Alpine Summit Steward programs in place to educate hikers about preparedness and to engage their help in protecting

alpine areas on their hikes. In 2016, the WMNF, Appalachian Trail Conference (ATC), Waterman Fund, and numerous state and nongovernmental partners convened to implement a Visitor Use Management Framework (VUMF) on Franconia Ridge. This framework was developed by all the major federal land managing agencies — Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and National Park Service — for land areas facing complex management challenges. The VUMF is a step-wise, adaptive management strategy that identifies issues, challenges, strategies, actions, and monitoring and evaluation feedbacks needed to adjust actions to achieve desired conditions on Franconia Ridge in long term. It is the first application of the framework in the Northeast. In addition, the AMC Trail Steward for Franconia Ridge initiated a trail stewardship internship with Middlebury College focused on Franconia Ridge and the AMC Trails and Research Departments are developing specific trail prescriptions for addressing needed trail work and maintenance sensitive to preserving alpine vegetation.

In summary, the recent Franconia Ridge vegetation monitoring report indicates that management of user impacts in alpine areas on Franconia Ridge have had mixed results on the scale of decades. Both positive and negative trends in the condition of vegetation adjacent to the Franconia Ridge trail have occurred in site-specific areas. The trend depends on original site conditions, degree of disturbance and remnant soil resources, technique used, and likely, the substantial and increasing hiking pressure along the Appalachian Trail, which occurs along Franconia Ridge. The recovering areas are promising, but the degraded sections appear to have increased in the past 20 years and require near-term attention in cases where damage is still recoverable. The results and conclusions of more than 40 years of monitoring work put the WMNF in a demonstrably better position to make specific management decisions and prescriptions for areas that still have hope for recovery. In response, the WMNF and partners are engaged in vigorous, and multi-faceted, planning and management initiatives that seek to protect the ecological integrity of the Ridge while providing opportunities for recreation.

Recommendations

At this time, the VUMF and other stewardship and trail work efforts described above provide appropriate management direction for Franconia Ridge and are consistent with the Forest Plan. Many lessons from Franconia Ridge are applicable to other alpine areas and trails on the WMNF, such as the need for additional monitoring and follow-up on existing monitoring efforts in the Presidential Range and additional site-specific follow-up on Franconia Ridge. Several monitoring efforts related to recreation impacts in the alpine zone were underway in the Presidential Range in 2018, including detailed documentation of vegetation condition and rare plants occurring along the Crawford Path in concert with substantial trail work to remedy problem areas. Protection of all alpine areas consistent with the intent of the Forest Plan will require specific attention to preventing user impacts and recovering damaged areas in site-specific ways, as well as broader education and stewardship tactics.

Evaluation of Monitoring Question and Indicator(s)

The monitoring question and indicators continue to be appropriate and informative.

References

Cogbill, C. V. 1994. Vegetation of Franconia Ridge, New Hampshire. Historical ecology and management effects. New Hampshire Natural Heritage Inventory, Concord, NH.

Cogbill, C.V. 2017. Vegetation of Franconia Ridge, New Hampshire: Evaluation of 42 Years of trail Management and vegetation change. Beyond Ktaadn, New Salem, Massachusetts. Challenge cost-share agreement FS 15-CS-11092200-021.

USDA Forest Service. 2017. Unpublished data on rare plants and vegetation of Franconia Ridge. Project files. White Mountain National Forest, Campton, NH.

5.2.2 – What are the effects of cliff-related recreation use on cliff plant abundance and rare plant persistence?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2009.

Monitoring Indicator(s)

- Rock climbing and access hiking route use levels
- Vegetative cover (percent cover) on and at base of cliffs
- Surveys for circumneutral cliffs, rare plants, and sensitive habitat locations

Monitoring Frequency

Every 5 years.

Background and Driver(s)

Initial surveys were conducted in 2008 (Allard 2008, Phase 1) and 2009 (Johnson and Smith 2009, Phase 2). Periodic follow-up, as a part of the WMNF's Cliff Community Monitoring Study (Phase 3), help quantify recreational impacts on representative cliffs on the WMNF.

Phase 3a: Supplemental surveys of cliffs identify specific locations of greatest concern for potential recreation impacts to increase the usefulness of monitoring in assessing potential effects on rare plant species. Specific locations include important cliffs or cliff features on the WMNF such as (1) circumneutral cliffs (an outstanding natural community), (2) cliff systems with RFSS species or sensitive habitats, and (3) specific locations within cliffs where these features occur. Surveys are based primarily on ground-level surveys (non-technical climbing), build off the results of Phases 1 and 2, and result in documentation of areas of cliffs most in need of additional monitoring in terms of resource sensitivity and potential for impacts. These surveys include identification of largely unimpacted cliffs where climbing activity is expected to increase, which offer the best opportunity to document impacts over time.

Phase 3b: Ocular survey of cliff face and/or base and along specific climbing routes are described in cliff ecological indicator protocol documents. This is the anticipated resurvey of the original Phase 2 study, with appropriate revisions informed by Phase 2 and Phase 3a results.

Results and Discussion

This monitoring question is not being evaluated in this report. It will be considered for evaluation in the next biennial monitoring report.

Recommendations and Evaluation of Monitoring Question and Indicator

This question will be considered for evaluation in a future monitoring report.

References

Allard, D. 2008. White Mountain National Forest cliff community monitoring study: Phase 1. Unpublished document. Available at: White Mountain National Forest, Campton, New Hampshire.

Johnson, S. and W. Smith. 2009. White Mountain National Forest cliff community monitoring study: Phase 2. Unpublished document. Available at: White Mountain National Forest, Campton, New Hampshire.

5.2.3 – Are individual known occurrences of threatened, endangered, or sensitive plants on the Forest increasing, stable, or decreasing?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Standard surveys
    - Number of individuals or size of populations as well as other standard information
- Permanent plot surveys
    - Timed surveys in permanent plots or transects (defined, geo-referenced areas)
    - Number of individuals and area of occupancy (cover)
    - Abundance of associated species
    - Habitat parameters

Design of surveys will depend on population and site characteristics.

Monitoring Frequency

Annual.

Background and Driver(s)

Monitoring helps establish population trends in order to ensure the threatened, endangered, and sensitive (TES) species persist on the Forest. Two methods are employed: standard survey protocols and permanent plot surveys. Standard survey protocols are in wide use in the region and employed for most species and populations. They are useful for establishing presence-absence and persistence as well as detecting major changes in population size and trends. Subsets of RFSS plant species are visited each year. Sites are visited during appropriate identification season (usually summer). Plants are counted and reported according to Maine Natural Areas Program (MNAP) or New Hampshire Natural Heritage Bureau (NHNHB) protocols (see their survey forms). Some occurrences are visited each year such that each occurrence is typically visited every 5 years, or more often if population trends dictate.

The goal of permanent plot surveys is to establish permanently referenced, reproducible surveys for a subset of the most vulnerable RFSS species and populations to provide better resolution and confidence in population trends across the spectrum of habitats and communities on the WMNF in which RFSS occur. Particular species and populations selected will include taxa in each of the major plant habitats and communities on the WMNF, and will be prioritized based on rarity, threats, vulnerability, feasibility

of implementation, and adequacy of trend data available from standard surveys. We expect this to involve about 25 to 30 populations and to be implemented over a 5-year period (resurveyed on a 5-year rotation).

Results

The status of rare plants analyzed here is based on an assessment of population trends of individual occurrences over time. We assigned population trends according to the following five categories: Stable; Stable/Increasing; Indeterminate; Declining; Declining/Extirpated; and Extirpated for most RFSS plants (definitions below). Assigning individual populations to one of these categories is not a precise quantitative exercise in most cases. Population data for any given occurrence is rarely robust enough to support statistically significant trends or population viability analysis, due to the limitations of standard monitoring protocols and the great amount of time and funding required for more intense monitoring. Potential sources variability or uncertainty in the plant counts among monitoring events include the number of repeat surveys available, the time span of those observations, differences in survey area and survey effort, and natural variability in demographics of different species. The trend analysis does not directly account for population characteristics such as size, habitat condition, context, and known threats, but it does include these factors indirectly, to the extent that they affect population trends. Nonetheless, despite the limitations of the data, the exercise serves to indicate some broad trends and suggest prioritization for future surveys. As we continue to accumulate more and better survey observations over time, we can continue to refine our assessment of trends.

Table 1, Table 2, Table 3, and Table 4 list 64 rare species in New Hampshire that include the full spectrum of RFSS habitats on the Forest (most are RFSS or proposed for listing; a few are only New Hampshire state listed). The trend categories are defined as follows:

1) **Stable (S):** Population levels appear to be relatively stable or vary within similar range over time without a definitive directional trend. A subcategory was also tracked (Stable/Small), corresponding to populations with apparently stable relatively small population levels (about 10-20 plants).
2) **Stable/Increasing (S/Inc):** Populations that have a directional, increasing trend over several observation events.
3) **Indeterminate (Ind):** Populations with survey data that is not definitive enough to indicate a trend. This may be due to a limited number of observations over time, population counts that may reflect incomplete surveys during some monitoring visits, variable survey effort over time, or other factors that may have contributed to variable counts (such as difficulty of distinguishing between number of stems versus number of genetic individuals).
4) **Declining (D):** Populations with several observations that seem to indicate a directional downward trend over time. This includes populations that have had 10 or fewer individuals observed in recent surveys, with the assumption that, in most cases, 10 or fewer plants indicate a vulnerable ecological and genetic condition and likely declining condition of a population over the long term.
5) **Declining/Extirpated (D/X):** Declining populations that have not been observed recently and are therefore potentially extirpated. In most cases, these populations have been explicitly surveyed for or are in well-studied areas where they are less likely to have been overlooked over the course of decades.
6) **Extirpated (X):** Populations or occurrences for which there is a high level of confidence that they no longer exist at the original location due to direct observations and absence during repeated surveys.

Table 1. Trend status of declining alpine species, RFSS, and state-listed species in New Hampshire. The number of populations excludes historical locations that are too general to relocate specifically.

Scientific name	Common name	Number of populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Barbarea orthoceras	American yellow-rocket	1	0	0	100
Bistorta vivipara	Alpine bistort	6	17	33	50
Calamagrostis canadensis var. *langsdorfii*	Langsdorf's bluejoint	2	0	50	50
Cardamine bellidifolia var. *bellidifolia*	Alpine bittercress	8	0	38	63
Carex arctogena	Capitate sedge	4	0	25	75
Carex atratiformis	Scabrous black sedge	2	0	0	100
Carex capillaris ssp. fuscidula	Hair-like sedge	3	33	0	67
Castilleja septentrionalis	Northern painted cup	13	0	15	85
Diphasiastrum sitchense	Sitka clubmoss	5	20	20	60
Epilobium anagallidifolium	Pimpernell willow herb	2	0	0	100
Euphrasia oakesii	Oakes' eyebright	2	50	0	50
Euphrasia williamsii	Williams' eyebright	2	50	0	50
Festuca prolifera	Prolific fescue	2	0	50	50
Harrimanella hypnoides	Moss plant	12	17	25	58
Luzula confusa	Northern wood rush	4	0	0	100
Omalotheca supina	Alpine cudweed	4	25	0	75
Poa glauca ssp. glauca	Glaucous bluegrass	6	0	0	100
Rhinanthus minor ssp. *groenlandicus*	Greenland yellow-rattle	4	50	0	50
Salix herbacea	Herb-like willow	6	33	0	67
Sibbaldia procumbens	Sibbaldia	1	0	0	100
Silene acaulis	Moss campion	7	29	0	71

Table 2. Trend status of stable to indeterminate alpine species, RFSS, and state-listed species in New Hampshire. The number of populations excludes historical locations that are too general to relocate specifically.

Scientific name	Common name	Number of Populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Arctous alpina	Alpine bearberry	10	50	20	30
Arnica lanceolata ssp. *lanceolata*	Lance-leaved arnica	8	38	25	38
Carex scirpoidea ssp. scirpoidea	Scirpus-like sedge	12	25	33	42
Geum peckii	Mountain avens	22	59	27	14
Oxyria digyna	Mountain wood sorrel	4	75	0	25
Poa laxa ssp. fernaldiana	Wavy bluegrass	16	38	25	38
Poa pratensis ssp. alpigena	Alpine bluegrass	7	29	57	14

Scientific name	Common name	Number of Populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Potentilla robbinsiana	Dwarf cinquefoil	4	75	0	25
Salix argyrocarpa	Silver willow	5	100	0	0
Salix planifolia ssp. planifolia	Tea-leaved willow	7	86	0	14
Saxifraga cernua	Nodding saxifrage	1	100	0	0
Saxifraga paniculata ssp. paniculata	Live-long saxifrage	2	100	0	0
Saxifraga rivularis ssp. rivularis	Alpine brook saxifrage	3	67	0	33
Vahlodea atropurpurea	Arctic hairgrass	19	0	84	16
Veronica wormskjoldii var. *wormskjoldii*	Alpine speedwell	5	60	20	20
Viola palustris var. *palustris*	Alpine marsh violet	8	75	25	0

Table 3. Trend status of declining lowland species, RFSS, and state-listed species in New Hampshire. The number of populations excludes historical locations that are too general to relocate specifically.

Scientific name	Common name	Number of populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Boechera missouriensis	Missouri rockcress	1	0	0	100
Chenopodium foggii	Fogg's goosefoot	1	0	0	100
Corallorhiza odontorhiza var. *odontorhiza*	Late autumn corallroot	2	0	50	50
Cypripedium parviflorum var. *pubescens*	Large yellow lady's slipper	1	0	0	100
Dryopteris fragrans	Fragrant fern	4	25	0	75
Isotria medeoloides	Small whorled pogonia	2	50	0	50
Neottia auriculata	Auricled twayblade	2	0	50	50
Neottia cordata	Heart-leaved twayblade	13	15	0	85
Ophioglossum pusillum	Northern adder's-tongue fern	4	0	50	50
Osmorhiza berteroi	Mountain sweet cicely	6	0	0	100
Paronychia argyrocoma	Silverling	14	36	7	57

Table 4. Trend status of stable to indeterminate lowland species, RFSS, and state-listed species in New Hampshire. The number of populations excludes historical locations that are too general to relocate specifically.

Scientific name	Common name	Number of populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Adlumia fungosa	Climbing funatory	1	0	100	0
Boechera laevigata	Smooth rockcress	1	0	100	0
Carex cumulata	Piled-up sedge	3	67	0	33
Carex wiegandii	Wiegand's sedge	6	33	33	33
Geocaulon lividum	Northern comandra	10	10	50	40

Scientific name	Common name	Number of populations	Stable (%)	Indeterminate (%)	Declining/ extirpated (%)
Juniperus horizontalis	Horizontal juniper	1	100	0	0
Nabalus boottii	Boott's rattlesnake root	8	38	63	0
Neottia convallarioides	Lily-leaved twayblade	5	40	40	20
Oligoneuron album	White-topped aster	1	0	100	0
Panax quinquefolius	American ginseng	31	29	29	42
Petasites frigidus var. *palmatus*	Sweet coltsfoot	3	0	100	0
Piptatheropsis canadensis	Canada mountain ricegrass	2	0	100	0
Polygonum douglasii	Douglas' knotweed	5	80	0	20
Pyrola asarifolia ssp. *asarifolia*	Pink wintergreen	1	100	0	0
Sanicula trifoliata	Three-leaved snakeroot	3	67	33	0
Triphora trianthophoros ssp. *trianthophoros*	Three-birds orchid	11	82	9	9

Discussion

The trend status of 64 RFSS and state-listed species in New Hampshire is compiled in Table 1, Table 2, Table 3, and Table 4. The number of populations excludes historical locations that are too general to relocate specifically.

The broad conclusions are that 57 percent of alpine species (21 of 37) and 41 percent of lowland species (11 of 27) have half or more of their populations assigned to Declining or Declining/Extirpated categories. This reflects trends over the approximately 140-year history of botanical observations on the WMNF. As such, it is difficult to directly associate individual trends to causal factors. It is also difficult to detect only trends within the 18-year period since the Forest Plan was established (2005), due to the limited number of observations of populations during that period. Nonetheless, the overall trends indicate that alpine RFSS plants are declining more rapidly than lowland plants. This likely reflects a combination of vulnerability and stressors that are amplified in the alpine zone, including intense recreation pressure, natural competitive dynamics and disturbances that are undergoing shifts due to climate change, and direct effects of climate change. For example, there is a predicted and documented shift towards a competitive advantage for robust shrubs, trees, and montane forest plants over alpine-restricted specialists, both globally and within the northeastern region.

Effects on populations of new projects implemented by the WMNF are minimized because a) projects are analyzed and effects mitigated prior to or during implementation, as required by NEPA, to ensure that the viability of populations and species are not threatened by management action; and b) standards and guidelines in alpine zone and other management areas help address threats at a general level. Despite these factors, many of the alpine species have general or specific pending threats stemming from recreation pressure that could be addressed with more management focus and effort. Updated and targeted monitoring could bring management priorities into better focus. For example, in the alpine zone, hiking pressure, spring skiing, and developed areas with buildings or roads, all represent stressors to rare plants, and better impact mitigations could be identified. The 2018 Monitoring Question 5.2.1 addresses this issue in more detail.

Small whorled pogonia (*Isotria medeoloides*)

There are three populations of this federally threatened species on the Forest. Two of them are in New Hampshire, and because one of the two populations is declining, the species appears in the "declining lowland species" section (Table 3). This is a little misleading because the trend data do not include 2023 observations, and several new plants were discovered at the declining population, boosting its apparent prospects slightly to "stable but small." Despite the small size of this population, it has persisted for more than three decades at the site; yet overall, this population is small and potentially vulnerable due to closed-canopy conditions and is at risk of blinking out over the long term. A proposed action is pending to stimulate the population by removing part of the shading canopy.

The second population is medium sized (about 50 plants) and responded well to a canopy removal about 15 years ago, which has resulted in a sustained population boost.

The third population is large, consisting of more than 200 plants. One interesting result from annual monitoring for 7 continuous years is that nearly all plants exhibit dormancy. For example, two-thirds of individual plants have remained below ground for 4 or more of the 7-year monitoring period, although not necessarily continuously (MNAP and WMNF data). A small portion of this population (where the particular colonies appear to have stagnated) is being considered for a canopy removal and/or girdling operation to stimulate reproduction and population levels. Canopy removal has been shown through repeated studies to have stimulated small whorled pogonia populations in northern New England. Monitoring small whorled pogonia populations has been completed through a combination of botany staff from the WMNF, Maine Natural Areas Program, and New Hampshire Natural Heritage Bureau.

Dwarf cinquefoil (*Potentilla robbinsiana*)

This formerly federally endangered species was delisted in 2002 following the establishment of two new transplant populations, and the apparent stabilization and transplant reinforcement of the main population. Since then, the WMNF has developed and introduced a new population sampling protocol at the largest, main population (WMNF and Beyond Ktaadn 2019). This new method is intended to be implemented on a biennial basis (every other year) and gives us a statistically valid method to estimate population levels with a much lower investment of time as seen in Figure 8. This is a modification of the former method, which was a complete census every 10 years. The former method took much longer to implement and yielded less frequent monitoring results. Monitoring appears to indicate that the main population has a relatively stable number of reproductive individuals over the last 20 years (about 4,300 plants), with potentially small decline, and a potentially decreased numbers of flowering individuals. The more frequent intervals of sampling should help clarify if apparent trends in demographics are directional and sustained, or part of normal variation. The two transplant locations appear to be slowly increasing over the last 20 years, and together, contribute a total of about 500 reproductive individuals. A very small fourth (natural) population appears to be declining over time. The recovery effort and delisting in 2002 was brought about through the combined efforts of WMNF, AMC, U.S. Fish and Wildlife Service, Native Plant Trust, and other partners. The more recent monitoring and protocol revision was the result of a collaboration of WMNF botany staff and a team of biologists with Beyond Ktaadn and the AMC.

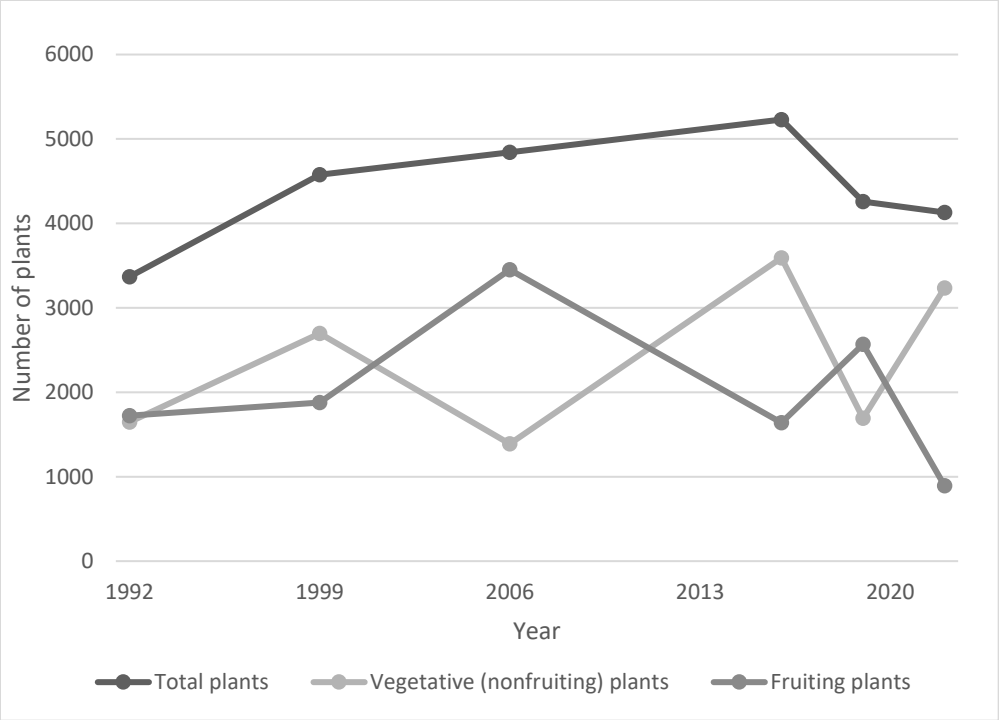

Figure 8. Population trend of the main population of mature reproductive-aged dwarf cinquefoil plants on Mount Washington, New Hampshire, from 1992 to 2022. The percentage of total plants that were fruiting varied over time from approximately 50 to 75 percent of total plants but dropped to approximately 25 percent of total plants in 2022.

Figure 8illustrates that the total number of mature plants (14 millimeters or greater in diameter, the minimum size for a reproductive plant) increased substantially up to 1999, then increased modestly for the next two census periods (2006 and 2016), then dipped during the next two census periods (2019 and 2022). Note that the 2019 and 2022 census periods excluded about 250 transplants that were outside of the primary sampling grid, so the recent decline is slightly less than the graph depicts. In addition, the total population reported in 2019 and 2022 is an estimate based on the extrapolation of the counts from sampling 33 percent of the population area (number of plants counted multiplied by three to obtain total population estimate). The percentage of fruiting plants varies over most of the sampling period from about 50 percent to 75 percent of total plants but dropped to about 25 percent of total plants in 2022. More frequent monitoring should help clarify the range of variability in demographic measures, and better assessment of trends (the trend lines for fruiting versus vegetative plants include some large sampling interval gaps and may not depict actual variation).

Sibbaldia (*Sibbaldia procumbens*)

Unfortunately, the rare alpine plant sibbaldia appears to have been extirpated from Mount Washington, and thus from alpine areas in the eastern United States. It existed at two locations in the same alpine ravine and was last observed in 2011. Searches since then have not detected any plants at the known locations. Its demise appears to be the result of a combination of over collection (more than 100 years ago), competition with more robust vegetation in both separate colony locations, and possibly natural or human-induced disturbances (Sperduto et al. 2018). The fate of this isolate relic may be indicative of the vulnerability of small alpine populations to multiple historic and current stressors — a “canary” of sorts for the growing number of rare alpine plants extant at only a few vulnerable locations.

Recommendations

The current combination of standard monitoring protocols (used in all New England states) and more robust permanently referenced and repeatable monitoring methods at a subset of locations is still valid and appropriate for tracking trends and detecting management needs. Standard monitoring methods are appropriate for most rare plant tracking needs and are robust and repeatable for many populations (particularly if they have well-defined boundaries). Overall, however, we are falling behind on the required frequency and degree of thoroughness of surveys to truly track trends at many populations. This is due to staffing and funding limitations. Note in Table 1 the number of populations for which we have an "Indeterminate" status, with too little data to detect trends. These limitations are apparent even though the WMNF benefits from the New England Plant Conservation Program (NEPCoP), which maintains both the state Task Forces in New Hampshire and Maine (consisting of professional botanists), as well as a Plant Conservation Volunteers Program, consisting of trained individuals with varying experience levels. Volunteers from both groups contribute many days each year assisting the WMNF with monitoring efforts.

The intent and effort to install more permanently referenced plots in representative populations of species across the range of rare plant habitats is a sound complimentary approach to standard survey methods. These more quantitative monitoring efforts will improve the confidence level in and robustness of tracking trends and our ability to inform management action. However, the number of populations with this level of monitoring is still relatively small and needs to be increased.

References

Beyond Ktaadn. 2019. Conserving alpine vegetation along the Crawford Path during its 200th anniversary. A report submitted to the USDA Forest Service, White Mountain National Forest, Campton, New Hampshire.

Sperduto, D., M. Jones, and L. Willey. Decline of *Sibbaldia procumbens* (Rosaceae) on Mount Washington, New Hampshire, USA. *Rhodora.* 120 (981): 65-75.

5.2.4 – What are the effects of even-age regeneration harvesting on herbaceous species? What is the change in percent cover in the herbaceous layer? Is there a change in species composition/diversity? If a change in species composition does occur, do those species originally present re-colonize the site? How long until the site is re-colonized by these species?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Results from this monitoring question have not been previously reported.

Monitoring Indicator(s)

- Changes in percent cover, composition, and recolonization rates compared to reference conditions

Monitoring Frequency

Every 5 years.

Background and Driver(s)

Standard project level botany survey protocols are conducted prior to all forestry projects for preharvest baseline. Stand surveys are repeated following harvesting of select stands. This method may be appropriate to compare gross composition differences at the stand scale. Marked plots are used to detect changes in percent cover, composition, and recolonization rates compared to reference conditions.

Results and Discussion

This monitoring question is not being evaluated in this report. It will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

This question will be considered for evaluation in a future monitoring report.

5.3 – Botany and Wildlife

The WMNF is home to three threatened or endangered species: small whorled pogonia (*Isotria medeoloides*), Canada lynx (*Lynx canadensis*), and northern long-eared bat (*Myotis septentrionalis*). Monitoring the status of key ecological conditions required by these species is an important means of detecting and tracking ecological changes influencing these species. This monitoring question pertains to the likelihood of persistence of small whorled pogonia and status of important habitat for the Canada lynx and northern long-eared bat populations on the WMNF.

5.3.1 – What is the status of key ecological conditions required by each federally listed threatened and endangered species known to occur on the White Mountain National Forest?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

There are three federally listed species included in this monitoring question. This report will address indicators for two of them:

- Acres of suitable foraging and denning habitat for Canada lynx (*Lynx canadensis*)
- Number of potentially suitable roost trees for northern long-eared bat (*Myotis septentrionalis*)

Monitoring Frequency

Acres of suitable Canada lynx habitat are generally calculated annually. The number of suitable roost trees for northern long-eared bat is a new monitoring item, as a result of the species being listed under the Endangered Species Act in 2015. However, data is available from both 2006 (data collected from 2002-2006) and 2016 (data collected from 2012-2016), so a decade-long comparison can be made.

Background and Driver(s)

This monitoring item addresses the following required monitoring elements in 36 CFR 219.12:

> *(5)(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.*
>
> *(5)(iv) The status of a select set of the ecological conditions required under 36 CFR § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

A sustainable Canada lynx population requires two unique habitats: foraging habitat that supports abundant populations of snowshoe hare (their primary prey), and denning habitat in which to protect kittens. Lynx habitat may be considered suitable (can currently support lynx foraging or denning) or unsuitable (does not currently support foraging or denning). Non-lynx habitat is not reasonably expected to contribute to foraging habitat. Suitable and unsuitable lynx habitats are based on stand forest type, structural conditions, and ecological land type criteria. On the WMNF, foraging habitat is defined as brushy wetlands, softwood, or mixedwood stands with thick regenerating vegetation to provide cover from snowshoe hare predators. A suitable den site is generally a small area of tangled large woody material that provides cover for kittens. While intense wind events can create local patches of blown-down trees of any age, suitable denning habitat is most likely to be found in older stands where trees are generally more decadent. On the WMNF, suitable denning habitat is assumed to be found in spruce, fir, or mixedwood stands at least 120 years old or white pine or hemlock stands at least 150 years old. Both foraging and denning habitat must be found next to each other within a lynx's home range and in suitable quantities to support a lynx population. Lynx habitat on the WMNF has been mapped into 13 Lynx Analysis Units (LAU), each of which is designed to approximate the home range of a single lynx (Forest Plan, Glossary, p. 16).

For northern long-eared bats, the most critical habitat feature on the WMNF is availability of roost trees, especially maternity roost trees (where adult females congregate to give birth and raise their young). Roost trees can vary in size but are most commonly 4 to 10 inches in diameter and, on the WMNF, are most often hardwood trees with a defect of some kind to provide a suitable cavity (U.S. Fish and Wildlife Service 2015, Sasse and Pekins 1996). Northern long-eared bats will use old, rotten standing dead trees (snags), as well as live trees that are mostly sound but with a small defect. Determining if a tree can function as a roost tree without seeing a bat exit the tree is close to impossible, so an assessment is made instead using inventory estimates of snags and live trees with known defects. This method misses trees that appear sound but have a hidden defect, but not every snag or live tree with a defect may be suitable for roosting, either.

Direction for these monitoring items appears in Forest Plan goals (pp. 1-8 to 1-9), as well as in Canada lynx standards and guidelines (p. 2-14). Northern long-eared bats were not listed under the Endangered Species Act when the Forest Plan was signed in 2005, but the WMNF had previously addressed the possibility of Indiana bats (*Myotis sodalis*, an endangered species) being present on the Forest. Using that previously developed direction, wildlife reserve tree standards and guidelines to conserve possible roost trees to benefit all woodland bats were incorporated into the revised plan (pp. 2-35 to 2-36).

Monitoring Indicator 1

Acres of suitable foraging and denning habitat (Canada lynx).

Results

For Canada lynx, Forest Plan standards and guidelines taken from the 2000 Canada Lynx Conservation Assessment and Strategy (Ruediger et al. 2000) focus on providing minimal thresholds of denning habitat (at least 10 percent) and total suitable habitat (at least 70 percent) in each LAU. Table 5 shows a comparison of lynx habitat over the 11-year period since the Forest Plan was revised.

Table 5. Comparison of mapped lynx habitat by Lynx Analysis Unit (LAU) on the WMNF in 2006 and 2017.

LAU	Total lynx habitat (acres) in 2006	Total suited (%) in 2006	2016 total foraging (%) in 2006	Denning (%) in 2006	Total lynx habitat (acres) in 2017	Total suited (%) in 2017	2016 total foraging (%) in 2017	Denning (%) in 2017
1	39,896	40	25	25	39,282	50	25	35
2	17,128	29	3	27	16,014	36	3	33
3	42,203	33	13	27	38,545	39	14	32
4	39,735	56	40	37	38,519	63	41	36
5	58,279	49	42	25	59,568	62	40	27
6	27,765	38	27	16	27,134	45	27	20
7	28,651	31	7	26	26,607	35	6	30
8	58,533	42	27	25	58,309	34	21	17
9	53782	58	46	24	54452	59	46	21
10	53,242	65	59	42	55,161	66	56	41
11	30,027	35	24	20	26,455	45	25	23
12	23,448	39	35	17	23,041	42	35	16
13	20,004	37	33	7	20,234	38	34	9

Discussion

For the most part, lynx habitat stayed the same across all LAUs over the decade. Raw data shows a small drop in total lynx habitat, which may be more a function of updated typing of forest types in various areas. It is unlikely the amount of total lynx habitat on the ground has changed, since ecological land types do not change and Forest Plan direction would generally move the WMNF towards more total lynx habitat, not less. Suitable lynx habitat increased across the Forest by almost 20,000 acres, resulting in a proportional increase in all but one LAU. Determining the specifics for the increase was challenging. The raw data show total acres of denning habitat in 2017 was within 1,000 acres of 2006 totals. Total acres of suitable foraging habitat decreased by over 6,000 acres over the same period. However, some suitable foraging habitat is also suitable denning habitat. There are two situations in which stands can be counted as both, provided the stand age is sufficiently old: 1) all spruce-fir above 2,500 feet elevation and 2) uneven-aged harvests of mixedwoods or softwoods on strong softwood ecological land types, done within the last 5 to 30 years. In this last case, the overall stand age remains the same because the

majority of the stand is not harvested. However, in small gaps where trees are harvested, dense softwood regeneration can provide suitable snowshoe hare habitat.

To calculate the total acres of suitable lynx habitat, foraging and denning habitat are added together, but then the amount of overlap between them is subtracted. It is in this overlap amount where the difference between 2006 and 2017 becomes apparent. In 2017, there were almost 24,000 fewer acres of this overlap compared to 2006. Much of this amount is likely attributable to our moving to a new reporting system that made it difficult to run data queries that would enable us to associate accomplishments (e.g., group cuts that are 5 to30 years old on strong softwood ecological land types) with on-the-ground locations. This resulted in an anticipated underestimation of the amount of suitable foraging habitat in 2017. The remainder is likely attributable to stands outside of the overlap area growing into denning habitat but offset by harvests elsewhere.

The challenges with this kind of analysis should be resolved as we transition to the new database system. In the meantime, the WMNF continues to be below minimum thresholds for suitable foraging habitat in all LAUs. We may never exceed the threshold with current levels of timber harvesting; however, Forest Plan standards and guidelines should help move the WMNF towards improving lynx habitat where possible. Denning habitat continues to be above minimum thresholds in all but one LAU and we have made steady progress in that LAU since 2006.

Monitoring Indicator 2

Number of potentially suitable roost trees for northern long-eared bats.

Results

To assess northern long-eared bat potential roosts, forest inventory data was queried for snags greater than or equal to 5 inches diameter at breast height (DBH) and cull trees greater than or equal to 3 inches DBH (Forest Inventory Data Online 2018). Snags are defined as standing dead trees. Although northern long-eared bats will roost in trees smaller than 5 inches DBH, this is the minimum captured in the database used. Rough culls are live trees that do not contain at least one 8-foot section of the merchantable bole that is reasonably free from defect. Examples of rough culls are trees with splits, large cracks, lightning strikes, and other defects. Rotten culls are live trees where more than two-thirds of the merchantable bole is defective and at least half of this is due to the tree being rotten. Rotten culls are usually trees with large hollow sections. On the WMNF, northern long-eared bats showed a preference for northern hardwood roost trees, so these were also analyzed separately (Figure 9).

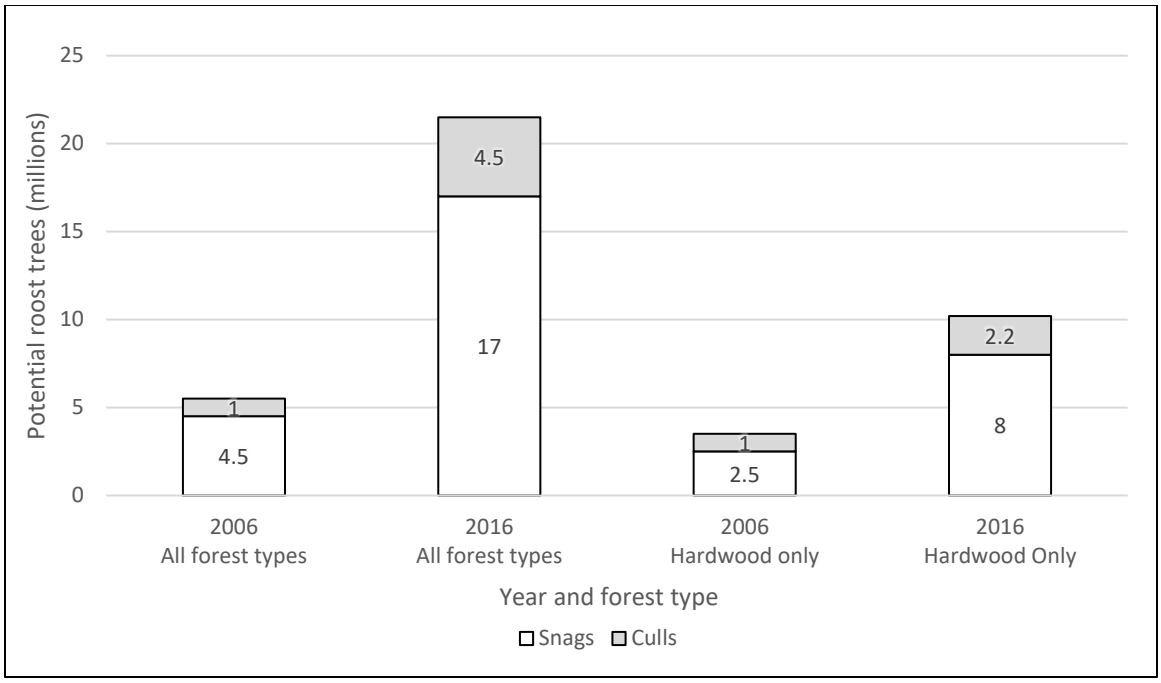

Figure 9. Estimate of the number of northern long-eared bat potential roost trees (in millions) on the WMNF by year and forest type.

Discussion

The sampling error varied for each species group and size class measured but was generally higher in 2006 than 2016. Regardless, it seems likely that there were more potential roost trees in all categories in 2016 compared to 2006. This is not a surprise, as the WMNF has been steadily aging since the large-scale timber harvests at the turn of the last century and estimates of land area impacted each year by Forest Service projects are less than one percent. Estimates of the number of potential roost trees cut during project implementation is even smaller, less than 0.1 percent (Sease and Prout 2015, p. 54). White-nose syndrome may continue to affect WMNF bat populations, but summer roosting habitat appears abundantly available.

Recommendations

No management changes are recommended.

Evaluation of Monitoring Question and Indicator(s)

No monitoring changes are recommended.

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5.4 – Climate Change

Predicted warmer temperatures, altered precipitation, and increased disturbance from storm events in the Northeast (U.S. Global Change Research Program 2023) will have important impacts on natural ecosystems and resources on the WMNF. This monitoring question pertains specifically to how changes in climate have affected snow characteristics on the WMNF since 1956.

*5.4.1 – How are the characteristics of snow changing on the White Mountain National Forest?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Maximum snow depth per season
- Cumulative snow depth per season
- Snow water equivalent
- Snow cover duration

Monitoring Frequency

Annual.

Background and Driver(s)

Reduced snow cover and depth coupled with increasing temperatures is predicted to result in more frequent freeze-thaw events, which will have direct impacts to management activities where frozen conditions are needed. Additionally, there are predicted ecosystem impacts from altered freeze-thaw regimes that could impact hydrology, tree phenology and growth, and potentially alter soil biogeochemical processes. The WMNF coordinates with Northern Research Station (Hubbard Brook and Bartlett Experimental Forests), the Northern Institute of Applied Climate Science, and many other partners to monitor forest resources, local climatic conditions, and the effectiveness of management

actions. These partners currently publish annual monitoring reports related to snow cover and other climate change impacts in the Northeast. The Forest is also developing methods to incorporate National Oceanic and Atmospheric Administration data to monitor snow duration over the entire Forest.

Monitoring Indicator 1

Maximum snow depth per season: The maximum snow depth on the course during the season.

Results

Data from multiple climate and snow monitoring stations at Hubbard Brook Experimental Forest (HBEF) were summarized through April 2024. Data from HBEF snow course 2, which has the longest record (1956–2024), shows that the maximum snow depth has declined approximately 11 inches (Figure 10).

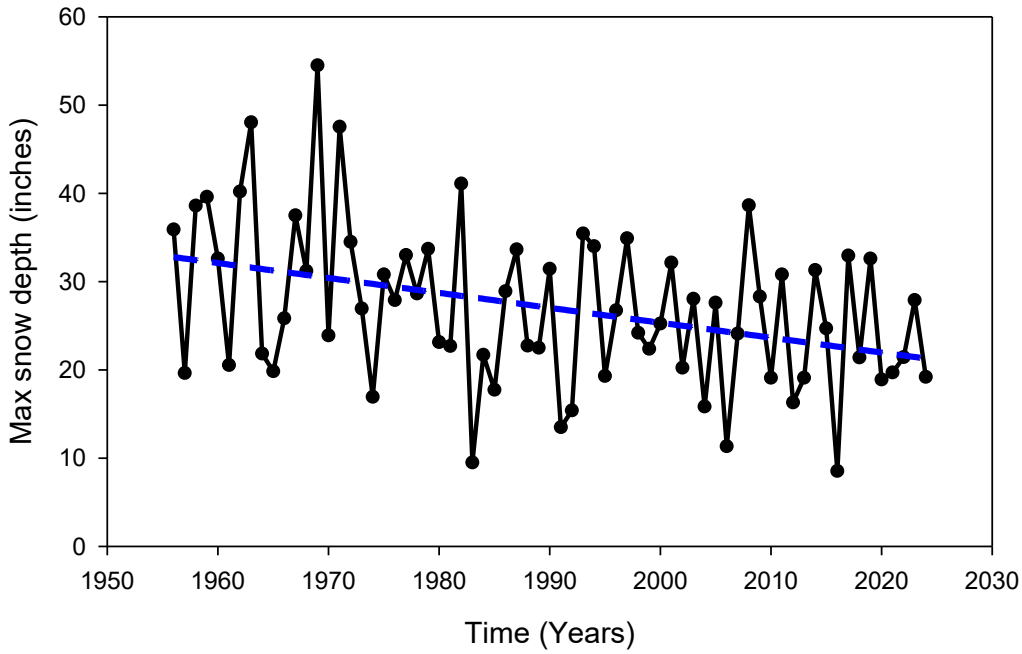

Figure 10. Long-term maximum annual snow depth measured at HBEF snow course 2 from Campbell et al. 2007 and updated with recent data through April 2024.

Monitoring Indicator 2

Cumulative snow depth per season: The total amount of snowfall on the course during the season.

Results

Data from multiple climate and snow monitoring stations were summarized through April 2024 (Environmental Data Initiative (EDI) Data Portal) to determine long-term trends for the state of New Hampshire. Overall, air temperatures in New Hampshire have increased approximately 3 degrees Fahrenheit since the beginning of the 20th century, and winter air temperatures have increased about 4 degrees Fahrenheit during this time. Long-term air temperature monitoring at HBEF corroborates this trend. Current long-term annual means, along various courses (transects) in HBEF, show air temperatures increased by about 2.5 degrees Fahrenheit, with winter temperatures increasing the most with a 3.6 degrees Fahrenheit average increase.

Increasing temperatures are correlated with less snow (U.S. Global Change Research Program 2023). The data from HBEF show that progressively less snow has fallen during the winter season, on average, which is reflected in the decline of median annual snow depth over time (Figure 11). The annual median snow depth has decreased approximately 10 inches from 1956 to 2024.

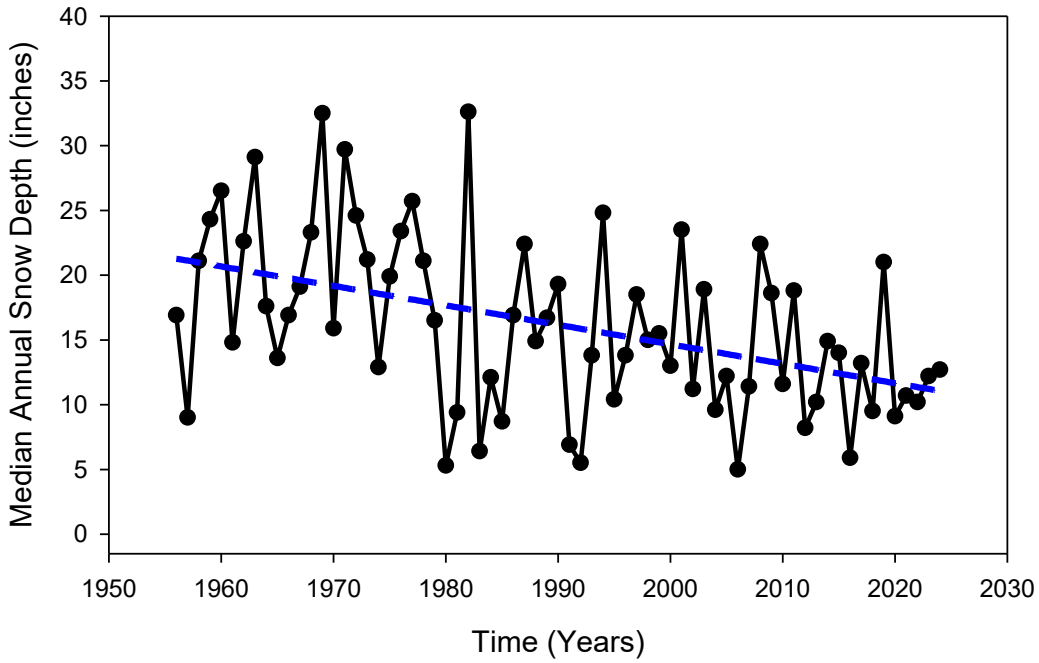

Figure 11. Median annual snow depth for HBEF snow course 2 from 1956 to April 2024.

Monitoring Indicator 3

Snow cover duration: The period from first recorded snow to last recorded snow.

Results

Data from multiple climate and snow monitoring stations at the HBEF were summarized through April 2024 (EDI Data Portal). Correlating with snow depth, the average number of days with snow cover has steadily decreased since the 1950s when this data collection started (Figure 12).

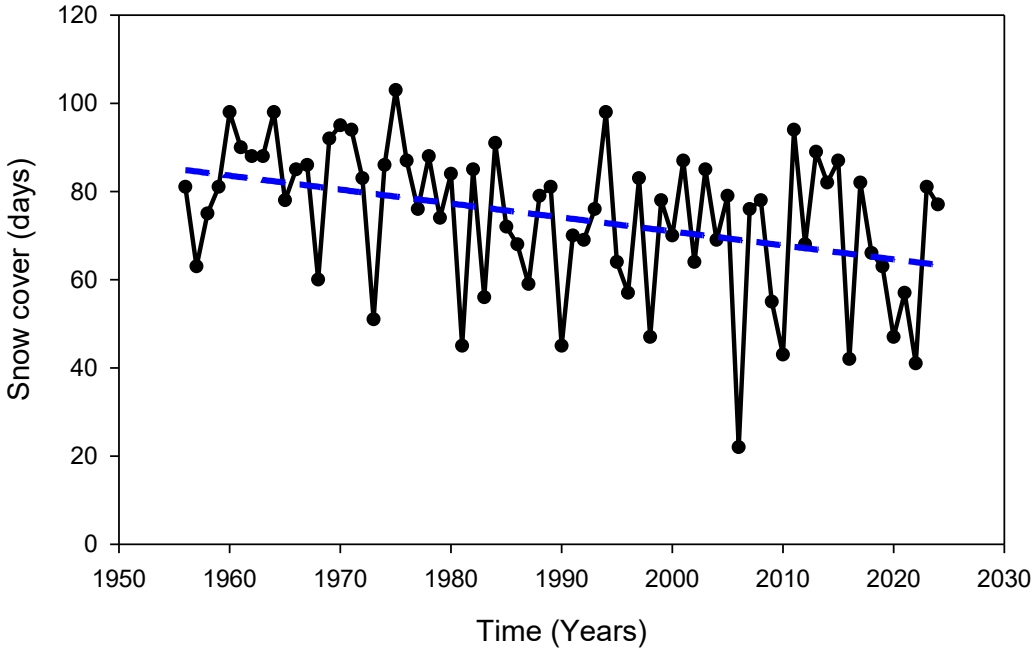

Figure 12. Number of days with snow cover measured at HBEF snow course 2 from Campbell et al. 2007 and updated with recent data through April 2024.

Monitoring Indicator 4

Snow water equivalent (SWE): The amount of water contained in the cumulative snow depth.

Results

Data from multiple climate and snow monitoring stations at HBEF were summarized through April 2024 (EDI Data Portal). In combination with the shortening duration of snow cover and snow depth, there is significant reduction in both the maximum SWE (Figure 13) and median SWE (Figure 14) recorded at stations across HBEF.

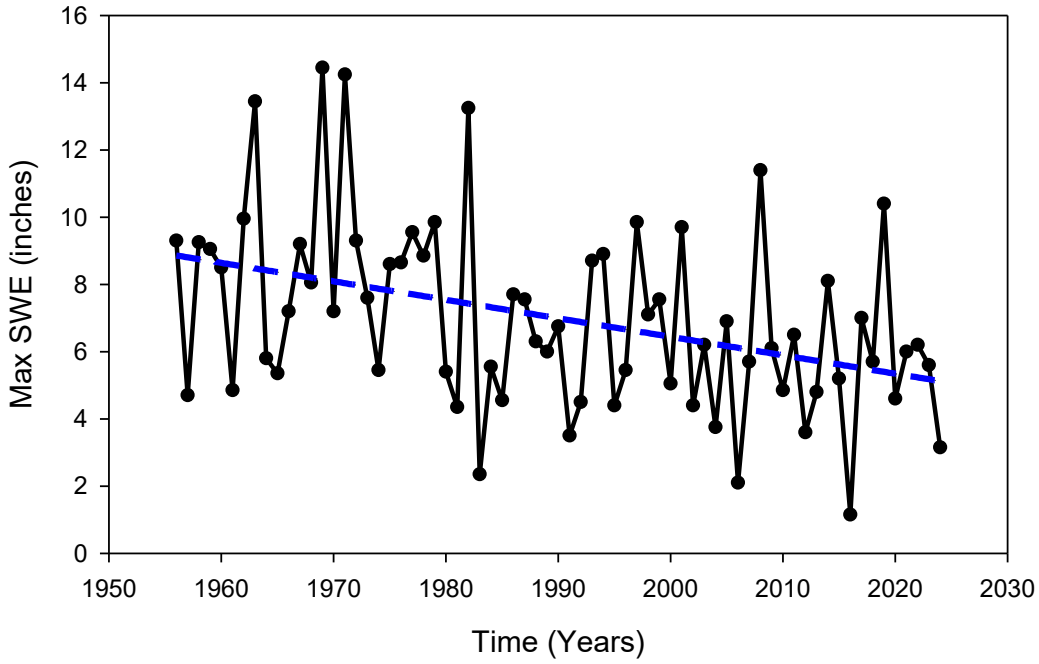

Figure 13. Maximum annual SWE for HBEF snow course 2 from 1956 to April 2024

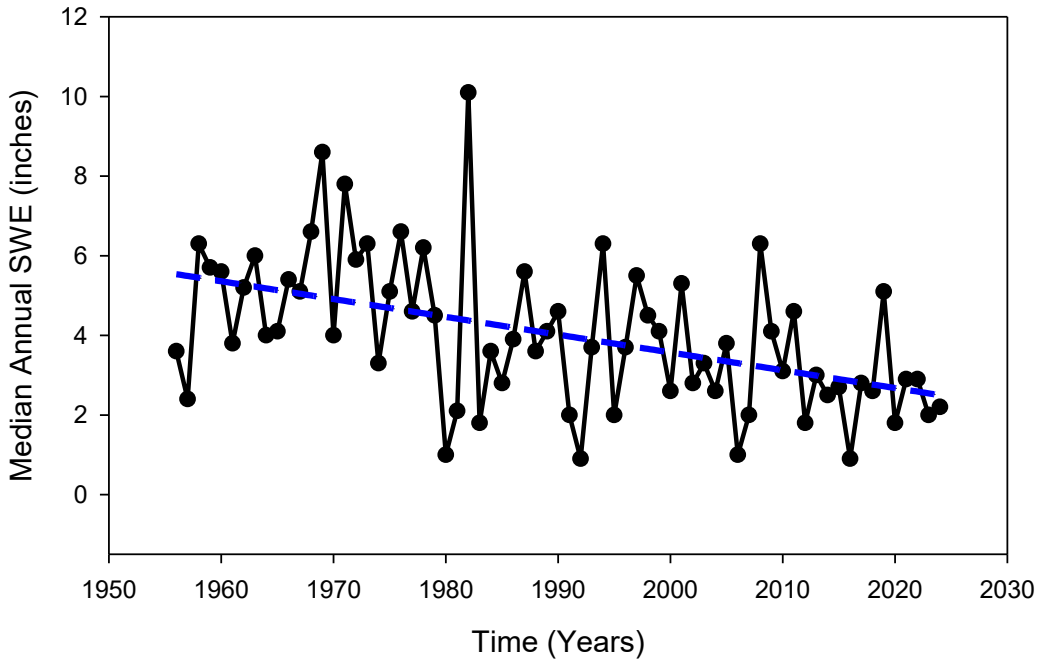

Figure 14. Median annual SWE for HBEF snow course 2 from 1956 to April 2024.

Discussion

Declines in snow depth and snow cover duration over time have had direct impacts to management activities on the Forest. Managers have responded to the loss of snow by relocating snowmobile trails from more at-risk areas such as south- and west-facing areas that tend to melt and lose snow cover

more easily to areas that are more protected and maintain snow cover longer. More drainage features are also being added to snowmobile trails to address increases in water flow during the winter in areas that previously would have stayed frozen. Downhill ski areas are also having to modify management, including investing in improved and more efficient snowmaking equipment to optimize manmade snow production when possible. This industry is also expanding their offerings to enhance recreational offerings, such as mountain biking, that are not reliant on snow conditions. Timber management is also experiencing impacts as the number of days with optimal ground conditions for harvesting are reduced or becoming more sporadic and less predictable through the season. As a result, loggers have needed a greater number of winter operating seasons to complete harvesting than what was needed in the past.

Recommendations

Monitoring snow depth and snow cover duration are important to management activities on the Forest, and the Forest should continue to coordinate with partners to monitor their change over time. No changes in monitoring protocols for these indicators are needed at this time. As optimal ground conditions for harvesting become fewer, more sporadic, and less predictable, the Forest is increasingly shifting toward summer timber harvesting, where appropriate, to broaden the operational opportunities. Furthermore, Forest recreation staff are currently looking for and should continue to look for opportunities to relocate snowmobile trails to areas that maintain snow cover longer, to lengthen the snowmobiling season and improve user experiences.

Projected increases in temperature, shifts in precipitation patterns, and more frequent severe storm events (U.S. Global Change Research Program 2023) are expected to affect natural ecosystems and Forest resources beyond changes in snow conditions alone. A broader understanding of how climate change is influencing these resources would further support sound management. Current monitoring efforts are adequate for informing management decisions. Should additional information needs emerge in the future, monitoring can be expanded or enhanced as necessary.

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5.5 – Fire

Goals for the WMNF Wildland Fire program include firefighter and public safety in all fire management activities; protection of human communities and community infrastructure; and protection of natural and cultural resources. The WMNF Wildland Fire program develops and maintains cooperative agreements with other federal, state, and local agencies to assist with fire suppression and prescribed burning across land boundaries. There are two different processes by which fire can be used to accomplish management objectives — prescribed fire and naturally ignited fire. The WMNF uses prescribed fires and naturally ignited fires to enhance ecosystem resiliency and reduce hazardous fuel loads where appropriate.

Prescribed fire is allowed in seven MAs. Prescribed fire may be used to meet the following management goals, among others:

- Reducing hazardous fuel loads
- Creating, maintaining, or improving habitat for wildlife
- Preparing sites for restoration of species
- Influencing the scale and pattern of vegetation across the landscape
- Managing insects and diseases
- Enhancing blueberry production
- Creating or maintaining scenic vistas

Naturally ignited fires are fires ignited by lightning and are a natural ecosystem process like wind and flood events. The WMNF has the option to manage these fires as natural events for resource benefit, allowing them to perform their role in an ecosystem if specific criteria consistent with the safety of people, property, and other resources can be met. Naturally ignited fires are allowed in nine MAs. Specific criteria to allow naturally ignited fire include the following:

- Firefighter and public safety
- Proximity to MA boundary
- Proximity to Class I Airshed
- Weather parameters
- Fuel parameters
- Effects on trail and campsite users
- Concurrent local or national fire activity

These monitoring questions pertain to how well prescribed fires and naturally ignited fires are being used to meet the goals of the WMNF Wildland Fire program.

*5.5.1 – Is prescribed fire being effectively used as a tool to meet management objectives set forth in the Forest Plan (Chapter 1)? Are prescribed burns meeting the fire effect objectives set forth in each burn plan?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Annual acres treated with fire
- Management objectives for prescribed fire
- Pre- and postfire conditions of the area burned

Monitoring Frequency

Annual.

Background and Driver(s)

Forest Plan objectives for prescribed fire are to treat approximately 80 to 300 acres annually to meet a wide range of forest objectives. Prescribed fire is used as a tool to support wildlife, timber, and recreation projects. Additionally, prescribed fire is used to reduce hazardous fuel loads that can contribute to rapid fire spread. Monitoring annual acres treated with fire indicates how aligned WMNF fire program is with forest plan objectives. Monitoring the different management objectives indicates how well the WMNF fire program meets the Forest Plan management goals. Meeting a variety of management objectives for prescribed burning aligns with the Forest lan. Measuring pre- and postfire conditions of burn units indicates whether the fire effect objectives set forth in each burn plan were met.

This monitoring question responds to the following monitoring elements in 36 CFR 219.12:

> *(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.*
>
> *(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.*

Monitoring Indicator 1

Annual acres treated with fire.

Results

In 2023, 120.5 acres of the WMNF were treated with prescribed fire. All the acres completed were in New Hampshire. These accomplishments met the objective for acres treated with prescribed fire.

Additionally, 60 acres of prescribed fire were completed by WMNF personnel at the Foss Mountain Fuels Reduction and Habitat Restoration project area through an agreement with the town of Eaton, New Hampshire.

In 2024, 201 acres of the WMNF were treated with prescribed fire: 160 acres in New Hampshire and 41 acres in Maine. This accomplishment met the objective for acres treated with prescribed fire. The Fall prescribed fire season was put on pause in October due to a lack of funding and very dry New England season so there were no burns implemented.

Discussion

The number of acres burned during 2023 and 2024 using prescribed fire is consistent with Forest Plan direction but the overall scale of prescribed fire does not meet current desired conditions. The objectives of the prescribed fires are mostly driven by wildlife or timber goals for maintaining wildlife habitat or increasing oak-pine regeneration. The burn units on Forest are small in scale, averaging 23 acres in 2023 and 2024, and do not comprehensively address the fuel reduction and habitat management desired conditions to increase regenerating age class and oak regeneration, and reduce hazardous fuels as described in the forest plan. Although the average acres burnt went up by an average of 14 acres per burn compared to the last monitoring period (2020-2022), it would still be more effective to burn fewer larger units and concentrate prescribed fire in areas where it will be most effective at meeting those objectives.

Monitoring Indicator 2

Management objectives for prescribed fire.

Results

In 2023, prescribed fire was applied to six units on the WMNF and partner lands. Hazardous fuel loads were reduced and produced mosaic conditions on all the units. Creating, maintaining, or improving wildlife habitat was the main objective for two units.

In 2024, prescribed fire was applied to nine units on WMNF. Hazardous fuels were reduced and produced mosaic conditions on all the units. Creating, maintaining, or improving habitat for wildlife was the main objective for all the units.

Discussion

The WMNF fire program is meeting the management objectives of prescribed fire. Prescribed fire was used to meet the following Forest Plan guidelines:

- G-1: Fire planning should be integrated into all resource management plans to ensure treatment objectives utilize fire in an appropriate manner from both ecological and resource protection standpoints.
- G-2: Fire suppression and prescribed fire impacts should be minimized by implementing Minimum Impact Suppression Tactics as described in the Interagency Standards for Fire and fire Aviation Operations.
- G-3: Existing standing dead, and dead-and-down, woody material should be retained and not damaged during fuel reduction activities unless they are considered a safety hazard. This applies especially to large (greater than or equal to 18 inches DBH) hollow or rotten logs and rotten stumps.

- G-4: Best available smoke management practices should be used to ensure that prescribed fire will not result in adverse effects on public health and safety, or visibility in Class I Airsheds.

Monitoring Indicator 3

Pre- and postfire conditions of the area burned.

Results

All prescribed burn units on the WMNF had pre- and postfire monitoring surveys completed to inform staff whether the objectives described in the burn plan were met. The complexity of the objectives determines the amount of pre- and postfire monitoring needed.

Case Study WMNF Hudson Farm Prescribed Burn

This prescribed fire occurred on April 17, 2024, in the New Hampshire town of Etna along the Appalachian Trail corridor. This was the second time the WMNF prescribed burned in the area, with the last entry in 2021. The project is moderately complex because WMNF land and privately owned land were burned in the project. Additionally, homes, roads, and other values were immediately adjacent to the unit. Improving nesting and forage habitat for bobolink (*Dolichonyx oryzivorus*) was the primary habitat objective of the prescribed burn. Prefire photos (Figure 15) and postfire photos (Figure 16) of the burn unit were taken and postfire field visits were conducted (Figure 17) to track bobolink populations throughout the summer of 2024.

Discussion

The habitat objectives for Hudson Farm are to maintain the opening by killing conifer and broadleaf seedlings and sprouts, and to encourage the growth of grasses and forbs by removing the previous year's dead material to provide nesting and forage habitat for bobolinks. Pre- and postfire photos of the unit were taken. Field visits to record habitat conditions and bobolink populations occurred for 4 weeks after burning.

Figure 15. Two firefighters are igniting a prescribed fire at Hudson Farm near Etna, New Hampshire. This photo shows prefire fuel conditions on April 17, 2024. WMNF photo.

Figure 16. A photo taken immediately after a prescribed fire at Hudson Farm on April 17, 2024. WMNF photo.

Figure 17. One month after a prescribed fire at Hudson Farm, May 23, 2024. WMNF photo.

*5.5.2 – Do wildland fires managed for resource benefit successfully meet objectives set forth in the Forest Plan and Fire Management Plan? Did the fire stay within the allowed management areas and fire behavior parameters presenting low risk to firefighter and public safety? Did the fire function as a natural ecosystem process to restore or maintain natural plant communities? Were hazardous fuels reduced?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Number of resource benefit fires

Monitoring Frequency

Annual.

Background and Driver(s)

It is well understood that for the past 120 years most fires in the United States have been aggressively suppressed and fire as a natural ecological process has been effectively removed from most ecosystems (Berry 2007). The WMNF is no different from the rest of the country, having been engaged in fire suppression since the first land purchase was made in 1914. Fire is a natural process like windstorms and floods and removing it has substantial ecological impacts and results in increased fuel loads that can

contribute to much greater intensity fires. The WMNF manages wildland fire for ecological benefits when specific conditions established in the Forest Plan and Fire Management Plan are met.

Results

From 2023 through 2024, two known naturally ignited fires occurred. Neither of these fires occurred in a MA that allowed resource benefit fire, so they were suppressed. One occurred near the Forest boundary and another near a Forest Service campground.

Discussion

The Forest Plan lists an objective to manage an estimated four to eight lightning-ignited fires as resource benefit fires during the first decade. The Final Environmental Impact Statement (FEIS) for the Forest Plan analyzed 30 years of fire data (1972–2002) and determined that 14 percent of fires on the WMNF were ignited by lightning. The WMNF decided that management of lightning fires would be feasible due to the low frequency of fire; high frequency of fire-ending events (e.g., rainfall and snow); numerous natural barriers to fire spread; and low fire growth rate on the landscape (FEIS, p. 3-425). Since 2005, the WMNF has managed one lightning-ignited fire for resource benefit: the Blueberry Fire on August 28, 2007.

The challenges of managing lightning-ignited fires in the Northeast include many factors. First, most lightning events are accompanied by rainfall and an ignition by lightning is either extinguished by rainfall or rainfall has saturated the fuels to the point where they do not support fire. Dry lightning storms are not as common in the Northeast as in the West. Most lightning fires on the WMNF occur during periods of drought in the summer. Multiple lightning fires are usually associated with a 30- to 50-year drought cycle as was seen from 2001 to 2002. The 2001 to 2002 drought doubled the number of lightning fires recorded on the WMNF from 1972 to 2002 and influenced the fire data analyzed in the FEIS. During this 2-year period the percentage of lightning-caused fires (as opposed to human-caused fires (e.g., campfires and arson fires), jumped to 20 percent. This would have been an excellent opportunity to manage fires for resource benefit but the Forest Plan at the time did not support this action. A fire managed for resource benefit that began in early August 2001 or 2002 could have burned for over a month before sufficient rainfall occurred to extinguish it.

Second, lightning-caused fires may not occur in MAs where wildland fire use is permitted. The majority of the WMNF allows wildland fire use. However, since the Blueberry Fire in 2007, only seven other lightning-caused fires have been found on the WMNF. Five were in MA 2.1 where wildland fire use for resource benefits is prohibited, one was on private property immediately adjacent to the Forest, and one was in the Sandwich Range Wilderness where resource benefit fire is supported but a member of the public had effectively suppressed the fire before it was reported.

Recommendations

It is important that the WMNF continue to manage wildland fires for resource benefits. Monitoring wildland fire effects has shown improved conditions for natural communities like red pine rocky ridge, a rare natural community on the WMNF. Communications between WMNF staff, state and local fire resources, and the public on the role of fire in the northeastern landscape needs to continue and improve. Ongoing fire ecology research can support future education and decisions regarding the use of wildland fire for ecological benefits.

Evaluation of Monitoring Question and Indicator(s)

No change is needed.

References

Berry, Alison. 2007. Forest Policy Up in Smoke: Fire Suppression in the United States. Property and Environmental Research Center.

5.6 – Forestry and Wildlife

A goal of the Forest Plan is to use timber harvesting as a tool to attain wildlife habitat (p. 1-17). These monitoring questions pertain to whether forest understory composition and even-aged regeneration harvest opening size and quantity objectives are being met for wildlife habitat.

*5.6.1 – Are we managing forests at the project level in ways that move the Forest toward our Forest Plan wildlife habitat objectives?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2013.

Monitoring Indicator(s)

- Presence and relative abundance of seedlings of desired tree species

Monitoring Frequency

Annual.

Background and Driver(s)

A Habitat Management Unit (HMU) is a block of Forest land in which habitat composition and age class objectives are established to help ensure diverse habitats are well-distributed across the Forest landscape and provide a framework for analyzing project impacts on wildlife habitat at a local scale (Forest Plan, Glossary, p. 12). HMUs are an effective tool in helping move the Forest toward habitat composition and age class objectives for MA 2.1 lands. Prior to implementation of any vegetative management, development of habitat composition and age class objectives are required for each HMU to ensure that landscape-level goals and objectives are connected and that project-level ecological conditions are considered during development of each project.

HMU-specific objectives are based on specific ecological conditions within each HMU. They consider soils, topography, current habitat conditions, access, other uses, and land ownership to determine what habitat conditions are most appropriate in that area. Regeneration age class objectives are intended to be met during the next 10 to 20 years. Young and mature age class objectives along with habitat composition objectives are long-term objectives because it can take decades, or even centuries, for forest habitats to succeed from young to mature or from hardwoods to spruce-fir.

Third-year stocking surveys and 10-year monitoring surveys are used to collect information indicating the presence and relative abundance of desired species in stands harvested to move conditions toward wildlife composition objectives. Desired species presence and abundance in the seedling pool of stands harvested for wildlife habitat improvement are compared with that in the overstory to determine if regeneration objectives were met.

Results

For the third-year stocking surveys, 69 stands were surveyed during 2023 and 2024. All stands met NFMA requirements for having adequate stocking of commercial species 3 years after regeneration cutting. Sixty-one of these stands surveyed met the silvicultural intent of aligning with desired stand type definitions (Forest Service Handbook, 2409.21d-R9, p. 260.2-2; Forest Plan, Glossary, p. 4-35). Eight of the stands that met NFMA requirements fell short of currently meeting the silvicultural intent of the prescription. These eight stands all had a desired goal of meeting mixedwood definitions. While all had softwood present, the softwood components of these eight stands fell short of the required 25 percent or more of stocking levels needed to align fully with the mixedwood stocking definition outlined in the Stocking Survey Manual: WMNF Protocol.

For the 10-year monitoring surveys, 12 stands were surveyed on the Forest during 2023 and 2024. Prescriptions implemented on these stands 10 years prior included clearcuts, patch cuts, overstory removals, and group-selection treatments. All stands surveyed were found to have successfully met the silvicultural regeneration objectives related to the Forest Plan wildlife habitat types at the project level.

Discussion

Harvest treatments were successful at moving stands and HMUs closer to desired conditions outlined in the HMU objectives. Ninety percent of all stands surveyed were found to have successfully met the silvicultural regeneration objectives related to the Forest Plan wildlife habitat objectives at the project level. Of the stands that fell short of meeting desired stand type definitions, no concerns were raised by the silviculturist because the increased presence of softwood species moved the stands closer to the desired conditions.

Recommendations

It is recommended to continue monitoring stocking levels of desired species in regeneration harvest areas and evaluate if results are meeting HMU wildlife objectives. WMNF forestry staff should continue to monitor stocking levels by continuing to implement third-year stocking surveys and 10-year monitoring surveys as outlined in the Stocking Survey Manual: WMNF Protocol.

References

Not applicable.

5.6.2 – Are even-age regeneration harvest openings exceeding the 30-acre maximum size (Forest Plan, Vegetation Management S-1, p. 2-29)? Are we meeting wildlife habitat regeneration objectives in both size and quantity of openings by habitat types? If not, why not?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Clearcut size
- Amount and proportion of even-aged regeneration harvests

- Reasons for changing proposed even-aged regeneration harvest prescriptions

Monitoring Frequency

Every 10 years.

Background and Driver(s)

This monitoring is important to (1) ensure that the Forest does not exceed clearcut size limits established in the Forest Plan and (2) determine progress towards meeting important wildlife habitat objectives. Age class objectives (Forest Plan, pp. 1-20 to 1-21) are to be met through even-aged regeneration harvest in MA 2.1. Tracking harvest accomplishment data and the reasons for why proposed clearcuts do not make it from the planning stage to implementation helps inform future management decisions.

This monitoring question responds to the following monitoring elements in 36 CFR 216.12:

> *(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.*
>
> *(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.*

Monitoring Indicator 1

Clearcut size.

Results

Based on the 2010 Monitoring Report, the average clearcut size between 2006 and 2009 was 12.3 acres. From 2010 through 2019 the average was 11.5 acres (Table 6).

Table 6. Average and median size of clearcuts completed from 2010 to 2019.

Fiscal year accomplished	Number of clearcut units	Average size (acres)	Median size (acres)
2010	21	9.6	10
2011	11	9.8	8
2012	20	12.6	10
2013	19	19.2	7
2014	8	12.6	12
2015	4	7	6.5
2016	3	10	10
2017	11	17.4	19
2018	12	14.8	14.5
2019	10	10.1	8

Discussion

Although there was some year-to-year variability in average opening size, there has been little change since the Forest Plan was revised in 2005. Although some individual clearcut units approach very closely

to the 30-acre limit, the overall average is well under that and 30 acres remains a reasonable size limit on the WMNF.

Monitoring Indicator 2

Amount and proportion of even-aged regeneration harvests.

Results

Even-aged regeneration harvests (e.g., clearcut, seed tree, or shelterwood seed tree) are summarized by fiscal year in Table 7.

Table 7. Regeneration harvest completed from 2006 to 2019.

Fiscal year harvested	Even-aged regeneration acres harvested	Total acres harvested	Even-aged regeneration acres as percent of annual harvest total
2006	384	2,045	19
2007	267	1,596	17
2008	127	1,091	12
2009	165	1,323	12
2010	327	1,760	19
2011	242	1,611	15
2012	455	1,678	27
2013	260	1,376	19
2014	238	1,072	22
2015	319	1,015	31
2016	319	780	41
2017	187	554	34
2018	189	722	26
2019	308	628	49

Projected acres of timber harvest by decade were presented in the FEIS accompanying the revised Forest Plan (FEIS, p. 3-130). Full implementation of the Forest Plan was anticipated to result in 34,300 total harvest acres in Decade 1 and 25,700 acres in Decade 2. Of those totals, 9,400 acres of even-aged regeneration harvests were projected in Decade 1 and 12,000 acres in Decade 2.

Between 2006 and 2015 (Decade 1), the WMNF harvested a total of 14,567 acres or 42 percent of the projected total for Decade 1. A total of 2,784 acres were harvested with even-aged regeneration prescriptions, only 30 percent of the Decade 1 projection. This percentage is the same as what was reported in 2010, approximately halfway through the decade. But the proportion of even-aged harvest compared to total harvest improved during the second half of the decade.

Decade 2 implementation began in 2016 but will not be complete until 2026. From 2016 through 2019 (40 percent through the decade), a total of 2,684 acres were harvested, with 1,003 acres from even-aged regeneration prescriptions. The actual total acres of harvest are approximately 26 percent of the projected total and even-aged regeneration harvest acres are 21 percent of projections.

Discussion

There are several reasons contributing to the Forest's shortfall in meeting Forest Plan harvest and age class objectives, including budget and staffing issues. Even-aged regeneration harvests have consistently lagged below proportional annual total harvest acres. In other words, if the total harvest acres were 50 percent of the decade projected total, then the even-aged regeneration acres harvested should also be 50 percent of the projected totals. Instead, the proportion of regeneration acres is lower than the proportion of total harvested acres. However, this has improved more recently. In the second decade, the proportion of even-aged regeneration harvests was projected to increase from 27 percent to 47 percent of the total harvest acres. The actual proportion from 2016 to 2019 is 37 percent. The proportion is not as high as projected but is higher than the 19 percent completed during Decade 1.

Monitoring Indicator 3

Reasons for changing proposed even-aged regeneration harvest prescriptions.

Results

A total of six recent planning projects were analyzed to determine why stands proposed for even-aged regeneration harvests were changed in the final decision (Table 8). The projects cross all three districts of the WMNF and include projects that underwent analysis from 2011 to 2019. A total of 73 stands had initial proposed harvests that included an even-aged regeneration prescription. However, through the analysis process, 30 units were dropped or changed to uneven-aged prescriptions. In the case of changes in silvicultural objectives, reasons include (1) stand not silviculturally ready for treatment, (2) ice storm damage requiring timber stand improvement instead, (3) concern about heavy browse damage leading to regeneration failure, and (4) changing to favor softwoods, which are generally managed under uneven-aged harvest systems.

Table 8. Rationale for changing proposed even-aged regeneration prescription for six projects analyzed between 2011 and 2019.

Rationale	Number of stands changed
Visual concerns	1
Topography (too steep or wet for equipment)	7
Cost of access (new roads or long skid distances)	7
Silvicultural objectives changed	14
Unknown	1

Discussion

When this monitoring question was last reported in 2010, some of the same reasons were given. Slope was a common reason then as well as now. Visual conflicts appear to have decreased, while access costs appear to be a growing issue. Interestingly, one of the more prevalent reasons in 2010 for changing silvicultural prescriptions was a shift to manage stands for high-quality sawtimber wood products (which are managed using uneven-aged prescriptions). This reason did not occur in the most recent analysis. Instead, reasons seemed to be based primarily on objective silvicultural concerns as opposed to changing subjective stand goals.

Recommendations

No recommendations are suggested at this time, beyond continued monitoring.

References

Not applicable.

5.7 – Forestry

A goal of the Forest Plan is to manage vegetation using an ecological approach to provide both healthy ecosystems and a sustainable yield of high-quality forest products, with special emphasis on sawtimber and veneer (p. 1-17). These monitoring questions pertain to whether harvested stands are regenerating as expected, whether timber harvests are meeting habitat objectives for wildlife, whether there are acceptable levels of tree damage during timber harvest, whether timber harvest is occurring on suitable lands, and the extent that the Forest is being affected by insects and diseases.

*5.7.1 – To what extent have destructive insects and disease organisms increased?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Acres affected
- Species of insects and types of diseases
- Number of outbreaks

Monitoring Frequency

Annual.

Background and Driver(s)

Monitoring the acres affected by insects and diseases and the number of outbreaks serves to measure changes within the Forest Plan area related to stressors that may be affecting the plan area. If monitoring shows greater than endemic levels, additional focused monitoring and an action plan will be required.

Monitoring Indicator 1

Acres affected, species of insects, and types of diseases.

Results

The state of New Hampshire Forest Health Program conducts annual aerial detection surveys of the WMNF, monitoring acres of forestland affected by insects and diseases (Table 9, Figure 18). Findings include:

- White pine needle damage spiked to 1,956 acres detected in 2024 following a steady decrease since 2016, with 0 acres detected in 2022 and 2023. White pine needle damage is attributed to two foliar diseases, *Canavirgella* needle cast caused by the fungus *Canavirgella banfieldii* and brown spot needle blight caused by the fungus *Mycosphaerella dearnessii*.

Both species of fungus are widely distributed throughout the range of eastern white pine in New England (Munck et al. 2011).

- Defoliation from spongy moth, *Lymantria dispar dispar* (LDD), formerly known as gypsy moth, was observed but reduced from 2022 peak levels. LDD affected 4,721 acres in 2024 compared to over 19,000 acres in 2022. LDD is a non-native insect that feeds on a variety of tree and shrub species, with oak as the preferred species. High LDD populations can lead to defoliation of most oaks and secondary species within a stand.
- A late hard frost occurred in the spring of 2023, within a day of many oaks leafing out. This frost damage was observed on over 1,200 acres. Areas of red oak that faced multiple years of high LDD defoliation that were also affected by the frost saw high mortality given the 3 consecutive years of defoliation. The Moat Mountain Range area in Conway on the Saco Ranger District was an area that saw high mortality.
- For the first time, in 2023, emerald ash borer (EAB) was widespread enough to be observed on the WMNF through aerial surveys (University of New Hampshire Extension 2025). EAB was first detected on the WMNF at the Hubbard Brook Experimental Forest in the summer of 2021. It has now been detected in all New Hampshire counties as well as in western Maine. Acres of EAB observations are likely to increase as the insect continues to spread across the Forest.
- While not observed during the aerial detection surveys, beech leaf disease (BLD) was discovered on Hubbard Brook Experimental Forest in 2024. BLD is caused by an invasive microscopic nematode *Litylenchus crenatae* subsp. *mccannii* (Lcm). In the spring, nematode feeding can begin at bud break, causing dark banding between the veins of tender foliage. As the season progresses and damage worsens, the leaves become leathery in texture and dark banding can turn yellow and kill affected branch tips. Once infected, serious decline and mortality of beech appear to occur within 3 to 6 years, depending on the vigor and size of infected trees. Currently, there is no known treatment.

Table 9. Acres of damage by type and year determined by aerial detection surveys. Dashes indicate that presence of the damage was not detected during surveys.

Damage type	2023	2024
Anthracnose	4,690	-
Spongy moth	3,947	4,721
Frost	1,245	-
Emerald ash borer	183	-
Balsam woolly adelgid	54	-
Birch leafminer	5	47
White pine needle damage	-	1,956
Wind-tornado/hurricane	-	184
Unknown	38	155
Total acres of damage	**10,162**	**7,063**

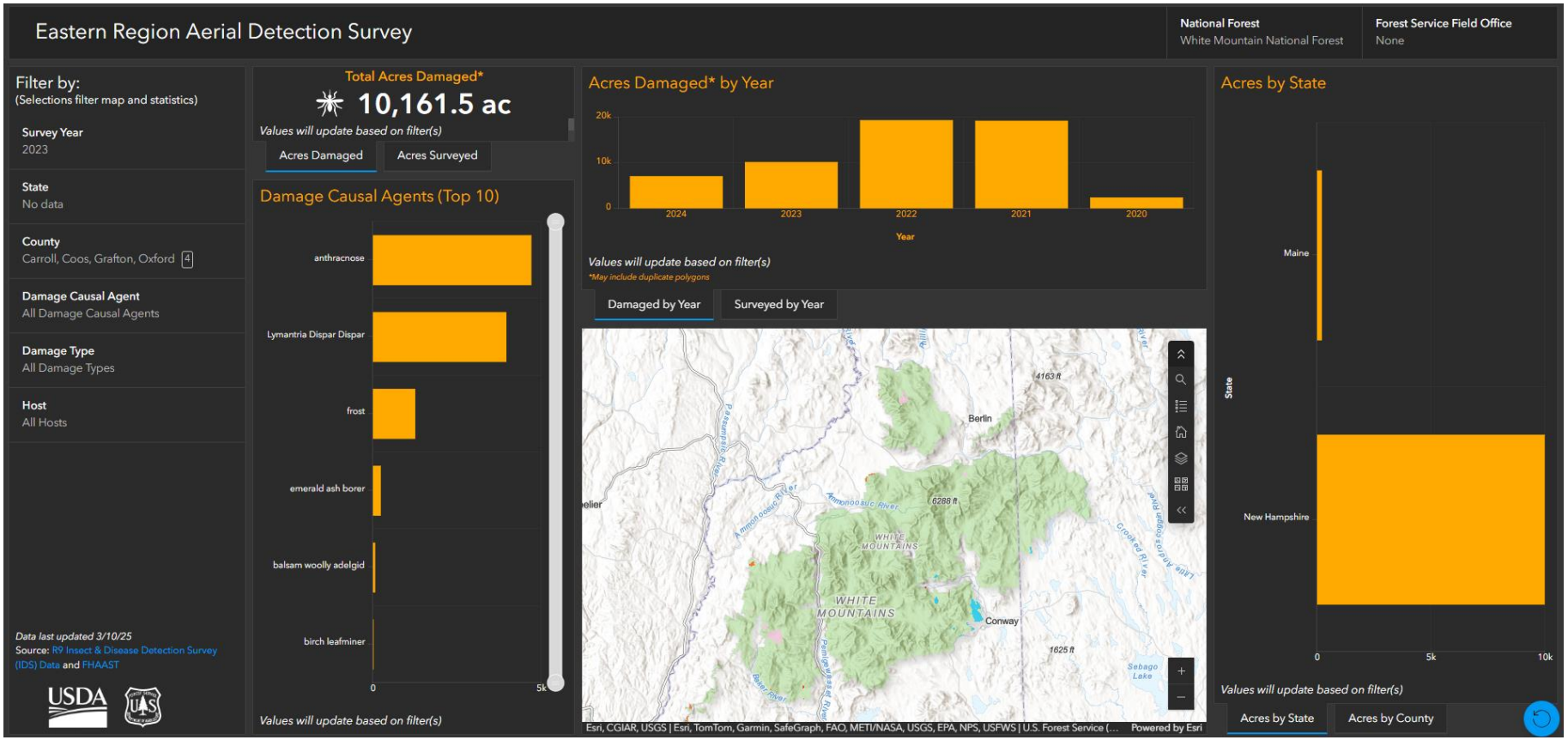

Figure 18. Report of the 2024 aerial detection survey for the WNNF using the Eastern Region Aerial Detection Survey Dashboard.

Discussion

The aerial detection survey results indicate acres affected and predominant damage type have generally fluctuated each year, consistent with regular outbreak intervals for native insects and diseases. The outbreak of non-native LDD is the first large outbreak of LDD since the early 1990s for New Hampshire and early 2000s for Maine; LDD last caused significant damage on the WMNF in the 1970s (Cooke 2022). In 2024, white pine needle damage likely returned due to the wet spring the year prior. Monitoring efforts are ongoing to track the spread of EAB. WMNF staff developed an action plan and are working to 1) address trees at risk to future EAB infestation and mortality that could result in hazard trees in developed recreation sites and 2) maintain genetics and biodiversity by preserving a component of ash species on the forest.

Monitoring Indicator 2

Number of outbreaks.

Results and Discussion

Forest Service, State and Private Forest Health Protection personnel, and WMNF staff annually monitor for outbreaks of multiple species of concern, including hemlock woolly adelgid (HWA), elongate hemlock scale, EAB, LDD, and BLD.

HWA, originally from Asia, was first discovered in New Hampshire in Portsmouth in 2000 and is a pest of concern for the hemlock resource on the WMNF. HWA and elongate hemlock scale monitoring efforts consist of ocular surveys of hemlock foliage across the WMNF, with particular focus on hemlock within timber sale areas. To date, no outbreaks of either have been discovered on the WMNF. However, HWA has been confirmed on a private parcel directly adjacent to the WMNF boundary in Albany, New Hampshire (Robert Cooke, personal communication).

EAB was first discovered in New Hampshire in Concord in April 2013 and has continued its steady spread across the state and the WMNF. A component of hardwood forests, ash is culturally and ecologically important. Once infested, ash mortality typically occurs within 2 to 5 years. In areas where EAB infestation is severe, over 99 percent of the ash trees may die. Forest staff began implementing the Ash Preservation Project in 2024. Across the Forest, 80 sites and about 20 ash trees per site will be chemically treated to preserve ash across this landscape.

Recommendations

Aerial detection and ground surveys (e.g., HWA and elongate hemlock scale monitoring, BLD monitoring, LDD egg mass surveys, and maple tapping monitoring) should continue. Continued monitoring improves the chances of early detection and eradication of pests. Foresters should continue to implement silvicultural prescriptions that promote healthy and resilient forested stands and encourage a diversity of age classes and species. Many insects and diseases tend to prefer stressed, dying, and dead trees. Maintaining diverse age classes of healthy trees can increase resistance and resiliency to pests.

References

Cooke, R.R. 2023. *Lymantria dispar dispar* monitoring. Unpublished report. On file at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH. 12 p.

Munck, Isabel A., William D. Ostrofsky, Barbara Burns. 2011. Pest alert eastern white pine needle damage. U.S. Department of Agriculture, Forest Service, NA-PR-01-11, Northeastern Area, State and Private Forestry, Newtown Square, PA. 4 p.

University of New Hampshire Extension. 2025. Emerald ash borer. Available: https://www.nhbugs.org/damaging-insects-diseases/emerald-ash-borer. [Accessed 25 November 2025].

*5.7.2 – Are lands adequately restocked within 5 years of a regeneration harvest or site preparation activities?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Stocking levels of suitable species in regeneration harvest areas

Monitoring Frequency

Annual.

Background and Driver(s)

The NFMA mandates that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans. Responsible officials must address stocking in their decision documents. This monitoring item ensures there is data to inform responsible officials when making their findings.

This question is tied to the Forest Plan objective of managing for commercial products using well-integrated prescriptions that protect biotic and abiotic resources and are compatible with the high level of recreational use on the Forest. The monitoring indicator "stocking levels of suitable species in regeneration harvest areas" is determined by performing stocking surveys. The WMNF Stocking Survey Protocol allows staff to determine if harvest activities resulted in lands with adequate stocking levels of suitable species within 5 years of a regeneration harvest. Three years following harvest activity, a minimum of thirty 1/1000-acre (3.72-foot radius) plots per harvest unit are used to determine stocking levels of suitable species in regeneration harvest. For example, within northern hardwood type, approximately 40 percent of the plots should be stocked with acceptable northern hardwood species to result in "C" line stocking. Sixty percent will result in "B" line stocking (Leak 2014). Should it be found during the stocking survey that the harvested unit is not fully restocked, Forest staff will use the remaining 2 years in the 5-year timeline to ensure the harvested unit is adequately restocked with suitable species.

Results

Stocking survey results are updated annually into a database called the Forest Service Activities Tracking System (FACTS). Monitoring results from stocking surveys continue to demonstrate that lands are adequately restocked within 5 years of a regeneration harvest or site preparation activities. Figure 19 shows a photo documenting adequate restocking following a clearcut harvest at Fifield Brook in harvest unit (HU) 13. The photo was taken in 2024, 3 years following the 2021 harvest. For 2023 to 2024, third-year stocking surveys were conducted on 69 stands totaling 1,001 acres. All stands were successfully regenerated and in compliance with the NFMA requirement for adequate stocking of commercial species following regeneration cutting and the Forest Plan objective was met.

Figure 19. Northern hardwood regeneration after clearcut harvest in HU13 at Fifield Brook.

Discussion

Current monitored conditions are consistent with the requirements for reforestation as outlined in the NFMA. This monitoring demonstrates that silvicultural prescriptions implemented on the WMNF are effective for adequately restocking stands within 5 years of a regeneration harvest or site preparation activities. Maintaining stocking levels of suitable species in regeneration harvest areas ensures a sustained yield of high-quality sawtimber and other timber products, which is one of the primary purposes and desired conditions of land in management where timber harvest is permitted.

Recommendations

WMNF staff should continue to monitor stocking levels of suitable species in regeneration harvest areas utilizing the WMNF Stocking Survey Protocol.

References

Leak, William B., Mariko Yamasaki, and Robbo Holleran. 2014. Silvicultural guide for northern hardwoods in the Northeast. USDA For. Ser. Gen. Tec. Report NRS-132, Northern Research Station, Newtown Square, PA. 8 p.

*5.7.3 – Are harvests occurring on lands suitable for timber management? Are our databases being kept current with identified changes that affect suitability determinations at the project and Forest Plan level?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Verify that the harvest areas only occurred on suitable lands
- Review GIS and FSVeg databases to see if they reasonably reflect accurate suitability determinations

Monitoring Frequency

Annual.

Background and Driver(s)

The first question provides information to help decisionmakers address an NFMA requirement in their project decision findings.

Keeping our databases updated helps with future project planning and will inform suitability analysis in the next Forest Plan revision. Changes can also affect our assumptions in the Forest Plan about the long-term availability of old-forest habitat.

Results

Recent (2023-2024) timber harvesting on the Schoolhouse Timber Sale of the Bowen Brook Project area was visited in winter of 2024 to confirm harvesting activities occurred on suited lands. Five harvest units, including overstory removal and group selection units were visited. Field verification was completed by Forest staff to ensure that harvesting activities occurred on suitable lands as planned. A follow-up GIS and FSVeg database review was also conducted for the same units by staff. The databases accurately reflected suitable lands with the appropriate management area designation (MA 2.1 - General Forest Management) and land suitability class code and description (500 - Timber Production Primary Emphasis).

Discussion

Confirmation of land suitability class, including updating of GIS and FSVeg databases, continues to be a required element in project planning and effects analysis for all vegetation management and timber harvesting projects.

Recommendations

Continued monitoring is recommended to help ensure decisionmakers have the data needed to address NFMA requirements in their project decision findings.

Verifying that GIS and FSVeg databases are updated will help with future project planning and will inform the suitability analysis of any future Forest Plan revisions.

References

Not applicable.

***5.7.4 – Are we accomplishing silvicultural objectives related to our Forest Plan wildlife habitat types at the project level? For instance, if a forestry activity was intended to help**

perpetuate a paper birch/aspen forest type, did we meet that objective for the stand or harvest area?

Current Evaluation

Reported in 2025.

Previous Evaluation

Reported in 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Determine whether most plots with preferred species are in the dominant crown position 3 and 10 years after regeneration harvest (i.e., clearcut, shelterwood, and single tree selection)

Monitoring Frequency

Annual and decadal.

Background and Driver(s)

The purpose of this question is to determine if implemented silvicultural prescriptions are resulting in the desired habitat type outcome. This monitoring question responds to the following monitoring elements in 36 CFR 216.12:

> *(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.*

The question is tied to the Forest Plan habitat composition (forest type) and age class objectives. Forest type is defined by its vegetation, particularly its dominant vegetation as based on percentage cover of trees (Society of American Foresters 2018).

This WMNF Stocking Survey Protocol allows staff to determine if silvicultural objectives related to the Forest Plan wildlife habitat types have been met. Field crews visited stands 3 years after regeneration harvest to determine if forest type management objectives have been attained by surveying a minimum of thirty 1/1000-acre (3.72-foot radius) plots per harvest unit. Seedling data is collected on these fixed-radius mil-acre plot locations by forestry staff. At each mil-acre plot within the unit, the tallest commercial seedling species and the second tallest commercial seedling species less than 5 inches DBH is recorded along with relevant notes and observations. Total seedling count per plot is not recorded. Non-commercial species, such as pin cherry or striped maple, are not surveyed but may be noted if they hinder acceptable regeneration. Based on the prescription, if there are important species such as red oak, white pine, sugar maple, or red spruce present on the plot but not recorded as the tallest or second tallest species, their presence is recorded as a focal species.

Forestry staff use the standards outlined in the WMNF Stocking Survey Manual protocol to determine minimum acceptable stocking levels for natural regeneration species groups:

- **Northern Hardwood:** Approximately 40 percent of the plots should be stocked with acceptable northern hardwood species to result in “C” line stocking. Sixty percent will result in “B” line stocking.
- **Aspen/Birch:** Approximately 50 percent of plots should be stocked with at least two vigorous free-to-grow aspen or birch seedlings to result in an adequately stocked aspen/birch stand.

- **Spruce/Fir and Hemlock:** Approximately 50 percent of the plots should be stocked with at least one acceptable spruce/fir or hemlock species to result in an adequately stocked spruce/fir or hemlock stand.
- **Oak/Pine:** Approximately 33 percent of plots would be stocked with at least one acceptable free-to-grow oak or pine species to result in an adequately stocked oak/pine stand.
- **Mixedwood:** At least 25 percent of plots will be stocked with at least one commercial hardwood species and at least 25 percent of plots will be stocked with at least one acceptable spruce/fir or hemlock species to result in an adequately stocked mixedwood stand.

Protocol for 10-year monitoring surveys was developed in 2018 to systematically visit a subsample of 10-year-old stands and/or harvest areas to review project and prescription objectives and outcomes on the ground. The protocols were implemented in 2019. Units are chosen randomly by the Forest silviculturist and assigned to District forestry staff. Fifteen 1/385-acre (6-foot radius) plots are sampled per stand. The 10-year monitoring survey has three components: (1) record the tallest and second tallest tree species stems, (2) count all commercial tree species stems by diameter class (less than 2 inches, 2-3 inches, and greater than 3 inches) that are less than 5 inches DBH, and (3) record the basal area by species for stems greater than 5 inches DBH. The results of these third-year and 10-year surveys are then documented in FACTS and summarized in district monitoring reports.

Results

For the third-year stocking surveys, 69 stands were surveyed during 2023 and 2024. All stands met NFMA requirements for having adequate stocking of commercial species 3 years after regeneration cutting. While having mixedwood present at high levels, 8 of the 69 stands that met NFMA requirements did not technically meet the silvicultural mixedwood requirements of having 25 percent mixedwood stocking outlined in the WMNF protocol. Additional plots may have captured a higher percentage of softwood species. All plots had species component levels high enough that no stand was identified as having concerns for their mixedwood progression. Based on these surveys, most stands met silvicultural objectives related to our Forest Plan wildlife habitat types at the project level. The stands that did not, were moved closer to the desired wildlife habitat type objectives than they were prior to treatment.

For the 10-year monitoring surveys, 12 stands were surveyed on the Forest during 2023 and 2024. Prescriptions implemented on these stands 10 years prior included clearcuts, patch cuts, overstory removals, and group selection treatments. All stands surveyed were found to have successfully met the silvicultural regeneration objectives related to the Forest Plan wildlife habitat types at the project level.

Figure 20. Kennison Ridge, Unit 7, prior to overstory removal resulting in desired mixedwood habitat type, including a diverse mixture of red spruce and northern hardwood regeneration.

Discussion

Monitoring is an important part of adaptive management as it allows us to observe the outcome of our treatments and adopt practices to reflect what we learn. This monitoring demonstrates that silvicultural prescriptions implemented on the WMNF are effective for adequately restocking stands with desired species at both 3 and 10 years following a regeneration harvest and that postharvest forest types are meeting stand objectives.

Recommendations

WMNF forestry staff should continue to monitor if silvicultural regeneration objectives are being met by continuing to implement third-year stocking surveys and 10-year monitoring surveys as outlined in the WMNF Stocking Survey Manual protocol. It is recommended to continue to describe habitat objectives as a range rather than as an exact percentage of requirements.

References

The Society of American Foresters. 2018. The dictionary of Forestry. 74 p.

*5.7.5 – Is residual tree damage from silvicultural activities within acceptable levels to meet our resource objectives?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Stocking levels of acceptable growing stock of suitable species in harvest areas to meet resource objectives

Monitoring Frequency

Annual.

Background and Driver(s)

There is a legal requirement in the NFMA that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans. This question is tied to the Forest Plan goal of managing vegetation using an ecological approach to provide both healthy ecosystems and a sustainable yield of high-quality forest products, with special emphasis on sawtimber and veneer (p. 1-17). The term "acceptable growing stock" (AGS) commonly is used to describe trees that have log potential now, or in the future, and a reasonable crown (Leak et al. 2014). Maintaining stocking levels of acceptable growing stock of suitable species in harvest areas helps ensure a sustainable yield of high-quality sawtimber and veneer.

Results

The timber sale administration team monitors protection of residual trees (provision BT6.32 under 2400-6T Timber Sale Contract) during routine inspections of logging operations (often inspections take place multiple times per week during active logging operations). Results of inspections are documented on Timber Sale Inspection Reports (TSIRs) which are reviewed and signed by the Sale Administrator (SA), Forest Service Representative (FSR), and timber purchaser/contractor. All harvest units are visited during logging operations.

In addition to the monitoring performed by timber sale administration team, a formalized residual stand damage survey is conducted. Several harvest units, selected at random, are surveyed annually. For each randomly selected unit, data is collected on a minimum of thirty 0.01-acre (12-foot radius) plots for all trees 5 inches DBH or greater. For trees that incurred logging damage, the location of the tree damage and severity is recorded as well as tree quality (acceptable versus unacceptable growing stock prior and post damage). Observations of crown and root conditions are recorded. Using this protocol, data were collected on two units in 2023 and 5 units in 2024. A total of five different timber sales were visited. Treatment types included single-tree selection, improvement cut, group selection, and shelterwood.

The residual stand damage surveys conducted on the five timber sales in 2023 and 2024 sampled 260 trees across 223 plots (1.17 trees per plot and about 117 trees per acre). Of the trees sampled, 46 trees (equivalent to 21 trees per acre) were damaged due to harvesting operations. Of the 46 damaged, 6 trees were determined to be acceptable growing stock prior to harvest but damaged in a manner during harvest

activities that they became unacceptable growing stock post operations (equivalent to 3 trees per acre). The residual stand damage from silvicultural activity was determined to be at an acceptable level.

Discussion

All units harvested from 2023 through 2024 were visited by various members of the sale administration team. It was determined that residual tree damage from silvicultural activities was within acceptable levels in majority of units (Figure 21). Some TSIRs indicated residual tree damage. As a result, increased communication with purchasers and contractors occurred to prevent future unnecessary damage.

Figure 21. Residual spruce-fir stand following logging operations on the WMNF.

Recommendations

Annually, continue to randomly select a minimum of two harvest units per district for residual tree damage surveys. These surveys should be conducted 3 years after harvest in stands with residual stocking levels of greater than 60 square feet of basal area per acre.

References

Leak, William B., Mariko Yamasaki, and Robby Holleran. 2014. Silvicultural guide for northern hardwoods in the Northeast. USDA For. Ser. Gen. Tec. Report NRS-132, Northern Research Station, Newtown Square, PA. 9 p.

5.8 – General

This section assesses the implementation of Forest Plan goals, objectives, standards, and guidelines to determine whether improvements need to be made.

5.8.1 – To what extent are Forest Plan goals and objectives being attained?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

- Varies by program and by goal or objective

Monitoring Frequency

Biennial.

Background and Driver(s)

Varies by program and by goal or objective. Every year, a sample of Forest Plan goals and objectives should be considered by Forest resource program managers to determine whether the Forest is on-track to attain the stated outcome or if additional or different work needs to be done.

Results and Discussion

This monitoring question is not being evaluated directly, however, many of the monitoring questions evaluated in this report speak to this question. This question will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

This question will be considered for evaluation in the next biennial monitoring report.

5.8.2 – Are Forest Plan standards and guidelines being implemented at the project level consistent with the Plan and NEPA analysis?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

- Varies by project based on applicable standards and guidelines

Monitoring Frequency

Annual.

Background and Driver(s)

Project-level reviews occur after project decision and implementation. Postdecision reviews determine whether standards and guidelines identified as applicable during the NEPA analysis were incorporated into project design and contracts. Postimplementation monitoring evaluates whether the standards and guidelines were followed on the ground. Random samples are selected by program staff. At least one project occurs on each District each year. Not every standard or guideline applicable to a given project can be evaluated in every review. Appropriate standards and guidelines for review are based on their importance to minimizing effects. Over 10 years, standards and guidelines selected should cover all programs.

Results and Discussion

This monitoring question is not being evaluated directly, however, many of the monitoring questions evaluated in this report (e.g., 5.6.1 and 5.7.4) speak to this question. This question will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

We recommend reconsidering inclusion of this question in future monitoring reports due to lack of capacity for project-specific monitoring. Program-specific monitoring and BMP monitoring are currently being conducted Forest-wide.

5.9 – Heritage

Every year WMNF heritage program staff, paraprofessionals, and volunteers conduct site monitoring visits and project postimplementation surveys to evaluate effects on cultural resources. Recommendations of site significance and determination of effects are validated through the National Historic Preservation Act Section 106 consultation process with the appropriate State Historic Preservation Office (SHPO). Design features developed during the project planning process are intended to avoid effects on cultural resources. When damage to a historic property's significance or integrity during project implementation is unavoidable, mitigation measures are developed in coordination with the SHPO and others, as appropriate, to capture the significant characteristics of the site before project implementation and to interpret those historic values in a public format.

The WMNF heritage program works extensively with partners, including on the SHPOs in New Hampshire and Maine, to interpret the rich history of the White Mountains. A stewardship and historic preservation ethic that reflects federal historic preservation law is part of that message. The WMNF Heritage Monitoring Strategy recognizes that management practices and uses of the Forest have the potential to adversely affect cultural resources. Two areas of potential effects are highlighted in the monitoring guide and addressed in the monitoring questions below: recreation management and use and vegetation management (timber harvest). A central element of cultural resource management is the determination of National Register of Historic Places (NRHP) eligibility for cultural sites on the Forest. It is this evaluation of significance and a site's status as a "historic property" that guides the management strategy for each site. A loss of integrity, as defined by NRHP criteria for eligibility, may irreparably diminish a historic property's significance. In the absence of a formal evaluation, all cultural sites must be treated as potentially eligible for the NRHP, and their integrity must be preserved.

*5.9.1 – What effect do management of recreation facilities and recreational use of the forest have on cultural and historic sites?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

Impacts on prehistoric and historic cultural sites from recreation. Unacceptable damage attributable to vandalism, visitor use, or management practice based on one or more of the following:

- a condition assessment of structural remains,

- presence or absence of ground disturbance near subsurface historic and prehistoric sites, and
- photos taken from established photo points (if applicable).

Monitoring Frequency

Annual.

Background and Driver(s)

It is an inevitability of hiking and camping that a good place to walk or camp has been used by people in the historic (and possibly prehistoric) past. Previous monitoring has shown that campers often choose campsite locations in the vicinity of historic archaeological sites (e.g., cellar holes, mills, barns, and lumber camps), and have occasionally disturbed historic sites by such activities as building fire rings with stones taken from historic foundations, collecting and rearranging or disposing of historic artifacts out of curiosity or an effort to "clean up" the site, or simply trampling and compacting archaeological deposits through use of the site. Most of these effects are inadvertent and a byproduct of recreation use. Ongoing efforts to raise general awareness of historic preservation issues with both Forest employees and the public in an educational format include training sessions, a volunteer site stewards program, outreach presentations, and signage. In situations where effects seem to be purposeful, law enforcement is notified.

Results

Routine monitoring of Priority Heritage Assets (PHAs) that also function as recreation sites across the WMNF indicates that historic structures and features continue to be subject to graffiti by the visiting public. Artifact disturbance was also frequently noted, with objects visible on the ground surface at or near recreation sites moved by visitors and relocated out of their historic context, damaging the integrity of the archaeological sites. Modern trash is also frequently dumped in or on historic features. In a few instances, small pits and disturbed soil indicated that unauthorized metal detecting for artifacts had occurred at archaeological sites.

Postimplementation monitoring of recreation projects, such as trail relocations, indicated that Heritage protection measures were appropriate and effective. Heritage staff monitoring during implementation is beneficial when proposed activities are in particularly sensitive areas.

Discussion

Actions taken in response to noted recreation concerns include increased signage informing visitors of the laws protecting historic and archaeological sites on Forest Service lands, targeted public education and outreach to inform visitors of the value and nonrenewable nature of these resources, and increased monitoring frequency for vulnerable sites. In some cases, law enforcement was notified of concerns to increase patrol of such areas.

Recommendations

Continue with routine site assessments, postimplementation monitoring, and public and internal education efforts to increase awareness and appreciation for cultural resources and applicable laws for their protection. Meet with District staff to discuss the Heritage Program's purpose and resource protection needs. There are many new employees on the Forest who are unfamiliar with National Historic Preservation Act requirements. Continue to coordinate with law enforcement to monitor vulnerable sites and develop a plan of action to follow when violations are noted.

References

Records maintained by the WMNF Heritage Program include WMNF cultural resources site forms, NRM Heritage database, WMNF Priority Heritage Assets records, and postimplementation heritage monitoring reports.

*5.9.2 – What effect do vegetation management activities have on cultural and historic sites?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

Impacts on prehistoric and historic cultural sites from vegetation management. Unacceptable damage attributable to vandalism, visitor use, or management practice based on one or more of the following:

- condition assessment of structural remains,
- presence or absence of ground disturbance near subsurface historic and prehistoric sites, and
- photos taken from established photo points (if applicable).

Monitoring Frequency

Annual.

Background and Driver(s)

Timber harvest includes use of heavy equipment and ground disturbance that has potential to damage subsurface archaeological deposits and destroy surface features such as stone building foundations. Road maintenance and/or construction needed to access timber harvest areas have potential to negatively impact cultural sites and features. The modern transportation system of forest roads and trails often overlays and overlaps with a transportation system that has been used for over 200 years, connecting long-abandoned historic community features. Modern logging equipment may require upgrades to these transportation systems. Disturbance from timber harvest activities may result in destruction of built features and buried artifacts, including loss of integrity to archaeological stratigraphy and cultural contexts, by mixing artifacts, materials, and soils originally deposited in layers over time. The mixing of these layers destroys evidence about the formation and use of an archaeological site, limiting its scientific and historical value. Prescribed burning has potential to damage or destroy artifacts and cultural features due to exposure to extreme heat, and the construction of fire lines to control and limit burned areas involves ground disturbance.

Projects are designed to avoid or minimize disturbance to historic sites, roadways, and associated features. A standard 50-foot buffer around archaeological sites is identified and documented by Heritage specialists during project planning, and monitoring is conducted to evaluate whether this buffer was effective in providing adequate archaeological site protection. In situations where 50-foot buffers are not possible because of pre-existing roads, skid trails, or log landings, or in other unique situations, site-specific protection measures are put in place. When all sites can be avoided, a project may be determined to have no effect on historic properties.

Results

Archaeological sites located in recently harvested timber units and burned prescribed fire units were visited and condition assessments were conducted to assess if implementation recommendations were followed and if they were effective. Issues were noted in cases where trees flagged in the field to establish buffers were harvested, making the site protection area less visible, or where site data was not fully or accurately recorded. In recent years, Heritage specialists have adopted new technology to record site boundary spatial data more accurately during project planning. In one of the projects monitored, heritage surveys were conducted 8 years prior to timber sale implementation and flagging was no longer visible at several sites. Many of the people working on the sale units were in different positions by the time the harvest started, so the person administering the sale was not aware of cultural resources present in the sale units. Effective communication helps ensure spatial data is available to operators in the field during implementation. For another monitored project, WMNF heritage staff coordinated with Timber Sale Administrators when monitoring indicated site boundaries had been breached by timber operators. Appropriate actions were taken to notify the contractor, and the responsible employee was dismissed. In another case, prescribed fire was allowed to burn through two sites that were documented and flagged for avoidance. Heritage staff met with fire staff and leadership to review what happened and make recommendations for future projects to prevent this from happening again. Impacts on cultural resources in both cases were documented by heritage staff, and while the potential for damage was significant, due to the nature of the sites and the level of disturbance in these particular situations, impacts were determined to be minor.

Discussion

Archaeological sites are not always obvious on the ground surface, and accurate spatial data and awareness of site protection measures by staff during project implementation is critical to ensure protection. Current protection measures appear to be largely effective in protecting archaeological sites when appropriately implemented, and enhanced technology is increasingly used to help identify sites and accurately document site boundaries. Communication between Heritage and the program leading implementation is critical for site protection. Continued monitoring helps to identify where communication needs exist and identify which site-specific measures are most effective. During prescribed burns near cultural sites and in situations where 50-foot buffer areas are not possible or site-specific protection measures are put in place, heritage staff should be on site during implementation to monitor the execution of protective measures.

Recommendations

Continue with routine site assessments, postimplementation monitoring, and public and internal education efforts to increase awareness and appreciation for cultural resources and applicable laws for their protection. Meet with District staff to discuss the Heritage Program's purpose and resource protection needs. There are many new employees on the Forest who are unfamiliar with National Historic Preservation Act requirements. Cultural resources recorded years ago may only have point data, and it is more helpful for timber and fire staff to have polygons to ensure accurate protection areas are maintained. It is important for heritage, timber, and fire staff to work together and it is recommended that timber staff reference GIS data for newer sales and check with heritage staff on older sales before harvesting begins to make sure there is accurate information about cultural resource locations.

References

Records maintained by the WMNF Heritage Program include WMNF cultural resources site forms, NRM Heritage database, WMNF Priority Heritage Assets records, and postimplementation heritage monitoring reports.

5.10 – Minerals

A goal of the Forest Plan is to contribute toward satisfying demand for hobby-collecting minerals through environmentally sound mineral site development (p. 1-6). This monitoring questions pertains to whether hobby collectors are adhering to recreational rock and mineral collecting standards and guidelines on the Forest (pp. 2.5–2.6) and determine whether actions are needed to protect mineral sites.

*5.10.1 – Are mineral collectors adhering to Forest Plan standards and guidelines?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

This report of geology and mineral activities on the forest includes the number of permits sold at Deer Hill, Lord Hill, and Moat Mountain and other permit information as available; inventory and site reports; GIS data; pictures; and other items.

Monitoring Frequency

Annual.

Background and Driver(s)

The purpose of this monitoring question is to determine whether established sites are being maintained to safety and resource protection standards with a focus on fee sites. This monitoring helps managers determine if additional actions are needed to protect the sites.

Another purpose of this monitoring is to determine the extent of excavation, the extent of damage to other resources, and the creation of new mineral collection sites. This monitoring helps managers determine if additional actions are needed to designate new sites, implement closure orders, or take other actions.

Results

The permit system for mineral collecting and gold panning was established in 2020. The number of permits issued is shown in Table 10 through Table 13. Permits for mineral collecting are daily permits, and permits for gold panning are annual permits. Permits for mineral collecting are specific to a designated mineral collecting area (Moat Mountain, Deer Hill, and Lord Hill), while gold panning permits are general on forest. Mineral collecting and gold panning are increasing in popularity on the WMNF. With popularity comes the increased likelihood of rule-breaking. Table 14 through Table 17 show citations and warnings issued for noncompliance with permit terms and conditions. In 2023 and 2024, there were few instances of noncompliance and no citations issued.

Within designated areas, there have been instances of resource damage beyond expectations as seen in Table 18 and Table 19. These issues are occurring at the Moat Mountain site and the Deer Hill site. Undermining of trees and damage to tree roots is a continuing issue, as well as holes being dug around large boulders and on steep slopes causing excessive soil disturbance. Because of the high use at these sites, new instances of resource damage are likely to continue.

Resource damage due to mineral collection activities outside of designated areas is documented in Table 19 and Table 21. At the Moat Mountain site, six new holes were dug along the Mineral Site trail, three new holes were dug beyond the boundary, and holes were dug and rocks were broken with a rock hammer in the brook that crosses the Mineral Site trail. At the Deer Hill site, 22 holes were dug outside of the designated area.

Restoration of sites with excessive resource damage occurred in 2023 and 2024 (Table 22 and Table 23). In 2023 and 2024, holes dug under trees were filled in at the Moat Mountain and Deer Hill sites. There have also been instances of resource damage outside of a designated mineral collecting site, where people have moved some of the brush at the site to make it easier to scramble up the slope to the closed mineral site. WMNF staff re-brushed the slope and removed rocks from the trail.

Overall, permit compliance has been acceptable and most mineral collectors are respecting the terms and conditions described by the permit. However, there continues to be instances of excessive resource damage both within and outside of designated mineral collecting areas.

Table 10. Number of mineral collecting permits issued on the WMNF in 2023.

Permit/activity type	Locations on Forest that can issue permits for	Number of permits issued
Mineral collecting	Moat Mountain Mineral Site	2,327
Mineral collecting	Deer Hill Trailhead and Mineral Site	1,009
Mineral collecting	Lord Hill Mineral Site	152
Mineral collecting	Total across the Forest	3,488

Table 11. Number of gold panning permits issued on the WMNF in 2023.

Permit/activity type	Locations on Forest that can issue permits for activity	Number of permits issued
Gold panning	Saco Ranger District Office	170
Gold panning	Forest Headquarters Office	191
Gold panning	Androscoggin Ranger District Office	41
Gold panning	In the field	3
Gold panning	White Mountain Visitor Center (Lincoln)	70
Gold panning	Lincoln Woods	1
Gold panning	Total across the Forest	476

Table 12. Number of mineral collecting permits issued on the WMNF in 2024.

Permit/activity type	Locations on Forest that can issue permits for activity	Number of permits issued
Mineral collecting	Moat Mountain Mineral Site	1,990
Mineral collecting	Deer Hill Trailhead and Mineral Site	919
Mineral collecting	Lord Hill Mineral Site	169
Mineral collecting	Total across the Forest	3,078

Table 13. Number of gold panning permits issues on the WMNF in 2024.

Permit/Activity Type	Locations on Forest that can Issue Permits for Activity	Number of Permits Issued
Gold panning	Saco Ranger District Office	219
Gold panning	Forest Headquarters Office	229
Gold panning	Androscoggin Ranger District Office	62
Gold panning	In the field	2
Gold panning	White Mountain Visitor Center (Lincoln)	112
Gold panning	Lincoln Woods	0
Gold panning	Total across the Forest	625

Table 14. Mineral collection citations and warnings issued in 2023.

Permit/activity type	Year	Reason	Number of citations	Number of warnings
Mineral collecting	2023	No permit	0	8
Mineral collecting	2023	Permit tab issue	0	0
Mineral collecting	2023	Exceed 20 permits	0	0
Mineral collecting	2023	Non-personal use	0	2
Mineral collecting	2023	Exceed collection limit	0	0
Mineral collecting	2023	Tools violation	0	1
Mineral collecting	2023	Outside designated site	0	0
Mineral collecting	2023	Surface disturbance conditions	0	0
Mineral collecting	2023	Total	0	11

Table 15. Mineral collection citations and warnings issued in 2024.

Permit/activity type	Year	Reason	Number of citations	Number of warnings
Mineral collecting	2024	No permit	0	6
Mineral collecting	2024	Permit tab issue	0	4
Mineral collecting	2024	Exceed 20 permits	0	0
Mineral collecting	2024	Non-personal use	0	0
Mineral collecting	2024	Exceed collection limit	0	0
Mineral collecting	2024	Tools violation	0	1
Mineral collecting	2024	Outside designated site	0	0
Mineral collecting	2024	Surface disturbance conditions	0	0
Mineral collecting	2024	Total	0	11

Table 16. Gold panning citations and warnings issued in 2023.

Permit/activity type	Year	Reason	Number of citations	Number of warnings
Gold panning	2023	No permit	0	3
Gold panning	2023	Non-personal use	0	0
Gold panning	2023	Tools violation	0	2
Gold panning	2023	Surface disturbance conditions	0	0
Gold panning	2023	Total	0	5

Table 17. Gold Panning citations and warnings issued in 2024.

Permit/activity type	Year	Reason	Number of citations	Number of warnings
Gold Panning	2024	No permit	0	0
Gold Panning	2024	Non-personal use	0	0
Gold Panning	2024	Tools Violation	0	1
Gold Panning	2024	Surface Disturbance conditions	0	1
Gold Panning	2024	Total	0	2

Table 18. Occurrences of new resource damage in excess of expectations within designated areas in 2023.

Permit/activity type	Site location	Vegetation damage	Erosion/ sedimentation	Excessive soil disturbance	Trash, waste, and contamination	Total area impacted (square feet)	Areas closed due to damage (square feet)
Mineral collecting	Moat	Present	Not present	Present	Not present	10,890	0
Mineral collecting	Deer Hill	Not present	Not present	Not present	Not present	0	0
Mineral collecting	Lord Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Moat	Not present	Not present	Not present	Not present	0	0
Gold panning	Deer Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Lord Hill	Not present	Not present	Not present	Not present	0	0

Table 19. Occurrences of new resource damage in excess of expectations within designated areas in 2024.

Permit/activity type	Site location	Vegetation damage	Erosion/ sedimentation	Excessive soil disturbance	Trash, waste, and contamination	Total area impacted (square feet)	Areas closed due to damage (square feet)
Mineral collecting	Moat	Present	Not present	Present	Not present	400	0
Mineral collecting	Deer Hill	Not present	Not present	Present	Not present	600	0
Mineral collecting	Lord Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Moat	Not present	Not present	Not present	Not present	0	0
Gold panning	Deer Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Lord Hill	Not present	Not present	Not present	Not present	0	0

Table 20. Occurrences of new resource damage outside of designated areas in 2023.

Permit/activity type	Site location	Vegetation damage	Erosion/ sedimentation	Excessive soil disturbance	Trash, waste, and contamination	Total area impacted (square feet)	Areas closed due to damage (square feet)
Mineral collecting	Moat	Present	Not present	Not present	Not present	Area was not measured. Only observed.	Total area was not measured. Only observed.
Mineral collecting	Deer Hill	Present	Not present	Not present	Not present	Area was not measured. Only observed.	Total area was not measured. Only observed.
Mineral collecting	Lord Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Moat	Not present	Not present	Not present	Not present	0	0
Gold panning	Deer Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Lord Hill	Not present	Not present	Not present	Not present	0	0

Table 21. Occurrences of new resource damage outside of designated areas in 2024.

Permit/activity type	Site location	Vegetation damage	Erosion/ sedimentation	Excessive soil disturbance	Trash, waste, and contamination	Total area impacted (square feet)	Areas closed due to damage (square feet)
Mineral collecting	Moat	Not present	Not present	Present	Not present	200	0
Mineral collecting	Deer Hill	Not present	Not present	Present	Not present	800	0
Mineral collecting	Lord Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Moat	Not present	Not present	Not present	Not present	0	0
Gold panning	Deer Hill	Not present	Not present	Not present	Not present	0	0
Gold panning	Lord Hill	Not present	Not present	Not present	Not present	0	0

Table 22. Restoration or improvement of conditions from past damage in 2023.

Permit/activity type	Site location	Total area restored or improved (square feet)
Mineral collecting	Moat	0
Mineral collecting	Deer Hill	8,712
Mineral collecting	Lord Hill	0
Gold panning	Moat	0
Gold panning	Deer Hill	0
Gold panning	Lord Hill	0

Table 23. Restoration or improvement of conditions from past damage in 2024.

Permit/activity type	Site location	Total area restored or improved (square feet)
Mineral collecting	Moat	200
Mineral collecting	Deer Hill	800
Mineral collecting	Lord Hill	0
Gold Panning	Moat	0
Gold Panning	Deer Hill	0
Gold Panning	Lord Hill	0

Discussion

The number of mineral collecting permits issued in 2023 and 2024 increased by 2,346 permits compared to 2021 and 2022. The number of gold panning permits issued in 2023 and 2024 increased by 90 permits. The Moat Mountain mineral collecting site continues to be the most popular. Most gold panning on the WMNF occurs in Wild Ammonoosuc River and Tunnel Brook.

On-the-ground presence of WMNF staff helps to ensure compliance. Gold panning has caused fewer documented instances of resource concerns, but less oversight and monitoring occur in the areas commonly used for gold panning. Increased monitoring and patrols of gold panning areas are recommended. With the increasing popularity of mineral collecting and the high use at mineral collecting sites, it is recommended to explore opportunities to add more mineral collecting areas to better distribute the use.

Recommendations

It is recommended to maintain or increase on-the-ground presence of Forest staff in mineral collecting areas.

References

Not applicable.

5.11 – Non-Native Invasive Species (NNIS)

The WMNF and the entire White Mountain region are fortunate that infestation levels of non-native invasive plants and animals are relatively low. Many species that are widespread throughout New England and the Northeast are not yet well established in the White Mountain region. The WMNF is undertaking prevention and control measures to minimize the impact of these introduced species on the landscape. These monitoring questions help to determine which species of invasive plants and insects occur on the Forest, which diseases are present and whether they are spreading, what proportion of the Forest is invaded by non-native invasive plants, and to what extent non-native invasive plants are being controlled.

5.11.1 – To what extent have been NNIS control objectives been attained?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator

- Area of infestation after treatment (area of coverage or number of stems, depending on species)

Monitoring Frequency

Annual.

Background and Driver(s)

Monitoring effectiveness of control efforts at known locations helps determine how effective NNIS eradication treatments are and guides future actions. Treatment sites are visited and monitored for effectiveness. Occurrences are measured and populations of NNIS are revisited after eradication treatment

to determine if size and/or condition of populations has declined. The frequency of visits to a given site depends on species, treatment, and other factors.

Results and Discussion

This monitoring question aims to evaluate the efficacy of invasive species treatments in working towards Forest Plan goals "to keep the WMNF as free of non-native invasive species as reasonably possible." The WMNF has been working to implement this goal using the Forest Wide Invasive Plant Control Strategy (USFS 2007) based on Integrated Pest Management (IPM) principles. IPM emphasizes a multi-pronged approach to preventing the introduction and spread of invasives. IPM goals include implementing preventative practices, fostering a weed-free ethic in Forest activities; utilizing varied control methods (manual, chemical, biological); conducting ongoing inventory and monitoring; and implementing early detection and rapid response (EDRR) for newly detected invasive species. Monitoring is a goal of IPM that assists Forest staff in assessing if current control techniques are achieving goals to prevent the spread and reduce invasive plant populations within WMNF to keep the Forest as weed-free as possible or if strategies need to be adjusted or re-evaluated based on past successes or challenges.

In this section, we present results from three primary indicators of control effectiveness. The first is based on control effectiveness of treatments on individual populations, and the second is a tally of the number of eradications observations on the Forest, and the third is an update on manual control of common dandelion infestations in the alpine zone on Mount Washington.

Effectiveness of Control Efforts on Individual Species Populations

Results are based on 415 monitoring observations of treatments on individual infestations (Figure 22 and Table 24). Table 24 shows the percent effectiveness of control efforts on 33 invasive species at 415 infestations on the WMNF, where effectiveness is the percentage of the population or colony that was successfully controlled (killed), based on a single treatment.

The average efficacy among the 415 observations was 82 percent. Among the 26 species for which we had two or more observations, 1 species had less than 65 percent effectiveness (phragmites), 11 had between 65 and 80 percent effectiveness, and 14 had more than 80 percent effectiveness. The common dandelion and garlic mustard were manually treated; wild chervil and bishop's goutweed were treated manually and with herbicide, and the remainder were treated with herbicide. For herbicide treatments, monitoring observations are conducted in the year following the treatment event, or sometimes later in the same year. Effectiveness is the percentage of the population or colony that was successfully controlled, based on single treatments (i.e., the percentage of individuals or percent cover of a population killed). In some manually controlled populations, weight (biomass) is a practical metric to track change in successive years (see Effectiveness of Common Dandelion Control Efforts on Mount Washington below).

Most treatments achieve less than 100 percent effectiveness because a single treatment of a well-established population (consisting of 10s, 100s, or 1000s of individuals) will miss some plants or not kill them completely. In addition, it is common for plants to resprout from underground roots if not killed or removed fully, or they can resprout from a long-lived seed bank in the soil (despite the death of individual aboveground plants), or become re-established from propagules spread by birds, flooding, or other means.

The species that have more than 80 percent effectiveness are those that respond the best to herbicide treatments, and include honeysuckles, barberry, burning bush, black locust, mugwort, tansy, knotweed, and glossy buckthorn. Species with less than 80 percent effectiveness after a single treatment included phragmites, Asian bittersweet, and various knapweeds.

One of the lessons from these results is that most invasive populations require multiple control events over

a period of years to either achieve full control, or to at least keep the population small, diminished, and/or with a reduced impact on the natural habitats they live in or threaten. Species that can become particularly entrenched include Japanese knotweed, glossy buckthorn, knapweeds, Asian bittersweet, and phragmites. These species can resprout from persistent underground roots, from a prolific or long-lived seed bank, or both.

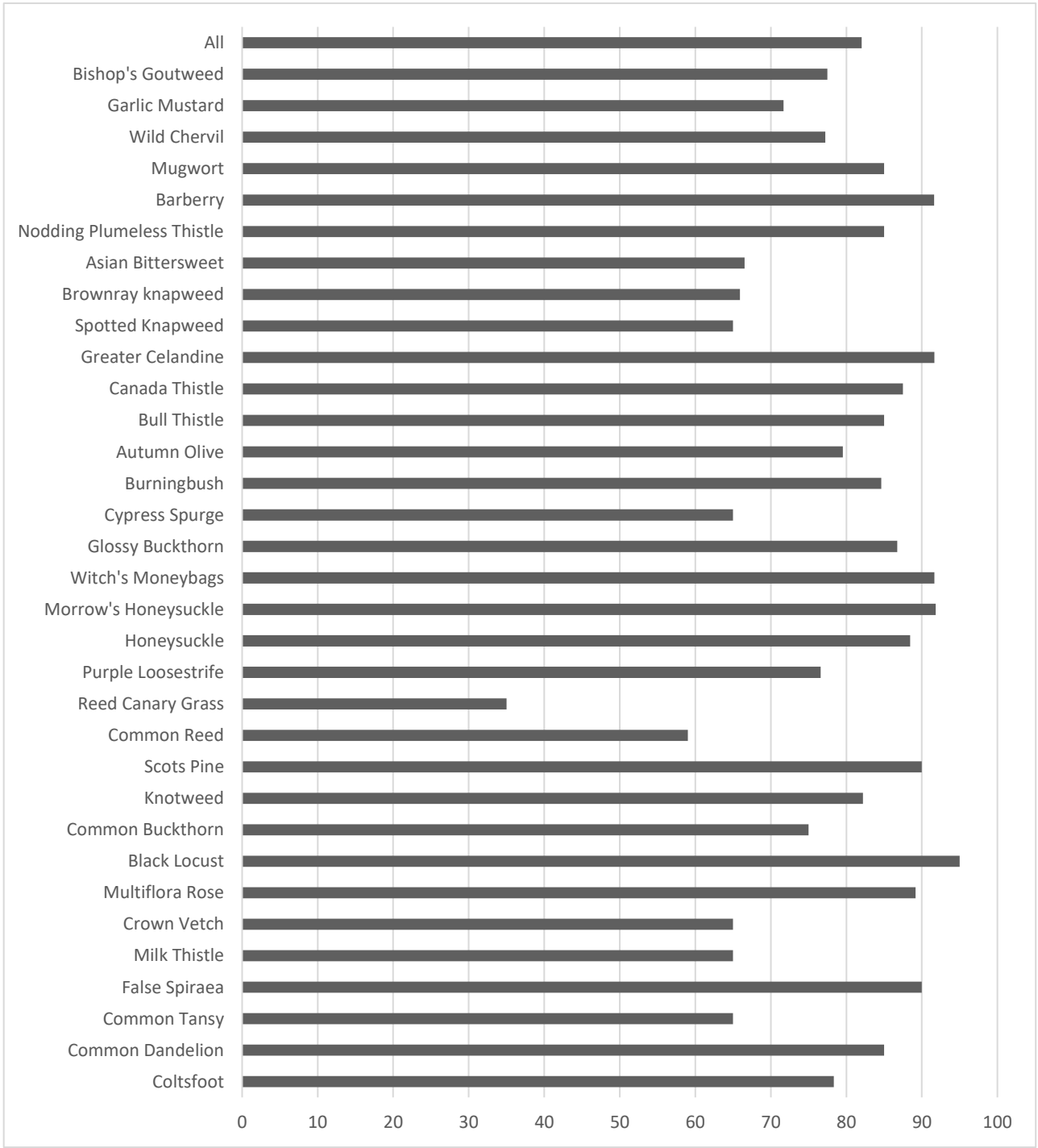

Figure 22. Average percent effectiveness of control efforts on 33 invasive species at 415 infestations on the WMNF.

Table 24. Percent effectiveness of control efforts on 33 invasive species at 415 infestations on the WMNF.

Species scientific name	Species common name	Number of infestations treated	Average efficacy (%)
Aegopodium podagraria	Bishop's goutweed	4	78
Alliaria petiolata	Garlic mustard	6	72
Anthriscus sylvestris	Wild chervil	18	77
Artemisia vulgaris	Mugwort	4	85
Berberis thunbergii	Barberry	43	92
Carduus nutans	Nodding plumeless thistle	1	85
Celastrus orbiculatus	Asian bittersweet	28	67
Centaurea jacea	Brownray knapweed	11	66
Centaurea stoebe ssp.	Spotted knapweed	4	65
Chelidonium majus	Greater celandine	3	92
Cirsium arvense	Canada thistle	3	88
Cirsium vulgare	Bull thistle	1	85
Elaeagnus umbellata	Autumn olive	11	80
Euonymus alatus	Burningbush	14	85
Euphorbia cyparissias	Cypress spurge	1	65
Frangula alnus	Glossy buckthorn	52	87
Hylotelephium telephium ssp. *telephium*	Witch's moneybags	3	92
Lonicera morrowii	Morrow's honeysuckle	19	92
Lonicera spp.	Honeysuckle	16	88
Lythrum salicaria	Purple loosestrife	28	77
Phalaris arundinacea	Reed canary grass	1	35
Phragmites australis var.	Common reed	5	59
Pinus sylvestris	Scots pine	2	90
Polygonum cuspidatum	Knotweed	76	82
Rhamnus cathartica	Common buckthorn	4	75
Robinia pseudoacacia	Black locust	12	95
Rosa multiflora	Multiflora rosa	12	89
Securigera varia	Crown vetch	1	65
Sonchus arvensis	Milk thistle	1	65
Sorbaria sorbifolia	False spiraea	2	90
Tanacetum vulgare	Common tansy	3	65
Taraxacum officinale	Common dandelion	1	85
Tussilago farfara	Coltsfoot	25	78

Species scientific name	Species common name	Number of infestations treated	Average efficacy (%)
All	**All**	**415**	**82**

Tally of Eradications of Invasive Species Populations

The number of observed eradications from 307 population locations were tallied between 2016 and 2022 (Table 25). Two sets of observations were from across the Forest (2016-2018 and 2020) and a third set of observations were from the Pemigewasset Ranger District in 2021, covering the western half of the WMNF. These were a combination of inventory and monitoring trips or visits for intended follow-up treatments. This set of sites includes small (less than 0.25 acres), medium, and large infestations (10s of acres). Overall, 80 of 307 infestations (26 percent) were documented as having non-native invasive species no longer present and presumed eradicated. In some cases, small infestations were eliminated by a single treatment, but in most cases the populations were treated more than once over a period of several years. This indicates that we are making measurable progress in controlling infestations and keeping the WMNF as free of invasive plants as reasonably possible, but that much work remains. For additional context, the 2018 monitoring report includes an analysis of the spread of invasives at a Forest-wide scale.

Table 25. Invasive plant eradication results from the WMNF from 2016 to 2021.

Sample period, location	Number of sites visited	Number present	Number eradicated	Eradicated (%)
2016–2018, Forest wide	195	151	44	23
2020, Forest wide	83	57	26	31
2021, Pemigewasset Ranger District	29	19	10	34
Total	**307**	**227**	**80**	**26**

Effectiveness of Common Dandelion Control Efforts on Mount Washington

Since 2015, the WMNF has led efforts to control common dandelions on Mount Washington with the help of key partners and volunteers. Dandelions occur in natural and disturbed areas in the alpine zone on the National Forest, State Park, Auto Road, and Cog Railway properties, and at AMC huts. The dandelions have been dug from natural meadows on the summit cone of Mount Washington, in and above Great Gulf, and around buildings and huts and along the Auto Road and Cog Railway. The bottom line is that we are seeing good results in areas where we have dug dandelions from the ground consistently (see example from "Snowbed Meadow #1" near Ball Crag in Figure 23). In addition to the great reduction in biomass, digging has dramatically reduced the number of dandelions, their percent cover, and has nearly eliminated flowering plants. The results indicate that we can achieve a more than 96 percent reduction in biomass after just 4 years of digging but achieving eradication may require more persistence or other strategies.

The results from a broader set of sites around the summit (Figure 24) indicate a substantial but less impressive reduction of dandelion biomass. This graph represents a large set of sites around the summit compared to Figure 23. These efforts also indicate significant progress towards controlling invasive dandelions but are somewhat less impressive than the Ball Crag meadows control work alone (Figure 23). It has been harder to maintain consistent and thorough digging at all sites across multiple ownerships throughout the 9-year period. This is because it has been difficult to maintain the same level of commitment and thoroughness of digging across a larger number of sites on multiple jurisdictions in the alpine zone with the combined efforts of WMNF staff and volunteer and partner contributions.

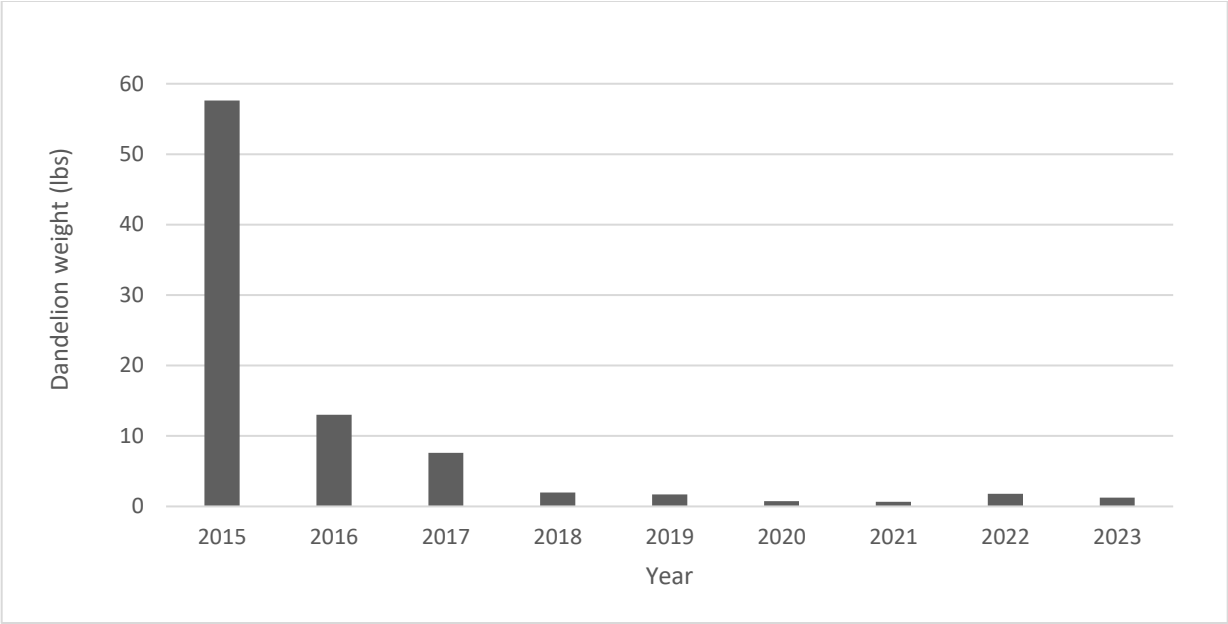

Figure 23. Weight of dandelions hand dug from "Snowbed Meadow #1" near Ball Crag, Mount Washington on the WMNF from 2015 to 2023.

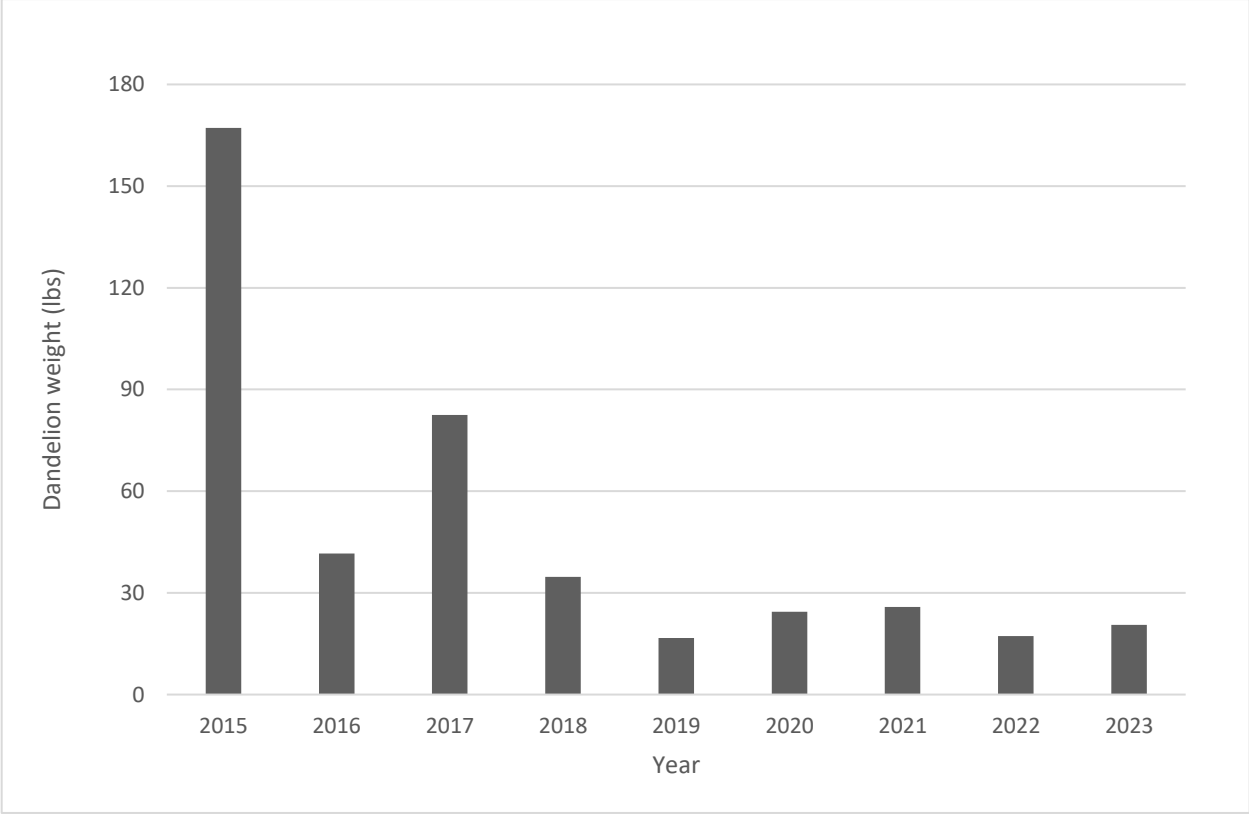

Figure 24. Weight of dandelions hand dug from Bell Crag Meadows, Bigelow Sedge Meadow, South Cones, and parking lots around the summit of Mount Washington on National Forest, State Park, and Auto Road properties.

Recommendations

The monitoring question and indicators are still relevant and applicable. The selective use of monitoring plots or other appropriate methods to track effectiveness and native vegetation recovery over longer time frames may complement the standard approaches. These techniques may yield insights on effectiveness of various techniques with different species as well as native vegetation response.

References

USDA Forest Service. 2007. Forest wide invasive plant control strategy. White Mountain National Forest, Campton, New Hampshire.

5.11.2 – Are invasive insects or diseases present on the WMNF? Where are the nearest infestations of these species?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

Record presence and absence of invasive insects and diseases on each Ranger District. If not present, update on a quarterly basis of the nearest known infestation of each species. If present, identify location with Global Positioning System (GPS) and map total acres affected.

Monitoring Frequency

Annual.

Background and Driver(s)

This monitoring tracks the movement and presence of several invasive pests that pose the greatest risk to forests of the WMNF. The insects that are monitored and/or tracked are Asian Long-horned beetle, emerald ash borer, hemlock woolly adelgid, and sirex wood wasp. The presence of sudden oak death, a disease caused by the invasive pathogen *Phytophthora ramorum*, is also monitored. Ocular ground surveys of host trees in campgrounds are conducted using binoculars. Canopy inspection of host trees are conducted by Northern Area Forest Health Protection (NA FHP) by climbing trees. Data collection and survey work are conducted in part by WMNF staff, contractors, and concessionaires while conducting hazard tree removal. Other data are collected via ground detection surveys in campgrounds and at high-use recreation areas by staff of WMNF and NA FHP.

Results and Discussion

This monitoring question is not being evaluated in this report. The question will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

This question will be considered for evaluation in the next biennial monitoring report.

5.11.3 – What portion of the Forest is infested with non-native, invasive plant species?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Number of new occurrences of infestations

Monitoring Frequency

Annual (ongoing inventory of some portion of the Forest each year, depending in part on budget and project locations).

Background and Driver(s)

The Forest Plan and Forest-Wide Invasive Plant Control Project (USDA Forest Service 2007) provide specific management direction and guidance for NNIS plant prevention, control, and eradication. Standards and guidelines for NNIS are listed in the Forest Plan from pages 2-11 to 2-12. This monitoring question relates to prevention of NNIS infestations on the Forest, toward the goal of remaining "as free of non-native invasive species as reasonably possible" (Forest Plan, p. 1-7). Trends in gauging infestation levels are accomplished by documenting which species occur where and the number of new infestations. Although the number of new occurrences provides a raw measure of infestation level, a better picture emerges by looking at the broader distributions of individual species on the Forest (i.e., Are species widespread or very limited in extent? Do they occur in interior areas?), and the extent to which EDRR is helping limit or eliminate new species arrivals to the Forest. Results below summarize changes in NNIS species' distribution on the Forest and EDRR efforts.

Monitoring Indicator 1

Distribution of invasive species.

Results

Approximately 300 individual patches of invasive species were mapped as of 2012 within the boundaries of the WMNF, and an additional 1,700 were documented from outside the boundaries in the immediate surrounding landscapes (valley bottoms and road corridors). Since 2012, WMNF staff have documented an additional 114 patches on the Forest. From 2016 to 2017, partners (e.g., New Hampshire Natural Heritage Bureau and Division of Forests and Lands) conducted additional widespread and detailed invasive species inventories. WMNF staff are in the process of remapping invasive species distribution and extent at a detailed scale based on new data on NNIS collected over the past 2 years. Until the new data are reconciled with the existing official database, it is difficult to calculate precisely how many new patches of NNIS there are as opposed to remapped extents of pre-existing populations.

A good gauge of the spread of NNIS over time into and across the Forest can be obtained by looking at coarser scale patterns. We compared the distribution of known and newly documented species on the Forest at the scale of HMUs in 2012 with that in 2017 (Table 26 and Table 27), including the existing official NNIS database and the new raw data. There are 60 HMUs on the Forest, averaging about 13,000 acres. At this scale, we can see the expansion of NNIS across the Forest, and additions of NNIS to the Forest since 2012.

Of the 38 species or genera that occur on the Forest, 25 occurred in five or fewer HMUs in 2017, indicating a low infestation level (8 percent of HMUs). Thirteen species are more widespread, with four (Japanese barberry, Japanese knotweed, glossy buckthorn, and Asiatic bittersweet) in 38 to 45 percent of HMUs (Table 26). Ten new species have been observed since 2012, but only two of 13 original "B"-list species expected to occur within 10 to 15 years have been documented (Table 26). Twenty-two species that are present on the WMNF were added to New Hampshire and Maine state prohibited and restricted lists in 2017 (Table 27).

Table 26. HMU distribution and status of non-native invasive plants on the WMNF, Part 1. Plants on original 2007 "A" and "B" lists and newly documented state prohibited or restricted species are marked with an "X". HMU 2012 indicates number of HMUs in which the species or genera was present as of 2012, and HMU 2017 is the number of new HMUs documented for the species or genera between 2013 and 2017. Administrative and legal status of each species is noted on columns: WMNF A-List (2007 species known or high potential for occurrence on WMNF and targeted for treatment); WMNF B-List (EDRR species with high potential to occur as of 2007; NH-P (prohibited for transport or sale, New Hampshire Department of Agriculture) and NH-R (restricted); and ME-P (prohibited). Genera are in bolded text.

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	Interior distribution	WMNF A-List	WMNF B-List	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
Autumn olive	*Elaeagnus umbellata*	4	4	8	No	X	-	X	-	X
Beach rose	*Rosa rugosa*	0	1	1	No	-	-	-	X	-
Bittersweet nightshade	*Solanum dulcamera*	0	1	1	No	X	-	-	-	-
Black locust	*Robinia pseudoacacia*	13	5	18	No	X	-	-	X	X
Swallow-worts	*Cynanchum spp.*	1	0	1	No	-	-	-	-	-
Black swallow-wort	*Cynanchum louiseae*	1	0	1	No	-	X	X	-	-
Pale swallow-wort	*Cynanchum rossicum*	0	0	0	-	-	X	X	-	-
Winged euonymus, Burning Bush	*Euonymus alatus*	4	0	4	No	X	-	X	-	X
Canada thistle	*Cirsium arvense*	0	1	1	No	X	-	-	X	-
Coltsfoot	*Tussilago farfara*			0	No	X	-	-	-	-
Common buckthorn	*Rhamnus cathartica*	2	1	3	No	X	-	X	-	-
Common dandelion - in alpine	*Taraxacum vulgare*	0	1	1	Occasional	-	-	-	-	-
Common reed	*Phragmites australis*	6	3	9	Occasional	X	-	-	-	-
Crown vetch	*Securiga varia*	0	1	1	No	-	-	-	X	-
Cypress spurge	*Euphorbia cyparissias*	1	3	4	Occasional	-	X	-	X	X
Dames rocket	*Hesperis matronalis*	0	0	0	-	-	X	X	-	X
European barberry, Common barberry	*Berberis vulgaris*	2	0	2	No	X	-	X	-	X
European black alder	*Alnus glutinosa*	0	1	1	No	-	-	X	-	-

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	Interior distribution	WMNF A-List	WMNF B-List	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
False spiraea	*Sorbaria sorbifolia*	2	0	2	No	-	-	-	-	-
Fig buttercup	*Ranunculus ficaria*	0	0	0	-	-	X	-	-	-
Garlic mustard	*Alliaria petiolata*	4	0	4	Occasional	X	-	X	-	X
Giant hogweed	*Heracleum mantegazzianum*	0	0	0	-	-	X	X	-	-
Glossy buckthorn	*Frangula alnus*	16	7	23	Occasional	X	-	X	-	X
Goutweed, Bishop's weed	*Aegopodium podagraria*	2	0	2	-	X	-	-	X	X
Honeysuckles	*Lonicera spp.*	17	1	18	No	X	-	-	-	-
Morrow's honeysuckle	*Lonicera morrowii*	16	1	17	-	-	-	X	-	X
Amur honeysuckle	*Lonicera maackii*	0	0	0	-	-	-	X	-	-
Amur honeysuckle, Bush honeysuckle	*Lonicera maackii*	0	0	0	-	-	-	-	-	X
Tartarian honeysuckle	*Lonicera tatarica*	1	0	1	-	-	-	X	-	X
Bella honeysuckle	*Lonicera × bella*	0	0	0	-	-	-	X	-	-
Japanese barberry	*Berberis thunbergii*	24	3	27	Occasional	X	-	X	-	X
Japanese knotweed	*Fallopia japonica*	19	5	24	No	X	-	X	-	X
Japanese stilt grass	*Microstegium vimineum*	0	0	0	-	-	X	X	-	X
Knapweeds and starthistles - all	***Centaurea spp.***	7	4	11	No	-	-	-	-	-
Black knapweed	*Centaurea nigra*	0	1	1	No	-	-	-	-	-
Brownray knapweed	*Centaurea jacea*	5	2	7	No	-	-	-	-	-
Spotted knapweed	*Centaurea stoebe* ssp. *micranthos*	2	1	3	No	-	-	X	-	-
Diffuse knapweed	*Centaurea diffusa*	0	0	0	-	X	-	-	X	-

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	Interior distribution	WMNF A-List	WMNF B-List	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
Yellow starthistle	*Centaurea solstitialis*	0	0	0	-	X	-	-	X	-
Leafy spurge	*Euphorbia esula*	0	0	0	-	-	X	-	X	-
Marsh thistle	*Cirsium palustre*	0	0	0	-	X	-	-	-	-
Mile-a-minute weed	*Persicaria perfoliata*	0	0	0	-	-	X	X	-	X
Moneywort	*Lysimachia nummularia*	0	0	0	-	X	-	X	-	-
Mugwort, Common mugwort	*Artemisia vulgaris*	0	1	1	No	-	-	-	X	X
Multiflora rose	*Rosa multiflora*	1	4	5	Occasional	X	-	X	-	X
Musk thistle	*Carduus nutans*	0	1	1	No	-	-	-	X	-
Narrow-leaved bittercress	*Cardamine impatiens*	0	0	0	-	-	X	-	-	-
Norway maple	*Acer platanoides*	3	0	3	No	X	-	X	-	X
Oriental bittersweet, Asiatic bittersweet	*Celastrus orbiculatus*	18	8	26	Occasional	X	-	X	-	X
Porcelain berry	*Ampelopsis glandulosa*	0	0	0	No	-	-	-	X	X
Privets	*Ligustrum spp.*	0	1	1	No	-	-	-	-	-
Blunt-leaved privet	*Ligustrum obtusifolium* var. *obtusifolium*	0	0	0	-	X	-	X	-	-
California privet	*Ligustrum ovalifolium*	0	0	0	-	X	-	-	-	-
Chinese privet	*Ligustrum sinense*	0	0	0	-	X	-	-	-	-
Common privet	*Ligustrum vulgare*	0	0	0	-	X	-	X	-	X
Purple loosestrife	*Lythroughm salicaria*	15	3	18	No	X	-	-	-	X
Reed canary grass	*Phalaris arundinacea*	7	9	16	No	X	-	-	X	-
Tree of heaven	*Ailanthus altissima*	0	0	0	-	-	X	X	-	X
True forget-me-not	*Myosotis scorpioides*	0	0	0	-	X	-	-	-	-

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	Interior distribution	WMNF A-List	WMNF B-List	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
Yellow iris; water flag	*Iris pseudacorus*	1	0	1	No	X	-	X	-	X
Wild chervil	*Anthriscus sylvestris*	0	0	0	-	-	X	-	X	-

Table 27. HMU distribution and status of non-native invasive plants on the WMNF, Part 2. Species present on the WMNF that were added to New Hampshire or Maine state prohibited and restricted lists in 2017 are marked with an "X".

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
Amur cork tree	*Phellodendron amurense*	0	0	0	-	-	X
Amur maple	*Acer ginnala*	0	0	0	-	-	X
Bicolor lespedeza	*Lespedeza bicolor*	0	0	0	-	X	-
Bohemia knotweed	*Reynoutria × bohemica*	0	0	0	X	-	-
Castor-aralia	*Kalopanax septemlobus*	0	0	0	-	X	-
Chinese bindweed	*Fallopia baldschuanica*	0	0	0	-	-	X
False indigo	*Amorpha fruticosa*	0	0	0	-	-	X
Giant knotweed	*Reynoutria sachalinensis*	0	0	0	X	-	-
Japanese honeysuckle	*Lonicera japonica*	0	0	0	X	-	X
Japanese hops	*Humulus japonicus*	0	0	0	-	X	-
Jimsonweed	*Datura stramonium*	0	0	0	-	X	-
Kudzu	*Pueraria montana var. lobata*	0	0	0	X	-	-
Ornamental jewelweed	*Impatiens glandulifera*	0	0	0	X	-	X
Paulownia	*Paulownia tomentosa*	0	0	0	-	-	X
Perennial pepperweed	*Lepidium latifolium*	0	0	0	X	-	-
Reed sweet grass	*Glyceria maxima*	0	0	0	X	-	-
Russian olive	*Elaeagnus angustifolia*	0	0	0	-	X	-
Siberian elm	*Ulmus pumila*	0	0	0	-	X	-
Wall lettuce	*Mycelis muralis*	0	0	0	-	X	-

Common name	Scientific name	Number of HMUs in 2012	Number of new HMUs in 2017	Total number of HMUs in 2017	New Hampshire prohibited	New Hampshire restricted	Maine prohibited
White poplar, White cottonwood	*Populus alba*	0	0	0	-	X	X
Wild parsnip	*Pastinaca sativa*	0	0	0	-	X	-
Wintercreeper	*Euonymus fortunei*	0	0	0	-	X	-

Discussion

Table 26 and Table 27 reflect some interesting and revealing patterns. First, many widespread NNIS continue to expand their extent within the Forest boundaries at the scale of HMUs (e.g., purple loosestrife, Asiatic bittersweet, reed canary grass, Japanese knotweed, Japanese barberry, glossy buckthorn, black locust, and knapweeds). Some of these likely represent new populations that were not present during original surveys of the Forest in the early 2000s. Others may be overlooked observations of pre-existing populations. However, it is likely the new observations do reflect some expansion of these species' ranges. In other cases (i.e., reed canary grass) the species are likely to have been widespread and established along roads and simply under documented, in part because of their lower priority as control targets. The distributional spread of many of the primary NNIS across the Forest noted above is not surprising: it reflects an expected and predicted pattern of expansion globally and regionally on the New England landscape, particularly given the network of managed corridors of roads and pressure of NNIS sources in the surrounding developed private landscapes. It should be noted that data in the table do not reflect control results at the HMU scale (some individual infestations have been eliminated); control efficacy is considered in monitoring question 5.11.1.

Second, with a few exceptions, the vast majority of NNIS populations occur along existing public road corridors, in maintained openings, and in certain wetland or stream corridors near roads or proximal to development. Most interior forested and naturally open locations of the Forest appear to remain largely free of NNIS, although there are exceptions.

Third, it is encouraging that roughly half of the known NNIS on the Forest are not widespread and have a low frequency (present in five or fewer HMUs). Further, at this time we have not seen invasions by EDRR species despite remaining vigilant to the presence of many EDRR species known from other places in northern New England.

Fourth, six new NNIS have been documented on the WMNF since 2012: black knapweed, beach rose, privet, European black alder, common dandelion (in alpine zone), Canada thistle, and bittersweet nightshade. Four of these have been discovered in the past 2 years and most have had initial control efforts when possible.

Fortunately, compared to many parts of central and southern New England, most of the new and existing NNIS populations on the WMNF are still relatively small and accessible, and most are presumed controllable with a continued commitment to the Forest Plan goals, objectives, and standards and the Forest-wide Non-native Invasive Plant Control Project. The control project calls for ongoing prioritization and responsiveness to new information on invasive species, including focus on EDRR to control new species and on infestations that are most threatening to high-value natural communities and other resources. In this respect, the inventory and tracking of infestations has been an important and effective means of evaluating the implementation of Forest Plan goals and objectives.

Monitoring Indicator 2

Early detection and rapid response efforts.

Results

Part of the prevention goals for limiting the number of species and infestations of NNIS on the Forest relies on the EDRR approach to detect and quickly control new invasive species in an area. This is critical because controlling invasive species when infestation levels are low and populations are small requires substantially less effort than controlling them when infestation levels are high and populations are large. Two examples of successful EDRR efforts are European black alder (*Alnus glutinosa*) along the Swift River and common dandelion (*Taraxacum officinale*) invasion of alpine meadows on Mount Washington.

European Black Alder invasion of Swift River Valley

European black alder was discovered along the Swift River below Lower Falls in 2014, apparently planted from misidentified nursery stock thought to be speckled alder. At the time of detection in 2014, it was not on state or regionally prohibited or restricted species lists or on EDRR lists, but it has exhibited very aggressive invasive ability in other parts of United States, and more recently, in Vermont and several other sites in New Hampshire. An appeal to the New Hampshire State Invasive Species Committee was made to add this species to the restricted species list, and control was initiated in 2015. The population is considered 90 percent controlled but will require several years of commitment to ensure that regrowth from sprouts and seeds continue to be controlled.

Common Dandelion Invasion of Alpine Meadows on Mount Washington

Common dandelion was first observed around the Summit House on Mount Washington in 1895. This raised no concern until 2014 when Allison Bell (member of a snowbed research team led by Bob Capers and Nancy Slack) discovered a large infestation in a natural meadow below Ball Crag on the WMNF. This was troubling, because dandelion infestations have been reported in other alpine and Arctic sites around the world, where it has become problematic. WMNF staff initiated a project to remove dandelions in 2015. The environmental analysis (USDA Forest Service 2015 and 2016) was complicated by the novelty of the situation, including (1) the sensitivity of the alpine environment and rare species involved, (2) the occurrence of dandelions in four management zones on the WMNF with five landowners, each with different management direction and permitting requirements and (3) coordination with other partners and groups. Manual dandelion removal was approved and initiated in 2015 by the WMNF on federal and state land, with digging and monitoring help from the Slack-Capers group (via Waterman Fund support), and other partners. In 2016 and 2017, New Hampshire Natural Heritage Bureau and Division of Parks organized additional volunteer crews, and the AMC removed dandelions at two huts. Dig crews involved dozens of volunteers, including students and other members of the public. Species composition and cover, number of dandelions, and dandelion biomass removal weights are monitored along two permanent transects in natural alpine meadows, and dandelion removal weights from all other locations are also recorded. From 2015 to 2017, dandelions were dug with hand weed diggers, totaling more than 150 person-days (Figure 25).

Results from monitoring transects (Sperduto et al. 2018), and dandelion weights elsewhere, indicate substantial progress in diminishing dandelion vigor and biomass over the 3-year period (Figure 26), with minimal change detected in the cover of native alpine species. Dandelions occur primarily (1) in lee positions of summit infrastructure features and along upper sections of the Auto Road on mineral soil, (2) on disturbed soils at two AMC huts near treeline, and (3) in four locations on organic soil in natural alpine communities, including herbaceous-shrub snowbank communities and Bigelow sedge meadows above Great Gulf, east of Ball Crag, and on the south-facing summit cone of Mount Washington. Numerous locations of rare plants have been discovered growing near or with dandelions, including *Saxifraga rivularis*, *Salix herbacea*, *Poa pratensis* ssp. *alpigena*, *Nabalus boottii*, and *Rhinanthus minor* ssp. *groenlandicus*. Dandelions occur within 100 feet of the Great Gulf Wilderness, and a few hundred feet from the Alpine Garden Research Natural Area (RNA). Results indicate that digging is an effective initial means of controlling dandelions in natural meadows, greatly reducing the vigor of plants emerging from root fragments in subsequent years. Results from 2018 are not graphed but totaled 1.98 pounds of dandelion.

Figure 25. Digging efforts in 2015, showing the mostly dug area in lower part of meadow, and yet un-dug area above.

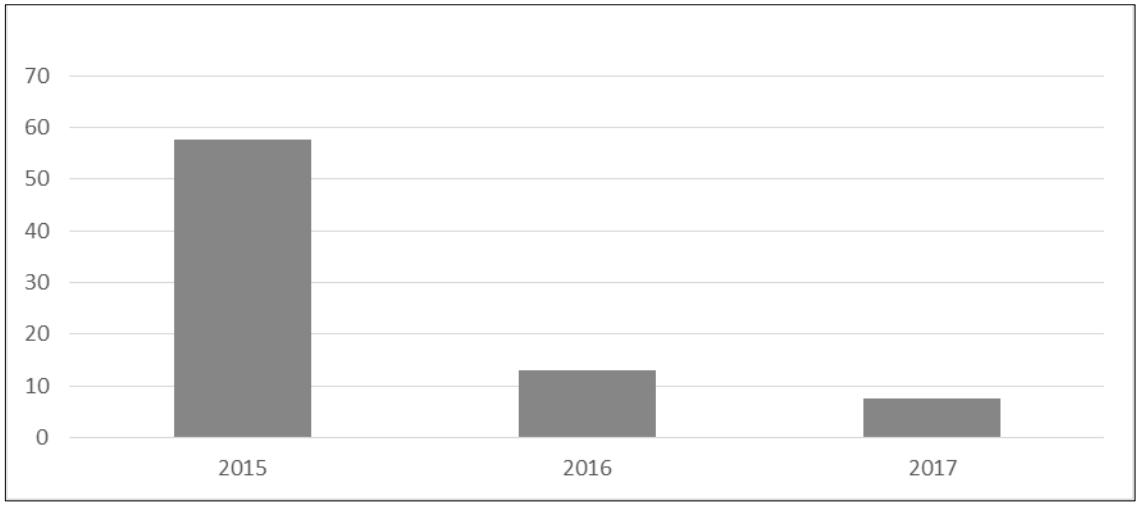

Figure 26. Gross weight in pounds of common dandelions dug from Snowbank Meadow (Transect #1) near Ball Crag in 2015, 2016, and 2016.

Discussion

The Forest Plan and Non-Native Invasive Plant Control Project inclusion and emphasis on the EDRR approach is effective. We rely on a network of WMNF staff and partners for detection of new species and infestations.

Table 26 and Table 27 indicate the status of known species and distribution on the Forest as of 2017. In the case of dandelions in the alpine zone, a network of several partners and landowners work in concert with one another to achieve the common goal of controlling dandelions that threaten certain parts of regionally rare and critical alpine areas. In both specific cases, we are confident that EDRR has been a critical aspect in

preventing additional spread of these invasive species. Neither species were on EDRR lists at the time, which underscores the importance of remaining observant of all species and invasive behavior more broadly. The dandelion invasion in natural snowbank communities may indicate a vulnerability of this habitat to not only dandelions, but possibly other wetland invasive species.

Recommendations

EDRR is an important part of any successful NNIS control strategy and will remain an important component of NNIS control strategy on the WMNF in the future.

Evaluation of Monitoring Question and Indicator(s)

The number of new occurrences is a useful metric, but other indicators should be considered to determine if there are better ways to address this monitoring question.

References

Sperduto, D., N. Slack, B. Capers, R. Johnson, and A. Lamb. 2018. Invasive common dandelion (*Taraxacum officinale*) removal effort on Mt. Washington, New Hampshire. Presentation to the 10th Biennial Alpine Stewardship Gathering. April 2018, Fairlee, Vermont.

USDA Forest Service. 2007 (updated 2017). White Mountain National Forest invasive plant control project environmental assessment. White Mountain National Forest, Campton, New Hampshire.

USDA Forest Service. 2015. Mount Washington dandelion removal project. Decision Memo. White Mountain National Forest, Gorham, New Hampshire.

USDA Forest Service. 2016. Invasive dandelion removal in the alpine zone. Decision Memo. White Mountain National Forest, Campton, New Hampshire.

5.12 – Recreation

The rugged mountains of the WMNF form a significant scenic and cultural landscape of New England. Whether viewing the forest via roads and trails or challenging themselves in the wilds of the backcountry, visitors find respite in the naturalness of the forest as nearby urban areas continue to grow. Cultural and recreational history are a key part of the recreation experience. The Forest maintains quality recreation opportunities while working closely with communities, partners, and private providers.

There are several different recreational experiences available on the WMNF. The area has an extensive non-motorized trail system which focuses on hiking, backpacking, snowshoeing, and skiing. Amenities such as shelters, camping areas, and huts are available for backcountry use. Campgrounds accessed by motor vehicles are open both seasonally and year-round across the Forest for tent and recreational vehicle camping. Six congressionally designated Wildernesses are managed for a natural, primitive experience. There are scenic byways that cross the Forest allowing for scenic drives with pull-offs for views and picnics and a number of developed day-use areas with short walks to waterfalls, swimming areas, and other beautiful natural features. Rock climbing and mountain biking are popular and still growing uses of the Forest. Alpine and Nordic skiing opportunities are provided by permittees. In addition, the Forest works with the states of New Hampshire and Maine to allow for a snowmobile trail system throughout the winter.

The WMNF provides a unique and important recreational opportunity and experience for visitors from around New England and beyond. The WMNF is classified as an urban forest, drawing in millions of visitors each year. It is within a day's drive of Boston, New York, and Montreal. As a national forest, its mandate is to manage for multiple uses including water quality, wildlife, timber, and recreation. While recreation is a

vital use of the forest it must be balanced with protecting its beautiful and valuable natural resources. The following monitoring questions report on off-road vehicle effects; the use at developed sites, trails, and by permittees; the quality of experience; and the perception of crowding among Forest visitors. They are monitored to assess how well that balance is being achieved.

5.12.1 – What is the effect of off-road vehicles when using snowmobile trails early or late in the winter use season on soil, water, vegetation, fish and wildlife, forest visitors, and cultural and historic resources?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Incidents of resource damage in the shoulder season by snowmobile use

Monitoring Frequency

Annual.

Background and Driver(s)

Monitoring of off-road vehicles is required in 36 CFR 212.57. The results help identify if there are problems in the shoulder seasons, when there is higher risk of resource damage than during other seasons, and help determine if management action is needed.

Results

There is no discernable trend in the number or location of incidents of resource damage due to off-road vehicle use from 2020 to 2022. While isolated and localized damage was observed on some trails during some years (mainly due to a thaw), significant damage was not recorded.

Discussion

Prior to 2011, monitoring of this indicator was not occurring on a systematic basis. Therefore, we cannot draw conclusions regarding the need for management action. Since then, a protocol was developed and a database created for tracking off-road vehicle monitoring. Implementation of the protocol started in 2012. To date, data collected at the District level show a low incidence of damage. Note that the last few seasons have had a late start due to lack of snow and an early end due to snow melting out. If this trend continues, we anticipate the occurrences of damage to increase.

Recommendations

By continuing to work with the states of New Hampshire and Maine on the opening and closing of the statewide systems, we can reduce the number of resource damage incidents noted. We need to continue to monitor trail use early and late in the season and during mid-winter thaws.

References

Not applicable.

5.12.2 – Where and how much backcountry use is attributed to permitted outfitter/guides?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Number of outfitter and guide permits
- Number of people using outfitters and guides
- Outfitter and guide use of recreation sites
- Outfitter and guide use of trails
- Organizations making use of outfitter and guide permits
- Activities being accomplished with outfitters and guides
- Location of outfitter and guide activity on the Forest

Monitoring Frequency

Annual.

Background and Driver

This monitoring helps identify trends and locations of use by outfitters and guides. The information will be helpful should the need arise to control use to protect resources.

Monitoring Indicator 1

Number of outfitter and guide permits and number of people using outfitters and guides.

Results and Discussion

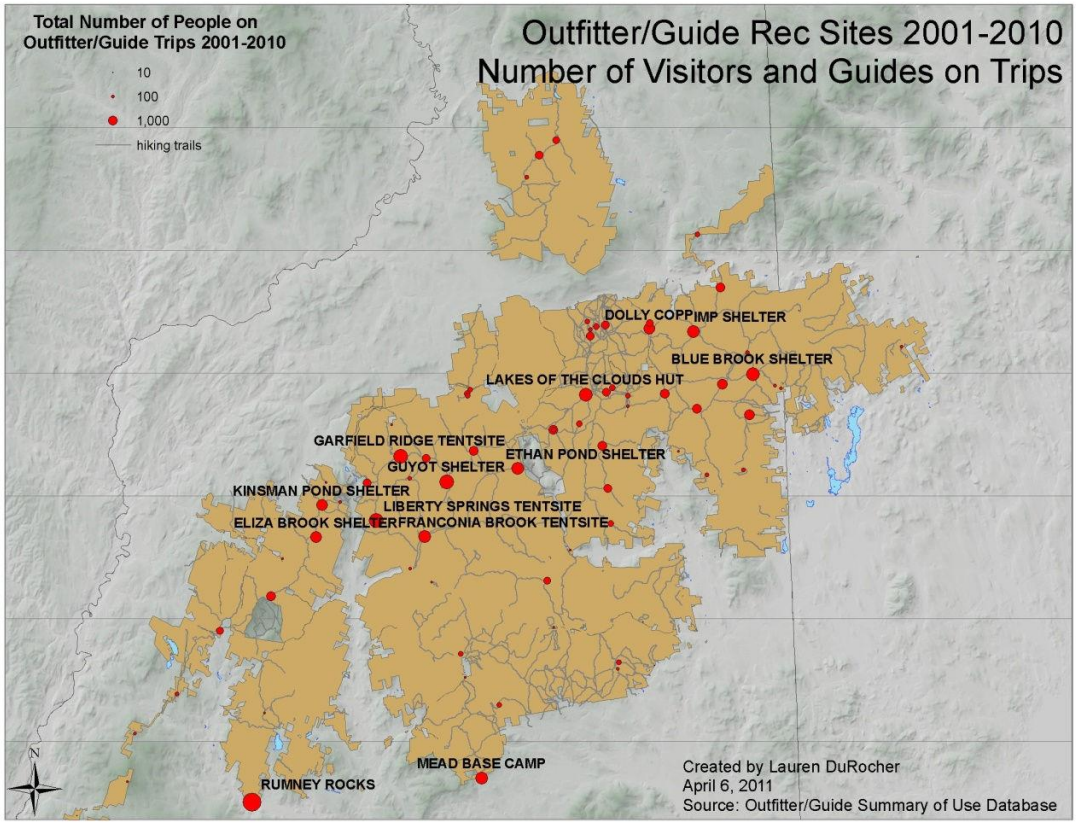

Figure 27. Total number of people on outfitter and guide trips reported by destination from 2001 to 2010.

The monitoring question assesses where and how much backcountry use is attributed to outfitter and guide use. All outfitters and guides who charge visitors a fee for a service they provide on the Forest are required to obtain a special use permit. As part of the permit outfitters and guides submit an annual summary of when and where their trips took place. This information includes the type of activity, trails visited, and overnight sites visited. The information is entered into a database that has this information going back to 2001. There are currently over 150 outfitters and guides operating with permits on the WMNF. The number of outfitters and guides operating on the WMNF has stayed between 150 and 165 permit holders in the past decade.

While examining this data, it is important to remember that this data is only outfitter and guide use. The WMNF does not have data that show where and how much general recreation use is being contributed by the general public. An area could be an area of high use by outfitters and guides but might not necessarily receive high use by the general public.

Monitoring Indicator 2

Outfitter and guide use of recreation sites.

Results and Discussion

On the summary of use forms, outfitters and guides report which recreation sites, particularly overnight camping spots, they visited. Using this information, the total number of people (clients and leaders) on trips from 2001 to 2010 was summed by recreation sites. Figure 27 shows proportional use of recreation sites during this period. The sites with the most use are labeled on the map. Generally, the sites listed are known

to be popular areas on the Forest. Annually there are between 120,000 and 200,000 people visiting recreation sites on outfitter and guide trips. Blue Brook shelter no longer exists and is currently a platform tent area, which could change the amount of outfitter and guide use in the future. Another area that stands out is the rock-climbing area Rumney Rocks. It receives by far the most use by outfitter and guide groups of any recreation site. Due to this fact, Rumney Rocks was part of the use and experience study (see monitoring guide question 5.12.3).

Monitoring Indicator 3

Outfitter and guide use of trails.

Results and Discussion

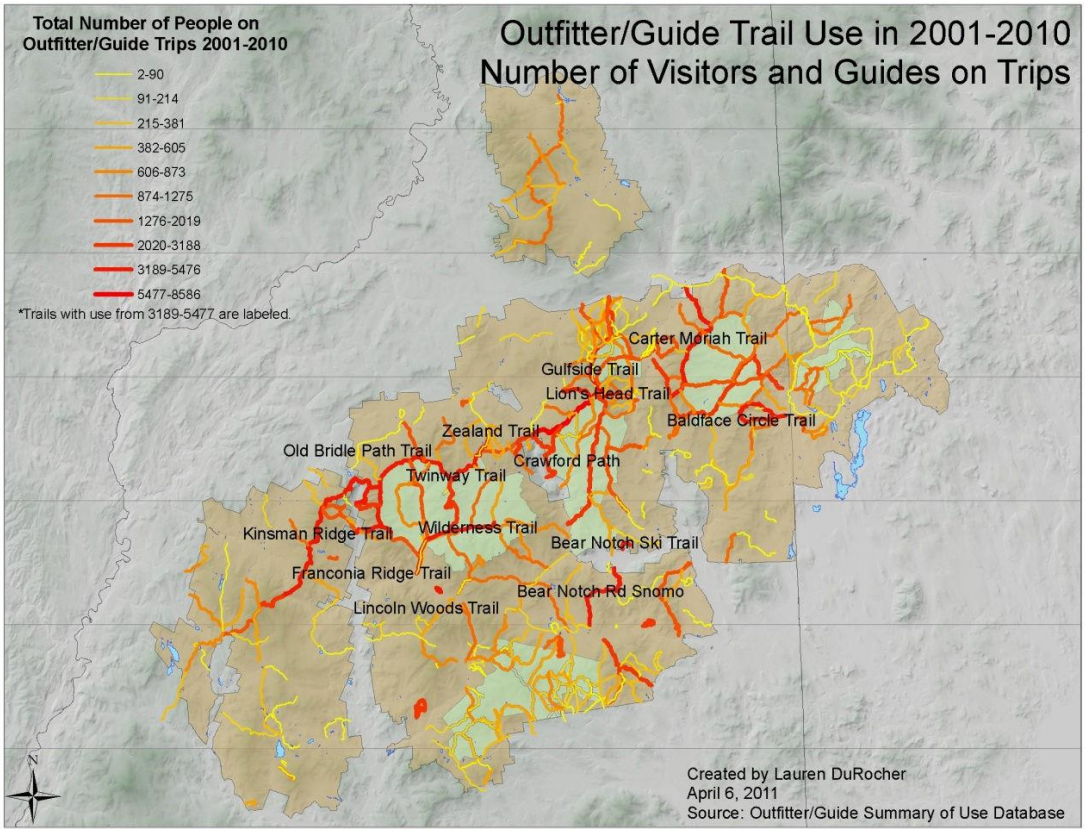

Figure 28. Total number of people on outfitter and guide trips reported by trail used from 2001 to 2010.

Trails that are used during outfitter and guide trips are also reported on the summary of use forms. This includes all types of trail use, including hiking, mountaineering, cross-country skiing, and snowmobiling. Each year approximately 200,000 to 300,000 people are on outfitter and guide trips that include using the trail system.

Using the information provided, the total number of people (clients and leaders) on trips from 2001 to 2010 was summed by trail. The amount of use was divided into 10 classifications for analysis based on natural breaks of the data (Figure 28). The trails with the most use are labeled in Figure 28. The trails listed are once again not particularly surprising and are generally recognized as high use trails on the Forest. There are a few discrepancies with the trail use level designations. From looking at past reports and talking with Forest recreation staff, these trail level designations were determined in the late 1990s from District knowledge of

the trails. It appears from both the trail register data and the outfitter and guide data that some of the initial classification is not an accurate reflection of actual use.

Recommendations

Particular trails that should be re-examined based on the outfitter data include Kinsman Ridge Trail (currently listed as low use), Bondcliff Trail, and Wilderness Trail. Districts should work to continue data collection to help inform future decisions.

Evaluation of Monitoring Question and Indicator(s)

The process of inputting all the summary of use information is a time-consuming task. As a result, there is a backlog of forms needing to be input into the database. In the winter of 2011, a seasonal employee was able to address past data, the results of which are presented here. The Forest needs to develop a new strategy for keeping this data up-to-date and in a usable form. The exercise of looking at the summary of use data should be repeated every 3 to 5 years to ascertain any trends.

References

DuRocher, L. 2011. Visitor use and wilderness trends at the White Mountain National Forest.

5.12.3 – What is the rock-climbing use on the Forest?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Level or use of trails accessing rock-climbing areas and parking lot occupancy and capacity

Monitoring Frequency

Every 3–5 years.

Background and Driver(s)

This monitoring question exists in order quantify rock-climbing use on the Forest.

Monitoring Indicator 1

Level of use on trails accessing rock-climbing areas.

Results

Figure 29 and Figure 30 show the trail counter results from data collected at Rumney Rocks during summer 2015 (University of Vermont, Park Studies Laboratory 2015).

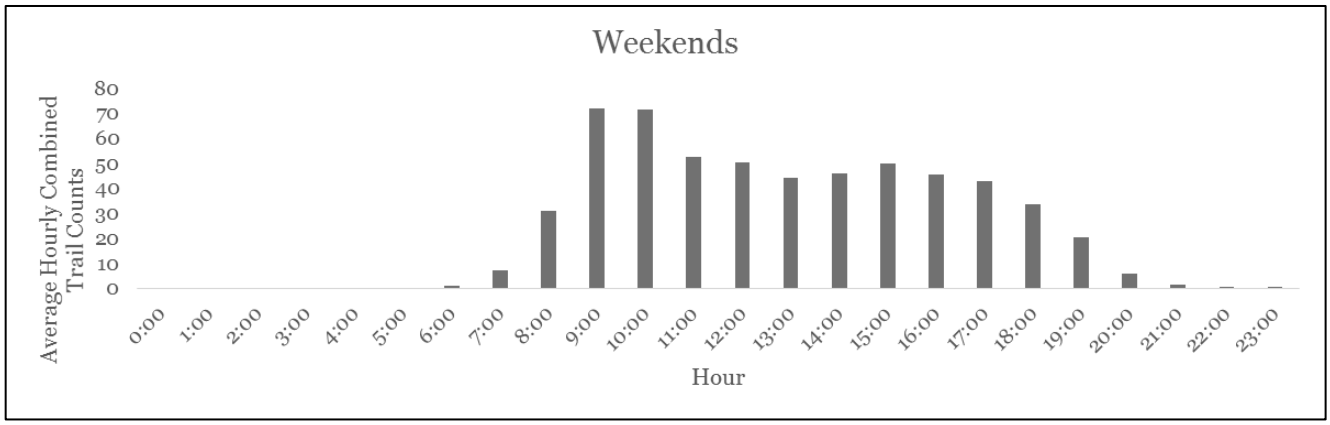

Figure 29. Average hourly use counts on weekends during summer 2015.

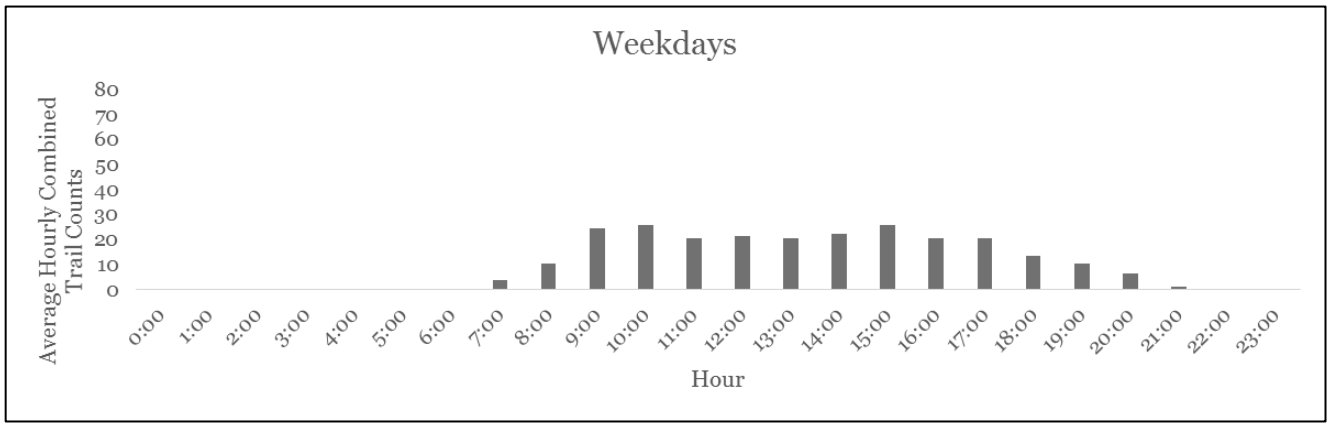

Figure 30. Average hourly use counts on weekdays during summer 2015.

Discussion

The dataset for climbing use only applies to Rumney Rocks, for 82 days, during the summer of 2015. It is, therefore, not a complete picture of rock-climbing use on the Forest. It is safe to say that Rumney Rocks is by far the most popular climbing area, in all seasons, located within the WMNF boundaries. However, no attempts were made to quantify use at other climbing areas around the Forest.

Monitoring Indicator 2

Parking lot occupancy and capacity at Rumney Rocks during summer 2015.

Results

Table 28. Parking lot occupancy and capacity at Rumney Rocks at 15:00 during summer 2015. The design capacity is 76 vehicles.

Occupancy and capacity measurement	Value
Total number of days	82
Average estimated parking occupancy	69
Median estimated parking occupancy	70
75th percentile estimated parking occupancy	96
90th percentile estimated parking occupancy	111
Number of days in excess of capacity	34
Percent of days in excess of capacity	41
Average number of excess vehicles when capacity is exceeded	100
Average percent of capacity when capacity is exceeded	131

Discussion

As with the trail use data presented above, the trailhead parking lot data displayed in Table 28 was collected for an 82-day period during the summer of 2015. It is, therefore, not a complete picture of the rock-climbing use on the Forest.

Recommendations

No recommendations can be made from the current dataset. Additional data on climbing use are needed.

Evaluation of Monitoring Question and Indicators

This indicator has not been fully implemented as of 2017. It may be worth narrowing the scope of the monitoring question to Rumney Rocks and repeating the use counts with the counters in the same locations as used during the previous survey.

References

University of Vermont, Park Studies Laboratory. 2015. Unpublished draft: Summary of field research and preliminary results.

5.12.4 – How is the amount of use at Forest developed campgrounds, day use areas, developed facilities, and ski areas changing over time?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Use data from concessionaires, day use areas, and ski areas

Monitoring Frequency

Annual.

Background and Driver(s)

Occupancy rates in developed campgrounds and use levels at day use and ski areas can help show a demand for additional or fewer facilities. Results can be used to help determine where management approaches need to be changed or where capacity needs to be adjusted. The developed campground information can help in discussing changes with concessionaires.

Results

Through 2011, use data showed a downward trend in camping and skiing. Data has not been analyzed since 2011. Ski areas are reporting an increase in both winter and summer use, and the campground concessionaire is seeing a slight increase in occupancy at certain campgrounds around the Forest.

Discussion

This section will be considered in the future.

Recommendations

Continue to collect data and update the 2011 analysis with current year's data.

Evaluation of Monitoring Question and Indicator

Evaluation of this monitoring question using the prescribed indicators continues to provide important information relevant to Forest management and implementation of the Forest Plan.

References

DuRocher, L. 2011. Visitor use and wilderness trends at the White Mountain National Forest.

5.12.5 – Over time is there a change in use at permitted Forest backcountry facilities?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Visitor overnight use

Monitoring Frequency

Annual.

Background and Driver(s)

This monitoring provides an idea of use trends in the backcountry. When combined with other backcountry trail monitoring, it can help inform managers about the type of use occurring and if changes in the amount of use indicate a need to change management in order to meet the recreation strategy of protecting recreation opportunities in low use areas.

Monitoring Indicator 1

Overnight use of AMC huts from 2018 to 2022.

Results

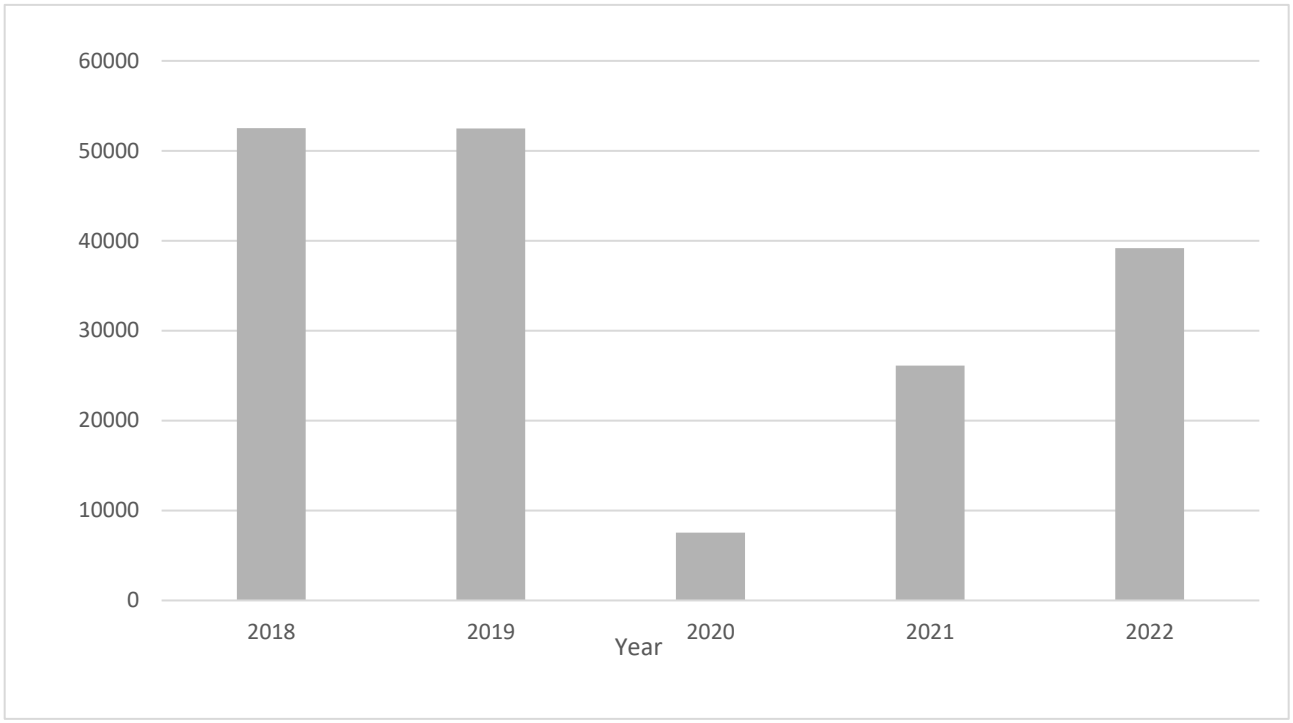

Figure 31. Reported overnight use (total number of nights) at AMC huts from 2018 to 2022.

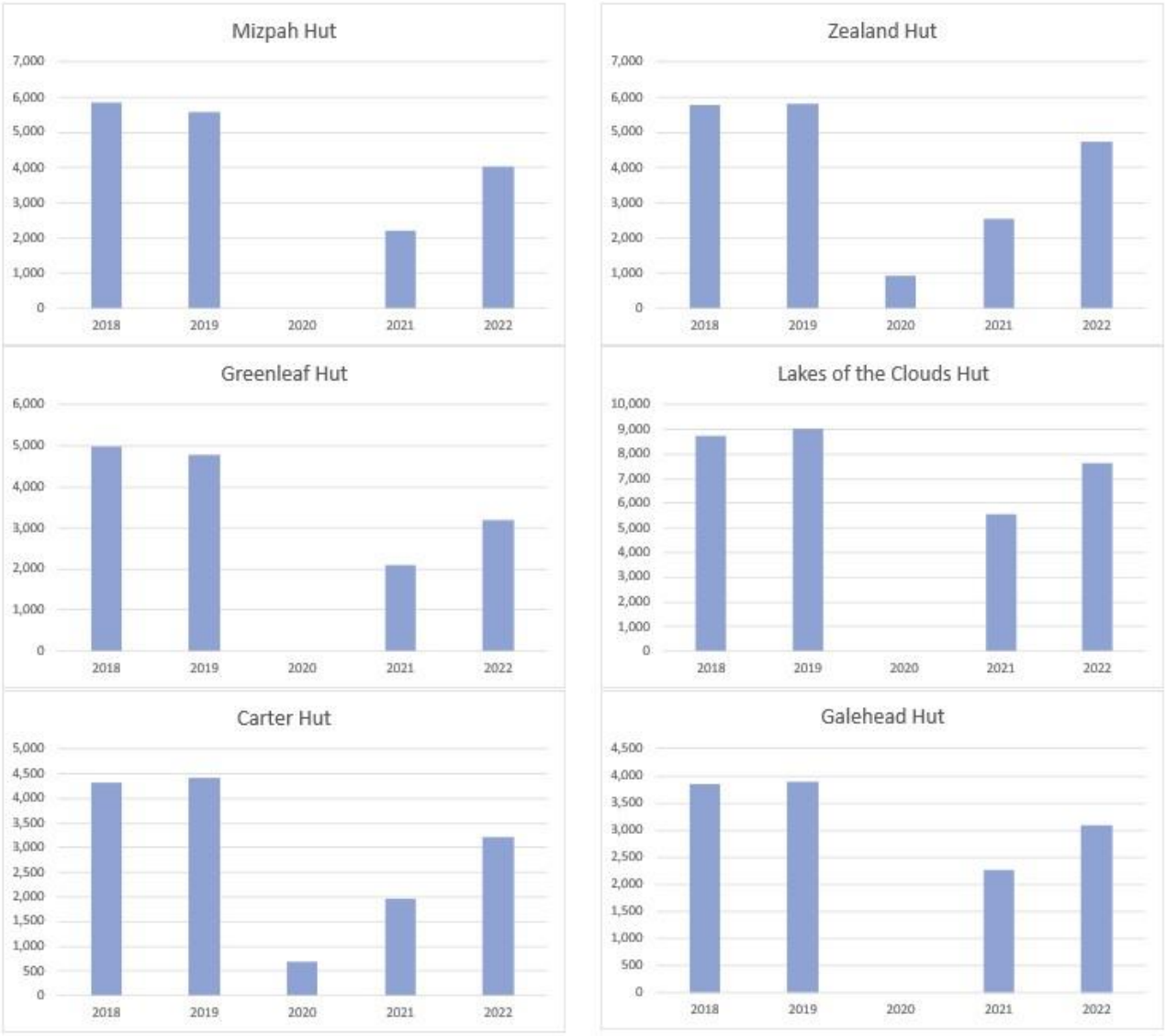

Figure 32. Overnight use (total number of nights) reported for individual Appalachian Mountain Huts from 2018 to 2022.

Discussion

This section will be considered in the future.

Monitoring Indicator 2

Recorded use through 2023 reported overnight visitor use at AMC permitted shelters (tent sites and campsites).

Results

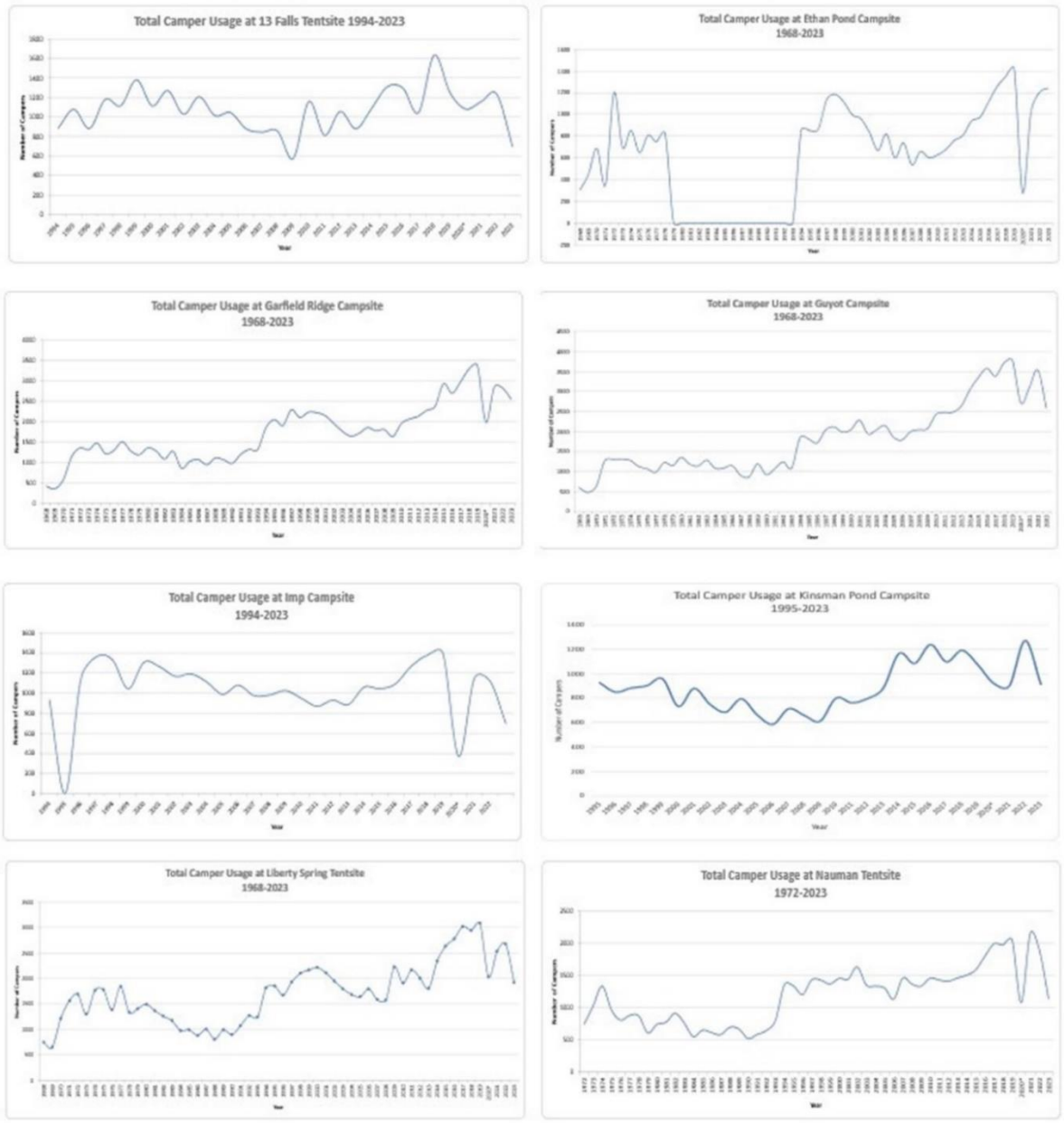

Figure 33. Reported overnight use (number of nights) at eight AMC tent sites and campsites.

Discussion

There has been an increase in total overnight use at AMC huts since 2020 (Figure 31). Overnight use at individual huts has consistently increased since 2020 but to varying degrees (Figure 32). As huts have fixed capacities and a strict reservation system, there are no additional environmental or social concerns for a hut being at capacity throughout the summer. The 1999 Environmental Impact Statement (EIS) re-permitting the operation of the AMC huts and the Pinkham Notch Visitor Center and special use permit used these capacities in their analysis.

Total reported use at AMC permitted shelters (tent sites and campsites) has seen an upward trend though trends at individual shelters vary (

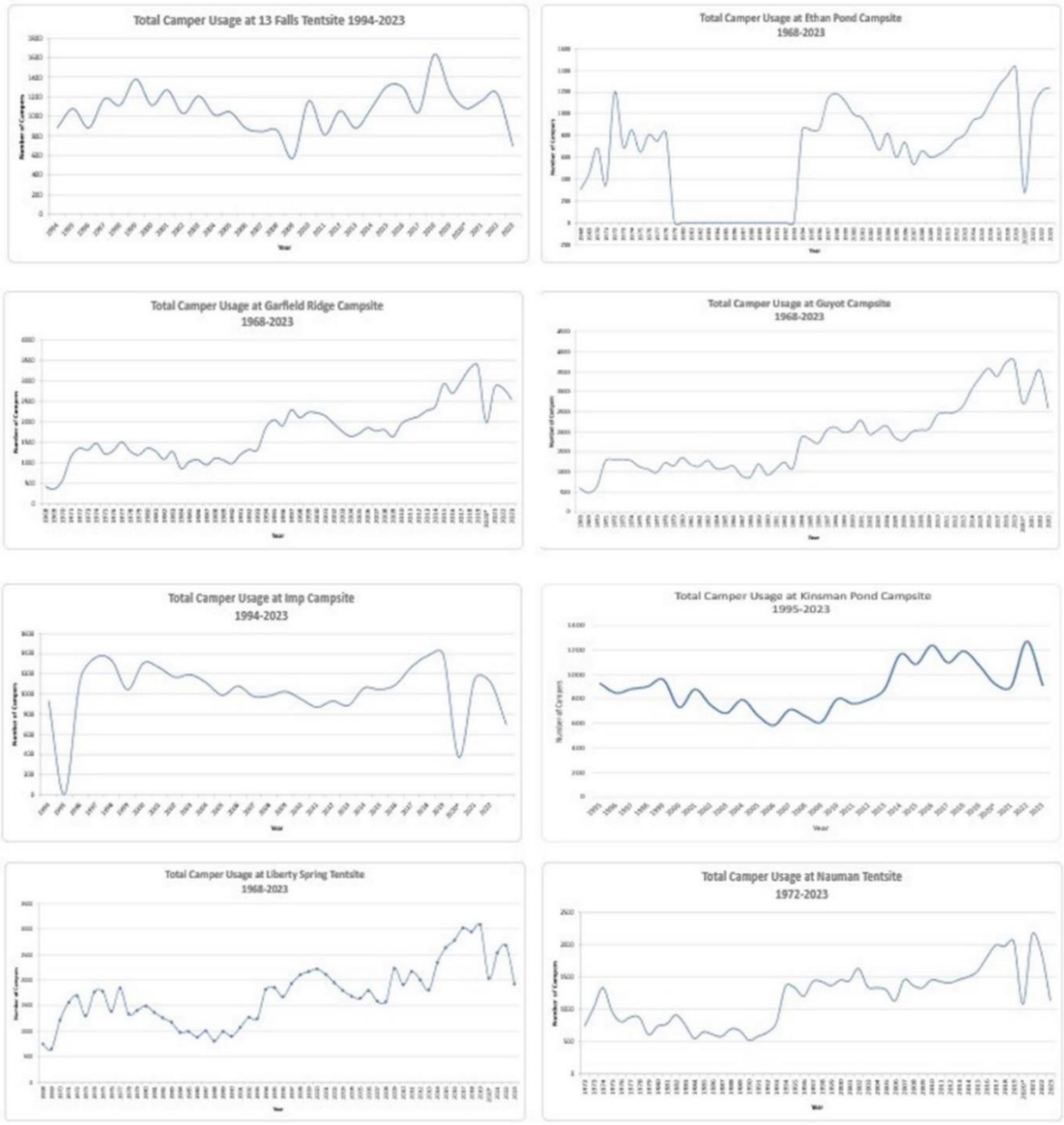

Figure 33). Of greater concern are the capacity issues seen across the system. The 2015 University of Vermont (UVM) study confirmed that, of the observed nights at selected shelters, all of them were

above design capacity on Saturday nights. Additionally, Guyot Campsite was above design capacity on every single observed night. Garfield Ridge Campsite was above capacity approximately 40 percent of the observed time. AMC has a policy, generally supported by the Forest Plan, of concentrating use at shelters. In practical terms, this means they do not turn anyone away. This leads to situations where use far exceeds the design capacity of the site.

Recommendations

If use trends continue upwards, it will be important to work with AMC regarding their policy to indefinitely concentrate use. Other management actions may be necessary in order to ensure resource and visitor experience goals are met.

Evaluation of Monitoring Question and Indicator(s)

AMC use numbers at permitted facilities remain an important data source. The Forest should continue to require annual use number reporting.

References

Reported use as part of AMC's backcountry shelter permit on file with the WMNF.

5.12.6 – Over time is there a change in use on Forest motorized and non-motorized trails?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Visits and visitor use numbers

Monitoring Frequency

3-year cycles every 10 years or so.

Background and Driver(s)

This monitoring information is needed to implement the Forest Plan recreation approach of maintaining a balance of recreation opportunities across the high-, moderate-, and low-use areas on the Forest. The information will indicate if there is a need to take management action to ensure a balance is maintained.

Results

Use of trails in summer was sampled from 1998 to 2000 and from 2008 to 2010. The monitoring provides insight on how trail us is changing over time. Monitoring is conducted across very high-, high-, moderate-, and low-use trails to indicate if there are changes in the balance of recreation opportunities in differing use areas. However, the use levels appear to be assigned incorrectly for some trails. Using trail register data from 2008 and 2010 and current District knowledge, the lists need to be updated. Having a more accurate list would provide a more accurate extrapolation of the data. Additionally, on

high and very high use trails, registers often ran out of space for signing and were thus missing some use.

Discussion

This section will be considered in the future.

Recommendations

Infrared trail counters may be a more efficient method for collecting this information.

The registers are reliant on self-reporting by those visiting the trail. To adjust for those who do not self-register, each sampled trail should also have compliance monitoring. The compliance monitoring estimates the percentage of visitors who do not register. Due to the labor intensity of compliance monitoring, it did not occur consistently across the Forest. This lack of information affects the final estimates of hikers on the Forest. The balance of hiker visits on the Forest appears to be staying consistent with use level across the Forest.

In 2014 during the UVM study, trail use data was collected using infra-red counters. This method should continue to be explored to replace the trail register data method. It is a more efficient and accurate way to collect data.

Evaluation of Monitoring Question and Indicator(s)

Monitoring has only occurred for summer non-motorized use. There is no capacity to monitor winter motorized and non-motorized use on the Forest.

References

DuRocher, L. 2011. Visitor use and wilderness trends at the White Mountain National Forest.

5.12.7 – What is the level of visitor satisfaction on the Forest (as measured by quality of experience and perception of crowding) at developed sites as well as in the backcountry?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Perceived quality of experience and perception of crowding among Forest visitors

Monitoring Frequency

Every 10 years.

Background and Drivers

Intent is to provide trend information to help managers determine if visitors' expectations are being met and to judge their reaction to the implementation of the recreation strategy. This gives managers an

indication of management actions that may need to be taken to meet visitors' needs. Overall trip satisfaction is often used as a primary management criterion for evaluating the quality of an outdoor recreation experience.

Monitoring Indicator 1

National Visitor Use Monitoring (NVUM) survey results from 2020 survey.

Results

Survey results collected during the 2020 round of National Visitor Use Monitoring (NVUM) show that approximately 84 percent of people visiting indicated they were very satisfied with the overall recreation experience and 14 percent were somewhat satisfied (Figure 34).

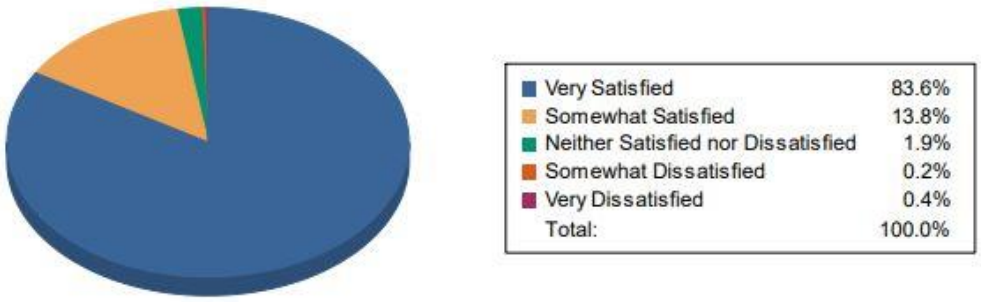

Figure 34. Percent of WMNF visits by overall satisfaction rating.

Table 29. Satisfaction ratings for survey respondents at developed sites (both day use and overnight sites), undeveloped areas, and designated wilderness areas.

Satisfaction element	Developed sites (%)	Undeveloped areas (General Management Areas) (%)	Designated Wilderness (%)
Developed facilities	94.9	91.7	99.4
Access	95.1	93.6	94.0
Services	90.8	88.5	89.6
Feeling of safety	99.3	98.8	98.6

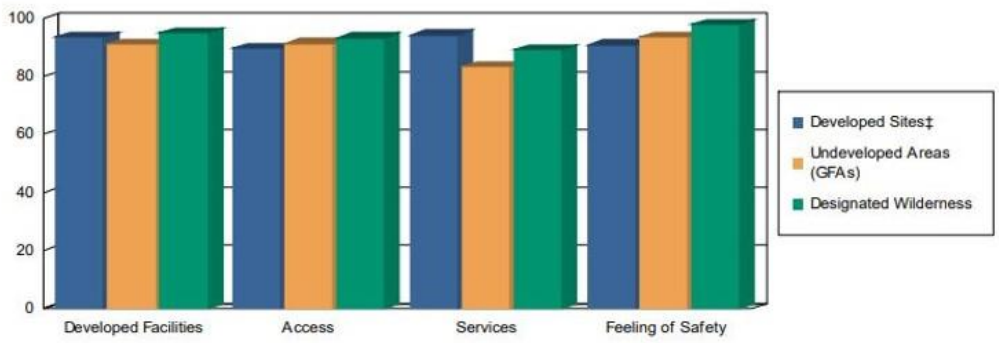

Figure 35. Percent Meets Expectations (PME) scores for developed facilities (both day use and overnight use), access, services, and feelings of safety. PME is the proportion of satisfaction ratings in which the numerical satisfaction rating for a particular element is equal to or greater than the importance rating for that element. This indicator tracks the congruence between the agency's performance and customer evaluations of importance. The idea behind this measure is that those elements with higher importance levels must have higher performance levels. Lower scores indicate a gap between desires and performance.

The NVUM also looked at visitors' perceptions of crowding. Visitors rated their perception of how crowded the recreation site or area felt to them. This information is useful when looking at the type of site the visitor was using since someone visiting a designated Wilderness may think 5 people is too many, while someone visiting a developed campground may think 200 people is about right. Table 30 shows the distribution of responses for each site type. Crowding was reported on a scale of 1 to 10 where 1 denotes hardly anyone was there, and a 10 indicates the area was perceived as overcrowded.

Table 30. Crowding rate (percent of site visits) for day use and overnight use developed sites, undeveloped areas, and designated wilderness based on survey respondents. A site visit is the entry of one person onto a national forest site or areas to participate in recreation activities for an unspecified period of time. Survey respondents rate how crowded the site or areas they were interviewed at was using a scale of 1 to 10 where 1 meant hardly anyone was there and 10 meant the site or area was overcrowded.

Crowding rating	Day use developed sites (%)	Overnight use developed sites (%)	Undeveloped areas (GFAs) (%)	Designated wilderness (%)
10 – Overcrowded	2.2	0.0	1.0	0.0
9	0.5	0.0	2.0	0.8
8	0.0	25.0	3.0	0.4
7	1.1	25.0	7.3	0.8
6	13.5	0.0	14.4	12.4
5	6.7	0.0	8.3	9.4
4	12.3	0.0	14.7	19.2
3	19.1	25.0	18.9	17.6
2	36.1	25.0	18.2	29.2
1 – Hardly anyone there	8.6	0.0	12.4	10.2
Average rating	**3.4**	**5.0**	**3.9**	**3.4**

Discussion

This section will be considered in the future.

Monitoring Indicator 2

University of New Hampshire (UNH) study to assess WMNF outdoor recreation visitors' perceptions, preferences, behaviors, and decision-making.

Results

The UNH study asked visitors to evaluate their overall level of satisfaction with the WMNF on both single-item (Table 31) and multi-item (Table 32) satisfaction scales.

The single-item measurement of overall satisfaction was measured on a seven-point scale where one represented "poor" and seven represented "perfect" (Table 31). Overall satisfaction was very high amongst respondents, with the majority of visitors (77 percent) indicating their overall trip that day to the WMNF was either excellent (6) or perfect (7).

Table 31. WMNF visitors' overall satisfaction rating for single-item measurements. The single-item measurement of WMNF visitors' satisfaction was measured on a seven-point scale where one represented "poor" and seven represented "perfect".

Overall satisfaction rating	Visitors surveyed (%)
1 – Poor	Greater than 1.0
2	Greater than 1.0
3	Greater than 1.0
4	5.1
5	14.5
6	51.7
7 – Perfect	24.8
Average rating	**5.97**

The multi-item measurement of the WMNF visitors' satisfaction was measured on a seven-point scale where one represented "completely disagree" and seven represented "completely agree" (Table 32). Most respondents (96 percent) agreed they thoroughly enjoyed their trip to the WMNF. Most (85 percent) of the sample agree that they cannot imagine better trips to the WMNF. Approximately 93 percent of the sample agreed that their trip was well worth the time and money spent to take it.

Table 32. WMNF visitor's overall satisfaction rating for multi-item measurements. Percentages may not equal 100 because of rounding. Response code ranged from one (completely disagree) to seven (completely agree).

Variable	Disagree (%)	Neutral (%)	Agree (%)
I have thoroughly enjoyed my trips to the WMNF	1.0	1.0	95.6
My trips to the WMNF have been well worth the money and time I spend to take them	1.5	2.2	93.4
I cannot imagine better trips to the WMNF	2.8	9.5	84.4

The study also asked visitors to rate undesirable conditions that would impact their experience on a one- to seven-point scale. Of the social impacts, crowding had the highest overall scale mean (4.15), suggesting that the social factor of crowding is most impactful upon the visitor experience on the WMNF.

Discussion

While both studies (NVUM and UNH) indicate high satisfaction in the recreation experiences on the Forest, the social factor of crowding impacting those experiences is slowly increasing. Many visitors, when faced with various suboptimal conditions (such as crowding or conflict), are more likely to employ resource and temporal substitution behaviors in an effort to adapt, preserve, and/or increase overall experience quality.

Evaluation of Monitoring Question and Indicator(s)

Continue to focus on satisfaction and experience quality and look at ways to employ strategies that will address crowding and conflict. Reduce monitoring interval from 10 years to 5 years to stay abreast of crowding and other social issues affecting the visitor experience.

References

USDA Forest Service. 2020. National visitor use monitoring, FY 2020.

University of New Hampshire, Department of Recreation Management and Policy. 2021. Assessing outdoor recreation visitor behaviors and decision-making on the White Mountain National Forest: Final Report.

5.13 – Scenery

Scenery is an important resource on the WMNF. It attracts many visitors to the Forest and influences the lives of those living in the Forest region. Maintaining a natural-appearing landscape is a key component of the Forest Plan. The rugged mountains of the Forest form a significant scenic and cultural New England landscape. Whether viewing the forest while driving, hiking, biking, or skiing, visitors find respite in the scenic naturalness of the Forest as nearby urban areas continue to grow. There are two National Scenic Byways that cross the Forest allowing for scenic drives with pull-offs for views and picnic areas. The WMNF is classified as an urban forest, drawing in millions of visitors each year. The Forest is within a day's drive of Boston, New York, and Montreal. Although scenery is vital to the appeal of the Forest for recreation and for living in the region, the WMNF is a working forest, and management for this resource must be balanced with other Forest uses, including timber management.

Scenery is a challenging resource to evaluate and manage because it is subjective. As the saying goes, beauty is in the eye of the beholder. How people perceive the landscape is influenced by their history, beliefs, work, knowledge, use of the land, and many other factors. Add in the complexities of the landscape (e.g., slope, aspect, vegetation, distance, houses, fields, development, mature and young forest, and weather) and each viewer will have a different perspective and assessment of what is "natural appearing" or appropriate within the context of the overall landscape. The following monitoring questions were developed to evaluate whether plan components are effective and appropriate and whether management is effective in maintaining or achieving progress toward desired conditions and objectives for the plan area.

5.13.1 – How do different harvest methods affect the visual landscape over time? Does modeling accurately display scenic conditions on the landscape?

Current Evaluation

This monitoring question was not updated in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

Visibility of openings created by harvesting from clearcuts and group-selection treatments. Impacts on the visual landscape are assessed using pre- and postharvest photographs and a comparison of modeled images to these photographs.

Monitoring Frequency

Annual.

Background and Driver(s)

The rate at which visual impacts of each harvest type change and impact foreground, middle ground, and background views are used to determine whether Forest Plan direction regarding size of openings relative to Scenic Integrity Objectives, project-level design features, and overall amount of opening on the landscape are appropriate given the types of harvest, variety of viewpoints, and rate of vegetative regrowth on the Forest. The results of the monitoring analysis will help to determine if the design concepts proposed as mitigation measures for the projects units, as derived by the modeling and associated analysis, are sufficient and if the design features are being applied during implementation.

Field observations and photographs were taken from the Mount Washington Resort & Spa and Crawford Path Trailhead viewpoints during the summer and fall of 2008 and 2009. Due to the locations and timing of harvests, first year and third year postharvest data was collected in September of 2016 (first-year and third-year treatments are immediately adjacent to one another). The pre- and postharvest landscape photographs were compared with images of the treatments produced by computer simulation visibility modeling.

Visibility modeling was applied to each viewpoint in order to provide a base reference as to what stands in the project area would be visible from that given point. The stand boundaries were then overlaid onto the terrain of the three-dimensional model and colored to allow a simulated view of the proposed treatment (clearcuts and group-selection treatments) on the simulated landscape from the viewpoint. Modeling is limited to bare earth or terrain modeling; stand height and foreground vegetation or architectural barriers must be interpreted using field data, including photographic data. The models provide a visualization of the view from the viewpoints and how the landscape might appear following harvest. Stands are projected as a two-dimensional representation; they appear on top of the vegetation of a three-dimensional model. This creates an illusion of potentially greater visual impact. Depending on the perspective and angle of the view being projected, the models overestimate visible canopy opening after harvest by approximately half to three-fourths and even more visible ground opening. As such, the models predict much more canopy opening than would ever actually be visible.

Results

As illustrated by Figure 36, Figure 37, and Figure 38, the work on the ground is not always translated exactly as the proposed mapping was analyzed and the designed mitigations created. This is partially expected due to the unknown, on-the-ground restrictive or inoperable features that have to be adjusted for and is noted as having a possibility of occurrence in the specialist report. As technology improves (and has improved since the layout of this project), designed layout and mitigations will become more accurately translated to the ground for harvest.

The modeling and mapping efforts prove to be accurate (within acceptable tolerances), displaying the scenic conditions and translating the proposal into a successful harvest that is visually sensitive to the landscape (Figure 39).

Figure 36. Area of the proposed project with modeled clearcuts and group-selection cuts.

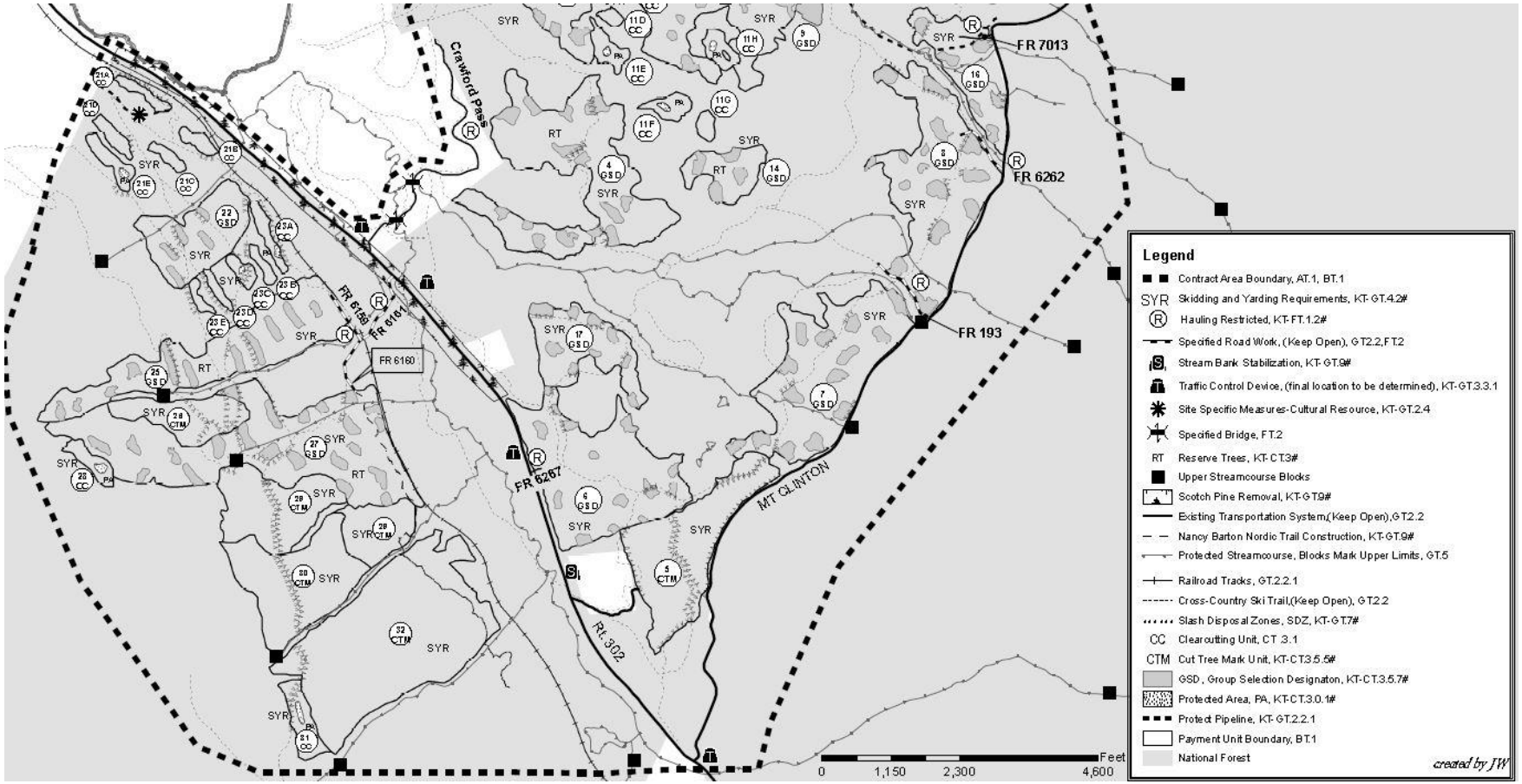

Figure 37. Map of 2013-2015 postharvest treatment area on the left side of U.S. Route 302 within both the Omni Mount Washington Resort & Spa and Crawford Trailhead viewsheds.

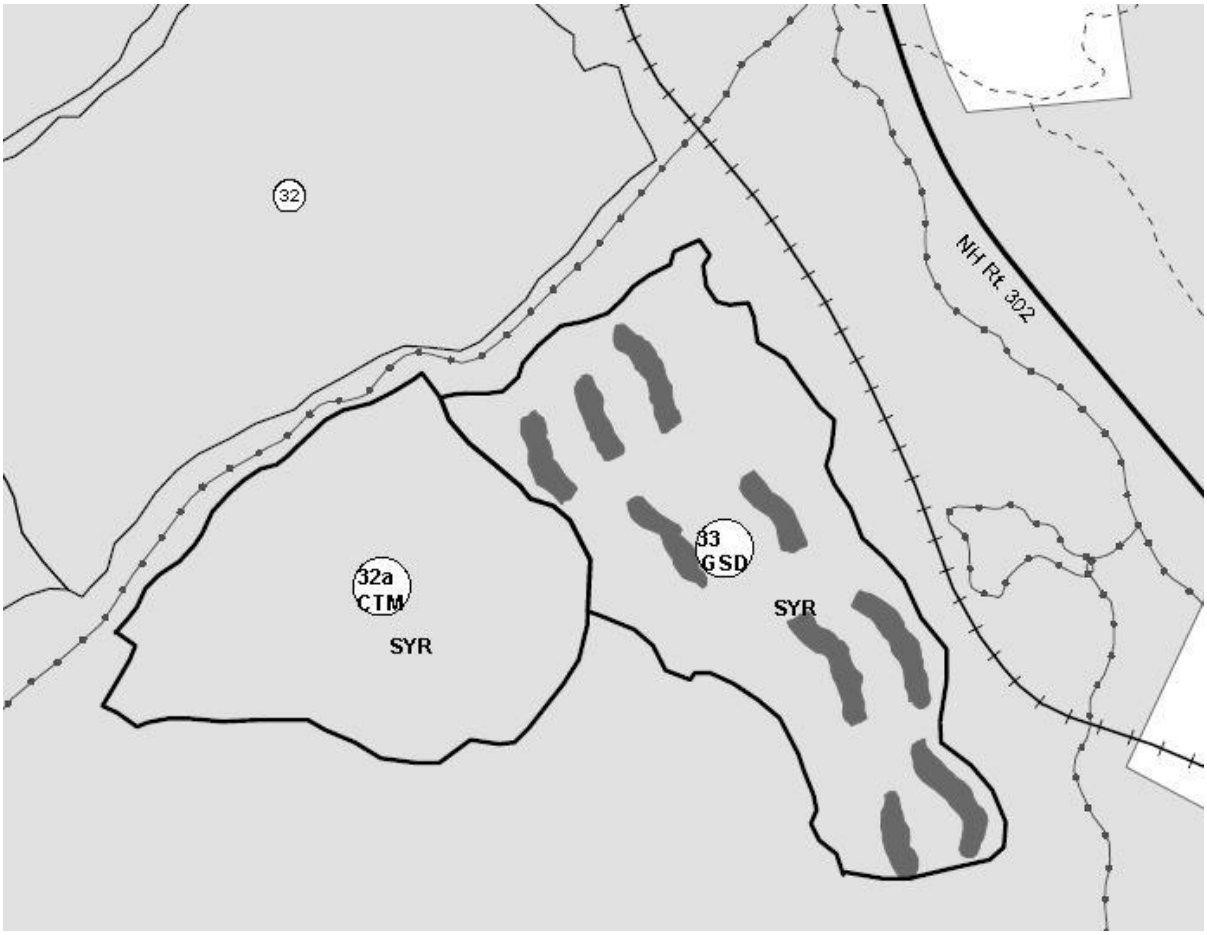

Figure 38. Map of additional harvest area within both the Omni Mount Washington Resort & Spa and Crawford Trailhead viewsheds.

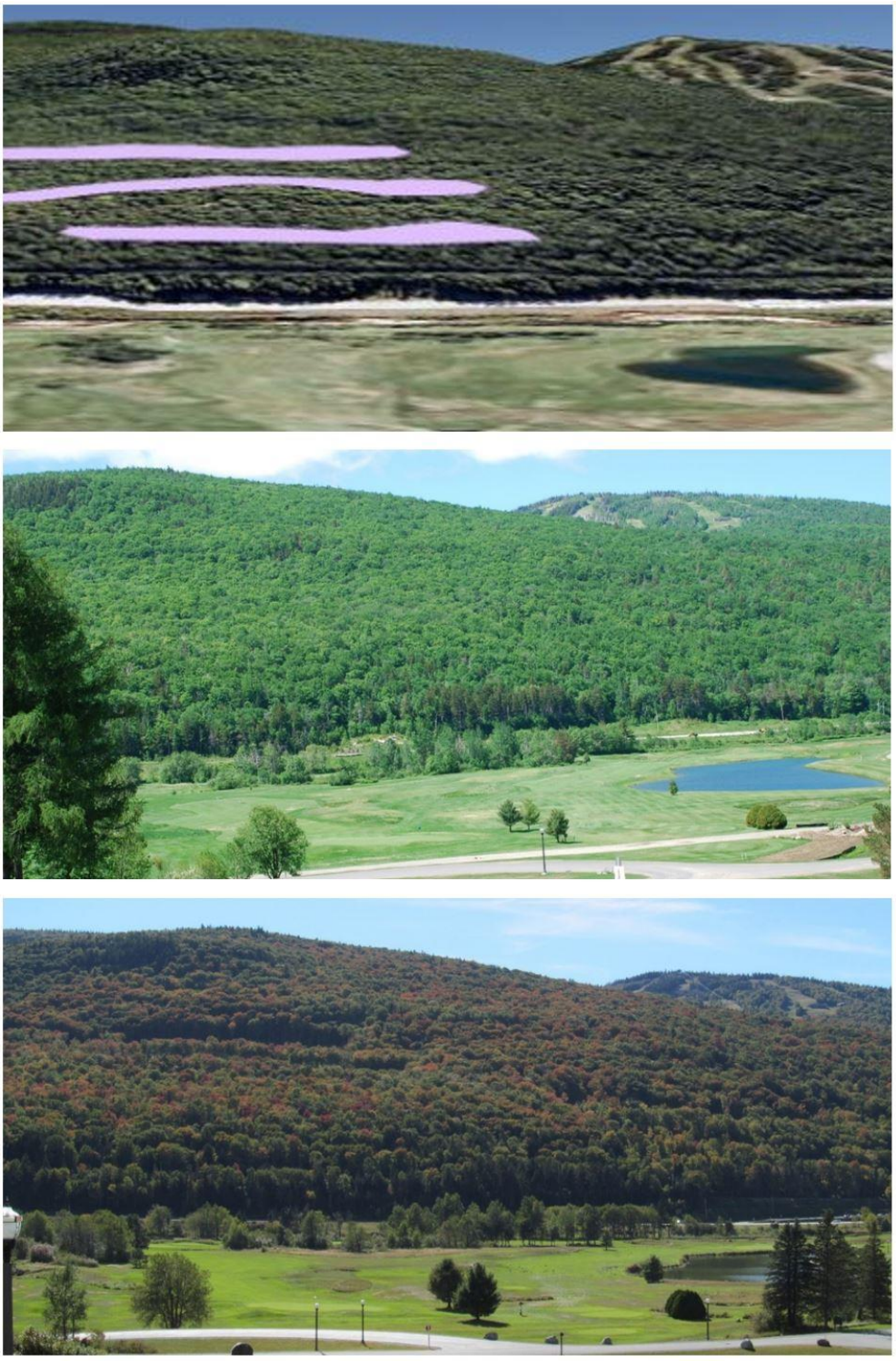

Figure 39. Model of proposed treatments (top), prior to harvest in 2008 (middle), and after harvest in 2016 (bottom) as seen from the Omni Mount Washington Resort & Spa.

Discussion

The views monitored in this analysis have received many visitors since harvesting has been completed, including State elected officials and Regional and National leaders of the Forest Service. They have noted

that they were extremely impressed with the visual results and integrity of the scenic condition from these viewpoints. When asked, members of the public have indicated that they did not notice or recognize that there had been harvest activity on the hillside they were observing. Public opinions were reexamined, and the same comments were received in 2019 and 2020. It is worth noting that the Omni Mount Washington Resort & Spa has expanded since 2018 and the visitation has likely increased as a result, with nothing negative reported related to the viewshed's postharvest appearance.

Recommendations

If the sale layout results in substantial changes to the stand boundaries, the modifications should be reviewed to determine whether the changes affect consistency with scenery guidelines.

References

Not applicable.

5.13.2 – To what degree are Scenic Integrity Objectives being followed in our decisions?

The Scenery Management System (SMS) was used during Forest Plan revision to identify those areas of the Forest where scenery is of greatest concern due to concentrated public use and current high scenic quality. SMS also helped with developing direction on how to maintain a natural-appearing landscape. The result was a series of scenery-related data layers identifying the scenic concern level of all roads and trails, the current scenic integrity, and the scenic integrity objective.

As with many resources, much of the direction in the Forest Plan related to scenery management is in the form of guidelines, not standards. This was intentional to allow some flexibility to balance resource needs based on site-specific conditions and project objectives. However, as the Forest Plan says (p. 2-3), "a guideline is a required course of action or level of attainment". A guideline can be modified or not implemented, but only when site-specific conditions indicate it is necessary so the Forest can move toward its goals and objectives.

The goal is that WMNF will conduct all management activities to be consistent with assigned Scenic *Integrity* Objectives, realizing the importance to local communities and Forest users of a natural-appearing landscape, distinct from the human-made environments dominant in the East.

Forest standards are actually descriptions of the Scenic Integrity Objectives (SIOs) and tools available to help the Forest meet those objectives, not management direction. This monitoring question addresses the following Forest Plant Guideline: Scenery Management, G-1, (p. 2-26):

> *All management activities should meet or exceed Scenic Integrity Objectives established for the Forest through the Scenery Management System (SMS) outlined in Agriculture Handbook 701, Landscape Aesthetics — A Handbook for Scenery Management.*

Table 2-02a under Scenery Management in the Forest Plan (p. 2-27) identifies the SIOs for the management areas most commonly managed as part of integrated projects. The project monitored is in a high and moderate Scenic Integrity Objective area and are in the foreground and middle ground viewsheds of a National Scenic Byway, as well being across from a historic hotel and cultural landscape (Omni Mountain Washington Resort & Spa), plus a frequented and popular year-round trailhead (Crawford Path).

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

Scenic Integrity Objectives as identified in the Forest Plan.

Monitoring Frequency

Annual.

Background and Driver(s)

The results of the monitoring analysis will help to determine if the Scenic Integrity Objectives are being followed in decisions. A comparison of mapping and/or modeling with photographic data collected on the ground during follow-up monitoring assists in this analysis.

Results

The Crawford Notch project included lands within low and medium Scenic Integrity Objectives. Modeling was used during project development to meet those objectives (Figure 40).

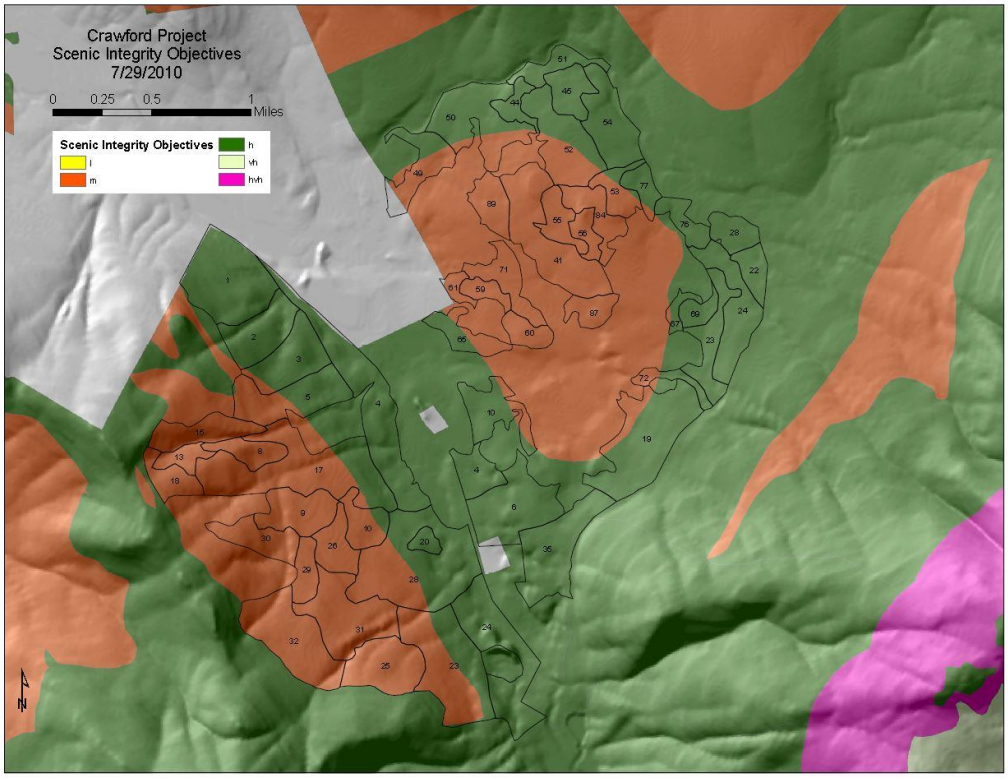

Figure 40. Scenic Integrity Objectives ranging from low (l) to high very high (hvh) overlayed on stands in the Crawford Notch Project area.

Discussion

The decisions have been consistent with the Scenic Integrity Objectives.

Recommendations

If the sale layout results in substantial changes to the stand boundaries, the modifications should be reviewed to determine whether the changes affect consistency with scenery guidelines.

Evaluation of Monitoring Question and Indicator(s)

Monitoring may best record the changes occurring on the landscape if performed annually for the first 5 years, then on year 7, 10, 15, and 20. During the 20th year the regeneration of the vegetation should be at sufficient height and canopy to be blending in the context of the surroundings.

References

Not applicable.

5.14 – Socioeconomics

A monitoring goal in the Forest Plan recognizes the socioeconomic role of the Forest in the region and seeks to determine to what extent the Forest is providing a mix of products, services, and amenities (p. 4-11). One monitoring question that follows examines the economic role of the Forest in the region in terms of Payments to States, Payments in Lieu of Taxes, stumpage value of timber sold, special use permits issued, recreation passes sold, and other local socioeconomic indicators. Another question examines how actual outputs and management activities compare with estimated practices identified in Forest Plan.

5.14.1 – What is the economic role of the Forest in the region?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Payments to States
- Payments in Lieu of Taxes
- Stumpage value and volume of timber sold and harvested
- Special use permit receipts
- Recreation pass receipts
- Recreation use
- WMNF annual budget and expenditures
- Number of full and part-time employees

Monitoring Frequency

Every 10 years.

Background and Driver(s)

Data will be collected from multiple sources, primarily including recurring budget and finance reports available from the Forest, Region, and Washington Office.

Results and Discussion

The results and discussion for this monitoring question are presented in Lee et al. 2015.

Recommendations

No recommendations were generated from the evaluation of this monitoring question.

Evaluation of Monitoring Question and Indicator

The evaluation of this monitoring question using this indicator continues to provide important information regarding the goals and objectives of the Forest Plan and its implementation.

References

Lee, D., M. Hall, and Z. Lacroix. 2015. Socioeconomic assessment to provide context for management of the White Mountain National Forest. Prepared by Plymouth State University Center for Rural Development for the White Mountain National Forest. Unpublished report. On file at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH.

5.14.2 – How do actual outputs and management activities compare with the estimated practices identified in Forest Plan Appendix B?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Volume of sawtimber and pulp sold (million board feet (MMBF))
- Acres of even-aged regeneration, even-aged intermediate, and uneven-aged harvest
- Total acres harvested
- Miles of stream habitat restored
- Number of road crossings where fish passage was restored
- Net increase in miles of non-motorized trails and snowmobile trails
- Net increase in number of developed campground sites
- Net increase in backcountry facility capacity (persons at one time (PAOT))
- Miles of roads constructed, reconstructed, and decommissioned
- Acres of improved watershed or soil conditions
- Number of fires where wildland fire was managed for resource benefits

Monitoring Frequency

Biennial.

Background and Driver(s)

Appendix B of the Forest Plan lists proposed and probable practices, goods produced, and other information and identifies a specific set of expected outputs and accomplishments for the first decade of the Plan's implementation, as well as some limits. Most of these measures come from the resource goals and objectives in Chapter 1 of the Plan. For this question, we utilize annual target reporting and existing databases to assemble the information.

Results

Table 33 shows the combined total accomplishment for each measure in FY 2018 and FY 2019 as well as the total for the first 14 years of Forest Plan implementation (FY 2006–2019). For activities implemented through contracts, the accomplishment is reported in the year the contract is awarded because most accomplishment reporting is tied to funding. Table 33 summarized our success at achieving those outputs and services identified in Appendix B, which are a small part of our annual work, along with other accomplishments in some program areas.

Table 33. Estimated management practices and accomplishments for the FY 2018–2019 reporting period and during the length of Forest Plan implementation, FY 2006–2019.

Activity or product	Unit of measure	Estimate for first decade	FY 2018-2019 Accomplishments	FY 2006-2019 Accomplishments
Aquatics (stream habitat restoration)	Miles	30	2.5	23.3
Aquatics (restore fish passage)	Road crossings	10	1	17
Fire management (unplanned wildfire managed for resource benefit)	Fires	4 to 8	0	1
Forestry (volume sawtimber harvested)	MMBF	137	8	66
Forestry (volume pulp harvested)	MMBF	106	11	85
Forestry (volume of timber sold)	MMBF	240	27	159
Forestry (even-aged regeneration harvest)	Acres	9,400	500	4,029
Forestry (even-aged intermediate harvest)	Acres	5,600	246	4,679
Forestry (uneven-aged harvests)	Acres	19,300	622	9,840
Forestry (total harvest)	Acres	34,300	1,368	18,548
Recreation (net increase hiking trail construction)	Miles	Up to 25	0	0
Recreation (net increase snowmobile trail construction)	Miles	Up to 20	0.6	2.0
Recreation (net increase developed campground sites)	Sites	Up to 32	0	0
Recreation (net increase backcountry facility	PAOT	Up to 40	0	0

Activity or product	Unit of measure	Estimate for first decade	FY 2018-2019 Accomplishments	FY 2006-2019 Accomplishments
capacity)				
Soils and watershed (improved watershed and soil conditions)	Acres	At least 250	304.4	1,601
Transportation (road construction)	Miles	10	0	6.4
Transportation (road reconstruction)	Miles	70	9.3	83.3
Transportation (classification of unclassified roads)	Miles	N/A	5.2	23.9
Transportation (road decommissioning)	Miles	5 to 40	4	7.9
Transportation (unclassified road decommissioning)	Miles	N/A	0.2	13.3

Discussion

The Forest continues to manage resources to meet the accomplishments and stay within the limits set forth in the Forest Plan. During FY 2018 and FY 2019, the Forest implemented several stream habitat restoration and aquatic organism passage projects to improve aquatic habitat and restore fish passages. Additional work will be implemented as integrated resource projects move forward or funding is available for stand-alone aquatic organism passage projects.

No wildland fires occurred in management areas where fire use is allowed.

Harvested and sold volumes continue to remain below Forest Plan estimates. Harvested volumes and acreages fluctuate from year to year based on markets for various products and choices by sale purchasers on which units to cut. Given national priorities for funding, our forestry and wildlife habitat accomplishments are likely to increase slightly in the next few years. It remains our goal to gradually increase the volume sold and acres treated.

New hiking and snowmobile trail segments are constructed in most years to get existing trails on more sustainable ground or improve access to key areas. Relocation projects to address resource concerns always include decommissioning the segment that is moved; some of these projects result in a net increase in mileage, others a net decrease. As a result, the net increase, which is what Forest Plan objectives limit, for hiking trails remains at zero while there was a small increase in snowmobile trail miles. There was no net increase in developed campsites or the capacity at backcountry facilities.

FY 2018 and FY 2019 saw 304 acres of soil and water improvement activities. Work included closing and rehabilitating campsites in riparian areas, improvements to bridges and culverts, improvements to reduce erosion on Forest roads, decommissioning of roads, trail relocation and drainage improvements, invasive plant control, and prescribed burning. The predicted accomplishment of at least 250 acres of watershed and soil improvement work was based on the average annual accomplishment before the revised Forest Plan was signed. It was identified as a minimum to allow for as much of this type of work as is needed and feasible with available funding. Accomplishments from FY 2015 to FY 2017 were lower than predicted during Forest Plan revision, although the Forest took advantage of opportunities to increase resiliency as part of Tropical Storm Irene recovery.

Four years into the second decade of Forest Plan implementation, most road mileages remain within the accomplishments projected in the Plan. Road decommissioning was within the anticipated mileage and, as in previous years, the Forest implemented several projects to reconstruct roads and bridges to address damage from Tropical Storm Irene and other large storm events. Projects also included decommissioning classified road segments that were damaged. Between FY 2018 and FY 2019 there were two NEPA decisions that resulted in classification or decommissioning of unclassified roads. The Forest-wide travel analysis that recommends which National Forest System roads are likely to be needed in the future and which are not was completed in FY 2015. These recommendations are being reviewed at the project level, and decisions related to road maintenance levels, classifications, and decommission are being made during site-specific NEPA analyses.

Recommendations

No recommendations were generated from this evaluation of monitoring.

Evaluation of Monitoring Question and Indicator(s)

Evaluation of this monitoring question using the prescribed indicators continues to provide important information relevant to Forest management and implementation of the Forest Plan.

References

Not applicable.

5.15 – Soils

Management goals described in the Forest Plan for soil resources include working closely with the Natural Resource Conservation Service and research entities to protect the long-term sustainability of soil resources on the WMNF, with an emphasis on maintaining appropriate soil nutrients (Forest Plan, p. 1-16). The monitoring questions that follow pertain to the effects of management actions on soil physical condition and productivity as well as long-term soil chemistry and productivity.

*5.15.1 – Is soil compaction or displacement occurring as a result of Forest management actions (harvest, prescribed fire, recreation management)? If so, are there indirect effects on forest productivity and/or forest health?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Soil erosion, rutting, and compaction
- Soil compaction indicator: Severity of bulk density
- Soil displacement indicator: Severity of erosion (sheet, rill, and gully)

Monitoring Frequency

Annual.

Background and Driver(s)

The Forest Service Manual (FSM) provides direction for monitoring soils for soil productivity and health in FSM 2500 – Watershed and Air Management, Chapter 2550 – Soil Management (USDA Forest Service 2022), specifically in Supplement No: R9-RO-2550-2012-1, 2551.6 – Monitoring Plans, and 2551.61 – Soil Quality Monitoring Projects and Plans.

Timber harvest units are monitored before and after harvest and observed soil disturbance is classified to evaluate the effects of management actions on soil physical condition and productivity. Monitoring is conducted following approved Forest Service protocols, which are periodically updated between monitoring reports. Any change in language used here is made to match updated language in agency protocols. A transect is laid out across the unit, collecting data at 30 points along the transect.

- **Soil disturbance class 0:** No evidence of compaction, no depressions or wheel tracks evident, forest floor layers present and intact, no soil displacement evident, no management-generated soil erosion, litter and duff layers not burned, and no soil char.
- **Soil disturbance class 1:** Faint wheel tracks or slight depressions evident (less than 5 centimeters deep). Forest-floor layers are present and intact and surface soil has not been displaced and shows minimal mixing with subsoil. Burning is light: depth of char less than 1 centimeters. Soil compaction is slightly greater than natural conditions and concentrated from 0 to 10 centimeters deep, change in soil structure from granular to platy restricted to surface 0 to 10 centimeters. Erosion is slight.
- **Soil disturbance class 2:** Wheel tracks or depressions are 5 to 10 centimeters deep. Forest-floor layers are partially missing, surface soil partially intact and may be mixed with subsoil. Soil burn severity is moderate: depth of char is 1 to 5 centimeters. Soil compaction is present from 10 to 30 centimeters and soil changes in structure from granular to platy from 10 to 30 centimeters. Erosion is moderate.
- **Soil disturbance class 3:** Wheel tracks or depressions are highly evident and greater than 10 centimeters. Forest-floor layers are missing and there is evidence of surface soil removal, gouging, or piling. Most surface soil is displaced, surface soil may be mixed with subsoil, and subsoil partially or totally exposed. Burning is severe: depth of char is greater than 5 centimeters and duff and litter layers are completely consumed. Soil compaction is deep, greater than 30 centimeters, and soil structure changes from granular to platy beyond 30-centimeters deep. Erosion is severe and has produced deep gullies or rills.

Results

Six preharvest surveys were completed in different timber sale units (hereafter, called a "unit") from July to October 2024. The following timber sale units were selected: Indigo Unit 76, Tunnel Stream Unit 80, Slope Mountain Unit 11, Norway Unit 5, Bull Brook Unit 8, and Schoolhouse Unit 61. All Units had disturbance class 0 for all monitoring points, except for Bull Brook Unit 8, which had 3 percent class 1 and 3 percent class 2 disturbances due to a shared skid trail with an active unit and an old borrow pit. Although not part of the disturbance classification, Schoolhouse Unit 61 was found to have earthworms across the unit.

Discussion

Due to turnover in personnel this year, monitoring was only completed on preharvest units in order to set up monitoring in future years and ensure a baseline for comparison. To determine the effects of harvest, postharvest surveys will occur 1 year after harvest, and again 3 to 5 years after harvest. Results from postharvest surveys will be compared to the conditions observed during the preharvest surveys.

Since Schoolhouse Unit 61 borders private land, the earthworms found in the unit may have spread from gardens or landscaping sources on the bordering private land. Earthworms are a concern because they are non-native and invasive in the glaciated Northeast. They change forest soils and can affect other parts of the ecosystem, such as plant regeneration and animal habitat. Nonnative earthworms consume the organic layer (decomposing litter and duff on the soil surface), mix the soil, and cause it to have a continuous crumbly structure. There are currently no treatment options, so prevention is key. Our timber sale administrators ensure that operators on Forest Service lands clean their equipment prior to starting a Forest Service sale, which should help stop the spread.

Recommendations

No recommendations were generated from the evaluation of this monitoring question.

References

U.S. Department of Agriculture [USDA], Forest Service. 2022. Forest Service manual 2500 – Watershed and Air Management, Chapter 2550 – Soil Management. National Headquarters, Washington Office, Washington, DC. 126 p. Available: https://www.fs.usda.gov/about-agency/regulations-policies/manual/2550-soil-management

*5.15.2 – Is soil base cation depletion occurring? If so, are there indirect effects on forest productivity or forest health?

Current Evaluation

Partial update reported 2025. Monitoring should still occur 10 years from previous monitoring date.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Change is soil chemistry or forest health
- Vigor and dieback ratings or forest productivity
- Biomass accumulation

This report presents monitoring data on soil chemistry.

Monitoring Frequency

Every 10 years.

Background and Driver(s)

The Forest Service Manual (FSM) provides direction for monitoring soils for soil productivity and health in FSM 2500 – Watershed and Air Management, Chapter 2550 – Soil Management (USDA Forest Service 2022), specifically in Supplement No: R9-RO-2550-2012-1, 2551.6 – Monitoring Plans, and 2551.61 – Soil Quality Monitoring Projects and Plans.

This is a long-term monitoring effort to measure soil, and ultimately, forest productivity. It responds to concerns about acid deposition effects on forest productivity.

Two sites were established within clearcuts in partnership with Trinity College's Environmental Science Program. The sites were Hogsback, located in the western region of the Forest in New Hampshire, and Milstone, located on the eastern region of the Forest in Maine. Hogsback is located in the Pemigewasset Ranger District near Benton, New Hampshire. Preharvest sampling occurred on June 23, 2013, at 35 sample locations over three transects. Postharvest sampling occurred on August 4, 2014, at 35 sample locations along three transects and on June 29, 2015, at 38 sample locations along three transects. Milstone is located within the Androscoggin Ranger District near Bethel, Maine. Preharvest sampling occurred on June 24, 2013, at 49 sample locations over six transects. Postharvest sampling occurred on October 11, 2014, at 50 sample locations along six transects and on June 30, 2015, at 53 sample locations along six transects.

Results

No significant change in aluminum concentrations was found by this study. A few sample locations of exceptionally high aluminum concentrations skewed averages, although no statistical change was found. No significant change in the O-horizon calcium concentrations was found at either site. Calcium concentrations in the B horizon did not change significantly at Hogsback but did decline significantly at Milstone. In both soil horizons at Hogsback, and in the O horizon at Milstone, soils showed resiliency in rapidly recovering from their respective changes. Soil pH did not change significantly at Hogsback and increased significantly at Milstone. Soil acidification is not occurring at either location. There was an association between pH and aluminum concentration for 2 of the 3 sample years at each site. There was a weak association of calcium and pH for only 1 year at one site. Thus, no correlation between calcium and pH was found.

2025 Update: Forty long-term soil and vegetation monitoring plots were established across the WMNF in 2001 and 2002 to inform the 2005 Forest Plan and to understand how forest health responds to soil productivity. These plots were fully retested in 2014 and 2015, and the vegetation data was resampled in 2024 and 2025, but the soil data still needs to be collected. These plots are planned to continue to be sampled to collect soil and vegetation data every 10 years by WMNF staff and partners.

A PhD student at UNH analyzed the soil data from 2001 to 2002 and 2014 to 2015. Soils were brought to a lab to measure pH and nutrients (e.g., carbon, nitrogen, aluminum, calcium, potassium, magnesium, manganese and sodium). Calcium, potassium, magnesium, manganese and sodium are called base cations since they are basic in terms of acidity. Data from 2014 and 2015 indicated an increase in carbon and calcium, potassium, and magnesium, and a decrease in aluminum in the O horizon compared to that from 2001 and 2002. Data from 2014 and 2015 also indicated that calcium and magnesium decreased in the Spodic horizon, while aluminum increased. Aluminum also increased in the B horizon and decreased in the C horizon between the 2001 and 2002 samples and the 2014 and 2015 samples (Fraser et al. 2019).

Discussion

The results indicate consistency with the Forest Plan objective of not reducing soil productivity as a result of land management activities. We found no evidence that the soil is losing nutrient capacity to sustain vegetation due to timber harvesting. This monitoring is consistent with applicable laws and regulations and with the Forest Plan direction for monitoring soil base cation depletion. The management practices required by the Forest Service have minimized the potentially harmful impacts of clearcutting on forest soil nutrients. The validation monitoring shows that we did consider whether soil base cation depletion is occurring. The results from this monitoring indicate that there is no effect on soil nutrients.

2025 Update: The purpose of sampling these plots is to understand how soil nutrients are changing over time, if soils are recovering from acid rain, and to help understand how these affect overall forest health and soil productivity. Acid deposition occurred heavily from 1967 to 2000, and soil acidification affects nutrient availability and leads to higher aluminum levels that can be toxic to plants. The sampling in 2014 and 2015 showed that aluminum had moved from the top of the soil into the Spodic and transition horizons. This may indicate that the soil is recovering from the effects of acid deposition (Fraser et al. 2019).

Recommendations

These long-term sites need to continue to be sampled and analyzed to better understand changes in soil chemistry and productivity over time, and how soil properties affect forest health. Forest vegetation data were collected from 2001 to 2002, from 2014 to 2015, and from 2024 to 2025, but has not been analyzed and compared to the soils data. This will be useful to understand how forest health and productivity respond to soil productivity.

References

Fraser, O. L., S.W. Bailey, and M. J. Ducey. 2019. Decadal change in soil chemistry of northern hardwood forests on the White Mountain National Forest, New Hampshire, USA. Soil Science Society of America Journal. 83: S96-S104.

U.S. Department of Agriculture [USDA], Forest Service. 2022. Forest Service manual 2500 – Watershed and Air Management, Chapter 2550 – Soil Management. National Headquarters, Washington Office, Washington, DC. 126 p. Available: https://www.fs.usda.gov/about-agency/regulations-policies/manual/2550-soil-management

5.16 – Water Resources and Aquatic Species

Surface waters on the White Mountain National Forest are considered "outstanding resource waters" under the Clean Water Act, which are identified as having high water quality, exceptional ecological or recreational values, or unique attributes. Management goals described in the Forest Plan for water resources include maintaining or improving water quality to protect existing and designated instream water uses such as aquatic life (Forest Plan, p. 1-18). Seven monitoring questions within this section help to determine whether this goal is being achieved. The monitoring questions that follow address the effectiveness of aquatic habitat improvements, effects of recreation use on water quality, effects of land management on water quality and brook trout (focal species), long-term effects of climate change on aquatic resources, wild brook trout assessments, watershed condition, and the implementation and effectiveness of Best Management Practices (BMPs).

5.16.1 – Are stream habitat restoration and improvement projects meeting objectives and increasing habitat complexity and fish productivity? Are aquatic organism passage projects providing fish passage and stable stream beds through the crossings?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Abundance and biomass of brook trout
- Percent of stream pool habitat
- Abundance of instream woody debris

Monitoring Frequency

Annual.

Background and Driver(s)

The Forest Plan established goals to restore and improve self-sustaining populations of wild brook trout and their habitats. It has been well documented that forest removal during the 19th century in the eastern United States altered stream habitats by reducing habitat complexity. The loss of old riparian forest resulted in a loss of future large, downed wood that is known to create instream habitat diversity. Recovery of these conditions is believed to take nearly 200 years or more as riparian forests return to over-mature ages and provide inputs of large old trees into stream channels and floodplains. This interaction between riparian forests and stream channels is believed to be a key ecological condition of stream ecosystems on the WMNF. The eastern brook trout was identified as the WMNF focal species for headwater streams where downed wood could have a big impact on stream ecosystems. This monitoring question was raised to examine the potential benefits that future instream wood loadings could have to stream habitats and the native eastern brook trout.

The Forest Plan envisioned that stream habitat restoration would occur through two management scenarios. First through natural recruitment of downed wood into channels from the slow succession of streamside forest to over-mature stages. Riparian management guidelines were written to allow a corridor of over-mature trees to be excluded from forest harvesting. Second, instream habitat complexity could be accelerated by actively adding downed wood into select watersheds where benefits to wild brook trout populations could be realized. This monitoring question was formulated to examine the success of this second management strategy and give managers clues as to the benefits to wild trout populations.

Stream large woody debris (LWD) addition projects were a focus on the Forest between 2003 and 2010, including during the first 5 years of management under the revised Forest Plan. They were planned in watersheds where a positive response to stream complexity was expected by creating pools with high cover, thereby increasing habitat for more adult brook trout. Wood addition projects occurred in Evans Brook (Gilead, Maine), Bog Brook (Mason, Maine), West Branch of the Upper Ammonoosuc River (Berlin, New Hampshire), Great Brook (Stoneham, Maine), Mill Brook (Carroll, New Hampshire), and Connor Brook (Shelburne, New Hampshire). This report focuses on the before and after monitoring results of the Great Brook project.

The Great Brook watershed was dominated by both second- and third-growth forests due to land use practices late into the 20th century. Much of the land was acquired by the Forest Service in the 1970s. Given the young riparian forest, the presence of instream wood in the stream channels was very low (less than 50 pieces per mile). At the time the project was planned (2003), the best available science suggested that 300 pieces of large wood per mile and 30 percent pool habitat were stream restoration objectives for New England mountain streams. The project was designed to meet this objective throughout the headwaters of the Great Brook watershed. This would include Great Brook above the Forest Service road bridge to the Wilderness boundary, and within its tributaries. In total, 2.4 miles of perennial stream channel were treated between 2003 and 2006. Four monitoring stations were established in treated streams totaling about 1,500 feet, or about 12 percent of total stream treated. Bankfull width averaged 4 to 8 meters and drainage area sizes averaged 1.5 to 8.5 square kilometers in the treatment monitoring stations. Channel slopes ranged from 1.6 to 4.0 percent and pool habitat ranged from 7 to 19 percent before wood additions. Two control stations on Willard Brook were established and had similar characteristics within the ranges noted above. Another control station on lower Great Brook (below the bridge and a bedrock gorge) was monitored as it had been monitored historically.

Monitoring Indicator 1

Habitat features.

Results

All sampling stations within treated stream reaches had substantial increases in wood loadings 4 to 6 years after project implementation (Figure 41). Three of four stations exceeded the objective of 300 pieces per mile, while Red Rock Brook (RED10) exceeded 200 pieces per mile. Control stream reaches continued to show very low instream wood densities, similar to pretreatment measures, with all estimates below 50 pieces per mile over a 7-year period (2004–2010).

Surface area of pool habitat exceeded the 30 percent pool habitat objective at all four treatment monitoring stations, ranging from 32 to 43 percent (Figure 42). Pool habitat at these sites increased between 25 to 28 percent at all four sites. Pool habitat at control sites ranged from 7 to 25 percent and changes between the pretreatment and post-treatment period ranged from -1 to 7 percent.

Total area of pool habitat increased, as did the frequency of pools within each sampling station. Total pools in all control stations increased from 11 to 12, while in all treatment stations pools increased from 11 to 34 from 2004 to 2009. The quality of pools within treatment stations increased from below average to above average, while in control stations pool quality decreased slightly from average to below average.

In summary, stream habitat within treatment reaches was far more diverse and complex after LWD additions. Treatment stations had more pools, more pool area, higher quality pools with wood cover, and deeper maximum depths than control stations over a 5-year post-treatment period.

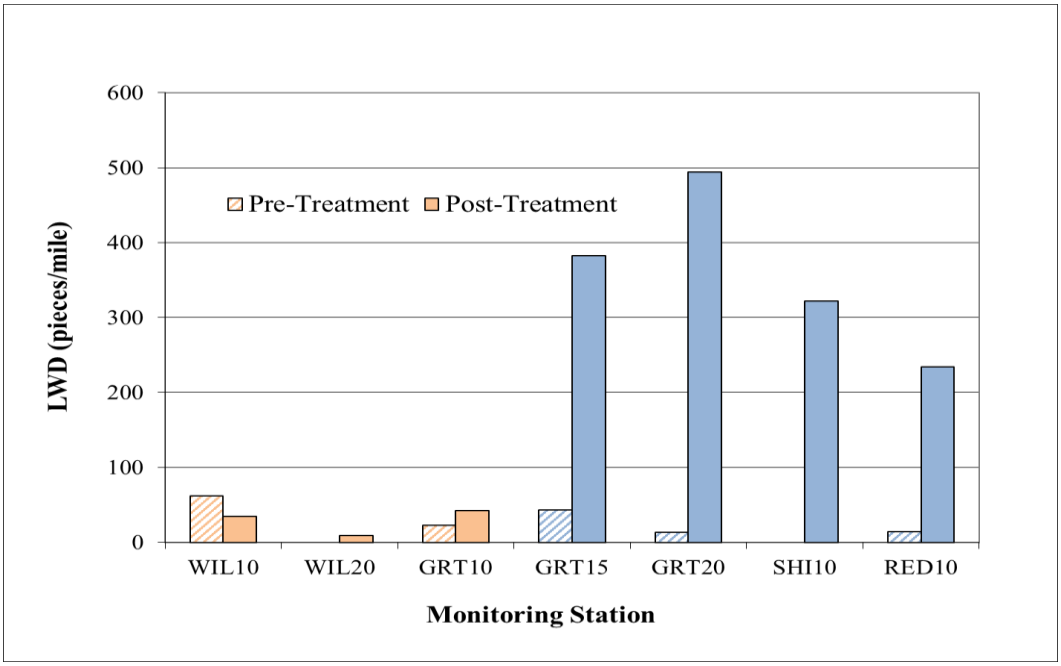

Figure 41. Large woody debris (LWD) counts before (2004) and after (2008-2010) wood additions to Great Brook and its tributaries. Control sites are WIL10, WIL20 (Willard Brook), and GRT10 (Great Brook). Treatment sites are GRT15, GRT20 (Great Brook), SHI10 (Shirley Brook), and RED10 (Red Rock Brook).

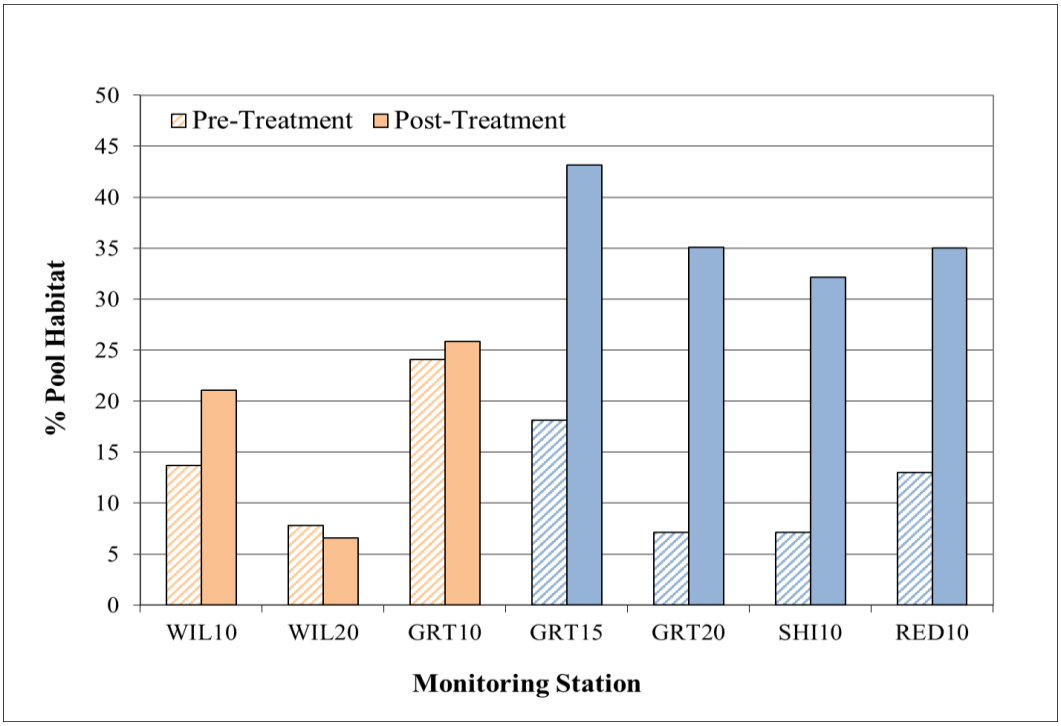

Figure 42. Percent pool habitat in sampling stations before (2004) and after (2008–2010) wood additions in Great Brook and its tributaries.

Discussion

This section will be considered in the future.

Monitoring Indicator 2

Brook trout abundance and biomass.

Results

Each year a new generation of brook trout hatches where available cold-water spawning habitat occurs. Late summer and early fall sampling finds this generation, referred to as young-of-year (YOY), ranging in length from 40 to 85 millimeters depending on the week of sampling and the density of the age class. There was very little difference in YOY densities between control stations and treatment stations on Great Brook (GRT15 and GRT20) before and after wood additions (Figure 43). There appeared to be no treatment effect in the mainstem of Great Brook as changes were minor and similar to control sites. YOY densities in treatment stations on Great Brook tributaries, however, increased substantially. Densities increased 10-fold in Shirley Brook and 3-fold in Red Rock Brook.

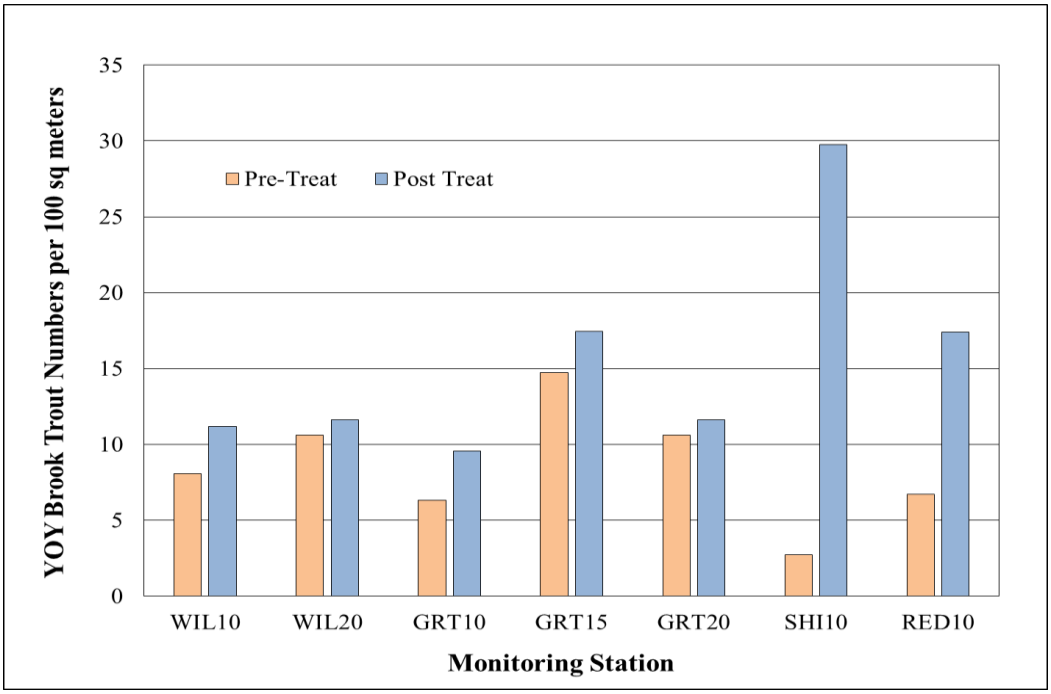

Figure 43. Density of young-of-year (YOY) brook trout before (2004) and after (2008–2010) wood additions in Great Brook and its tributaries.

Brook trout inhabiting New England streams generally become adults after their first year of life. Fish over 90 millimeters (3.5 inches) in late summer are considered to be older than 1 year as they hatch in March or April. Brook trout of 150 millimeters (6 inches) are generally considered the minimum size desired by anglers in New Hampshire. Changes in adult brook trout abundance in these two classes of adult fish are referred to as small (90-150 millimeters) and large (greater than 150 millimeters) adults. Biomass of small adults increased 79 percent after wood additions in treatment sites while control sites only increased 4 percent on average (Figure 44).

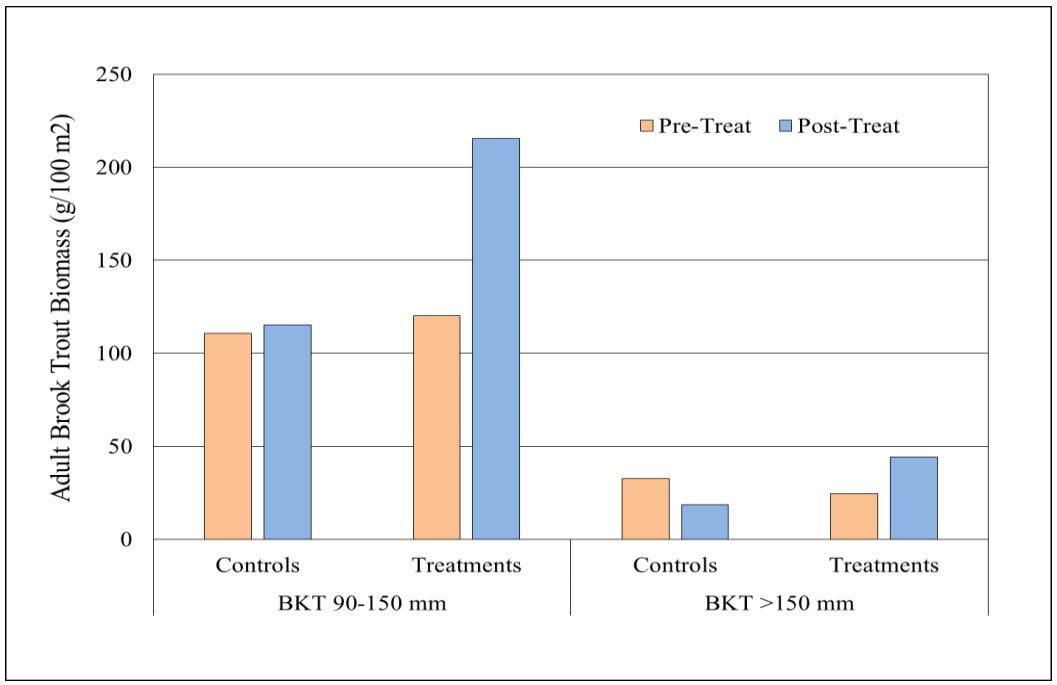

Figure 44. Average biomass of adult brook trout 90 to 150 millimeters long and greater than 150 millimeters long for control and treatment sites before and after wood additions in Great Brook and its tributaries for all sites combined.

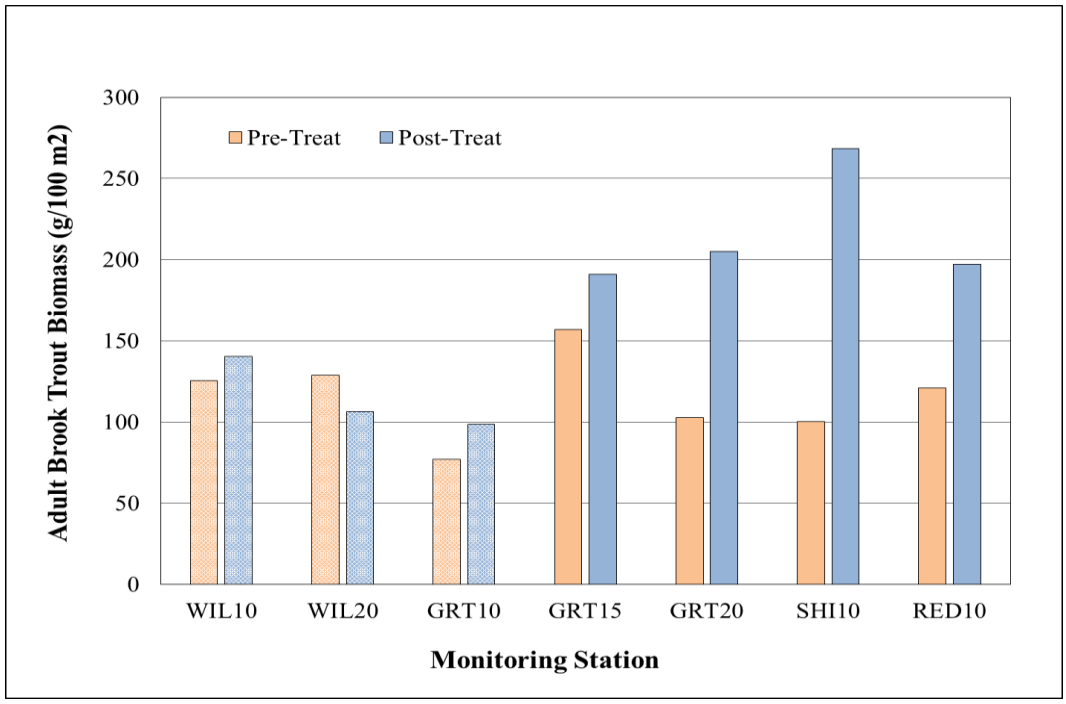

Figure 45. Adult brook trout biomass at control and treatment stations before and after wood additions in Great Brook and its tributaries.

Increases in biomass of small adults were found at all treatment sites, but the magnitude of increase varied substantially from 22 percent at station GRT15 to 167 percent at SHI10 (Figure 45). Biomass of large brook trout increased 81 percent after wood additions in treatment areas and declined by 43

percent in controls. Despite this large proportional change in biomass of large trout, it is a very small proportion of the overall adult population. Numbers of small brook trout increased from an average of 23 to 53 (130 percent) in treatment sites, while large trout increased only from an average of 1.7 to 3.4 (Figure 46). Numbers of small adult trout in control sites increased from 27 to 36 (33 percent), substantially less than observed in treatment areas. Numbers of large adults were low in both control and treatment stations, and relative to small adults, changes in treatment sites seemed inconsequential.

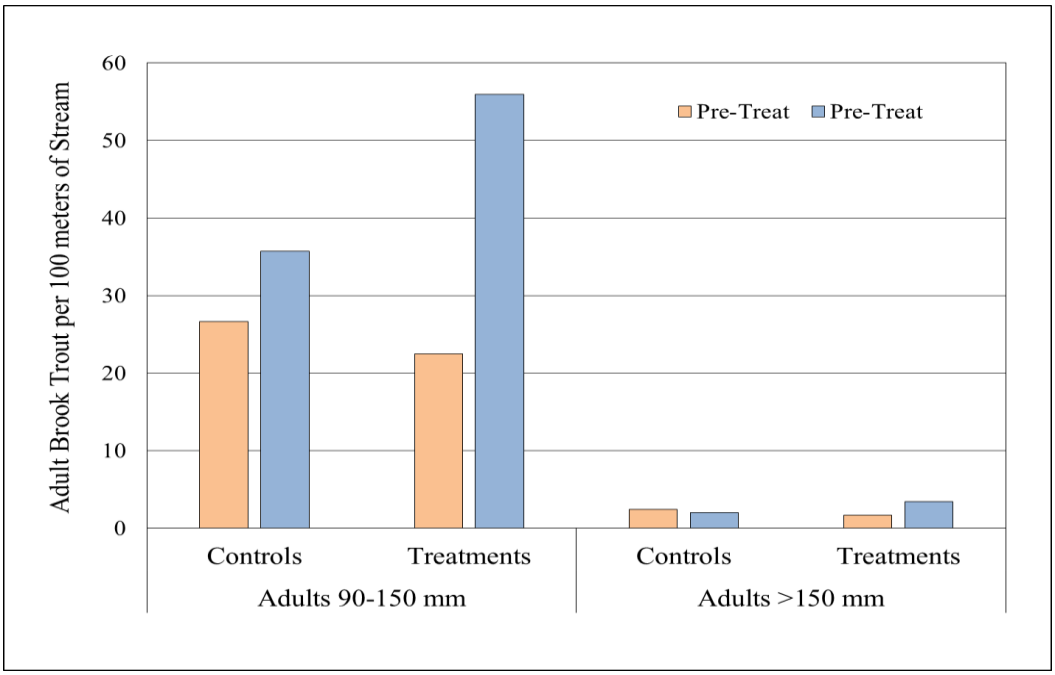

Figure 46. Average number of adult brook trout at control and treatment stations before and after wood additions in Great Brook and tributaries.

Discussion

Wood additions in the Great Brook watershed met project habitat objectives by creating approximately 300 pieces of large wood per mile of stream and increasing pool habitat to at least 30 percent of total stream habitat. The project added wood to over 2.4 miles of stream and wood counts at three of four sampling stations met these criteria when extrapolated to a per mile estimate. Pool habitat also increased to over 30 percent of stream habitat at all four sampling stations. Wood additions made some pools bigger, but they also added new pools. Before wood additions, there was a predominance of below-average quality pools, while after wood additions, pool quality improved. The project was successful at making a significant increase in instream habitat complexity compared to the pretreatment conditions.

Increases in fish productivity were hypothesized from increases instream habitat complexity. A common thought about mountain trout streams is that spawning habitat and pool habitat may limit overall productivity. A lack of small gravel stored in channels could limit brook trout spawning and sparse, deep-water habitats with cover limits the ability of larger brook trout to efficiently feed on larger prey items to sustain body size. Another hypothesis is that increased instream wood can increase nutrient storage and invertebrate abundance, leading to increased fish growth. While monitoring did not specifically address mechanisms that resulted in increases in fish abundance and biomass, the results do allow some resolution to how brook trout have responded to increased wood loadings in the White Mountains.

The greatest change between pre- and post-treatment monitoring was the large increase in young of the year brook trout in Shirley Brook, the smallest stream channel monitored in the project. Densities increased substantially in consecutive years with a post-treatment high of nearly 50 fish per 100 square meters, which is near the highest found within the WMNF from 1990 to present. In 2004, less than one young brook trout per 100 square meters was found, further emphasizing the extreme change. Since control stations did not show any upward or downward trend, changes in Shirley Brook could be attributed to habitat changes. In 2002, summer drought reduced flows in Shirley Brook substantially, so no electrofishing was conducted. After wood additions, the number, area, and quality of pools increased dramatically (Figure 47). In this small stream, those changes also allowed adult fish to remain in the stream during low flows, resulting in approximately a five-fold increase in adult fish during late summer low flows. Studies have shown that adult brook survival is higher in streams with more abundant pool habitat, especially in first- and second-order streams that are susceptible to drought-driven low flows (Hakala and Hartman 2003; Kanno et al. 2014).

Figure 47. Before (2004) and after (2009) photos of Shirley Brook following "chop and drop" of trees showing creation of a deep pool that resulted in large increases in brook trout at the sampling station.

The largest change in adult trout populations after wood addition was the increase in fish numbers and biomass of small adult trout relative to larger trout. While both groups increased, larger fish (most typically sought by anglers) were a minor proportion of the overall population present in stations during late summer, both before and after wood additions. Numbers of smaller adults outnumbered fish greater than 150 millimeters by 30 to 2 per 100 meters of stream in treatment areas. This suggests that habitat complexity created by wood additions may increase the number of feeding territories that allow individual fish to efficiently harvest food items relative to their body size. Perhaps the number of feeding territories increases by increasing the diversity of stream velocities and decreasing the visibility between territorial trout. The lack of large increases in larger trout in the stations suggests that larger adult fish are emigrating in search of larger food sources. Recent studies have shown that the majority of brook trout in West Virginia mountain streams greater than 125 millimeters (5 inches) in length migrate from shaded headwater streams to larger open-canopy rivers for supplemental foraging at some time in the year (Huntsman et al. 2016).

Changes in both habitat and brook trout abundance were not similar amongst all four treatment sites in Great Brook and its tributaries. The treatment sites differed in stream size, slope, and substrate size. Kratzer and Warren (2013) found that wood density in cold-water streams of Vermont is a major determinant of brook trout abundance. Kratzer (2018) found that additions of wood in second order

Vermont streams with less than a 4 percent stream gradient also increase brook trout abundance. Sweka et al. (2010) did not find a significant effect of wood additions on stream habitats and brook trout populations in West Virginia streams with an abundance of boulders and an average 3 percent stream gradient. Warren and Kraft (2003) suggested that habitat complexity in streams with an abundance of boulders may not be driven by instream wood densities, and therefore brook trout populations were not limited by the abundance of woody debris. Given the range of stream types in the White Mountains, we can expect that not all stream reaches would respond similarly to increasing wood inputs. In reality, we may see a diversity of stream reaches within a watershed that either transport wood or deposit wood. Therefore, brook trout abundance may be driven by boulders or wood depending on stream reach characteristics within the same watershed.

Recommendations

The results indicate that brook trout in first- and second-order WMNF streams with 2 to 4 percent gradients with low proportions of pool habitat can benefit from increased wood loadings. Furthermore, small streams that are susceptible to very low summer flows and that have a low abundance of pools can benefit the most from wood additions. This could be a useful mitigation for predicted warmer summers and increased droughts resulting from climate change. In the absence of wood addition projects, the use of no-cut buffers in riparian areas, or well-designed riparian silviculture prescriptions that promote wood loadings, could have benefits as well.

This project added substantial amounts of wood to 2.5 miles of streams. Some trees were dropped by chainsaw, while some wood was brought in with root wads, placed by an excavator, and cabled to boulders. Meeting habitat objectives through wood additions may indeed increase numbers of smaller adult brook trout, but it does not appear to substantially increase food productivity of these low nutrient systems. The absence of large increases in large trout numbers at fixed sampling stations suggests that food may still limit growth and survival of fish as they approach 150 millimeters. Further investigation into the mortality or movement of larger trout is needed to determine if habitat farther downstream is needed to expand numbers of larger mobile wild fish in watersheds.

This study did not examine the movement of wood after it was placed. Monitoring of the Great Brook Project ended in 2010 and Tropical Storm Irene went through the White Mountains in 2011. Other habitat projects implemented before 2010 did not have thorough evaluations before Irene impacted the Forest, however, “walk-throughs” of some treated reaches indicated that substantial amounts of placed wood had moved and created log jams in depositional stream reaches. In addition, both Tropical Storm Irene and Phillipe caused substantial instream wood inputs on rivers where mass wasting occurred. These natural wood additions were also mobile, and many created large wood jams that altered river flow dynamics, resulting in wide channels, access to floodplains, new side channels, or new main channels.

There have been far fewer wood addition projects since Tropical Storm Irene caused so much damage to infrastructure on the WMNF. This has been due to a change in priorities for both staff and programs. Natural wood loadings into streams are still expected to increase due to both large storm events and a continued increase in aging of the riparian forests within the WMNF. Future wood addition projects may focus on reconnecting rivers to floodplains or to protect roads by causing near-bank deposition rather than erosion. Projects designed to specifically benefit brook trout may be proposed, but the larger focus will shift to understanding how wood and floods will accelerate changes in river dynamics in the White Mountains. In some cases, this understanding may allow us to entertain using wood additions to improve access to floodplains after road decommissioning or to deflect flood energy away from

infrastructure when appropriate. In the process, we may discover benefits to migrant large brook trout who need access to larger streams and rivers for supplemental feeding.

Evaluation of Monitoring Question and Indicator(s)

This monitoring question was written when the Forest was conducting instream wood addition demonstration projects as a form of stream restoration to determine if high instream wood loading could increase trout stream productivity. It was also done to raise awareness that the maturing forest of the WMNF will result in more instream wood that may alter our view of what streams and rivers look like in the future.

The Great Brook project, and other wood addition efforts on the WMNF, were designed to add wood at high densities to examine immediate effects to brook trout habitat and populations in a localized response area. Wood was placed at regular intervals to promote a higher pool frequency and higher pool quality. Given the mobility of wood observed during high flow events, there is an opportunity to shift focus from stationary before-and-after evaluations of wood addition projects to wood mobility monitoring. Monitoring the source and movements of natural wood inputs, the changes in river morphology from log jam formation, the use of this natural instream wood by wild fish populations, and the potential risks to infrastructure from mobile wood within a watershed would better prepare the Forest for understanding the future expectations of ecosystem outputs as the forest continues to age. It is important to understand both the biological, physical, and social impacts of instream wood dynamics within the Forest and to adjacent communities, so local, state, and WMNF leaders can make informed decisions.

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5.16.2 – What are the effects of recreation use and related infrastructure on water quality?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Evidence of erosion, sedimentation, and/or waste in or near water bodies
- Turbidity
- Nutrients (nitrogen, phosphorus species)
- Bacteria (*E. coli*)
- Specific conductance (conductivity)

Monitoring Frequency

Each site was sampled two to four times in the timeframe indicated in the table below.

Background and Driver(s)

The purpose of answering this monitoring question is to determine whether established recreation sites are being maintained to safety and resource protection standards with a focus on fee sites. This monitoring helps managers determine if additional actions are needed to protect the sites, human health, or aquatic life and habitat. The WMNF receives a large number of visitors, and many recreation sites are adjacent to water. Collecting and analyzing data will help quantify the effects of recreation sites and their management on water quality.

Surface waters on the WMNF are considered "outstanding resource waters," and water quality is maintained or improved to protect existing and designated instream water uses, such as aquatic life. Watersheds will continue to provide high-quality water for public water supplies, recreational activities, aquatic biota such as fish, and other purposes.

This monitoring question addresses the following Forest Plan Standard: Soil and Water Conservation Practices, S-2 (p. 2-30):

> *Water quality must be maintained and protected, except that some discharges may be allowed if they are of limited extent and duration and result in no more than temporary and short-term changes in water quality. Such activities shall not permanently degrade water quality or result at any time in water quality lower than that necessary to protect the existing and designated uses. Such temporary and short-term degradation is only allowed when all practical and appropriate Soil and Water Conservation Practices are used to reduce impacts to water quality.*

Recreation sites were categorized and filtered to include sites near water. Categories include campgrounds, ski areas, and “other sites,” such as huts, picnic areas, and shelters. Sites were then randomly selected for monitoring.

Results

Table 34. Water quality monitoring results at WMNF recreation sites.

Location (sample years)	Sample point	Turbidity (NTU)	Conductivity (uS/cm)	E. coli (Counts/100ml)	Nitrate (ppm as N)	Phosphorus (ppm)	Ammonium (ppm as N)
Waterville Valley Alpine Ski Area (2014–2015)	Tecumseh Brook	0.3	57.2	—	0.32	0.01	less than 0.005
Waterville Valley Alpine Ski Area (2014–2015)	West Branch Mad River above Tecumseh Brook	0.0	16.9	—	0.18	0.00	less than 0.005
Waterville Valley Alpine Ski Area (2014–2015)	West Branch Mad River at FR 53	0.0	26.6	—	0.23	0.00	less than 0.005
Jigger Johnson Campground (2015)	Swift River above Campground	0.2	27.9	9	0.11	0.01	less than 0.005
Jigger Johnson Campground (2015)	Swift River below Campground	0.2	27.4	8	0.11	0.01	less than 0.005
Passaconaway Campground (2015)	Swift River above Campground	0.3	31.3	13	0.13	0.01	less than 0.005
Jigger Johnson Campground (2015)	Swift River below Campground	0.3	28.7	5	0.12	0.01	less than 0.005
Wildcat Alpine Ski Area (2015–2016)	Peabody River above Wildcat	0.2	105.1	4	0.07	0.00	less than 0.005
Wildcat Alpine Ski Area (2015–2016)	Peabody River at Wildcat	0.3	84.7	2	0.11	0.00	0.015
Wildcat Alpine Ski Area (2015-2016)	Peabody River below Thompson Brook	0.3	70.7	4	0.10	0.00	0.005
Wildcat Alpine Ski Area (2015–2016)	Thompson Brook	0.2	13.3	10	0.06	0.00	less than 0.005

Location (sample years)	Sample point	Turbidity (NTU)	Conductivity (uS/cm)	E. coli (Counts/100ml)	Nitrate (ppm as N)	Phosphorus (ppm)	Ammonium (ppm as N)
White Ledge Campground (2016)	East Brook above Campground	0.3	25.5	2	0.00	0.00	less than 0.005
White Ledge Campground (2016)	East Brook below Campground	0.3	24.7	2	0.01	0.02	less than 0.005
White Ledge Campground (2016)	Outlet below Campground	0.3	24.6	6	0.00	0.00	less than 0.005
White Ledge Campground (2016)	West Brook above Campground	0.3	33.9	—	0.01	0.00	less than 0.005
White Ledge Campground (2016)	West Brook below Campground	0.3	27.0	68	0.00	0.00	0.056
Waterville Campground (2017)	Mad River above Campground	0.2	55.7	9	0.13	0.00	less than 0.005
Waterville Campground (2017)	Mad River below Campground	0.2	55.7	4	0.13	0.00	less than 0.005
Osceola Vista Campground (2017)	West Branch Mad River above Campground	0.1	15.6	6	0.05	0.00	0.013
Osceola Vista Campground (2017)	West Branch Mad River below Campground	0.1	15.7	5	0.06	0.00	less than 0.005
Russell Pond Boat Launch (2017)	Russell Pond Boat Launch	0.3	12.9	8	0.01	0.00	0.009
Bear Notch Ski Touring (2017–2018)	Albany Brook	0.1	18.9	—	0.03	0.00	less than 0.005
Bear Notch Ski Touring (2017–2018)	Bartlett Brook at Bridge	0.2	17.4	—	0.04	0.00	less than 0.005

Location (sample years)	Sample point	Turbidity (NTU)	Conductivity (uS/cm)	E. coli (Counts/100ml)	Nitrate (ppm as N)	Phosphorus (ppm)	Ammonium (ppm as N)
Sugarloaf II Campground (2018)	Zealand River above Campground	0.2	19.7	5	0.06	0.00	less than 0.005
Sugarloaf II Campground (2018)	Zealand River below Campground	0.2	19.6	3	0.06	0.00	0.006
Hancock Campground (2019)	East Branch Pemigewasset River above Campground	0.2	17.6	5	0.12	0.00	less than 0.005
Hancock Campground (2019)	E. Branch Pemigewasset River below Campground	0.2	17.7	11	0.12	0.00	less than 0.005

None of the water quality samples taken as part of this monitoring project between 2015 and 2019, as reported here, exceed any state of New Hampshire water quality standard for any of the parameters measured (Table 34). Turbidity for all samples was very low, with no elevated turbidity for any site. Conductivity was higher than natural in the Peabody River, Tecumseh Brook, and Mad River. The cause of elevated conductivity is primarily road salt, and chloride concentrations were well below established water quality criteria. The only recreation site that was observed to be the primary source of road salt was the Waterville Valley Alpine Ski Area. Aside from Waterville Valley Alpine Ski Area, no noticeable increases in conductivity were observed due to the recreation sites. *E. coli* counts were generally very low, except for West Brook below White Ledge Campground. While the *E. coli* count of 68 colonies per 100 milliliters is below the New Hampshire water quality standard, it clearly shows evidence of organic waste entering the brook at White Ledge Campground. Nitrate, phosphorus, and ammonium were all very low, indicating that nutrient loading from these recreation sites is not an issue. The highest value of ammonium (although still very low) was found in West Brook below White Ledge Campground, providing further evidence of waste entering the brook at White Ledge Campground.

Discussion

This section will be considered in the future.

Recommendations

Because of the lack of water quality concerns at recreation sites across the WMNF, the recommendation is to discontinue collecting water chemistry at randomly selected sites and focus on only measuring bacteria at selected high-use recreation sites where bacteria may be a possible risk factor. Special attention should be given to Class A Waters as determined by the state of New Hampshire, as these waters are directly upstream of community drinking water sources.

Evaluation of Monitoring Question and Indicator(s)

Monitoring water quality at recreation sites for the purpose of answering this particular monitoring question formally began in 2010. The sites monitored in 2010 included Dolly Copp and Barnes Field Campgrounds, Tripoli Road dispersed camping area, Moat Mountain Trail System project area, and Lower Falls recreation site on the Swift River. The sites monitored in 2011 included Jigger Johnson, Passaconaway, and Waterville Valley Campgrounds; Waterville Valley Resort; Diana's Baths recreation area, and Tripoli Road dispersed camping area. The sites monitored in 2012 included Wildcat Mountain Resort, Loon Mountain Resort, Hastings Campground, Wild River Campground, and a dispersed camping area on Great Brook. The sites monitored in 2013 included Campton Campground and Loon Mountain Resort. The sites monitored in 2014 included Loon Mountain Resort and Wildwood Campground. Summaries of the results of water quality monitoring at recreation sites for 2010 through 2014 can be found in the monitoring reports for those years. In total, 25 recreation sites have been monitored between 2010 and 2019. The only reported water quality concern was one sample downstream of a riparian campsite on Tripoli Road showing *E. coli* counts above the New Hampshire water quality standard. This resulted in some campsites being closed and rehabilitated. Water chemistry was not a concern at any site, and all water chemistry values were well below water quality criteria.

References

Not applicable.

***5.16.3 – Are Forest Plan standards and guidelines sufficient for protecting, restoring, or improving headwater stream ecosystems (riparian and aquatic)? Are 25-foot no-cut**

zones and riparian management zones on perennial streams being implemented on timber sales?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

Selected water quality parameters within vegetation management projects:

- Distance of timber harvest units to stream
- Instream habitat
- Maximum average 30-day water temperature
- Brook trout density and biomass

Monitoring Frequency

Annual, with each site sampled once in spring, summer, and fall each year.

Background and Driver(s)

For this report, these monitoring indicators are used to determine if riparian and aquatic habitat standards and guidelines (Forest Plan, p. 2-24 to 2-26) were implemented in the Province Timber Sale for payment units that occur within the Weeks Brook drainage (Figure 48).

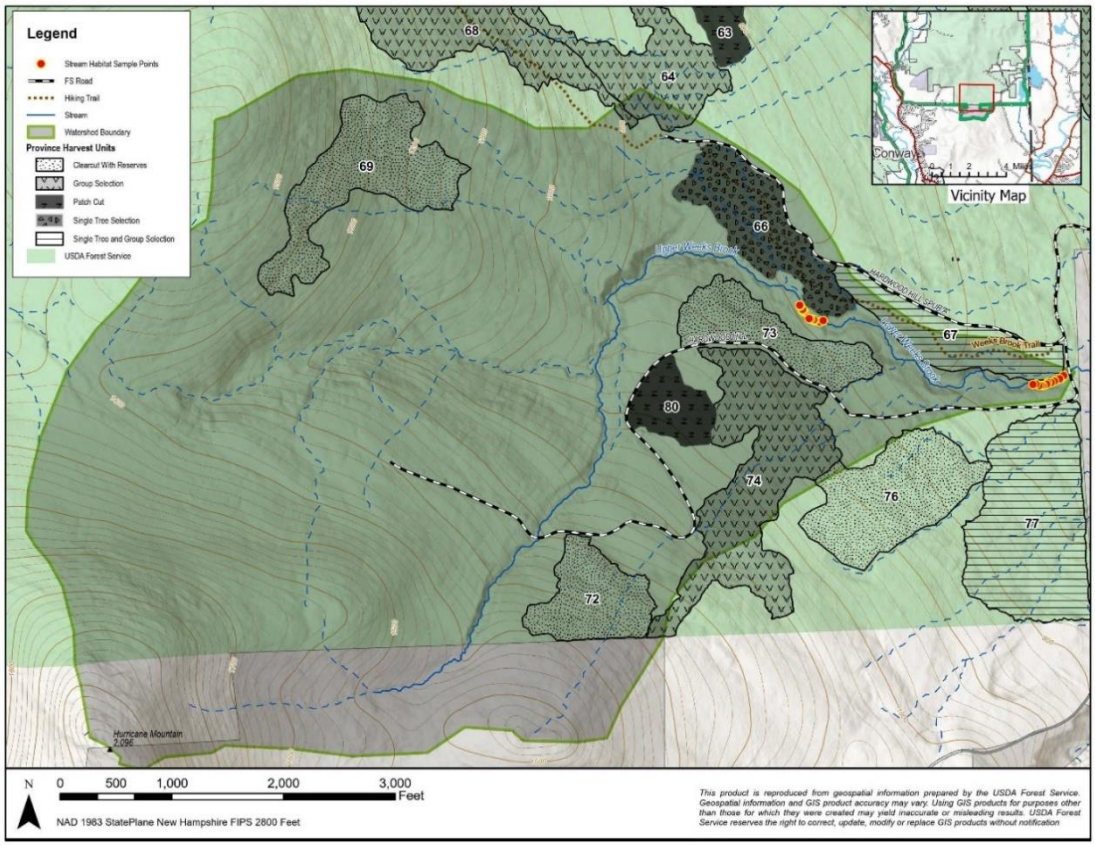

Figure 48. Payment units of the Province Timber Sale within the Weeks Brook watershed. Red points are habitats where brook trout were sampled and water temperature was measured at Upper Weeks Brook (leftmost group) and Lower Weeks Brook (rightmost group).

The purpose of answering this monitoring question is to document the effectiveness of the Forest Plan as it relates to protecting aquatic resources, including water quality and aquatic ecosystems. This monitoring helps managers determine if additional actions are needed to protect water quality, aquatic life, and aquatic habitat. Collecting and analyzing data will help quantify the effects of routine forest management activities.

Surface waters on the WMNF are considered "outstanding resource waters," and water quality is maintained or improved to protect existing and designated instream water uses such as aquatic life. Watersheds will continue to provide high-quality water for public water supplies, recreational activities, aquatic biota such as fish, and other purposes.

Monitoring Indicator 1

Distance of timber harvest units to stream.

Results

Payment unit 66 within the Weeks Brook riparian area was harvested in December of 2016, an uneven-aged silvicultural treatment where single trees were selected from a stand dominated by eastern hemlock and to a lesser extent, red maple (Figure 49). Measurements from the harvest boundary line

(painted trees) to the closest stream bank averaged 46 feet (range: 15-83 feet). Only one single tree was cut within the 25-foot no-cut zone along the 0.25-mile unit boundary within the true riparian area.

Figure 49. Payment unit 66 in the Province Timber Sale shown after harvesting. Note the greater amount of sunlight on the forest floor in the treated area in the foreground compared with the denser forest in the untreated area adjacent to the Weeks Brook floodplain shown in the background.

Two other payment units occurred within or near the Weeks Brook riparian area. No trees were cut within the 25-foot no-cut zone within the true riparian area of these units. Payment unit 73 was a regeneration clearcut to create an even-aged stand of hardwoods and provide early successional habitat for wildlife species. This unit, containing sugar maple, American beech, and eastern hemlock, was harvested in October 2018. The boundary line of this unit came within 115 feet of Weeks Brook at its closest point but mostly occurred greater than 150 feet from the brook. Payment unit 67 was an uneven-aged treatment of eastern hemlock forest where single trees and small groups of trees were harvested in January of 2021. This unit bordered the Weeks Brook riparian area for 0.4 mile, and the unit boundary was mostly 40 feet or greater from the closest stream bank.

Discussion

Sale layout of harvest areas along Weeks Brook by foresters on the Saco Ranger District was done with recognition of riparian values. Forest Plan standards and guidelines for riparian and aquatic habitats were met with the layout of all three units that bordered Weeks Brook, with the exception of one tree that was cut within the 25-foot no-cut zone. Riparian areas are defined in the Forest Plan glossary as "geographically delineable areas with distinctive resource values and characteristics that are comprised of aquatic and riparian ecosystems" (p. 24) and riparian and aquatic habitats guideline G-1 states that "Tree cutting and harvest should not occur within 25 feet of the bank of mapped perennial streams, the high water mark of a pond, or a identified natural vernal pool, unless prescribed to benefit hydrological or ecological function of the associated stream, pond, or riparian area" (Forest Plan, p. 2-24). The reason for the varying width of the harvest boundary line (range: 15-83 feet) and the cutting of the single tree within the no-cut zone is that the foresters who laid out the harvest unit were following the terrace

bank of the brook, staying out of the lower flood-prone area, which better meets the intent of the guideline by following the actual boundary of the riparian area rather than adhering to strict distance measurements.

Monitoring Indicator 2

Instream habitat.

Results

Two sampling sites, comprised of reaches of 328 feet (100 meters) each, were identified on Weeks Brook adjacent to riparian forest stands where forest harvesting was planned. At these sites, water temperature, pool habitat, and brook trout numbers were monitored from 2016 to 2024. Similar data was collected on two additional sites on Johnson Brook within the WMNF, approximately 30 miles west of Weeks Brook. Johnson Brook was identified as a good control site because it had an above-average amount of sandy sediment on the stream bed compared to Weeks Brook (Figure 50), which is believed to be the result of high stream bank failures upstream. Sedimentation from timber harvesting has long been recognized as having the potential to degrade fish habitat. The expectation was that habitat in Weeks Brook would be of higher quality than in Johnson Brook before forest harvesting occurred, therefore resulting in a potentially higher biomass of brook trout. If forest harvesting had a negative effect on habitat in Weeks Brook, then brook trout numbers and biomass may decline.

Pool habitat was measured with very coarse definitions for the purpose of identifying major changes in pool habitat. After 2017 Tropical Storm Phillipe caused flooding on the WMNF, there was a noticeable visual reduction of sand along the bottom of Johnson Brook. With each passing year, visual inspection indicated that the presence of sand had become rarer and more typical of other WMNF streams. While the visual loss of sand was noticed by crews, pool habitat measurements did not indicate any change in sand using standard methods. There were no upward or downward trends in pool habitat over the entire sampling period at any site in either Weeks Brook or Johnson Brook (Figure 51). Pool habitat had a very similar range across all four sites (approximately 10 to 22 percent).

Figure 50. Abnormally high density of sandy substrate in Johnson Brook in 2015.

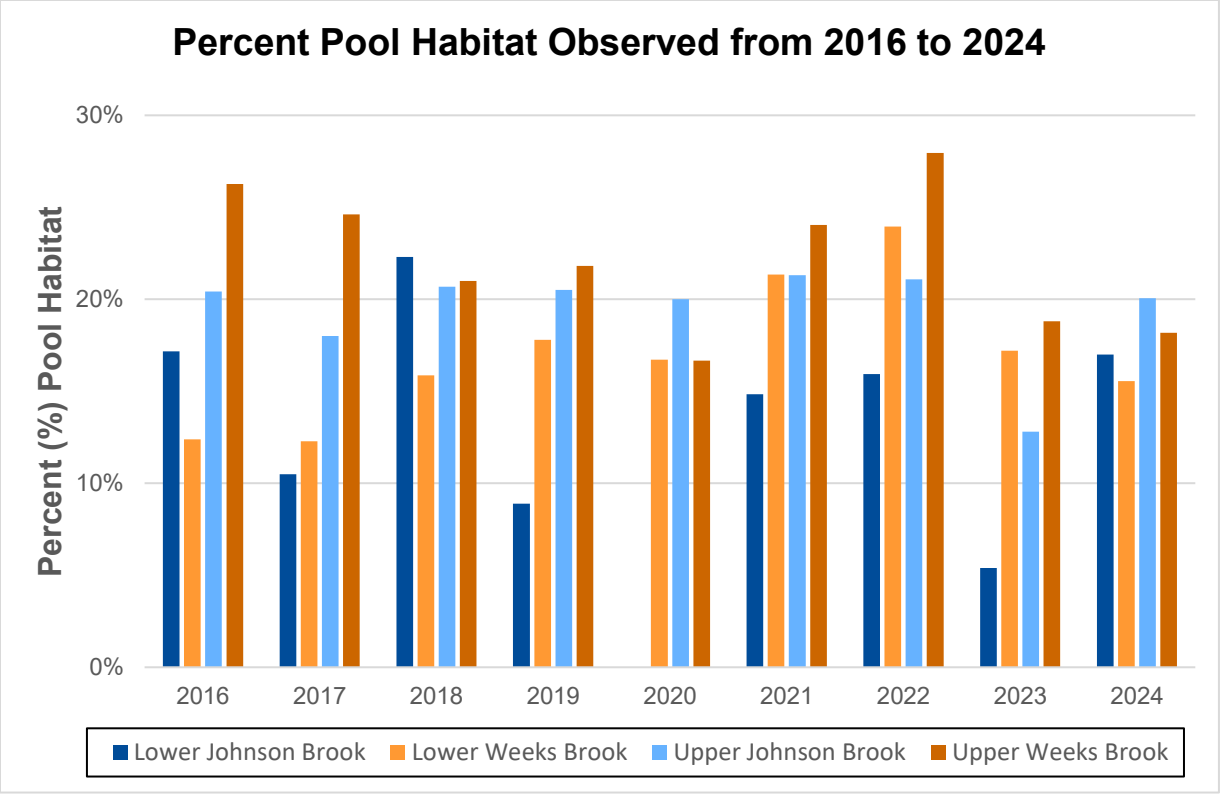

Figure 51. Percent of pool habitat in brook trout sampling stations at Johnson and Weeks Brooks from 2016 to 2024

Discussion

While there was a noticeable visual reduction of sand along the bottom of Johnson Brook, pool habitat measurements did not indicate any change in sand using standard methods. This suggests that the standard methods may not be appropriate for use in small streams like Johnson Brook.

Monitoring Indicator 3

Maximum average 30-day water temperature.

Results

We measured stream temperature at two sites along Weeks Brook (Upper Weeks Brook and Lower Weeks Brook, hereafter) where forest harvesting was planned, and at one site at Johnson Brook (Lower Johnson Brook, hereafter) where forest harvesting would not occur within this analysis period. Air temperature was only measured at the lower stations at both Johnson Brook and Weeks Brook. Air temperature loggers were located under forest canopy within 25 feet of the stream bank at both locations, while water loggers were placed under boulders in pools.

Air temperatures were consistently higher at Lower Weeks Brook than at Lower Johnson Brook, but both sites seem to follow the same pattern throughout the summer in 2016 before any forest harvesting occurred.

On a given summer day, Lower Weeks Brook temperatures were up to 3 degrees Celsius warmer than Lower Johnson Brook. Johnson Brook drains a larger area of land and from a higher elevation than Weeks Brook, resulting in cooler temperatures.

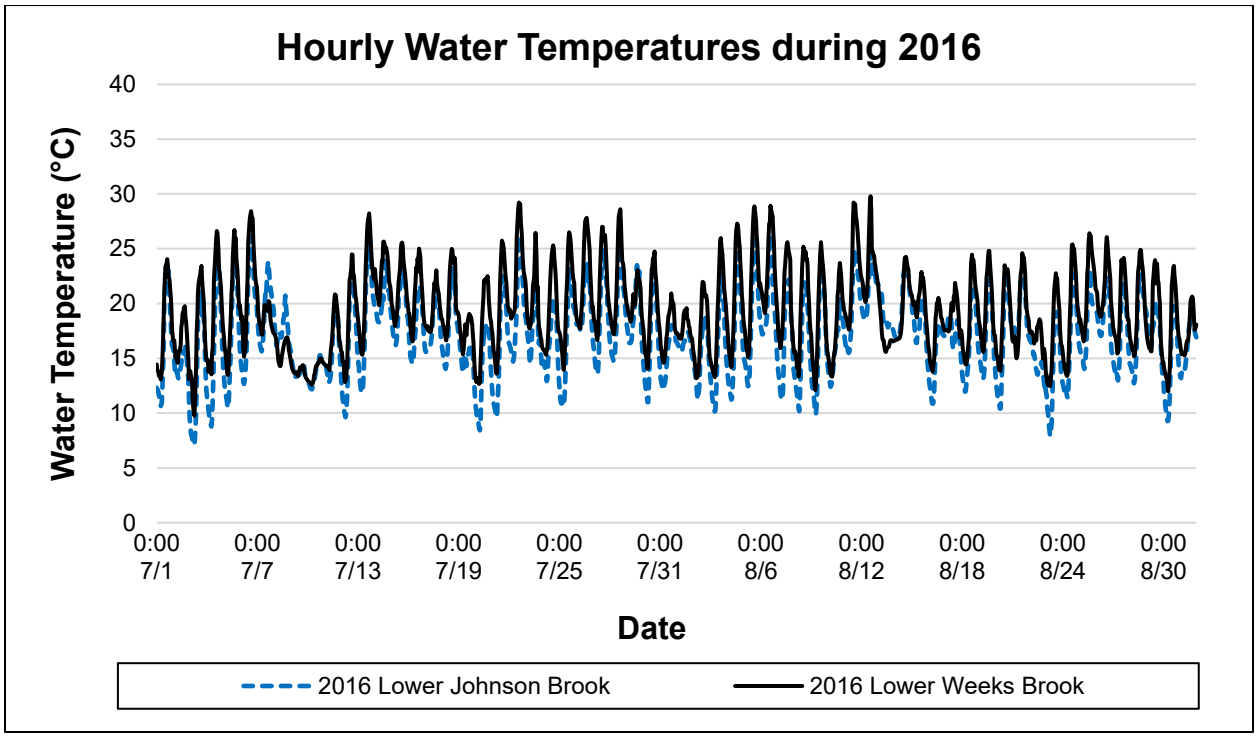

Figure 52. Hourly water temperatures at Lower Johnson Brook and Lower Weeks Brook in the summer of 2016.

Water temperatures at all three sites followed the same pattern of daily variability as air temperatures throughout the summer, each year, even after forest harvesting occurred on Weeks Brook. Despite the annual differences in the temperature metric, both brooks classified as true "cold-water" streams (less than 18 degrees Celsius) every year (Figure 53). Even after forest harvesting along both the Upper and Lower Weeks Brook sites, average temperatures varied proportionally to the annual variability found at Lower Johnson Brook. Note that the two warmest summers (2022 and 2024) did push Lower Weeks Brook up to the cold-water/cool-water ecological threshold.

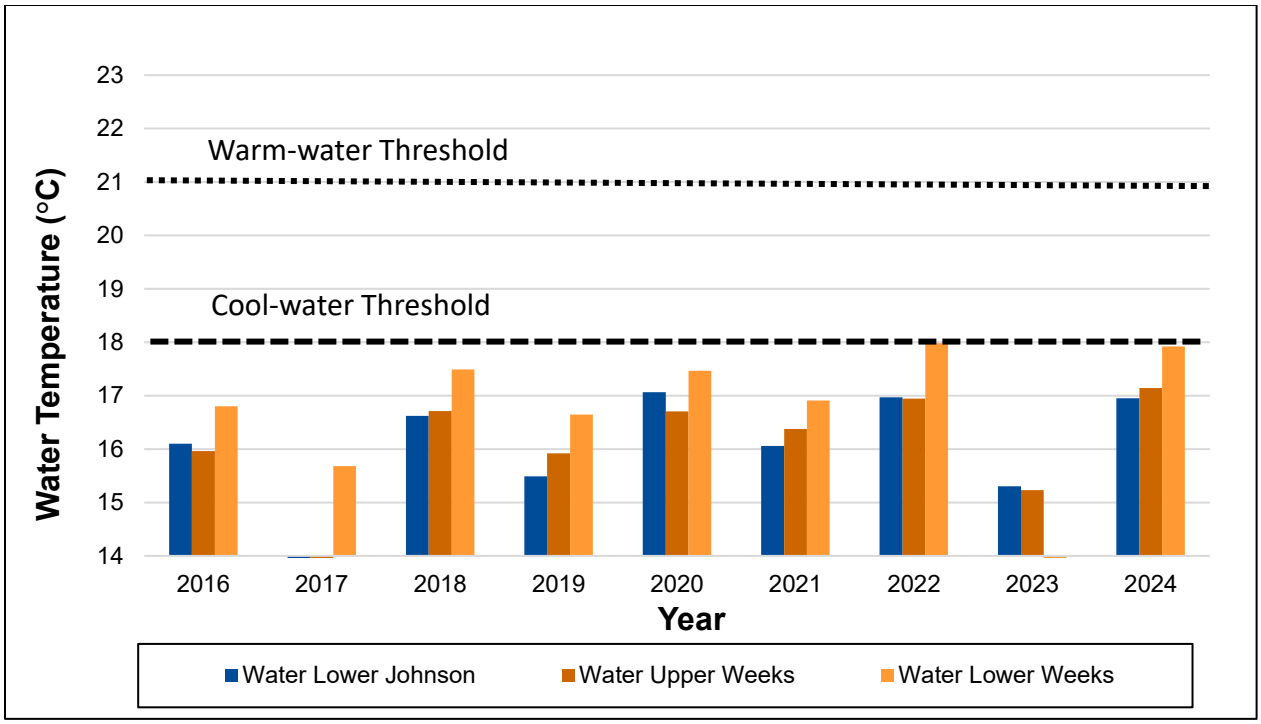

Figure 53. The maximum 30-day average stream temperature in summer from 2016 to 2024 at Lower Johnson Brook and Lower and Upper Weeks Brook.

Discussion

Long-term weather trends and regional daily weather patterns are important drivers of stream water temperatures in naturally forested systems. Differences in watershed characteristics such as maximum elevation and drainage area size most likely account for differences in temperature ranges and diurnal temperature swings, as seen at Johnson Brook and Weeks Brook in 2016 before forest harvesting occurred. Figure 54 shows how current riparian guidelines for forest harvesting look along Upper Weeks Brook, showing the "no-cut zone" on the left and the 100-foot riparian management zone on both sides. On the left, single-tree selection and group selection are implemented outside of the 25-foot no-cut zone. On the right, a clearcut is shown outside of the riparian management zone, over 100 feet away. These guidelines appear to be sufficient in the White Mountains to ensure water temperatures are not elevated to a threshold where cold-water aquatic ecosystems are at risk, at least at this scale of harvesting. Note, however, that there was not extensive forest harvesting upstream throughout the watershed.

Figure 54. Payment unit 66 (single-tree selection harvesting) on the left and payment unit 73 (clearcut greater than 100 feet from the brook) on the right of Weeks Brook.

Monitoring Indicator 4

Brook trout density and biomass.

Results

Annual biomass estimates of wild brook trout at Upper Weeks Brook ranged from 21.5 to 30.8 kilograms/hectare, with one exception of 10.2 kilograms/hectare in the extremely wet summer of 2023. Biomass averages for the years 2014 to 2016 and 2017 to 2019 were nearly identical for the timeframe when risks of negative impacts to brook trout from forest harvesting would have been the highest (Figure 55). If any impacts did occur, they appear to have had little impact to productivity. Brook trout productivity was measured as moderate before and after timber harvesting. Upper Johnson Brook increased from a moderate productivity class (16.2 kilograms/hectare) to a high productivity class (40.5 kilograms/hectare) during the monitoring period, before returning to the moderate productivity class (26.7 kilograms/hectare) in 2024. A similar increase in biomass was not observed at Upper Weeks Brook.

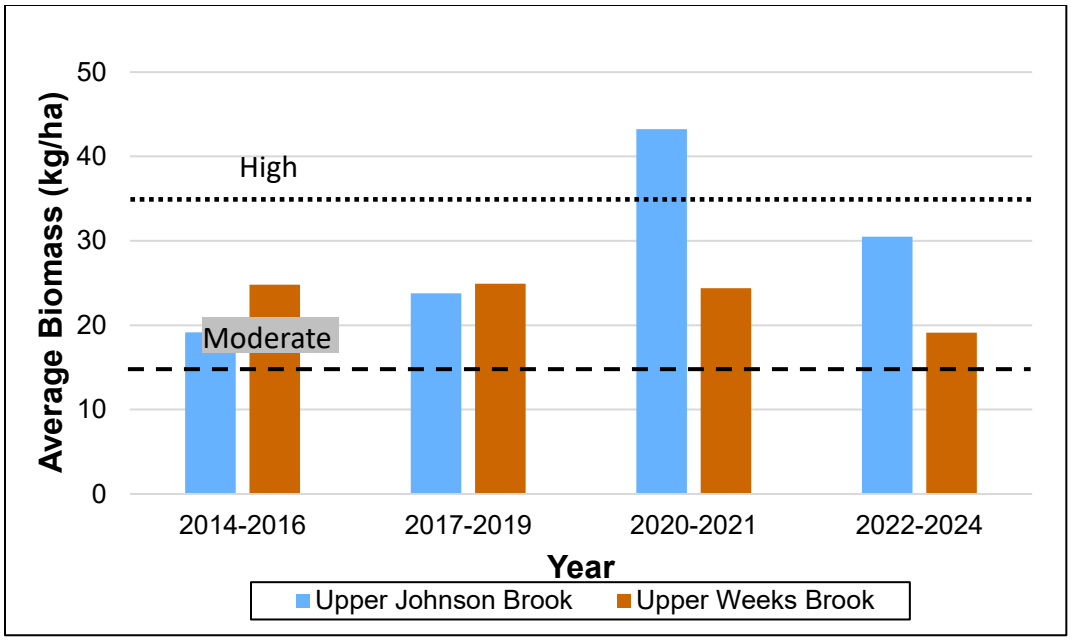

Figure 55. Average biomass (kilograms/hectare) of wild brook trout in Upper Johnson Brook and Upper Weeks Brook before (2014-2016), during (2017-2019 and 2020-2021), and after (2022-2024) timber harvest.

Biomass estimates at Lower Weeks Brook were very stable (21.3–24.0 kilograms/hectare) from 2020 to 2024 when the potential impacts from forest harvesting might have occurred there, as compared to the years 2014 to 2019 (10.9–25.1 kilograms/hectare). Meanwhile at Upper Johnson Brook, where no timber harvesting occurred, biomass increased from 2018 to 2020. Lower Johnson Brook changed from a low productivity class (6.9 kilograms/hectare) to a moderate productivity class (22.6 kilograms/hectare) by 2024 (Figure 56).

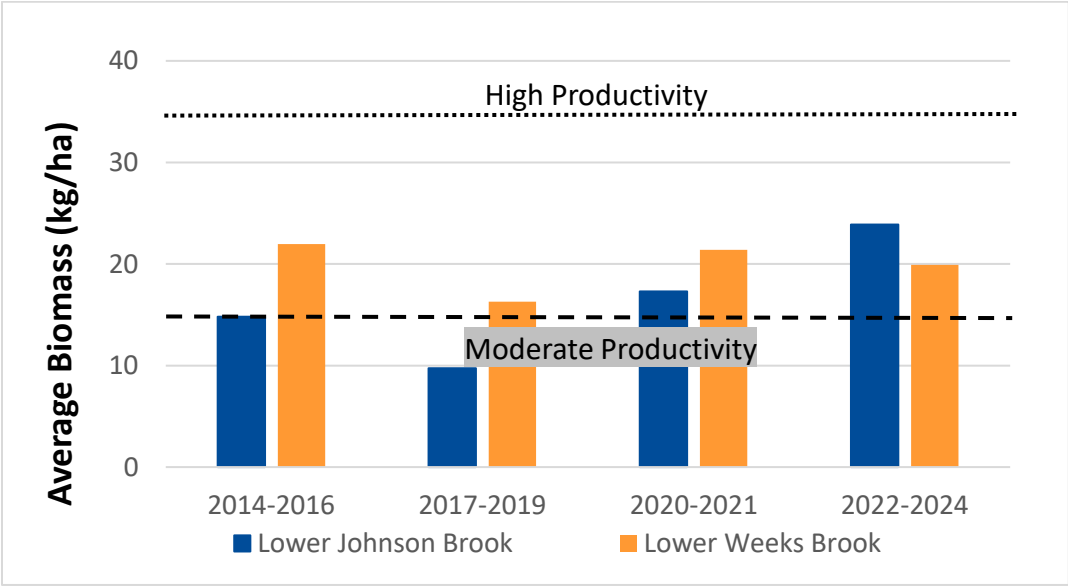

Figure 56. Average biomass (kilograms/hectare) of wild brook trout in Lower Johnson Brook and Lower Weeks Brook before (2014-2016), during (2017-2019 and 2020-2021), and after (2022-2024) timber harvest.

Densities of young-of-the-year (YOY) brook trout were highly variable within all sites across all years, falling in all productivity classes (low, moderate, and high) at all sites (Figure 57and Figure 58). Average YOY densities at Upper Weeks Brook declined from 2017 to 2019, which could suggest that forest harvesting adjacent to the sampling station impacted either spawning success or young fish survival. Numbers of young trout, however, were down at all sites in Weeks Brook and Johnson Brook in 2018, as well as other sites in the White Mountains. This is believed to be related to Tropical Storm Phillipe moving through the area on November 1, 2017, just as the brook trout spawning season was ending. Variability of YOY densities at both sites in Weeks Brook was no greater than variability observed at both sites in Johnson Brook.

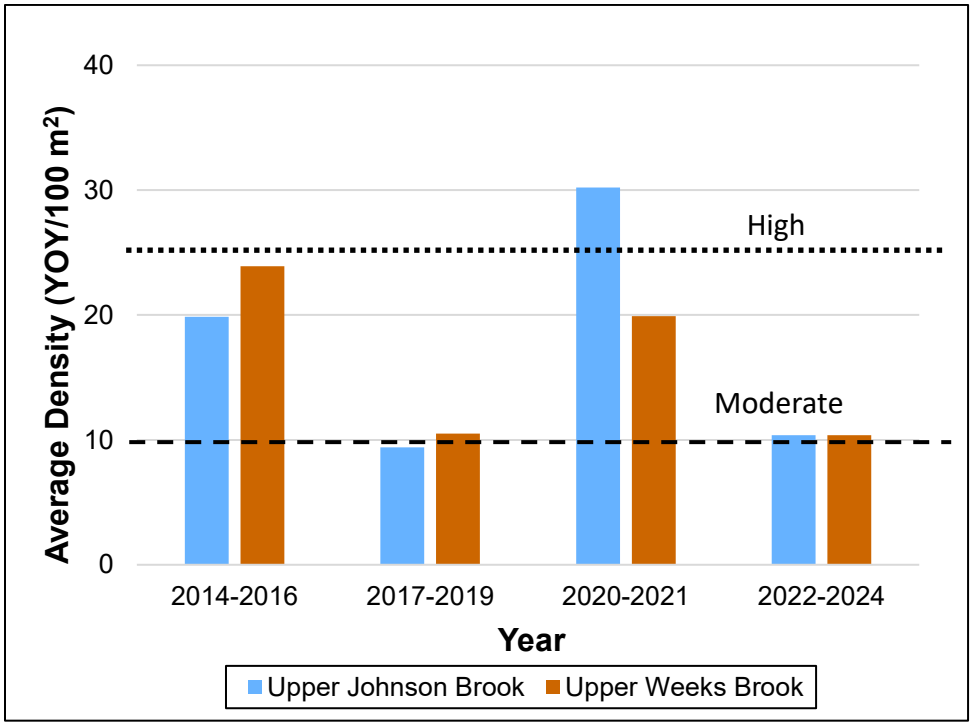

Figure 57. Average densities of young-of-the-year (YOY) wild brook trout from 2014 to 2024 in Upper Johnson Brook and Upper Weeks Brook before (2014-2016), during (2017-2019 and 2020-2021), and after (2022-2024) timber harvest.

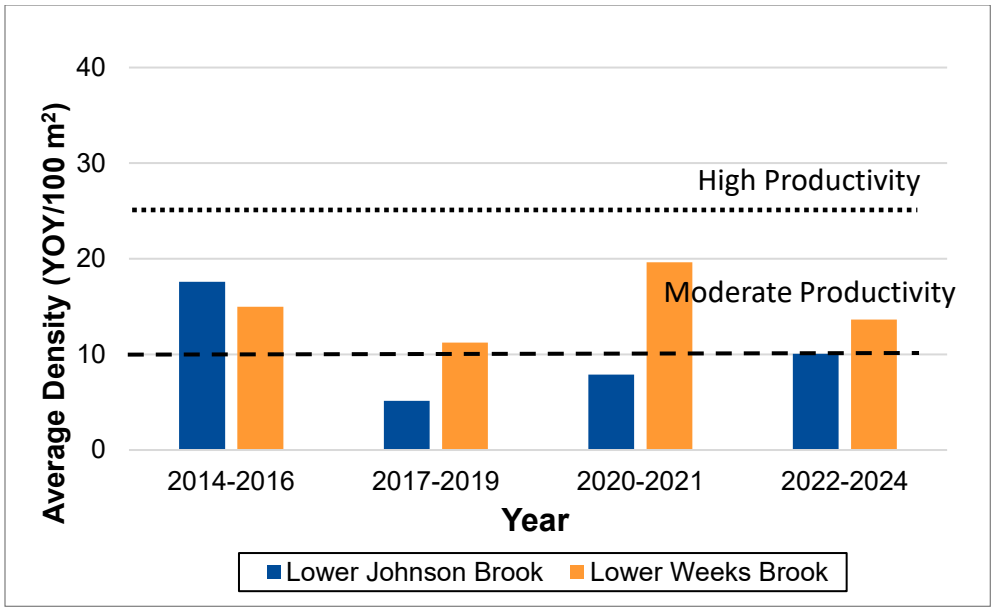

Figure 58. Average densities of young-of-the-year (YOY) brook trout from 2014 to 2024 in Lower Johnson Brook and Upper Weeks Brook before (2014-2016), during (2017-2019 and 2020-2021), and after (2022-2024) timber harvest.

Discussion

The variability of brook trout population metrics was consistent with what has been observed elsewhere in the White Mountains in the absence of forest harvesting. There was no evidence that forest harvesting on the Province Timber Sale resulted in large temperature or habitat changes that resulted in changes in brook trout populations. Annual habitat and stream temperature changes seem to vary by regional weather patterns which cause weekly flows to fluctuate throughout the year. Stream flows most likely affect the amount of habitat available for trout, thereby influencing growth and survival rates. There was no evidence that "typical" land use, such as the Province Timber Sale, has a greater impact than the natural flow variability that occurs within the landscape. There appears to be some minor evidence that larger events such as floods and droughts have more impact than current land uses on the WMNF.

Recommendations

Riparian guidelines that follow set distances for various types of management are good starting points for ensuring cold-water ecosystem protection. We found that during timber sale layout, foresters on the Province Timber Sale were following land formations more than adhering to strict protection distances. In the Weeks Brook watershed, at this low magnitude of harvesting, guidelines were sufficient to protect cold-water temperatures. An interesting observation is that the more recent warmer summers of 2022 and 2024 found water temperatures reaching the 18-degree Celsius threshold. This is not a serious threat to brook trout as they generally are quite common in cool-water streams, especially under 19.5 degrees Celsius. It is, however, recommended that attention be given to small streams (first and second order) that flow off lower maximum elevations, such as Weeks Brook, when more extensive harvesting is proposed throughout the drainage. If the trend in warmer summers continues, monitoring efforts should focus on those areas that may be more at risk of disturbances to forest canopy or hyporheic zones within the riparian area. It is also recommended that stream reaches in low gradient valleys, which have the potential to migrate from accumulating wood and sediment and developing side

channels, be identified and considered for wider no-cut zones, especially in drainages of higher average temperature.

The rapid habitat survey used for monitoring stream habitat changes in the WMNF may not be appropriate for monitoring smaller land use changes in streams such as Johnson Brook. The survey uses a definition of "pool" that may only be appropriate in streams where boulders are a minor component in the substrate, more typical of streams of less than a 2 percent gradient. Pebble counts and more detailed habitat mapping may be necessary to track habitat changes.

Beaver Brook in the Six Lid Timber Sale in Stoneham Maine, is currently being monitored in a similar fashion as the Province Timber Sale. Forest harvesting will cover a larger proportion of the drainage area of Beaver Brook. This provides an opportunity to determine if more intensive harvesting in the drainage area has any effect on brook trout populations and their habitat. Monitoring results at that location should be reported in the 5 years after forest harvesting is complete.

This would be an appropriate time to begin mapping riparian areas now that lidar imagery is available for the entire WMNF. Riparian buffers were debated during the 2005 Forest Plan Revision, planning of the Albany South Project Area, and during public review of the 2012 Planning Rule. The focus is on fixed distances for management zones. Real riparian areas are of varying widths depending on landforms such as valleys and floodplains, which change throughout mountain geography. The establishment of long-term stream reach monitoring sites provides an opportunity to begin mapping real riparian area boundaries in areas where valleys and floodplains are wider. Although monitoring has shown that foresters on the WMNF have been following landforms when laying out harvesting unit boundaries, the mapping of real riparian boundaries and management zones may build public trust earlier in the project planning process and improve riparian protections as more instream wood accumulates in streams and floodplains.

References

Not applicable.

5.16.4 – Are stream temperatures changing over time? Are fish communities changing with temperature changes?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Maximum average 30-day summer water temperature

Monitoring Frequency

Annual.

Background and Driver(s)

Summer stream temperatures, in general, control aquatic species composition of stream ecosystems. Landforms, current climate, summer weather patterns, and land management activities ultimately control summer stream temperatures. A goal of the WMNF is to maintain the cold-water stream communities within the natural capability of the land. During the last 5 years, WMNF staff have focused on documenting the range of stream temperatures within five watersheds that contain large portions of MA 2.1 (General Forest Management). Additional data has also been collected for streams at the project level in other watersheds, but these will not be reported here at this time. The annual data collected in the five watersheds serves to track long-term trends of stream temperatures. It can also be used to evaluate the effects of land management activities at the project level across the WMNF.

Results

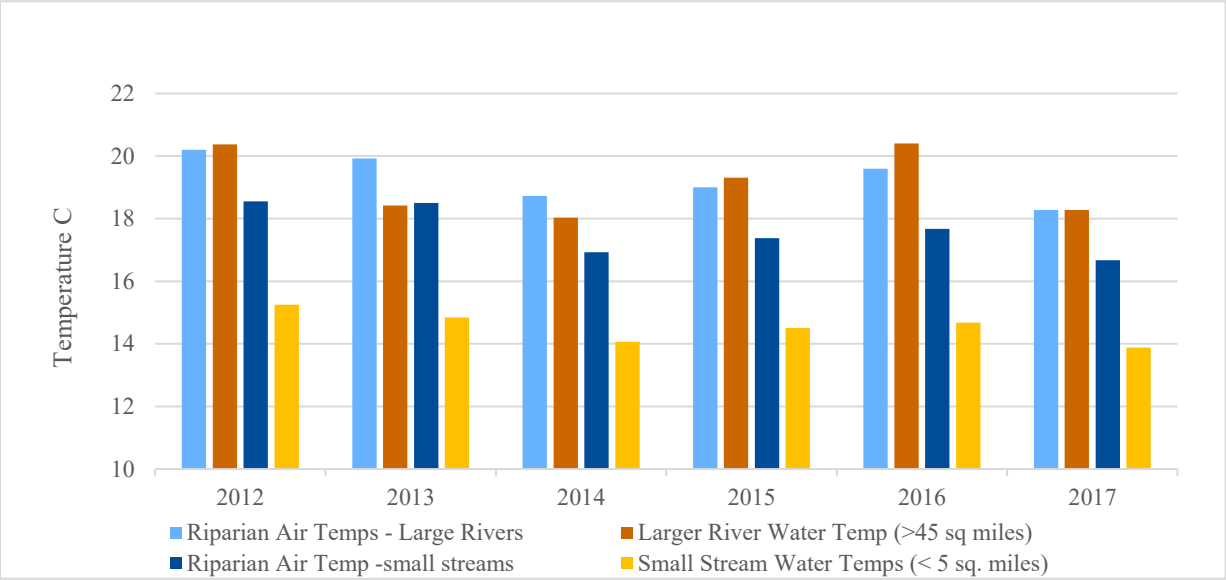

Figure 59. Annual average summer riparian air temperatures and stream temperatures within five watersheds of the WMNF (Mad River, Wild Ammonoosuc River, Swift River, South Branch of the Israel River, and the Upper Ammonoosuc River) from 2012 to 2017.

Both large rivers and small headwater streams followed year-to-year patterns of air temperature over the summers of 2012 to 2017 (Figure 59). As expected, larger rivers varied more from year to year than small streams and mimicked air temperatures. The dense shading of small streams in the WMNF kept average stream temperatures nearly 3 degrees Celsius cooler than riparian average air temperatures. Individual small streams varied from 1.1 to 2.2 degrees Celsius from year to year over the 6-year period, while individual large rivers varied from 2.1 to 2.5 degrees Celsius.

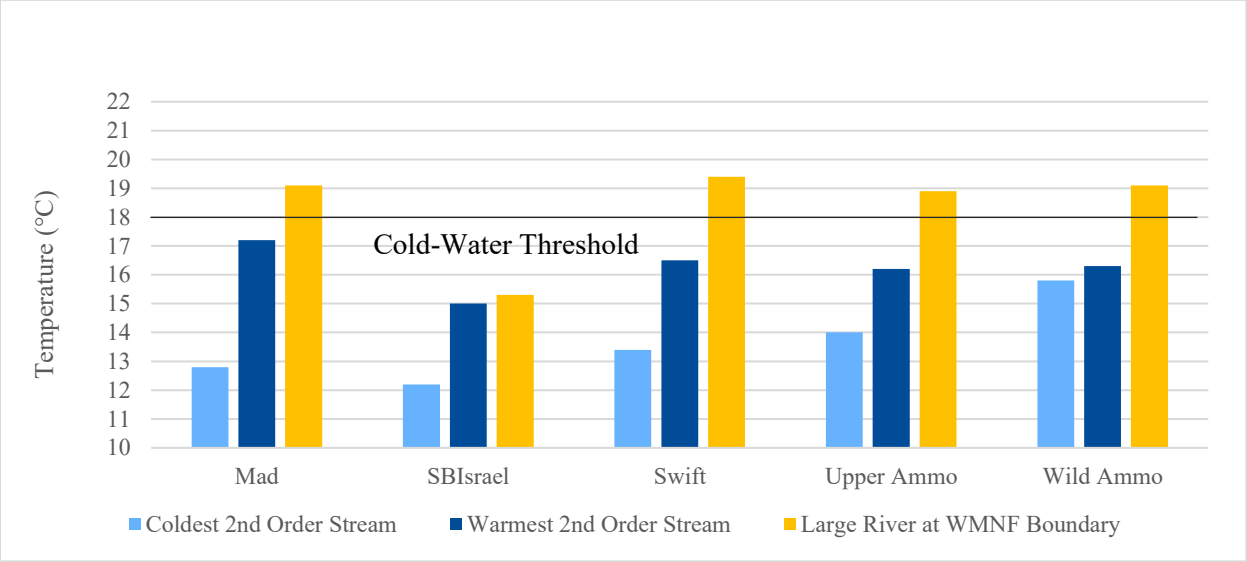

Figure 60. Average summer stream temperatures for large main stem rivers and small headwater streams within each of the five watersheds. Averages are for years 2012 to 2017 are combined.

Summer water temperatures of individual small streams, averaged from 2012 to 2017, ranged from 12.2 to 17.2 degrees Celsius across the five watersheds (Figure 60). Despite the broad range in small stream temperatures, they all lie below the cold-water threshold of 18 degrees Celsius. Water temperatures of the four largest river sites were very similar, ranging from 18.9 to 19.4 degrees Celsius, and were classified as cool-water streams. The South Branch of the Israel River, a much smaller watershed, was classified as cold-water throughout its entirety. Fish sampling in 2012 and 2013 confirmed that brook trout and slimy sculpin (a cold-water fish species) dominated all streams with average summer water temperatures less than 19 degrees Celsius.

Discussion

Brook trout are considered the focal species for cold headwater streams in the WMNF. The WMNF has identified 18 degrees Celsius as the water temperature threshold for "true" cold-water streams, based on the best available science (Beauchene et al. 2014, Lyons et al. 2009). All first- and second-order streams monitored here averaged well below the cold-water threshold over the 6-year study period. While brook trout are an indicator of cold-water streams, they can also be common in cool-water streams (18-21 degrees Celsius), although other fish species may be more dominant. Given that temperatures of the larger rivers averaged less than 19.5 degrees Celsius in all watersheds monitored, it is clear that any increase in stream temperatures that may have occurred over past decades has not resulted in a loss or fragmentation of cold-water stream communities in these watersheds. During this short monitoring period of 6 years, no trends in annual summer stream temperatures were found.

Recommendations

No recommendations were generated from the evaluation of this monitoring question.

Evaluation of Monitoring Question and Indicator(s)

Baseline temperature data has been collected across a broad range of streams on the WMNF over the last 6 years. Cold-water streams dominate the landscape, while the larger mainstem rivers transition to

cool-water streams as they exit the Forest. Future monitoring will focus on fewer long-term sites for the purpose of detecting trends in temperature changes. Additional monitoring in the near future will focus on the magnitude and duration of any forest management effects to determine if riparian management guidelines are effective at maintaining cold-water stream temperatures. The long-term stream temperature sites can be used for comparison to sites undergoing forest management.

References

Beauchene, M., M. Becker, C.J. Bellucci, N. Hagstrom, and Y. Kanno. 2014. Summer thermal thresholds of fish community transitions in Connecticut streams. North American Journal of Fisheries Management. 31(1): 119-131.

Lyons, J., T. Zorn, J. Stewart, P. Seelbach, K. Wehrly, and L. Wang. 2009. Defining and characterizing coolwater streams and their fish assemblages in Michigan and Wisconsin, USA, North America. Journal of Fisheries Management. 29(4): 1130-1151.

5.16.5 – Is the Forest providing a range of fishing opportunities that meets fishing demand while identifying and protecting wild populations of brook trout?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2006.

Monitoring Indicator(s)

- Wild trout biomass

Monitoring Frequency

Annual.

Background and Driver(s)

A goal of fisheries management given in the Forest Plan is to provide a range of recreational fishing opportunities (stocked put-and-take fisheries to non-stocked wild fisheries) in a manner that will protect self-sustaining populations of indigenous fish species (p. 1-15). To determine whether this goal is being meet, Forest staff, in cooperation with New Hampshire Fish and Game Department, electrofish select watersheds to estimate wild trout biomass. All stocked fish in the watershed are marked for the years that the assessment occurs to ensure origin of the fish is known.

Results and Discussion

This monitoring question is not being evaluated in this report. This question will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

This question will be considered for evaluation in the next biennial monitoring report.

*5.16.6 – Are watersheds fully functioning as ecological systems? Is watershed condition being maintained or improved?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Whether watersheds have been moved to an improved condition.

Monitoring Frequency

Annual.

Background and Driver(s)

This monitoring determines what watersheds are fully functioning based on physical and biological indicators for both aquatic environments and terrestrial parameters that influence water quality and quantity. This will help select priority locations for watershed improvement projects. Results of periodic watershed condition assessments and targeted action plans will determine whether watershed restoration has resulted in improvement or maintenance of watershed condition, or whether watershed function is at risk of deterioration. The monitoring will also help meet Forest Plan water resources goals.

The Forest Plan (pp. 1-17 to 1-18) lists the following goals for water resources with the objective of improving watershed and soil condition on at least 25 acres per year:

- Surface waters on the WMNF are considered "outstanding resource waters," and water quality is maintained or improved to protect existing and designated instream water uses such as aquatic life.
- The Forest Service will use watershed assessments to help guide planning and management activities.
- The Forest Service will manage streams at proper functioning condition to dissipate stream energy associated with high water flows, thereby decreasing erosion, reducing flood damage, and improving water quality.
- Watersheds will continue to provide high quality water for public water supplies, recreational activities, aquatic biota such as fish, and other purposes.
- The Forest Service will work cooperatively with communities within public water supplies to maintain high quality drinking water. Management activities may occur in these watersheds consistent with management area objectives.

Collectively, these goals and objectives are met by improving the condition of watersheds. In 2011, the Forest Service implemented a nation-wide program called the Watershed Condition Framework, which is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands (USDA Forest Service 2011).

Results

In FY 2023 and FY 2024, no priority watersheds were formally declared as improved. For a priority watershed to be declared as improved, all projects within a Watershed Restoration Action Plan (WRAP) must be completed. There are currently three priority watersheds on the WMNF and none have been completed. Forest staff are currently revisiting the Headwaters Upper Ammonoosuc River WRAP to update existing essential projects and add new essential projects. On the Headwaters Gale River WRAP, some essential projects are complete, while others have yet to be implemented. On the Eastman Brook WRAP, initial development is in progress. The Eastman Brook WRAP is a new priority watershed since this question was last reported in the 2020 Monitoring Report.

Discussion

The Watershed Condition Framework has provided an efficient mechanism to document watershed restoration activities on the WMNF that addresses the goals and objectives for water resources as stated in the Forest Plan.

Recommendations

The current recommendation is to continue full support of the Watershed Condition Framework and to continue to assign priority watershed status to new watersheds as opportunities arise.

References

Unites States Department of Agriculture [USDA], Forest Service, 2011. Watershed condition framework. Report No. FS-977.
https://www.fs.usda.gov/biology/resources/pubs/watershed/maps/Watershed_Condition_Framework2011FS977.pdf

*5.16.7 – Are Best Management Practices (BMPs) for soil and water being implemented? Are BMPs effective at preventing negative impacts to soil and water?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2022.

Monitoring Indicator(s)

Rather than analyzing a specific set of indicators, addressing this monitoring question involves the use of nationally standardized protocols and forms that help determine the level of BMP implementation and BMP effectiveness across a diverse set of management activities.

Monitoring Frequency

Annual, with the target of accomplishing at least 14 evaluations every 2 years.

Background and Driver(s)

In 2013, the Forest Service began implementing a nationally standardized BMP evaluation program, based on the National Core BMP and Monitoring Technical Guides. These documents provide

monitoring protocols that tier to Forest Plan standards and guides and state BMPs, where applicable, allowing these items to be monitored in an integrated fashion.

The Forest Plan lists several monitoring goals, including the goal of managing for ecosystem health (Goal 1, p. 4-11). The Forest Service actively monitors the implementation of management activities through timber sale administrators, special use permit administrators, and contracting officer representatives. These individuals have the authority to take corrective or adaptive management actions during implementation when issues are identified. By addressing this monitoring question, we are determining whether management activities are being implemented in such a way that satisfies this goal.

Furthermore, this monitoring determines whether BMPs are implemented for management activities in accordance with any guidance referenced in decision documents or operating plans. This guidance may include Forest Plan standards and guidelines, state or national BMPs, or applicable regulations for soil and water conservation. It also evaluates the effectiveness of BMP implementation at meeting goals and objectives as stated in the Forest Plan.

Refer to the Forest Service's Best Management Practices (BMP) Program website for more information about the program and to access documentation describing each indicator for the sites accomplished during this evaluation period by management activity type.

Results

Nineteen BMP evaluations were completed in 2023 and 2024 (.). All evaluations were performed by interdisciplinary teams following the protocols established as part of the national BMP monitoring program. All sites were randomly selected, except when indicated otherwise. Results of each evaluation are summarized in Table 35, grouped by resource area.

Table 35. BMP evaluations completed within 2023 and 2024 listed by monitoring activity, resource area, site, date of evaluation, and whether the site was selected randomly.

Monitoring activity	Resource area	Site	Date of evaluation	Selected randomly
Active construction of aquatic ecosystem improvements	Aquatic ecosystems	Zealand River Restoration Project	September 27, 2023	Yes
Active construction of aquatic ecosystem improvements	Aquatic ecosystems	Zealand River Restoration Project, Year 2	September 27, 2024	Yes
Active road decommissioning	Roads	Forest Road 27	June 6, 2024	Yes
Active road decommissioning	Roads	Forst Road XB44E	June 6, 2024	Yes
Use of prescribed fire	Fire management	Bent Field	May 13, 2024	Yes
Ground-based skidding and harvesting	Vegetation management	Basin Timber Sale, Unit 1	June 5, 2023	Yes
Ground-based skidding and harvesting	Vegetation management	Basin Timber Sale, Unit 7	June 5, 2023	Yes

Monitoring activity	Resource area	Site	Date of evaluation	Selected randomly
Ground-based skidding and harvesting	Vegetation management	Basin Timber Sale, Unit 16	June 5, 2023	No
Ground-based skidding and harvesting	Vegetation management	Fifield Brook Timber Sale, Unit 12	June 8, 2023	Yes
Ground-based skidding and harvesting	Vegetation management	Norway Timber Sale, Unit 9	June 8, 2023	Yes
Ground-based skidding and harvesting	Vegetation management	Bull Brook Timber Sale, Unit 14	June 13, 2024	Yes
Ground-based skidding and harvesting	Vegetation management	Lombard Pond Timber Sale, Unit 11	June 20, 2024	Yes
Ground-based skidding and harvesting	Vegetation management	Lombard Pond Timber Sale, Unit 12	June 20, 2024	No
Completed construction or operation and maintenance of water wells for monitoring or production	Water uses	Russell Basin Bedrock Well Number 5	May 15, 2024	Yes
Completed construction or operation and maintenance of water wells for monitoring or production	Water uses	Crocker Pond Campground Hand Pump	June 20, 2024	Yes
Completed ski area construction or reconstruction	Recreation	Loon Mountain Resort, Jack Pot Fox Run Trail	May 21, 2024	No
Developed recreation sites	Recreation	Loon Mountain Resort, Camp Three Lodge	May 21, 2024	No
Motorized or nonmotorized trail operation and maintenance	Recreation	Loon Mountain Resort, Hopper Non-Forest Service Trail	May 21, 2024	No
Ski run operation and maintenance	Recreation	Loon Mountain Resort, Flume	May 21, 2024	No

Aquatic Ecosystems, Active Construction of Aquatic Ecosystem Improvements: Zealand River Restoration Project, Years 1 and 2

BMP implementation, planning, on-the-ground execution, and project oversight were classified as mostly adequate because implementation was different than expected. In year 1, a change to the planned primary access route location occurred during implementation due to it being a particularly wet season, which presented a need to locate the route closer to the primary work area in order to more effectively move equipment in and out of the area. BMPs were adequately applied to the route implemented. In year 2, the channel was not dewatered as planned because it was not deemed necessary and would have delayed project implementation beyond optimal timing to maximize water quality protection. Effects of not dewatering on water quality did not exceed what was expected if it had not been dewatered. BMP effectiveness on minimizing waterbody and floodplain disturbance was mostly adequate. In the waterbody disturbance area, water was largely controlled in year 1 and

marginally controlled in year 2, effects to bank erosion and waterbody morphology changes did not exceed what was expected, and there was no evidence of uncontrolled erosion or sedimentation originating from floodplain disturbance. There was no evidence of chemical or fuel spills or leaks or waste containers. No corrective actions or adaptive management actions were identified. A "Completed Aquatic Ecosystem Improvements" BMP evaluation is planned for 2025.

Roads, Active Road Decommissioning: Forest Road 27 (FR27, Rocky Branch) and Forest Road XB44E (FRXB44E, Bartlett)

At FR27 and FRXB44E, crossing removal (of a bridge and culvert, respectively) was ongoing at the time of the reviews. BMP implementation, planning, on-the-ground execution, and project oversight were mostly adequate. All planned BMPs were fully implemented, except piled materials remained next to the stream at the FR27 site rather than being moved farther from the stream as planned. No erosion or sedimentation from the piled materials was observed. BMPs were fully effective at FRXB44E and mostly effective at FR27. At FR27, BMPs required were not specified in planning documents and uncontrolled erosion was observed at the waterbody crossing within the aquatic management zone but not entering the waterbody. Evidence included limited locations with localized sediment deposition, substrate changes, bank instability, vegetation damage and bare ground, sheet erosion, slumping, mass wasting, and sediment plumes but the observed erosion and sedimentation were not substantial and within expected limits. There was no evidence of chemical or fuel spills or leaks or waste containers. For FR27, no corrective or adaptive management actions were identified for either implementation or effectiveness, except one implementation corrective action, which describes sloping back waterbody crossing approaches immediately after bridge removal. For FRXB44E, no corrective or adaptive management actions were identified for implementation. For effectiveness, a corrective action identified was to improve the riprap elevation because recent high flows indicated the elevation was too low for the site. In addition, increasing roadbed material slope backs to account for erodibility of roadbed material was an adaptive management action identified for effectiveness at this site.

Fire Management, Use of Prescribed Fire: Bent Field

The stream reviewed was a minor ephemeral stream that ran from within the Bent Field burn unit, across the fire line, and out of the unit. BMP implementation, planning, on-the-ground execution, and project oversight were fully implemented. BMPs were only moderately effective because evidence of erosion and sedimentation in the waterbody was observed. Evidence included very limited localized sediment deposition, bank instability, bank trampling and compaction, and gully erosion and rutting. Erosion and sedimentation were likely caused by the wetness of the area during the burn and all-terrain vehicles making multiple passes over the channel. There was no evidence of chemical or fuel spills or leaks or waste containers. No corrective actions were identified as needed. One adaptive management action was identified for effectiveness, which describes monitoring crossings and associated erosion and sedimentation for potential increase from more frequent and higher magnitude precipitation events and other shifts that may affect the typical wetness of fire lines and surrounding areas.

Vegetation Management, Ground Based Skidding and Harvesting: Basin Timber Sale, Unit 1, 7, and 16; Fifield Brook Timber Sale, Unit 12; Norway Timber Sale, Unit 9; Bull Brook Timber Sale, Unit 14; Lombard Pond Timber Sale, Unit 11 and 12

All units were selected at random except Unit 16 of the Basin Timber Sale and Unit 12 of the Lombard Timber Sale. These evaluations were conducted opportunistically due to their proximity to other units, which were selected at random. Sites near each other may report information for the same skid trail and/or landing used.

BMP implementation, planning, on-the-ground execution, and project oversight were mostly adequate. Inspections were conducted at critical times during implementation for all units evaluated. In some areas, supplemental erosion control was needed, and in all cases was applied fully. No corrective actions or adaptive management action were identified for implementation. All BMPs were effective as anticipated in all units, except Unit 14 of the Bull Brook Timber Sale and the two units in the Lombard Timber Sale. In Bull Brook Timber Sale, Unit 14 BMPs were fully effective at preventing impacts to the adjacent waterbody, associated aquatic management zone, and the area in and around the landing. Erosion and sedimentation were observed associated with the skid trail connecting the unit to the landing. The evidence was outside of an aquatic management zone and greater than 100 feet from a waterbody. Evidence presented as sheet erosion, sediment plumes, and rutting originating on and/or from the skid trail. The causes included suboptimal treatment prescription, skid techniques, and timing of operations. Erosion and sedimentation were also observed at the waterbody crossing on the skid trail within the aquatic management zone but not reaching the waterbody. Evidence presented as sheet erosion, sediment plumes, and rutting. Corrective actions identified to address the deficiencies in BMP effectiveness included applying more slash to the skid trails, applying straw and mulch more heavily, and having an earlier application of winter rye for improved germination.

In Lombard Timber Sale, Units 11 and 12 were both clearcuts. Unit 12 was located upslope of Unit 11, both units were accessed by the same skid trail, used the same landing, and were bisected by the same perennial stream, so information presented here for both units applies to one skid trail, landing, and stream, in slightly different locations or coincident. The areas evaluated were adjacent to a wet meadow (wetland), which was damaged by about 10 percent by recent activities. Erosion and sedimentation were observed in the aquatic management zone and in the waterbody in one to two locations in each unit. Evidence of erosion presented as traceable evidence, bank trampling and compaction, vegetation damage and bare ground, rill erosion, and rutting. The source of the erosion and sedimentation was log drag ruts and skid trail use. The causes of the erosion and sedimentation included suboptimal road location and timing of operations. There was no evidence of erosion or sedimentation in or around the landing. Erosion and sedimentation were observed associated with the skid trail connecting the unit to the landing. The evidence was outside of an aquatic management zone and greater than 100 feet from a waterbody. Evidence presented as vegetation damage and bare ground and rutting originating on and/or from the skid trail. The causes included suboptimal skid techniques and timing of operations. Erosion and sedimentation were also observed at the waterbody crossing on the skid trail within the aquatic management zone and in the waterbody. Evidence of erosion presented as traceable evidence, bank trampling and compaction, vegetation damage and bare ground, and rutting. Corrective actions identified to address the deficiencies in BMP effectiveness included better preparing for warmer winters with less frozen conditions and stockpile slash, as well as avoiding wet areas for skid trail layout.

Water Uses, Completed Construction or Operation and Maintenance of Water Wells for Monitoring or Production: Russell Basin Bedrock Well Number Five and Crocker Pond Campground Hand Pump

BMP implementation, planning, on-the-ground execution, and project oversight were mostly adequate. Only one corrective action was identified for implementation at the Crocker Pond site, which was to replace a cracked well apron. For BMP effectiveness, no issues were observed with erosion and sedimentation, ground water, or groundwater-dependent vegetation. No corrective actions or adaptive management actions were identified.

Recreation, Completed Ski Area Construction or Reconstruction, Developed Recreation Sites, Motorized or Nonmotorized Trail Operation and Maintenance, Ski Run Operation and Maintenance: Loon Mountain Resort, Jack Pot Fox Run Trail; Loon Mountain Resort, Camp Three Lodge; Loon Mountain Resort, Hopper Non-Forest Service Trail; Loon Mountain Resort, Flume

All sites were not selected at random. There were known issues with the completed ski area construction of Jack Pot Fox Run Trail at Loon Mountain Resort that led to the prioritization of conducting a BMP evaluation at the site to assess implementation and effectiveness and identify any needed corrective actions or adaptive management actions. The other evaluations were conducted opportunistically due to their proximity to the Jack Pot Fox Run Trail location.

For the completed ski area construction or reconstruction along Jack Pot Fox Run Trail, BMP planning and on-the-ground execution were not fully implemented. Resource protection provisions from guidance documents that were fully implemented on the ground include ski run location, lift line location, snowmaking system location, and slope grade requirements. Those that were not fully implemented on the ground include timing of activities, cross drain spacing, cross drain construction, surface treatment requirements, ground cover requirements, access route maintenance, and vegetation clearing and disposal, which was likely implemented but compromised due to reentry. Project oversight was not fully implemented. All applicable permits were obtained. Supplemental erosion control was needed but not fully applied; the area was not revegetating, and erosion control measures were overwhelmed and/or ineffective. Inspections were not conducted at critical times. Corrective actions were needed but not taken. No spills or leaks were observed. Corrective actions for BMP implementation include effective monitoring, including appropriate timing of monitoring, Adaptive management actions identified include more oversight, attention to construction sequencing to reduce reentry and subsequent impacts, and utilizing a better seed mix or other form of stabilization after construction. For BMP effectiveness, erosion and sedimentation were observed in the evaluated waterbody in one to two locations. Evidence presented as turbidity, substrate changes, bank trampling and compaction, vegetation damage and bare ground, sheet erosion, rill erosion, sediment plumes, and rutting. The causes of erosion and sedimentation included lack of water control features, improper water control spacing, poor water control construction, poor water control maintenance, insufficient ground cover, and road-related causes. Erosion and sedimentation were observed at the waterbody crossing in the waterbody evaluated. Evidence presented as turbidity, localized sediment deposition, substrate changes, bank trampling and compaction, vegetation damage and bare ground, sheet erosion, rill erosion, sediment plumes, and rutting. There was no evidence of chemical or fuel spills or leaks. Lack of oversight contributed to the observed problems. Corrective actions identified for BMP effectiveness include reestablishing water bars, improving project sequencing, increasing seed germination, and exploring other seed mixes and/or applications. Adaptive management actions identified include:

- requiring sequencing of the project components to reduce reentry,
- increasing oversight throughout project implementation,
- establishing restrictions for limiting travel in the project area,
- ensuring compliance with the New Hampshire State Alternation of Terrain Permit, which has requirements for percent cover of vegetation, and
- reevaluating seeding methodology, including seed mix composition and season of application.

A follow-up BMP evaluation is planned for the Jack Pot Fox Run Trail in 2025.

At the developed recreation site at Camp Three Lodge at Loon Mountain Resort, BMP implementation, planning, on-the-ground execution, project oversight, and recreation site closures or treatments were mostly adequate. No corrective actions were identified. For BMP effectiveness no erosion or sedimentation was observed at the site. Some evidence of trash was observed within the aquatic management zone. The cause of the trash was ski area operational refuse. Percent of waterbody transect with evidence of impacts to water quality from trash was approximately 10 percent. Unresolved maintenance needs and lack of administration contributed to the observed problem. Corrective actions identified include reseeding the access path to the front entrance of the lodge and resurfacing the path to reduce sloughing into the bike trail. No adaptive management actions were identified.

Motorized or nonmotorized trail operation and maintenance along Hopper Non-Forest Service Trail at Loon Mountain Resort, were mostly adequate with regard to BMP implementation, planning, on-the-ground execution, project oversight, and recreation site closures and treatments. No corrective actions were identified. For BMP effectiveness, erosion and sedimentation on or originating from the trail were observed in the waterbody in one to two locations. Evidence presented as localized sediment deposition and substrate changes. The causes of the erosion and sedimentation included suboptimal trail location. Erosion and sedimentation were observed at the waterbody crossing within the aquatic management zone. Evidence of erosion and sedimentation presented as slumping and slips. Causes of erosion and sedimentation included lack of vegetation and a cut slope that was too steep. Corrective actions identified include reseeding steep cut slopes if bare soil is present. No adaptive management actions were identified.

For ski run operation and maintenance of the Flume Trail at Loon Mountain Resort, BMP implementation, planning, on-the-ground execution, project oversight, and trail closures and treatment were mostly adequate. No corrective actions were identified. For BMP effectiveness, no erosion or sedimentation was observed at the ski run and waterbody crossing. There was no evidence of trash and sanitary waste or chemical or fuel spills or leaks. No corrective actions or adaptive management actions were identified.

Discussion

Overall, BMPs are mostly being implemented as planned across multiple types of projects on the Forest. BMPs are being adequately included in planning documents and contracts. Issues in BMP implementation are generally caused by the contractor not following the operating plan or contracts. Project administrators, as well as other Forest staff that conduct programmatic monitoring, are doing a good job identifying problems during project implementation that have affected or potentially may affect water, aquatic, and riparian resources and implementing corrective actions when needed. When and where BMPs have been properly implemented and installed, they have mostly been effective at minimizing effects to water, aquatic, and riparian resources due to erosion and sedimentation.

Some improvements can be made, particularly in larger scale projects, to ensure BMPs are fully planned, implemented, and effective. Shifting climatic conditions can contribute to uncertainties in effectiveness and project managers will need to adapt in order to continue to limit impacts of activities to water quality.

Recommendations

Based on the results of the BMP evaluations, the recommendation is to continue to improve upon our ability to keep contractors and permit holders accountable for adhering to the project plans and/or contracts by continuing to share the results of our BMP evaluations with proponents, specialists, and staff to provide learning opportunities and evaluating and standardizing protocols for addressing

noncompliance with the operating plan or contracts. BMP evaluations are beneficial and should continue indefinitely.

References

USDA Forest Service. 2012. National best management practices for water quality management on National Forest System lands, Report No. FS-990a. Available at: https://www.fs.usda.gov/naturalresources/watershed/pubs/FS_National_Core_BMPs_April2012.pdf

USDA Forest Service, 2014 [draft]. Forest Service Handbook 2509.19, National best management practices, Chapter 10, National Core Management Practices. Available at: https://www.fs.usda.gov/naturalresources/watershed/pubs/Draft_FSH_2509_19.pdf

5.17 – Wild and Scenic Rivers

The WMNF is home to the Wildcat Wild and Scenic River and several rivers eligible for Wild and Scenic River designation. The Forest Plan states that the purpose of MA 8.6 – Wildcat Wild and Scenic River (p. 3-69) includes the following:

- Maintain, enhance, and protect the free-flowing character and outstandingly remarkable values of the designated rivers included in the National Wild and Scenic River System.
- Manage the designated river segments of the Wildcat River and tributaries according to the Wild and Scenic River Act (Public Law 90-542) and legislation designating the Wildcat River a Wild and Scenic River (Public Law 100-554).
- Manage those segments of the designated Wildcat Wild and Scenic River off National Forest System land in accordance with requirements in the National Wild and Scenic Rivers Act and Public Law 100-554, which designated the Wildcat Wild and Scenic River.

The following monitoring question pertains to whether activities within the Wildcat Wild and Scenic River corridor as consistent with the Wild and Scenic River Act and Public Law 100-554.

5.17.1 – Are developments and projects within the Wildcat Wild and Scenic River corridor consistent with the Wild and Scenic Rivers Act?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2007.

Monitoring Indicator(s)

- Number of wetland permit applications received and consultations provided
- Consistency of private and agency activities, and town zoning ordinances, with the Comprehensive River Management Plan (CRMP) and the Wild and Scenic Rivers Act

Monitoring Frequency

Every 3–5 years.

Background and Driver(s)

The Forest has a legal responsibility as the lead agency to ensure both federal and private land use in the corridor is consistent with the CRMP, and Section 7 requirements of the Clean Water Act. This monitoring evaluates recent and past Section 7 consultation reports to ensure that we are meeting this responsibility. Field review of completed projects where permits are issued by state or town occur every 3 to 5 years. Approval of New Hampshire Department of Environmental Services Wetland permit or Clean Water Act Section 404 permits occur prior to Endangered Species Act Section 7 determination, if applicable.

Results and Discussion

This monitoring question is not being evaluated in this report. This question will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

We recommend reconsidering how impacts to and legal requirements of the W&S River Act are being evaluated.

5.18 – Wilderness

There are currently six Wildernesses on the WMNF. They are:

- Great Gulf Wilderness: 5,500 acres, designated by the 1964 Wilderness Act.
- Presidential Range-Dry River Wilderness: 29,000 acres, designated by the 1975 Eastern Wilderness Act and expanded in the 1984 New Hampshire Wilderness Act.
- Pemigewasset Wilderness: 45,000 acres, designated by the 1984 New Hampshire Wilderness Act.
- Sandwich Range Wilderness: 35,800 acres: 25,000 designated by the 1984 New Hampshire Wilderness Act and 10,800 designated by the 2006 New England Wilderness Act.
- Caribou-Speckled Mountain Wilderness: 14,000 acres, designated by the 1990 Maine Wilderness Act.
- Wild River Wilderness: 23,700 acres, designated by the 2006 New England Wilderness Act.

These lands are managed to allow natural processes to continue with minimal impediment, to minimize the effects and impacts of human use, to provide primitive and unconfined recreation opportunities, to foster appreciation of the qualities of wilderness landscapes, to continue use for educational and scientific purposes, and to recognize their evolving roles in the history of the landscape.

The WMNF Wilderness Management Plan is an appendix to Forest Plan. The plan selected indicators for measuring Wilderness conditions and set clear standards, beyond which direct management action may become necessary. The following monitoring questions pertain to visitor use in Wilderness, specifically the number of visitors, campsite density and size, litter and human waste issues, and visitor satisfaction.

5.18.1 – Is there a change in the number of incidents of improperly disposed of human litter and waste in Wilderness?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Litter and human waste

Monitoring Frequency

Every 3 years.

Background and Driver(s)

Concerns around the inability for workforce to effectively control litter and human waste through basic operations and maintenance.

Results

Reported incidents of human waste have declined since 2008 in all Wilderness areas monitored (Figure 61).

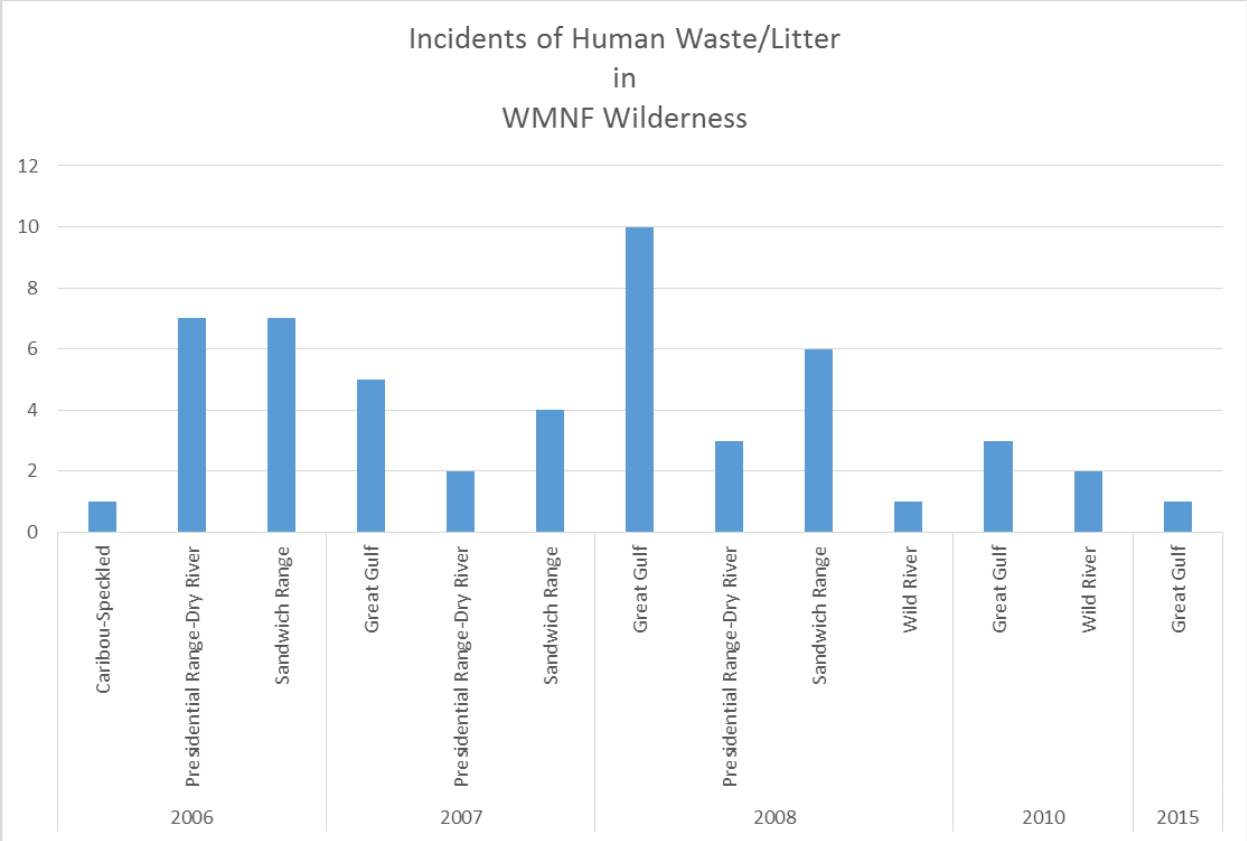

Figure 61. Observed incidents of human waste and litter in each of the six WMNF designated Wilderness areas.

Discussion

The number of reported incidents of human waste appear to have declined since 2008. This is likely due to a lack of reporting due to a decrease in backcountry (wilderness) staffing rather than an actual

decrease in occurrences. Given the data gaps, it is not possible to draw any significant conclusions from the available data. In 2018 discussions with backcountry staff, anecdotal evidence suggests that incidents of human waste are likely to be stable or increasing. However, there are less staff patrolling and focusing on entering incidents in 2018 than there were from 2006 to 2008.

Recommendations

There are no management recommendations that can be drawn from the current dataset. In order to take management actions based on this data the Forest will need a renewed focus on incident entry.

Evaluation of Monitoring Question and Indicator(s)

The Forest should consider implementing ArcGIS Online with Survey123 in order to increase the ability of staff to report and analyze data.

References

United States Department of Agriculture, Forest Service. WMNF Wilderness Monitoring Database. Unpublished data. Located at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH.

5.18.2 – Over time is there a change in visitor use at Wilderness destinations?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

- Visitor use at destination areas

Monitoring Frequency

Annual.

Background and Driver(s)

The Forest Plan lists a variety of sites and desired social conditions for the sites in the Wilderness Management Plan (pp. E5-E9). This monitoring will help determine if desired future conditions for these sites are being met and if management action is needed. Visitor use is sampled at the same destinations and on determined dates and times over the life of the Plan. The intent is to measure the direct and immediate effects of humans on other humans (p. E-11). Standards in the social component (e.g., visitor use) are definable and measurable but can be viewed as subjective and arbitrary. Excess of the desired standard triggers examination of management actions and policies. Data informs decision-making and serves warning that use-related problems may increase.

Results

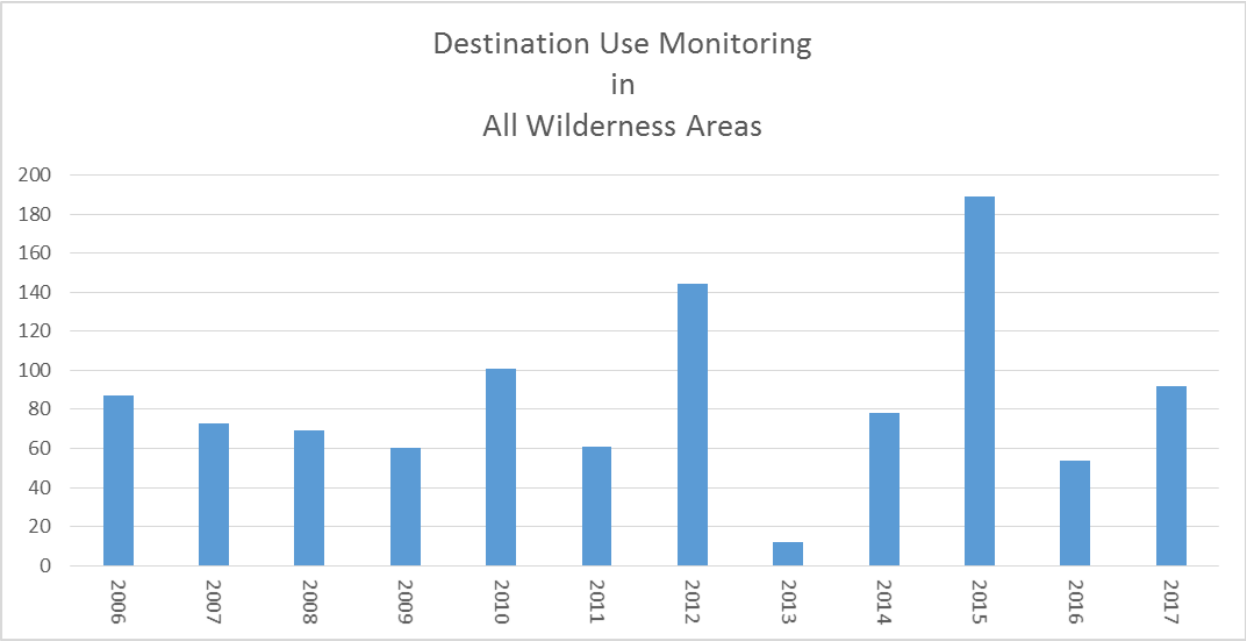

Figure 62. Reported annual visitation to destination areas in all Wilderness areas from 2006 to 2017.

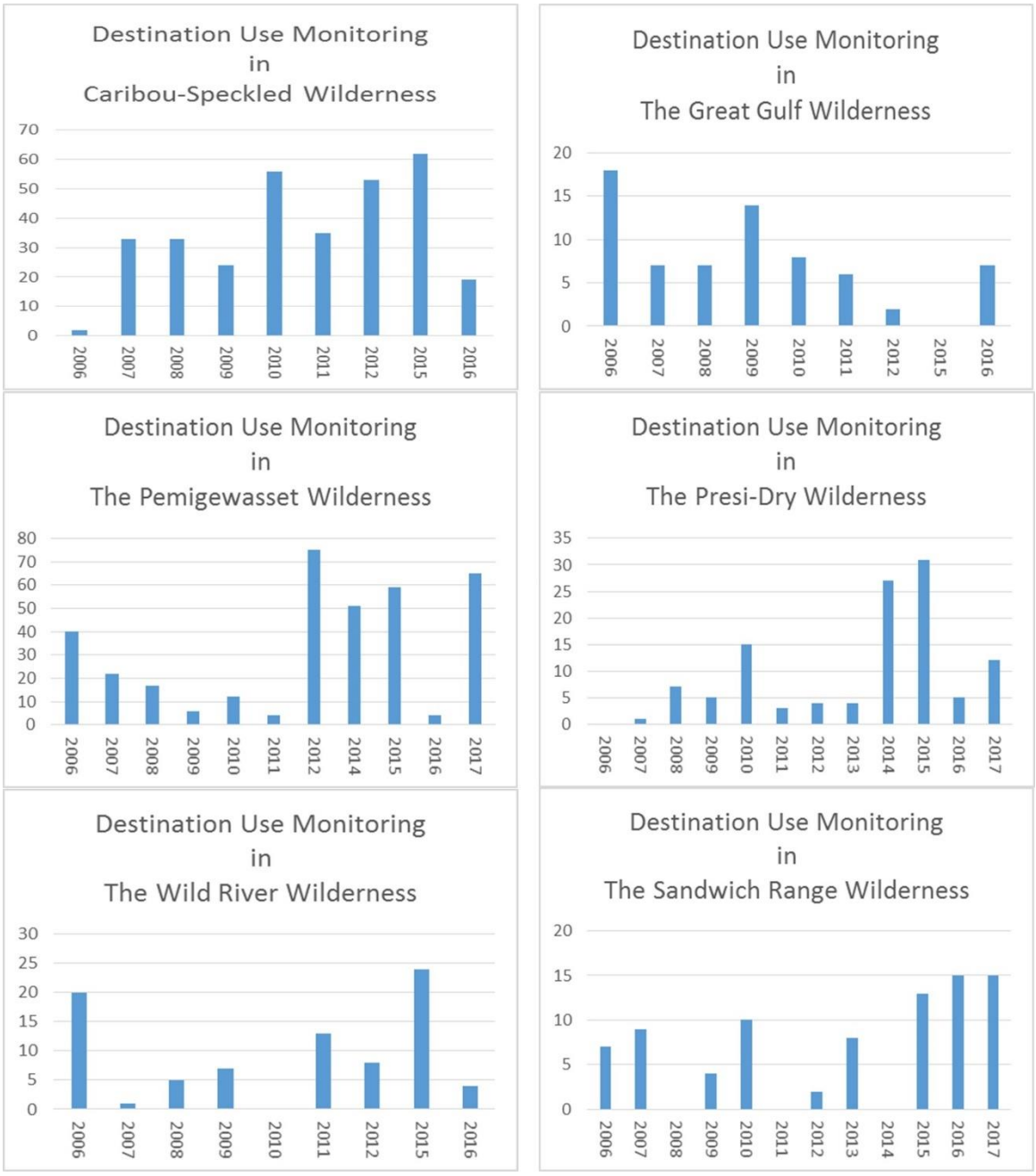

Figure 63. Reported destination use in each of six WMNF designated wilderness areas.

In aggregate, reported annual visitation to destination areas in Wilderness area during monitoring sessions appears to be relatively stable (Figure 62). There is a notable, but vacillating, increase and decrease of use during monitoring sessions from 2010 to2015. However, use appears to have returned to previous levels during 2016 and in early results from 2017.

For individual Wilderness areas, there is a high degree of variability of reported use during monitoring sessions from year to year (Figure 63). The plan states analysis should occur within a 3-year window. Within those windows, reported use appears to fall and drop with no discernable pattern. The only outlier is a steady general increase in reported use in Caribou-Speckled Mountain Wilderness. This is

followed by a sharp decline in 2016. Though anecdotal evidence suggests that use is on the rise across Wilderness areas, the snapshot of use at these locations and times offer no distinct conclusions.

Discussion

This section will be considered in the future.

Recommendations

There is no conclusive evidence from reported use during monitoring sessions that management actions need to be taken in order to address use in Wilderness areas. Efforts should be made, if possible and as funding allows, to gather more robust use numbers within Wilderness areas on the Forest.

Evaluation of Monitoring Question and Indicator(s)

Destination and trail use monitoring are the longest running and most robust datasets for wilderness use that the WMNF currently has. Though there is currently no discernable pattern, it is possible that these indicators may still trigger future actions if necessary. Though we may be able to discern how use is changing over time, this question does not address what an acceptable level of use from a social standpoint is. It will continue to be necessary to use this indicator in concert with other visitors' experiences and ecological-based indicators. Additional consideration is necessary to set more definitive guidance on appropriate levels of use for each zone.

References

United States Department of Agriculture, Forest Service. WMNF Wilderness Monitoring Database. Unpublished data. Located at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH.

5.18.3 – Does the density and size of dispersed campsites in Wilderness meet set criteria?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Campsite density and size

Monitoring Frequency

On a 3-year rotation.

Background and Driver(s)

As part of the Wilderness Plan's aesthetic component (p. E-11), this indicator attempts to measure the density and size of dispersed campsites in Wilderness. These numbers are then compared to a standard set for each zone classification within the Wilderness area. In terms of wilderness character, this indicator seeks to quantify opportunities for solitude and opportunities for primitive or unconfined

recreation. Standards in the aesthetic component of the Wilderness Plan are definable and measurable. Excess of the desired standard triggers controlling action on Wilderness visitors.

Monitoring Indicator 1

Campsite size.

Results

Using the exact size of campsites in Wilderness areas was abandoned as a standard after it was found that multiple people measured the same campsite differently. The use of size as an indicator was abandoned in 2011 as part of an all-hands meeting on Wilderness monitoring. The program switched over to the more general Wilderness Rapid Campsite Assessment method. Density of sites remains a monitoring standard. There are no results display.

Discussion

It was determined that the *exact* size of a campsite was impossible to determine at the level of the plan's standard. Small variations in how each individual measures a campsite might trigger the standards prematurely. The decision was made to move to the Wilderness Rapid Campsite Assessment. One of the measurements is a general look at size within broad categories. This keeps the variance of individual measurements down to a minimum. It does not lend itself as well to checking for 10 percent increases as precisely because the group breaks are beyond 10 percent increments. However, there is an ability to clearly note when a campsite moves from one impact category to the next.

Monitoring Indicator 2

Campsite density.

Results

There are no results to display in this report. This section will be considered in the next biennial monitoring report.

Discussion

Campsite density outside of the plan's prescription continues to be a problem within all of our Wilderness areas. Recent work, funded through an internal Forest Service grant, allowed for the rehabilitation of 150 total campsites within the six Wilderness areas.

Recommendations

It is expected that campsite rehabilitation will remain a large part of the workload for our backcountry staff. Staff will continue to use the Wilderness Plan standards to evaluate the priority for rehabilitating old sites, and suitability of new sites as they develop. A renewed commitment to monitoring and tracking campsites is necessary for the full utilization of this indicator.

Evaluation of Monitoring Question and Indicator(s)

The density indicator should remain as is. The size indicator needs to be dropped or reworded in favor of the new method of Wilderness campsite classification.

References

United States Department of Agriculture, Forest Service. WMNF Wilderness Monitoring Database. Unpublished data. Located at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH.

United States Department of Agriculture, Forest Service. 2015. Monitoring procedures for the recreation sites element of the Forest Service's wilderness stewardship performance minimum recreation site monitoring protocol. Available: https://www.wilderness.net/toolboxes/documents/recsitemonitor/National%20Minimum%20Recreation%20Site%20Monitoring%20Protocol.pdf 6 p.

5.18.4 – Over time is there a change in visitor use on trails in Wilderness?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Visitor use on trails

Monitoring Frequency

Annual.

Background and Driver(s)

This is part of the Wilderness Plan's social component that measures the direct and immediate human effects on other humans (p. E-11). Visitor use on trails is sampled along the same trails and on determined dates and times over the life of the Plan. Standards in the social component are definable and measurable but can be viewed as subjective and arbitrary. Excess of the desired standard triggers examination of management actions and policies. Data informs decision-making and serves warning that use-related problems may increase. Added monitoring sessions bring the direction provided in the Wilderness Plan up to National Solitude Monitoring standards.

Results

Data on trail use in WMNF Wilderness was collected from 2006 through 2017.

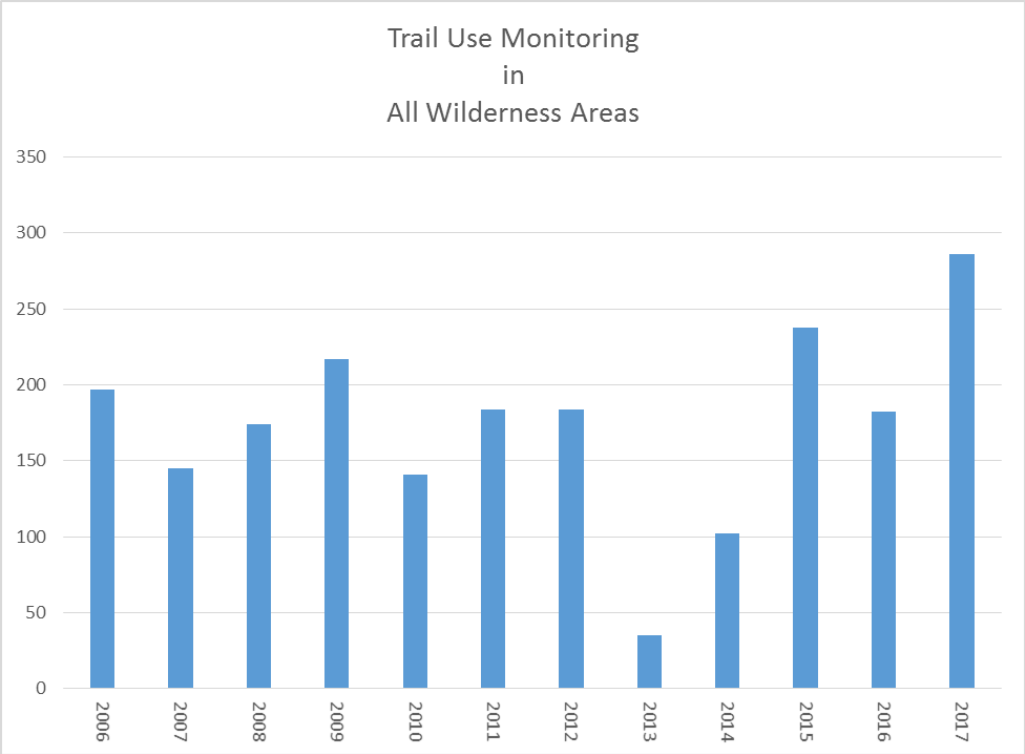

Figure 64. Total reported trail use by visitors in all WMNF Wilderness areas.

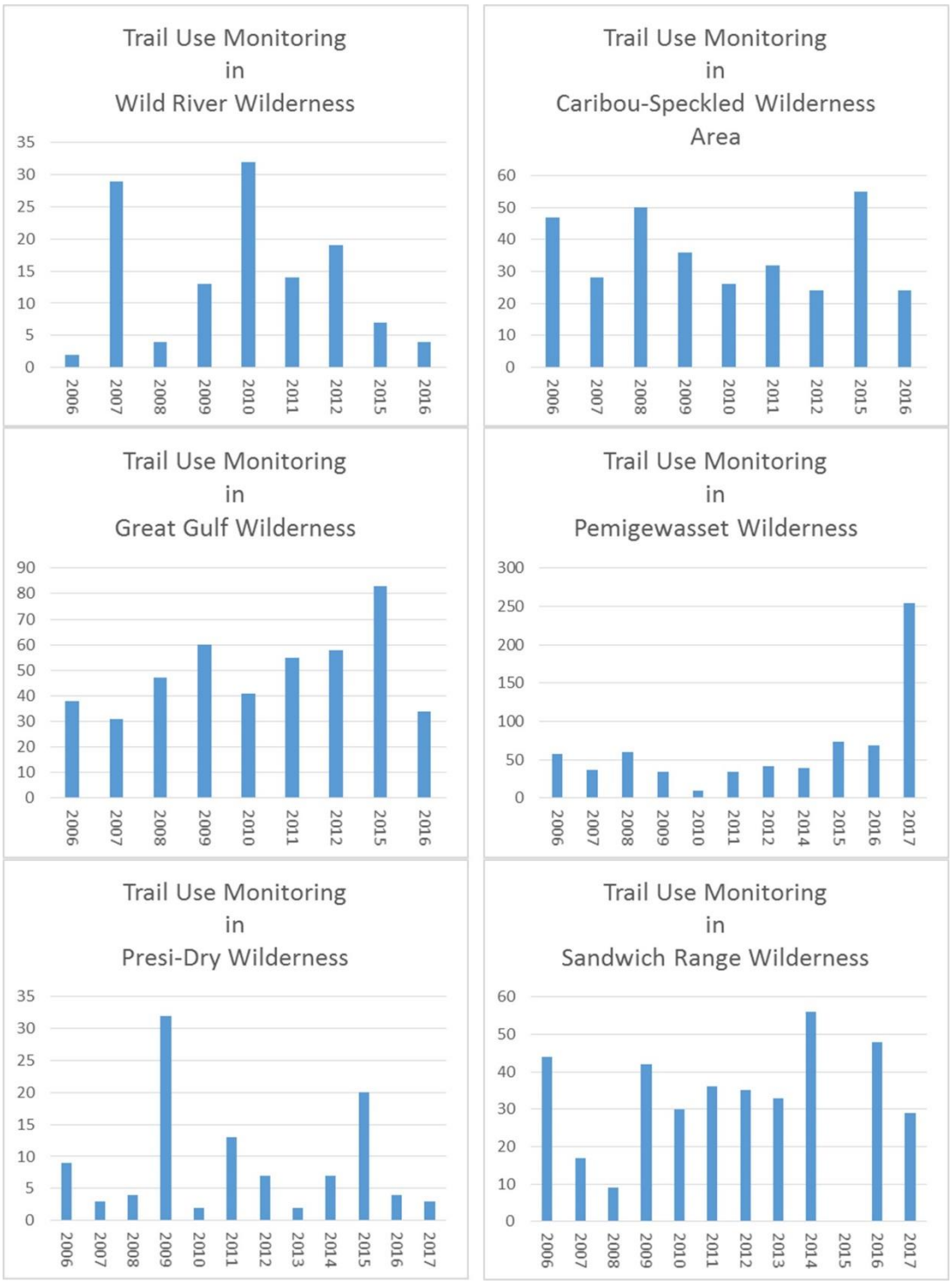

Figure 65. Reported trail use by Wilderness area.

Though there are ebbs and flows in reported use, trail visitation in Wilderness during monitoring sessions appears to be trending slightly upwards (Figure 64). That slight uptick holds true for most of the individual Wilderness areas (Figure 65). Presidential-Dry Range Wilderness and Wild River Wilderness are the two notable exceptions. These areas show reported use trending slightly downward. All areas saw a wide range of variability throughout the dataset. It is unclear how much missed or additional

monitoring sessions impacted these counts. As with destination monitoring, the Forest Plan states analysis should occur in a 3-year window. Within those windows, reported use appears to fall and rise with no discernable pattern. Anecdotal evidence suggests that use is on the rise across Wilderness areas. Reported trail use monitoring generally supports this assertion.

Discussion

This section will be considered in the future.

Recommendations

There is no conclusive evidence from reported use during monitoring sessions that management actions need to be taken in order to address use in Wilderness. Efforts should be made, if possible and as funding allows, to gather more robust use numbers within WMNF Wilderness areas.

Evaluation of Monitoring Question and Indicator(s)

Variability in the dataset makes it difficult to know when it is necessary to take additional management actions. This is exacerbated by the Plan's direction to evaluate on a 3-year cycle. A longer 5- to 10-year cycle should be considered.

References

United States Department of Agriculture, Forest Service. WMNF Wilderness Monitoring Database. Unpublished data. Located at: U.S. Department of Agriculture, Forest Service, White Mountain National Forest, Campton, NH.

5.18.5 – What is the level of visitor satisfaction in Wilderness (quality of experience and perception of crowding)?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Perceptions of crowding
- Quality of experience

Monitoring Frequency

Survey once for baseline information and once halfway through the life of the plan. Survey will focus on visitor perceptions of crowding at selected sites within Wilderness and quality of recreation experience. Survey will also assess whether information delivery and education messages are helping visitors find the appropriate recreation opportunity within or outside Wilderness.

Background and Driver(s)

This indicator was meant to capture visitor perceptions of outstanding opportunities for solitude or primitive and unconfined recreation as part of the Wilderness Plan's Social component. The intent is to measure the direct and immediate human effects on other humans. Standards in the social component

are definable and measurable but can be viewed as subjective and arbitrary. Excess of the desired standard triggers examination of management actions and policies. Data informs decision-making and serves warning that use-related problems may increase.

Monitoring Indicator 1

Perceptions of crowding.

Results

The Forest partnered with UVM to develop a survey and trail count method that helped evaluate this indicator. We do not have the final results from the UVM survey. Trail counters were used to collect data in 2015 and surveys were completed in 2016. Full results are expected in 2018. Here, we present preliminary results. Figure 66 shows the results from four survey questions that were directly related to overall experience of visitors and their perceptions of crowding. The results are presented as the percentage of visitors that choose a particular response to each question. There were approximately 800 survey respondents.

Discussion

It is important to note that these surveys and the associated use counts were not completed within actual Wilderness areas. These surveys were conducted at the following very high use areas throughout the Forest: Franconia, Gulfside Trail, Crawford Path, and Rumney Rocks Climbing Area. It is possible that the very high use nature of these locations will limit the applicability of these results to direct Wilderness experiences and perceptions. The level of use seen at these survey locations would generally be incompatible with Wilderness management objectives. However, the preliminary results show respondents to this survey do not appear to perceive issues with crowding on the Forest at these very high use locations. These same visitors overwhelmingly answered that they had a great experience on the WMNF and would not support any visitor use limits for trails.

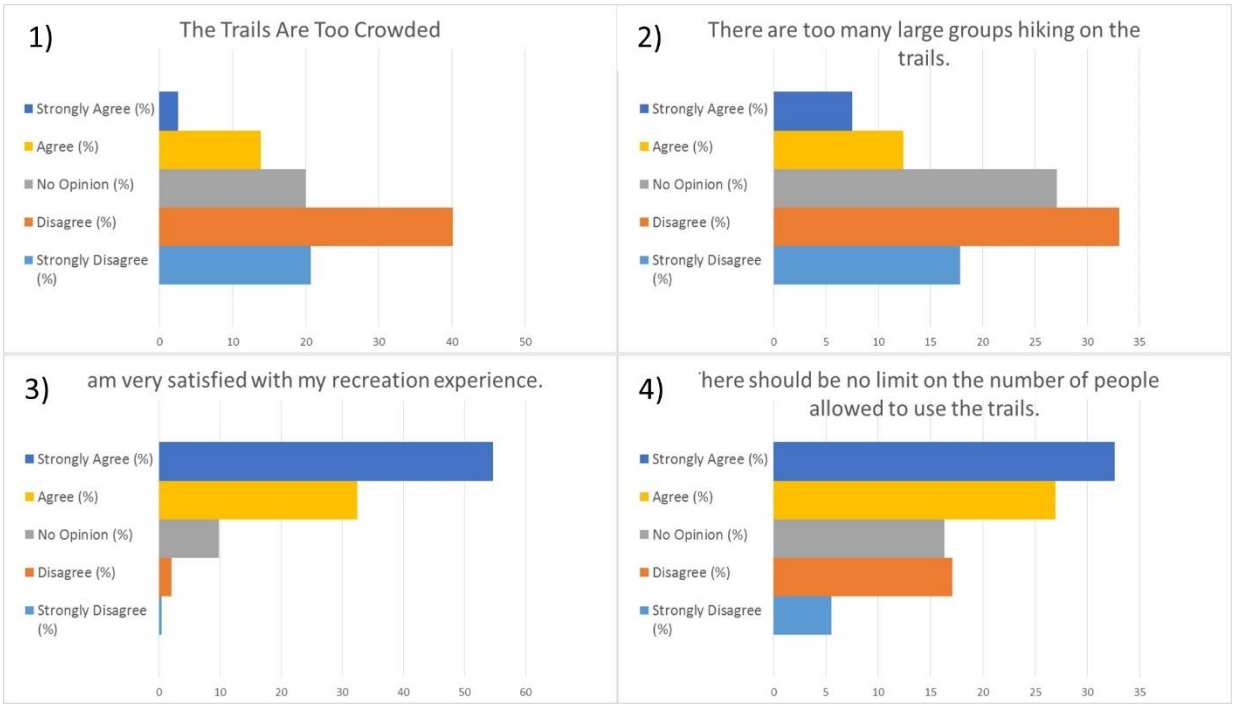

Figure 66. Results of visitor surveys completed by the University of Vermont in 2016.

Monitoring Indicator 2

Quality of experience.

Results

NVUM surveys were conducted in 2005, 2010, and 2015 to determine perceptions of crowding in Wilderness areas. Visitors were asked to rate their satisfaction with various aspects of their experience accessing and recreating in the Wilderness areas. These factors were: Restroom Cleanliness, Developed Facilities, Condition of Environment, Employee Helpfulness, Interpretive Displays, Parking Availability, Parking Lot Condition, Recreation Information Availability, Road Condition, Feeling of Safety, Scenery, Signage Adequacy, Trail Condition, and Value for Fee Paid. The results of these surveys were combined to provide one overall metric of satisfaction (Figure 67).

Discussion

NVUM results show that respondents overwhelmingly felt that they were very satisfied with their Wilderness experience. There does not appear to be a significant change in satisfaction between these 5-year snapshots.

Recommendations

Based on the results, there does not appear to be a visitor experience reason to alter direct visitor management actions in our Wilderness areas. Current visitor management practices should continue until better research or other factors necessitate intervention.

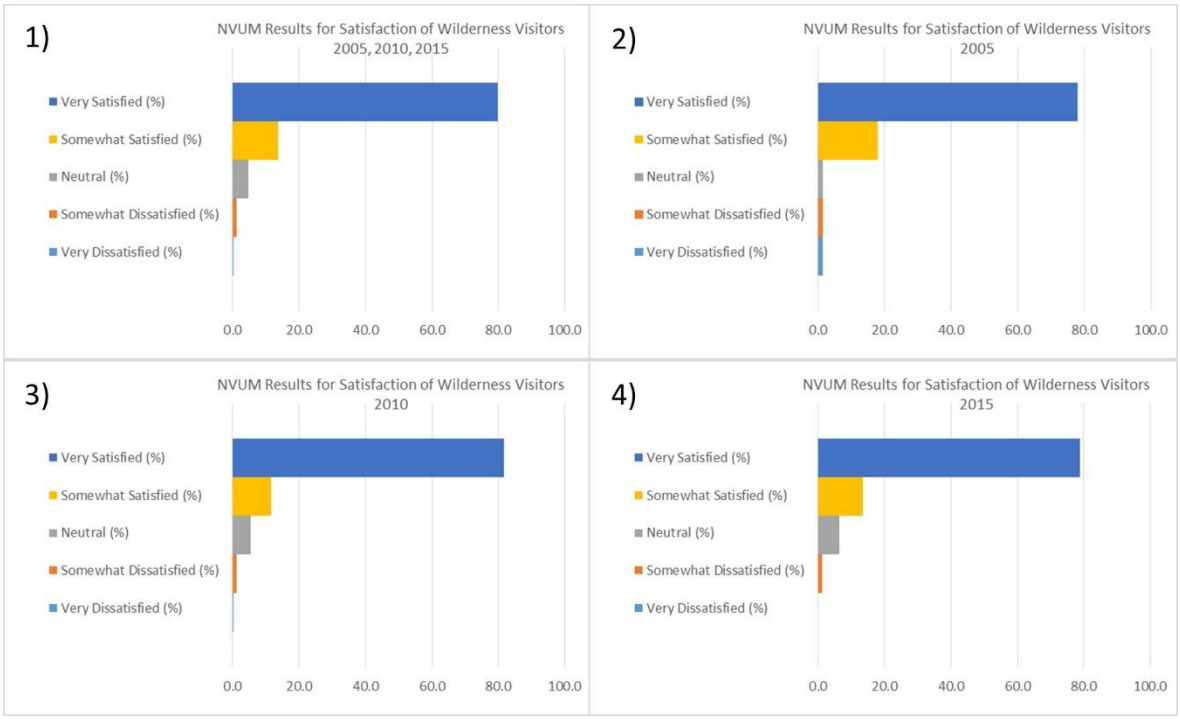

Figure 67. National Visitor Use Monitoring (NVUM) survey results showing 1) survey results from 2005, 2010, and 2015 combined and survey results from 2) 2005, 3) 2010, and 4) 2015.

Evaluation of Monitoring Question and Indicator(s)

Monitoring questions and indicators should continue as is. Additional Wilderness-specific surveys should be completed as funding and workload allow.

References

University of Vermont, Park Studies Laboratory. 2015. Unpublished draft: Summary of field research and preliminary results.

United States Department of Agriculture, Forest Service, Natural Resource Manager. Results of National Visitor Use Monitoring for the White Mountain National Forest: 2005, 2010, and 2015. UDSA Forest Service. Available: https://apps.fs.usda.gov/nvum/results

5.19 – Wildlife

Many species of wildlife occur on the WMNF, including threatened (Canda lynx) and endangered (northern long-eared bat) species and nearly 100 RFSS wildlife species. Monitoring questions pertain to these species and their habitats as well as to important groups of species, such as low-elevation and high-elevation breeding birds, and their habitats. The following monitoring questions use presence-absence and abundance data on these species as important indicators of the health of these species' populations.

5.19.1 – Are population trends of low-elevation breeding birds consistent with those projected under the Plan based on projected habitat changes?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Number of birds counted on fixed-point transects over time

Monitoring Frequency

Data is collected in even-numbered years.

Background and Driver(s)

This protocol addresses two monitoring needs. A large volume of bird observations is collected each survey year, providing data to assess population trends of various bird species over time. Using a single protocol, a large number of species covering a wide range of habitat requirements can be evaluated. In addition, the data allows for species trend comparisons between management areas where timber harvest is allowed versus management areas that emphasize more semi-primitive conditions. This helps validate the effects projected in the FEIS completed for the revised Forest Plan in 2005, as well as improve understanding of the role the WMNF plays in the larger landscape context.

Low-elevation bird monitoring addresses the following required monitoring element in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

The most direct way of determining if species populations are changing is to count individuals during the breeding season when birds are most vocal. Also, a standard breeding bird survey allows data to be collected for multiple species, providing opportunities to compare trends across multiple species. For this analysis, data from 16 transects (each with 15 fixed points) were used. Transects were surveyed annually from 1992 to 2002 and then every other year from 2004 through 2018. All birds seen or heard during a 10-minute period were recorded, with observations categorized as first noted in the first 3 minutes, next 2 minutes, or final 5 minutes of the survey. Birds were identified as falling either within or outside a 50-meter radius circle around the surveyor. Each transect was surveyed three times between the last week in May through the end of June.

Data were analyzed using two different methods. To obtain a more statistically accurate estimate of population in each year, the first method calculated the probability of detection for each species in each year. Only bird observations identified as falling within the 50-meter survey circle were counted in order to evaluate a more consistent survey area from year to year and to provide a way to project density estimates. However, this required that all of the observations across the Forest be lumped together for

analysis, rather than evaluating observations point by point. The survey replicate with the highest total number of observations was used for any given year.

The Farnsworth removal model (Farnsworth et al. 2002) was used to estimate each species' survey population size in each year, utilizing formulas provided by Donovan and Alldredge (2007). Then these estimates were graphed for a visual representation of the trend. Population trends were compared to those based on New Hampshire Breeding Bird Survey (BBS) data (Sauer et al. 2017) to evaluate trends on the WMNF in the context of the larger surrounding landscape.

A second analysis was done using the full dataset, evaluating observations point by point. Observations both within and outside the 50-meter circle were considered. Like the Farnsworth method, only the survey replicate with the highest number of observations was included. For each species, all point observations were ranked by year and the ranks graphed to discern visual trends. In addition, the mean number of observations per year was graphed to confirm visual trends.

Finally, because the data was evaluated by point, it was possible to categorize the observations based on their management area location on the Forest. Thus, the data were also graphed based on those that fell in MA 2.1 (general forest management) and those that fell in MA 6.1 or 6.2 (semi-primitive recreation) to determine any differences based on management approach.

Monitoring Indicator 1

Probability of detection for each species in each year.

Results and Discussion

Of the 132 species counted over the entirety of this survey protocol, 39 had a sufficient number of observations over the survey period to determine an annual rate of change based on Farnsworth estimates (Table 36).

Table 36. Survey results of 39 bird species on the WMNF from 1992 to 2018. The text is bolded in cells with percent annual change greater than 5 percent and in cells with graphed data that show obvious visual trends. Species are in bolded text if they have a percent annual change greater than 5 percent *and* graphed data that show obvious visual trends. New Hampshire (NH) Breeding Bird Survey (BBS) relative index values in italics represent 95 percent confidence intervals with uncertain trend direction.

Common name	Percent annual change	Obvious visual change?	NH BBS relative index
Canada warbler	**-13.0**	**Yes**	-5.16
Yellow-rumped warbler	**-8.7**	**Yes**, generally higher prior to 2000	*0.39*
Wood thrush	**-8.3**	**Yes**, being driven by high numbers early	-3.98
Veery	**-7.4**	**Yes**	-1.51
White-throated sparrow	**-7.4**	**Yes**, being driven by high numbers early	-3.54
Dark-eyed junco	**-6.5**	No	-1.96
Least flycatcher	**-6.0**	No	-4.46
Common raven	**-5.6**	No	5.17

Common name	Percent annual change	Obvious visual change?	NH BBS relative index
Scarlet tanager	**-5.4**	**Yes**, being driven by high numbers early	1.71
Common yellowthroat	**-5.3**	No	*0.78*
White-breasted nuthatch	**-5.0**	No	2.90
Black-throated green warbler	-4.4	No, although last 2 years are very low	*0.54*
Magnolia warbler	-4.1	No	*0.02*
American redstart	-3.9	**Yes,** there is a difference between early years and later years	-2.55
Winter wren	-3.8	No	*0.13*
Ovenbird	-3.6	No, although last 2 years are very low	*0.23*
Brown creeper	-3.2	No, although very small numbers overall so hard to detect trend	*0.53*
Blackburnian warbler	-3.0	No	*0.90*
Rose-breasted grosbeak	-2.9	No	-2.45
Red-breasted nuthatch	-2.9	No	*1.13*
Hermit thrush	-2.8	No	*0.88*
Chestnut-sided warbler	-2.4	**Yes**, started high and has since leveled out	-1.68
Swainson's thrush	-2.1	no	*1.58*
Downy woodpecker	-2.1	No	1.56
Blue-headed vireo	-2.0	**Yes**	1.64
Red-eyed vireo	-1.6	No, although last 2 years are very low	0.78
Black-throated blue warbler	-1.5	No, although last 2 years are very low	1.48
Mourning warbler	-1.4	No	*-1.17*
Blue jay	-0.6	No	-1.69
Hairy woodpecker	-0.5	No	*0.71*
Eastern wood-pewee	-0.3	No	-1.82
Yellow-bellied sapsucker	-0.2	**Yes**, but in opposite direction	2.19

Common name	Percent annual change	Obvious visual change?	NH BBS relative index
Black-capped chickadee	0.0	No	1.14
Nashville warbler	0.4	No	-3.2
Pileated woodpecker	1.0	**Yes**	3.34
Golden-crowned kinglet	1.1	No	*2.23*
Black-and-white warbler	1.1	No	-2.32
American robin	1.4	No	-0.88
Ruffed grouse	4.4	No	-3.61

For this analysis, annual changes that were at least 5 percent (either positive or negative) were assumed to be more likely to indicate a real population shift compared to species with lower percent annual changes. A total of 11 species (Canada warbler, yellow-rumped warbler, wood thrush, veery, white-throated sparrow, dark-eyed junco, least flycatcher, common raven, scarlet tanager, common yellowthroat, and white-breasted nuthatch) had annual changes of at least 5 percent. Of these 11 species, Canada warbler (Figure 68), yellow-rumped warbler (Figure 69), wood thrush (Figure 70), veery (Figure 71), white-throated sparrow (Figure 72), and scarlet tanager (Figure 73) also had obvious visual trends when plotting both the mean number of bird observations per point and using nonparametric statistical rankings of the points by year.

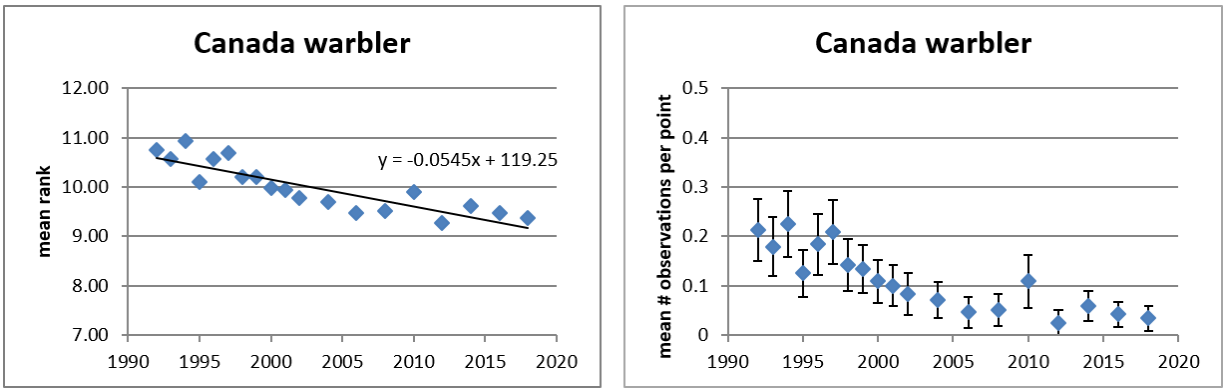

Figure 68. Trends in Canada warbler populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

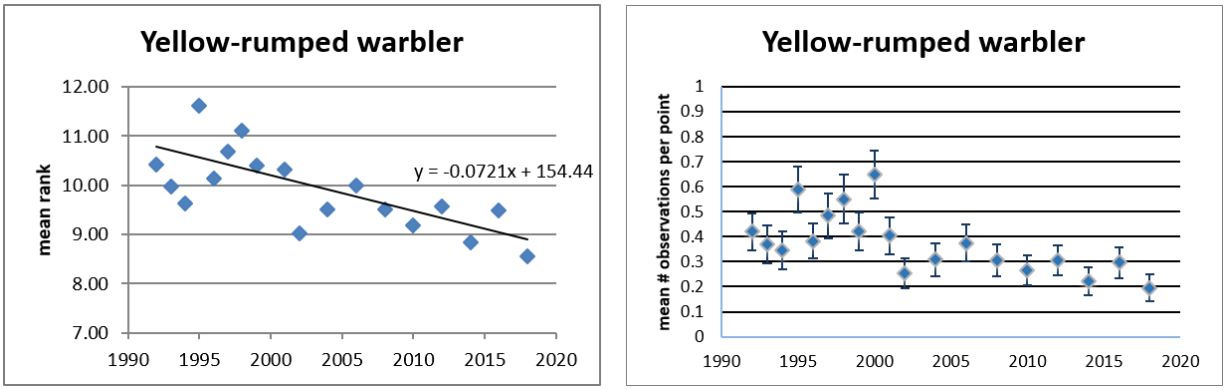

Figure 69. Trends in yellow-rumped warbler populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

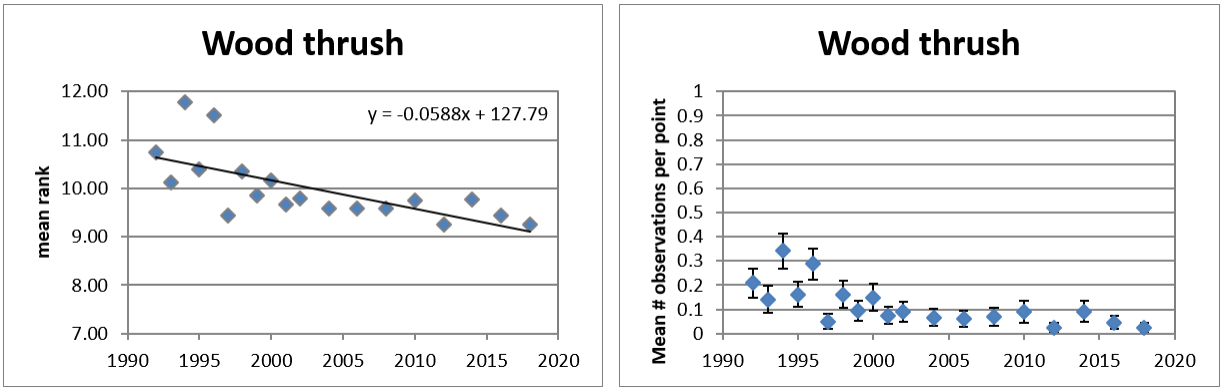

Figure 70. Trends in wood thrush populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

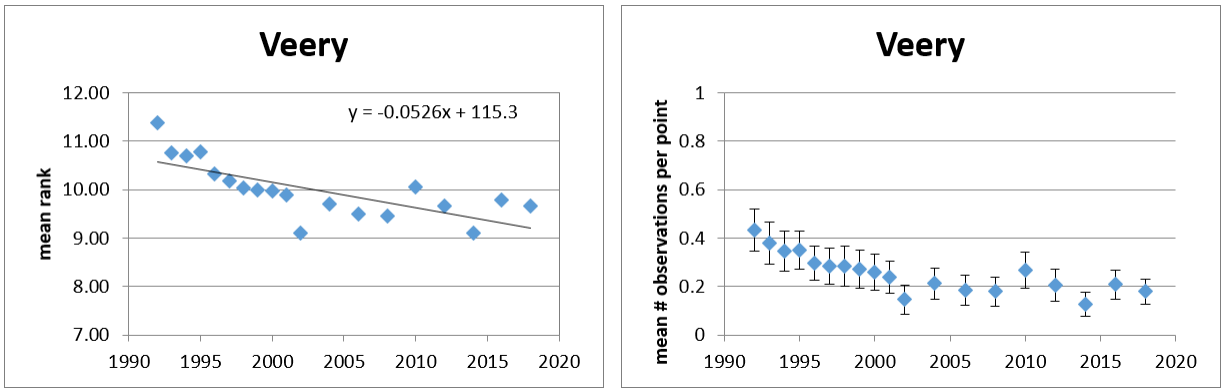

Figure 71. Trends in veery populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

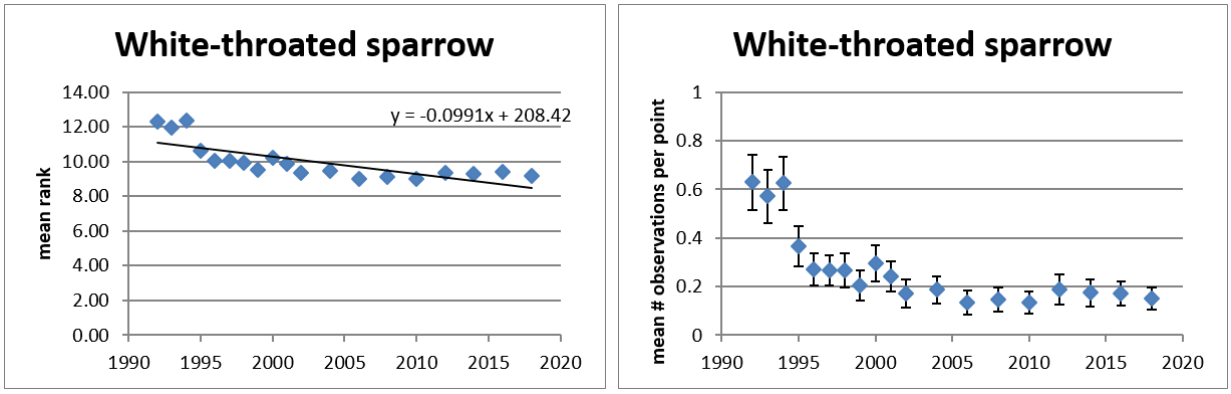

Figure 72. Trends in white-throated sparrow populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

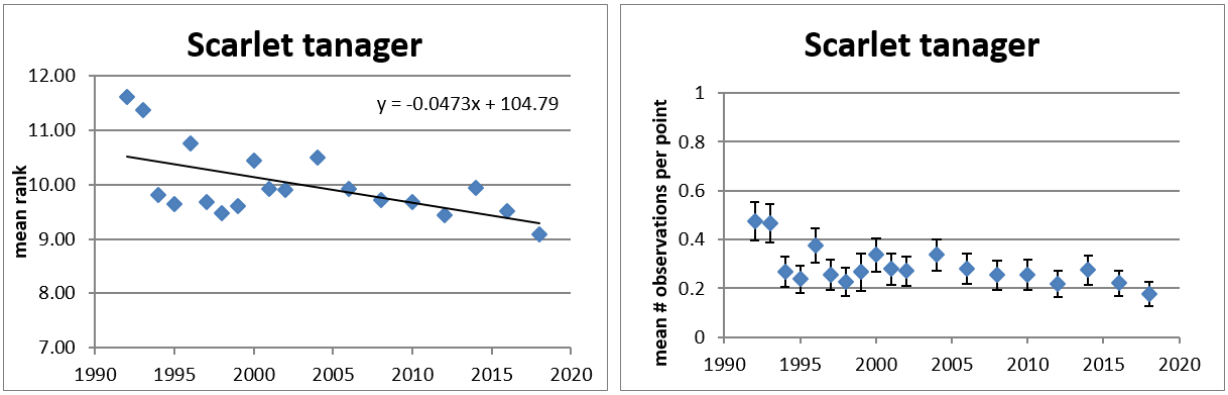

Figure 73. Trends in scarlet tanager populations on the WMNF from 1992 to 2018 based on mean rank (left) and mean number of observations per point (right).

Interestingly, all of the species showing at least 5 percent change had negative population trends. In fact, for 10 of the total species evaluated (26 percent), 2018 was the lowest recorded year on record.

To understand if these declines are unique to the WMNF or part of a larger regional trend, results were compared to the North American BBS (Sauer et al. 2017) using data from 1992 to 2015 (the last available year for trend analysis). The metrics for evaluating BBS trends are based on annual index changes, so are

not directly comparable to the numbers in Table 36. However, general directions of trends may be illustrative. Of the 16 WMNF species evaluated in Table 36 whose percent annual change was at least 5 percent negative, half also showed declining trends in the BBS in New Hampshire. They included wood thrush, veery, white-throated sparrow, dark-eyed junco, least flycatcher, scarlet tanager, Canada warbler, and American redstart. This indicates that population trends for these species on the WMNF are likely reflective of similar state-wide or larger trends. Several of these species are known to have more wide-ranging population declines due to winter habitat loss (e.g., Canada warbler) or widespread maturing forests (e.g., white-throated sparrow and wood thrush) (Hunt 2009). The only species where the numerical trend on the Forest appeared noticeably different from the BBS was the yellow-rumped warbler, which seems to be declining on the WMNF but appears stable throughout New Hampshire. However, when comparing the actual graphed trends, the WMNF data points mirror the same trend seen in both New Hampshire as well as the larger United States population (Sauer et al. 2017). Although concerning, it would not appear the declines of any species on the WMNF are attributable directly to Forest Service management. This is also supported by Rosenberg et al. (2019), who found that over the last 50 years, North American birds have declined across the continent by almost 30 percent. Ninety percent of this decline can be attributed to just 12 of 67 bird families, including all of the above species except the scarlet tanager, which still appeared in the top third of declining families.

Monitoring Indicator 2

Visual trends in bird populations over time.

Results

In the second analysis, survey point results were categorized by Management Area to determine possible differences based on management focus. Survey points are located in one of two categories: MA 2.1 (General Management Area), where timber harvest and developed recreation occur; and MA 6.x, where points fell into either MA 6.1 or 6.2, both of which emphasize semiprimitive, nonmotorized recreation. A number of species showed similar trends in both Management Area categories but had overall higher observations in one category or the other. Table 37 lists presumed Management Area preference by species.

Table 37. Presumed Management Area (MA) preference by species. MA 2.1 is General Management Area and MA 6.x includes either MA 6.1 or 6.2, both of which emphasize semiprimitive, nonmotorized recreation.

MA 2.1	MA 6.x
Blue jay	Dark-eyed junco
Common yellowthroat	Swainson's thrush
Chestnut-sided warbler	Yellow-rumped warbler
Hermit thrush	Winter wren
Rose-breasted grosbeak	—
Red-eyed vireo	—
Scarlet tanager	—
White-throated sparrow	—
Yellow-bellied sapsucker	—

These results are not surprising as they reflect known habitat preferences. Species in the MA 2.1 column include those that favor early successional or shrubby understory habitats that would be created by

timber harvests or favor mature deciduous forests, which also are common in this Management Area. The species in the MA 6.x category all favor coniferous forests, which are more prevalent in this Management Area.

A few species, though, showed different trend patterns between the two Management Area categories. The most obvious of these is the veery, which shows a fairly stable pattern in MA 6.x, but a noticeable decline in MA 2.1, especially in the early survey years through about 2002 (Figure 74). Veeries prefer mature hardwood or mixed hardwood-conifer forests but require dense understories for breeding. Given that the MA 6.x trend seems stable, it is likely that the MA 2.1 trend reflects more survey points that were near recently harvested stands earlier in the survey period.

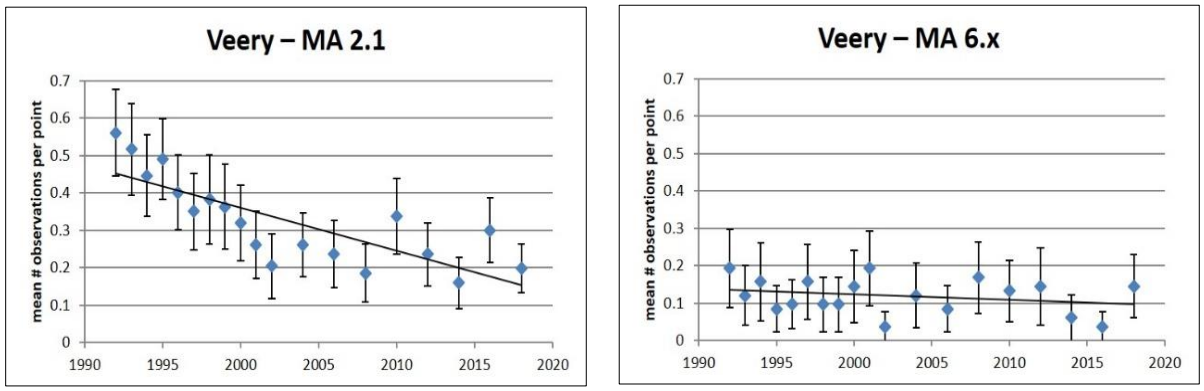

Figure 74. Veery population trends on the WMNF in MA2.1 (left) and MA 6.x (right) from 1992 to 2018.

The ovenbird shows a similar difference (Figure 75), although the MA 2.1 trend is more suspect as it is clearly being influenced by the last 2 years. Without the 2016 and 2018 data points, the MA 2.1 trend would appear stable like the MA 6.x trend. Ovenbirds are found in large expanses of closed-canopy hardwood forests, but unlike the veery, they prefer open understories.

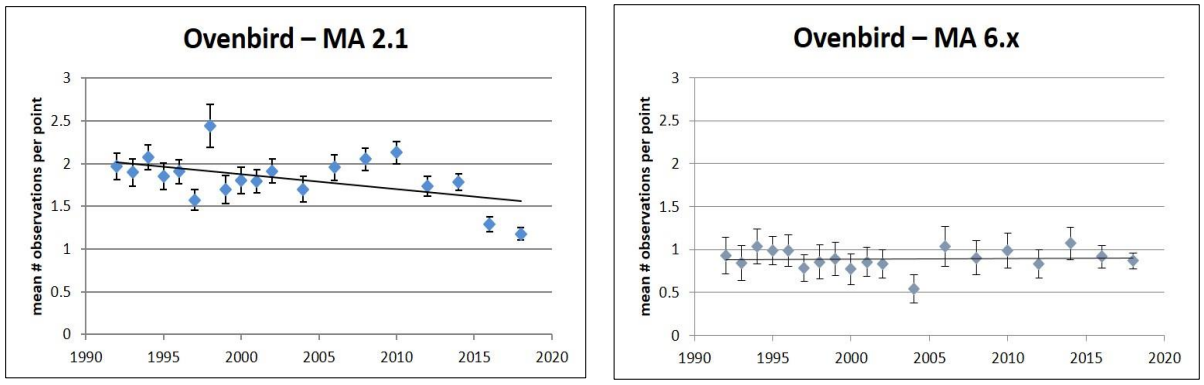

Figure 75. Ovenbird population trends on the WMNF in MA2.1 (left) and MA 6.x (right) from 1992 to 2018.

The opposite pattern is seen in the magnolia warbler and black-throated blue warbler, which show fairly stable patterns in MA 2.1, but declines (albeit with substantial variation) in MA 6.x (Figure 76 and Figure 77).

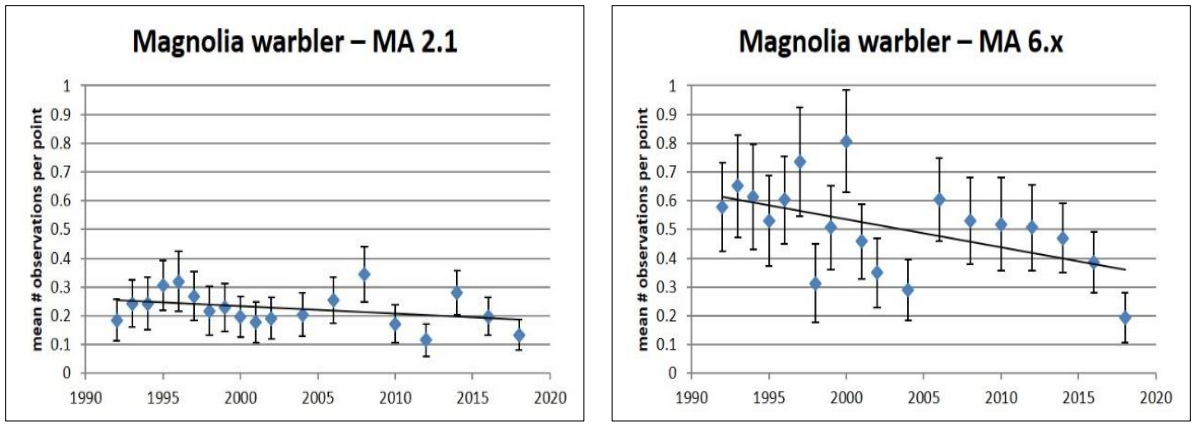

Figure 76. Magnolia warbler population trends on the WMNF in MA2.1 (left) and MA 6.x (right) from 1992 to 2018.

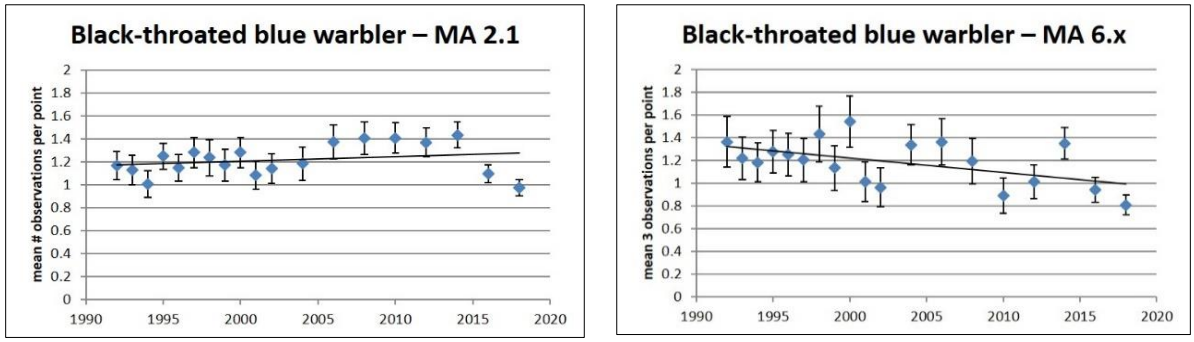

Figure 77. Black-throated blue warbler population trends on the WMNF in MA2.1 (left) and MA 6.x (right) from 1992 to 2018.

One thing these species have in common is they both prefer dense horizontal cover. Magnolia warblers are associated with young, dense spruce stands, while black-throated blue warblers are generally found in shrubby understories of hardwood or mixed hardwood-conifer forests. Perhaps the maturing of MA 6.x forest stands is slowly reducing these components, whereas they continue to be created through harvest in MA 2.1. Or perhaps some survey points fell in or near areas of natural regeneration caused by wind or ice storms (e.g., fir waves) earlier in the survey period, which have not been replaced. It is possible that as the forest continues to mature, natural canopy caps will again lead to the shrubby understory conditions that would increase habitat for these species.

The last species with different Management Area trend patterns is the mourning warbler, which showed a quite variable set of data points in MA 2.1 and almost no observations in MA 6.x (Figure 78).

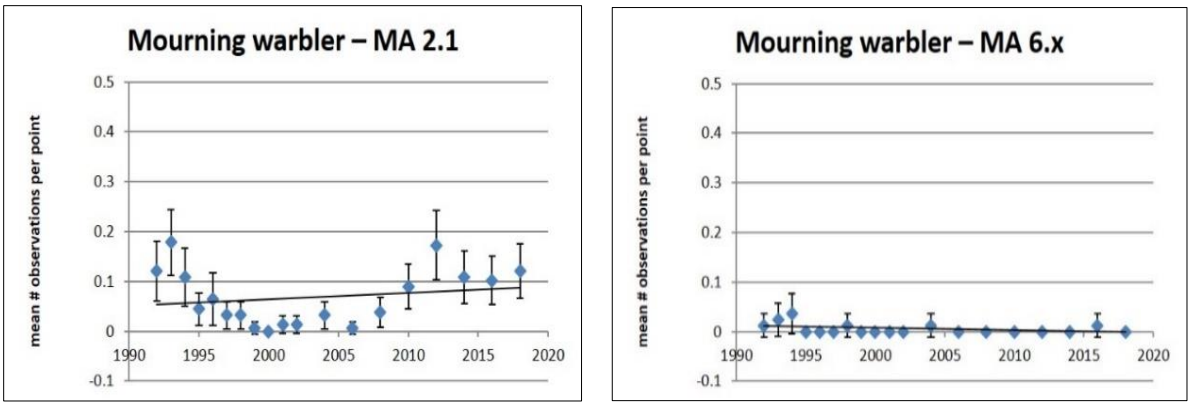

Figure 78. Mourning warbler population trends on the WMNF in MA2.1 (left) and MA 6.x (right) from 1992 to 2018.

The mourning warbler is an early successional habitat specialist, appearing early following hardwood clearcut harvests and declining after 7 to 10 years (DeGraaf 1991). The variability depicted in MA 2.1 is likely a reflection of having survey points that fell near clearcut patches early and later in the survey period.

Discussion

Results of the WMNF low-elevation bird monitoring to date showed that many species are more or less stable on the Forest. The fact that species with annual rates of change greater than 5 percent were all negative is concerning, but there is no obvious forest management activity attributable to these shifts. Instead, they probably reflect similar species' declines evident throughout the continent. Rosenberg et al. (2019) state that the depth of loss across various habitats, migratory guilds, and bird families likely indicates multiple factors at play, including loss of winter habitat, pesticide toxicity, urbanization, and agricultural intensification.

Recommendations

Continued monitoring will provide additional data to elucidate trends. One shortfall that has plagued this analysis for decades is that the Forest does not have a reliable dataset to track changes in forest stand vegetation across all management areas. However, advances in lidar imagery may soon provide a reasonable method of determining stand structure that can be translated into habitat conditions. This would allow for a more effective comparison of bird trends against corresponding habitat trends near the survey points.

Evaluation of Monitoring Question and Indicator(s)

No changes to this monitoring question are proposed at this time.

References

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5.19.2 – How has the amount and quality of habitat changed relative to the changes projected by the Forest Plan?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2014.

Monitoring Indicator(s)

- Acres of habitat by forest type and age class.

Monitoring Frequency

Every 5 years.

Background and Driver(s)

Query acres of habitat type and age classes from existing databases. Use the Habitat Guidance document to identify which forest types and age classes are tied to each habitat type (e.g., hardwoods, softwoods, and mixedwoods) for each habitat category.

Results and Discussion

This question section will be considered for evaluation in the next biennial monitoring report.

Recommendations, Evaluation of Monitoring Question and Indicator, and References

This question will be considered for evaluation in the next biennial monitoring report.

5.19.3 – What is the population trend of Bicknell's thrush (*Catharus bicknelli*) on the Forest?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Population changes over time

Monitoring Frequency

Bicknell's thrush and other high-elevation ecological indicator species are counted in odd-numbered years.

Background and Driver(s)

Bicknell's thrush is a globally rare species that breeds in montane and coastal forests dominated by balsam fir. Suitable habitat is found in just four northeastern states (New York, Vermont, New Hampshire, and Maine) and in southern Canada. The WMNF supports both the largest block of Bicknell's thrush habitat in the United States (26 percent) and the largest proportion of the total species population (31 percent) (Hill and Lloyd 2017). Potential threats on the breeding grounds include climate change, wind energy development, communication towers, acid precipitation, ski area development, and others. The Forest Service has recognized the important conservation role it plays in the management of Bicknell's thrush, designating it an RFSS for more than two decades, and the WMNF included a standard in the Forest Plan (p. 2-16) to ensure no net loss of Bicknell's thrush habitat from Forest Service decisions.

Bicknell's thrush monitoring addresses the following required monitoring elements in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

The most direct way of determining if the Bicknell's thrush population is changing is to count individuals during the breeding season when birds are most vocal. A standard breeding bird survey also allows data to be collected for multiple species in addition to Bicknell's thrush, providing opportunities to compare trends across multiple species. Over 500 fixed survey points have been established in high-elevation spruce-fir habitats on the WMNF. They were surveyed annually from 1993 to 2000 and then biennially from 2003 to 2017. All birds (not just Bicknell's thrush) seen or counted during a 5-minute period are recorded.

Results

Mean Bicknell's thrush observations per point were compared by year (Figure 79). Data from 2003 were omitted due to a skewed lack of survey effort in that year.

Because Bicknell's thrush is a migratory species, population trends can be influenced by outside factors such as habitat conditions on the wintering grounds. Examining population trends of other high-elevation species over the same time period can help to identify if non-local factors might be contributing to changes. The Forest Plan includes a suite of five ecological indicator species to represent high-elevation spruce-fir habitats (Figure 80). In addition to Bicknell's thrush, these include the blackpoll warbler (*Setophaga striata*), yellow-bellied flycatcher (*Empidonax flaviventris*), boreal chickadee (*Poecile hudsonicus*), and spruce grouse (*Canachites canadensis*). Of these species, three are long-distance, neotropical migrants. Bicknell's thrush spends the winter on just four Caribbean islands, primarily on Hispaniola. Blackpoll warblers and yellow-bellied flycatchers travel to northern South America and

Central America, respectively. Both the boreal chickadee and spruce grouse are winter residents that do not migrate.

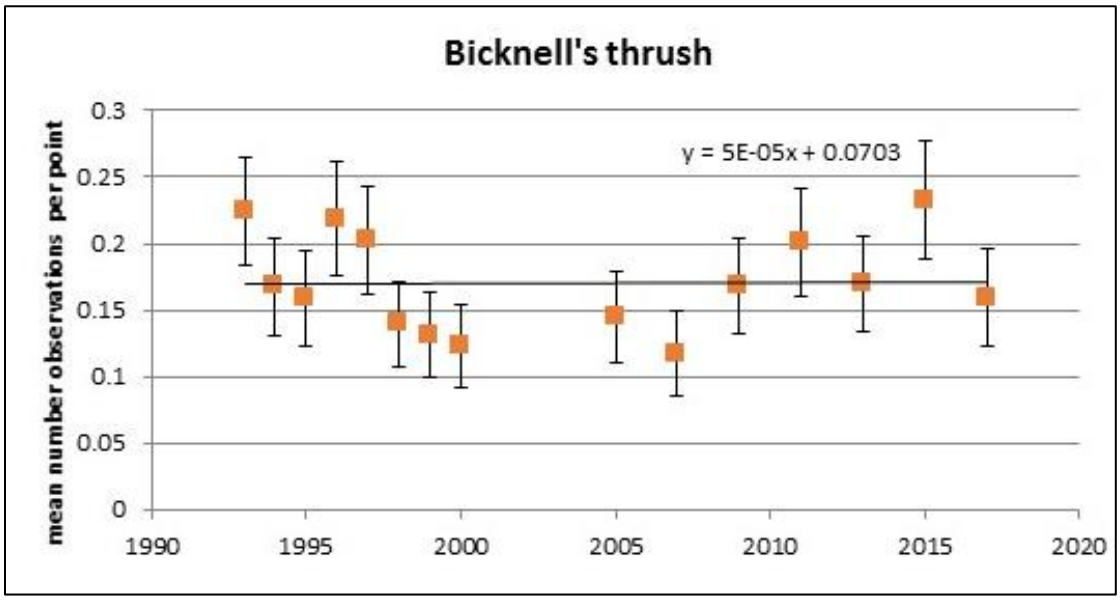

Figure 79. Bicknell's thrush observations on the WMNF from 1993 to 2017.

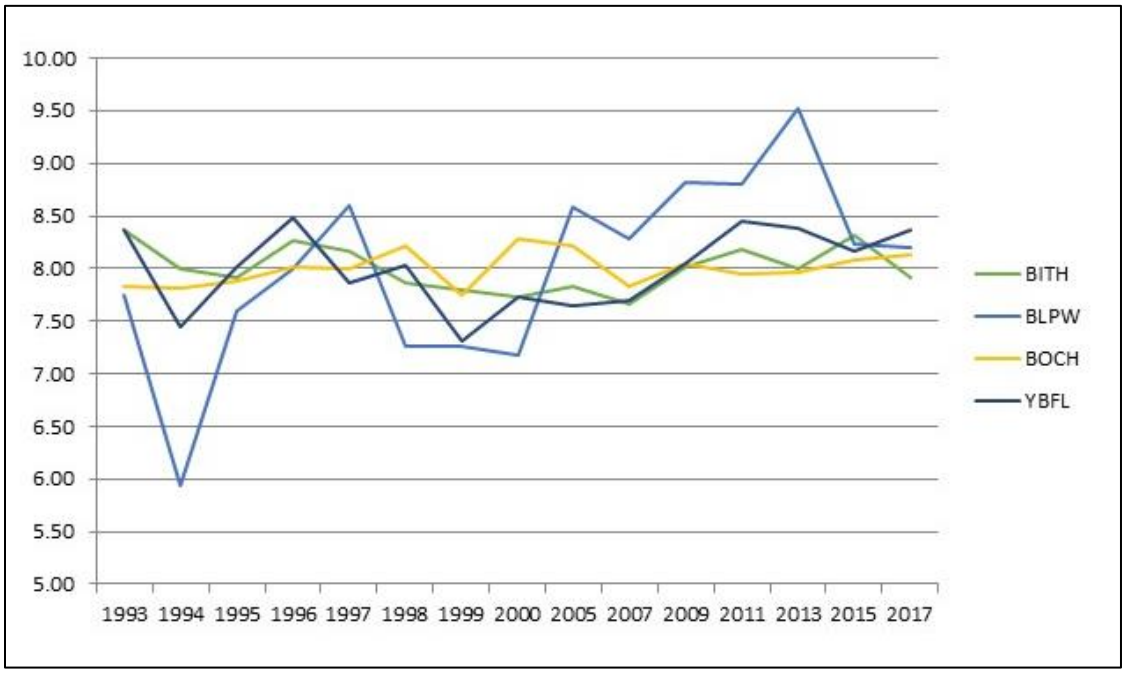

Figure 80. Relative rank of mean observations per point per year for Bicknell's thrush (BITH), blackpoll warbler (BLPW), boreal chickadee (BOCH), and yellow-bellied flycatcher (YBFL).

Spruce grouse have only been detected 39 times over the 13 years of the survey data, which is not enough to elucidate meaningful trends. However, the other four species are more common. Bicknell's thrushes were recorded at a total of 450 points (78 percent), with blackpoll warblers and yellow-bellied flycatchers found at 99.7 percent and 94 percent of points, respectively. Boreal chickadees were slightly less common, being recorded at 64 percent of points. In order to compare occurrence over time for

these species together, the mean number of observations per point were ranked by year for each species (Figure 80).

Discussion

Results show that despite a seemingly downward trend between 1993 and 2000, the Bicknell's thrush population seems to have rebounded since 2006, with an overall stable trend. A similar pattern was documented by the Vermont Center for Ecostudies (2018) using citizen science data collected throughout the breeding range. A stable trend over the survey period is also reflected in the boreal chickadee and yellow-bellied flycatcher. The blackpoll warbler shows much more volatility over time on the WMNF, but with a likely increasing trend over the whole survey period.

This information indicates that, at the very least, high-elevation spruce-fir forests on the WMNF continue to provide suitable habitat for these indicator species. The significance of this habitat is expected to become more pronounced in the future, as a result of climate change. A temperature increase of just 1 degree Celsius is predicted to reduce the amount of suitable habitat by more than 50 percent (Rodenhouse et al. 2007). The tall peaks of the White Mountains may provide the last available habitat in the Northeast.

Recommendations

No management changes are indicated at this time.

Evaluation of Monitoring Question and Indicator(s)

Evaluation of this monitoring question using the prescribed indicators continues to provide important information relevant to Forest Management and implementation of the Forest Plan.

References

Hill, J.M. and J.D. Lloyd. 2017. A fine-scale U.S. population estimate of a montane spruce-fir bird species of conservation concern. Ecosphere 8(8): e01921. 10.1002/ecs2.1921

Rodenhouse, N.L., S.N. Matthews, K.P. McFarland, J.D. Lambert, L.R. Iverson, A. Prasad, T.S. Sillett, and R.T. Holmes. 2007. Potential effects of climate change on birds of the Northeast. Mitig. Adapt. Strat. Glob. Change 13:517-540.

Vermont Center for Ecostudies. 2018. The state of the mountain birds. Available: https://mountainbirds.vtecostudies.org/. [Accessed 12 February 2018].

5.19.4 – Are Canada lynx (*Lynx canadensis*) and gray wolf (*Canis lupus*) present as residents on the WMNF?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Number of individuals

Monitoring Frequency

Annual.

Background and Driver(s)

Monitoring the status of federally listed species is an important part of the Forest Service conservation mission. Canada lynx is listed as a threatened species and gray wolf is listed as endangered in the Northeast. The Forest Plan includes goals (pp. 1-9 to 1-10), as well as standards and guidelines (pp. 2-13 to 2-15) related to providing adequate suitable habitat to support recovery of these species.

The WMNF implemented a winter snow track survey on fixed transects from 2003 through 2011. This protocol was not optimal due primarily to low staffing levels limiting the area that could be surveyed. In addition, the survey window was highly dependent on suitable weather conditions, which often did not materialize. Shortly thereafter, WMNF biologists decided to try a new approach: using game cameras to collect data. Since 2013, a research project through the University of Massachusetts has been implemented in northern New Hampshire and Vermont (including the WMNF) to capture information about Canada lynx, gray wolf, and other large mammals using game cameras in conjunction with traditional snow tracking transects. Approximately 80 trail cameras were placed in various locations across the Forest, targeting winter activity, but many were left to run all year. Sites were baited every 2 weeks during the winter using a combination of scent attractants. Bait was placed on top of a wooden measuring stick placed in view of the camera and topped with a large feather as a visual attractant.

This monitoring item addresses the following required monitoring element in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

Results

Prior to the current research project, no wolves had ever been found in WMNF surveys. Canada lynx also were not located during surveys, although tracks were occasionally found opportunistically. Data analysis for this research project is currently being completed as part of a PhD program. However, during the 6 to 7 years of data collection, no evidence of any gray wolves was found. Canada lynx, while uncommon, did appear multiple times between 2006 and 2019 (Table 38 and Figure 81).

Table 38. All Canada lynx occurrences recorded on the WMNF from 2005 to 2019.

Month and year	General location	Method and source
January 2006	Hwy 2	Tracks - Contract biologist
March 2006	Kilkenny unit	Tracks - NH Fish and Game Department
April 2013	Kinsman area	Tracks – NH Fish and Game Department
January 2016	Zealand	Tracks – AMC
July 2016	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project
July 2017	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project

July 2017	Kinsman	Camera – Research project
November 2018	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project
December 2018	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project
February 2018	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project
April 2018	Mount Avalon, Mount Field, and Mount Tom	Camera – Research project
March 2019	Wildcat Ridge	Tracks – WMNF staff

Figure 81. Photo of a Canada lynx taken on the WMNF. Photo courtesy of Alexej Sirén.

Discussion

It would appear that wolves are extirpated from the WMNF, since none have been found in several decades. A total of 12 Canada lynx observations in the last 14 years indicate that Canada lynx have not been completely extirpated from the Forest. However, all observations or tracks were from adult animals and there has been no evidence of breeding or other signs of reproduction.

Of note are the general locations where Canada lynx have been found. Seven of the 12 observations were from the area between Zealand Ridge and Mount Field, a distance of only a few miles. This is the same area where the most Canada lynx tracks were observed in the 1980s during another intensive search for the species. In total, almost half (9 of 20) of the WMNF's total known Canada lynx observations are from this general area. The other area with more than one occurrence is Kinsman (4 occurrences since 1993). The number of occurrences is too small and sporadic to consider that resident

animals or self-sustaining populations exist but suggests that perhaps these two areas support the best suitable habitat on the Forest.

Recommendations

No additional recommendations are suggested at this time.

Evaluation of Monitoring Question and Indicator(s)

Recommend continued monitoring. Final analysis results of the current research project may help direct future management or monitoring actions.

References

Not applicable.

*5.19.5 – Where are woodland bats located on the Forest and what are their population trends?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Presence or absence per survey site using stationary surveys, where bat detectors are left for days at a time. These collect calls that may be from many bats flying by the microphone once or a few bats flying past the microphone multiple times.
- Relative call abundance over time using driving surveys, where the assumption is that each call is from a different bat.

Bat population trends based on acoustic driving surveys were last evaluated in the monitoring report for FY 2018. This report only addresses stationary acoustic surveys and evaluates changes in presumed bat presence or absence in areas where they were previously found.

Monitoring Frequency

Bat acoustic driving surveys were completed annually from 2009 through 2015 and have since been put on a 5-year schedule. A subset of stationary surveys from 2014 through 2024 were analyzed and presented in this report.

Background and Driver(s)

This monitoring question responds to the following required monitoring element in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

In 2007, the new disease white-nose syndrome was discovered and has since spread rapidly. Population declines were estimated at over 90 percent just a few years after the disease reached a new location. As a result, the U.S. Fish and Wildlife Service listed the northern long-eared bat (*Myotis septentrionalis*) as threatened under the Endangered Species Act in 2015 and reclassified the species to endangered in 2022. The tri-colored bat (*Perimyotis subflavus*) was proposed to be listed as endangered in 2023. The remaining WMNF small hibernating bats (little brown bat (*M. lucifugus*) and eastern small-footed bat (*M. leibii*)) have been designated as RFSS.

This monitoring supports the following Forest Plan Rare and Unique Features Goals (p. 1-8):

- The WMNF will provide sufficient habitat and protection to preclude the need for species listing under the Federal Endangered Species Act due to National Forest habitat conditions or effects of activities.
- For species currently listed under the Federal Endangered Species Act or designated RFSS, the Forest Service will contribute to conservation and recovery of species and their habitats.

Prior to white-nose syndrome, species such as the little brown bat and northern long-eared bat were considered fairly common and widespread on the WMNF (e.g., Chenger 2002, Chenger 2004). The eastern small-footed bat and tri-colored bat have always been considered naturally less common. Stationary acoustic surveys allow biologists to identify possible areas of bat activity on the landscape, as well as track overall changes in distribution and potential habitat preferences.

Survey methods were developed by the U.S. Fish and Wildlife Service for the Indiana bat (*Myotis sodalist*) and northern long-eared bat (e.g., U.S. Fish and Wildlife Service 2024) but are useful for recording all bat species occurrences. Sophisticated bat detectors record bat echolocation calls as the animals fly past the detector's microphone. Later analysis can link recorded files to previously recorded calls of known species in order to determine species presence at a site.

Survey areas (most often based on proposed projects) are subdivided in a way to allow two bat detector stations for every 123 acres. The detectors are programed to record all bat calls between 6:00 p.m. and 5:00 a.m. and are left to record for at least two nights with suitable weather conditions (at least 50 degrees Fahrenheit and minimal rain or wind). Calls are first screened, then passed through two automated species classifier programs, and confirmed by hand to obtain results.

For a period of approximately 5 years, WMNF biologists conducted stationary acoustic surveys at large, proposed tree-cutting projects (e.g., timber harvests). In the subsequent decade, a number of these areas were harvested. The purpose of monitoring conducted in 2024 was to compare recent bat activity at sites where federally endangered northern long-eared bats had been found in 2014 or 2015. Evaluation included all of the small hibernating bat species (i.e., northern long-eared bat, little brown bat, eastern small-footed bat, and tri-colored bat) together as a group. This was done because all four species share similar forested habitats, all have suffered significant population losses from white-nose syndrome, so are noticeably scarcer on the landscape, and these species' calls can be notoriously ambiguous and difficult to distinguish between other species in this group.

Analysis involved screening out noise files from each night's recording using automated software (Kaleidoscope Pro, version 5.2.1). The remaining files with bat calls approximately 40 kilohertz or higher (the range in which the four species in question call) were viewed and classified by hand. All nights of recorded data were reviewed, but only nights that met weather parameters prescribed by the U.S. Fish and Wildlife Service survey guidelines were counted. The final analysis evaluated the number of nights

per site where bat activity (from northern long-eared bats, little brown bats, eastern small-footed bats, or tri-colored bats) was confirmed or suspected.

The U.S. Fish and Wildlife Service survey guidelines from 2014 and 2015 recommended fewer survey nights per site than more recent guidelines. As a result, there were generally more survey nights of data in later years. To account for this, analysis evaluated the proportion of survey nights where bats were active in respective years. In all years, only survey nights that met weather parameters prescribed by the U.S. Fish and Wildlife Service survey guidelines were counted.

Results

Eleven survey sites were selected where northern long-eared bat calls were confirmed in 2014 or 2015. These included two sites in Martins Location, New Hampshire, one site in Milan, New Hampshire, four sites in Easton, New Hampshire, and four sites in Stoneham, Maine (Table 39). Although all of these sites were within larger project areas with proposed tree cutting, not all of the individual survey sites were proposed for harvest. Of the 11 survey sites, 5 were in natural openings or stands with no harvest completed as of 2024. The proximity of the remaining 6 sites to harvested areas ranged from approximately 800 feet away from a harvested stand to within the harvest unit. Harvest prescriptions included two clearcuts (where most trees are removed), three group selection harvests (where only a relatively small portion of the stand is harvested in small patches), and one intermediate harvest (where smaller trees are removed to focus growth on the remaining higher quality trees).

Table 39. Number of survey nights with bat activity during 2014 or 2015 and 2024.

Site name (town)	Number of nights with bat activity (2014 or 2015)	Number of nights with bat activity (2024)	Habitat description
AS5 (Stoneham)	1 of 3	8 of 12	On small stream surrounded by beech, birch, aspen (no harvest)
AS8 (Stoneham)	2 of 2	0 of 8	On road surrounded by mature northern hardwoods (no harvest)
AS10 (Stoneham)	2 of 2	14 of 15	Knox wildlife opening adjacent to intermediate cut (harvested in 2023)
AS24 (Stoneham)	1 of 3	0 of 7	Natural opening surrounded by red oak and beech (no harvest)
BB0 (Easton)	1 of 2	12 of 15	Mixed hardwoods (group cut harvest approximately 200 feet away in 2017)
BB16 (Easton)	1 of 4	2 of 8	Trail edge in mixed hardwoods/spruce (group cut harvest in 2017)
BB48 (Easton)	1 of 2	0 of 10	Maple/beech stand facing field (clearcut approximately 200 feet away in 2017)
BB59 (Easton)	3 of 3	3 of 13	Hemlock grove near wetland (clearcut approximately 500 feet away in 2017)
DC1 (Martins Location)	1 pf 5	1 of 10	Powerline corridor within mature mixedwood (no harvest)
DC5 (Martins Location)	0 of 3 (but one bat was counted on a non-suitable weather night)	10 of 10	Natural stream/wetland corridor in mixedwood pole stand (no harvest)
DR36 (Milan)	2 of 3	8 of 14	Natural opening in mature paper birch, spruce, maple (group cut approximately 800 feet away in 2024)

Discussion

The most consistently active site was the Knox wildlife opening (AS10), where bats were active a total of 16 of 17 nights across both survey years. This location continues to be one of the most species diverse survey sites on the WMNF, with all seven bat species known to occur on the Forest recorded here in 2024. Other notable increases in activity occurred at BB0 (group cut harvest nearby in 2017), where activity increased by 30 percent, and DC5 (unharvested natural stream and wetland corridor), where no bats were counted in 2014 (one was found on an unsuitable weather night), but bats were recorded on all 10 survey nights in 2024.

A notable decline in bat activity was noted at BB59 (clearcut approximately 500 feet away), where bats were found all 3 nights in 2014 but only on 3 of 13 nights in 2024. Site AS8 (a natural opening with no harvest in the vicinity) had bat activity on both survey nights in 2014, but no bat activity over eight nights in 2024. Somewhat less clear is the decline at BB48 (clearcut harvest approximately 200 feet away). Bat activity was noted on 1 of 2 survey nights in 2014, but not at all over 10 nights in 2024. Worth pointing out is that the 2014 data was just a single bat call, so this may have been an anomaly (perhaps a bat just passing through) and not an indication of more persistent use at the site.

The only site where the survey station was actually located within the harvested stand (BB16) showed no change in the proportion of survey nights with bat activity over both years. Overall, the results do not point to any obvious correlations. Sites with harvest nearby showed both increases and decreases in bat activity. The same was true for natural sites with no harvest activity. The small data set and limited number of bats on the landscape likely confound the analysis to some extent. In addition, the reason that the U.S. Fish and Wildlife Service survey guidelines in later years prescribe more nights of survey per site is because the agency has determined that detectability is less accurate with fewer nights. Continued monitoring of additional pre- and postharvest units may provide additional insights.

Recommendations

The use of acoustic bat detectors can provide large quantities of survey data for relatively little effort. No change in monitoring protocols for this topic is recommended at this time.

References

Chenger, J. 2002. Summer survey for New Hampshire woodland bats. Report prepared for U.S. Fish and Wildlife Service Ecological Services, New England Field Office. Bat Conservation and Management, Inc. Carlisle, PA. 47 pp.

Chenger, J. 2004. 2004 woodland bat survey of the White Mountain National Forest. Bat Conservation and Management, Inc. Carlisle, PA. 45 pp.

U.S. Fish and Wildlife Service. 2024. Range-wide Indiana bat and northern long-eared bat survey guidelines. U.S. Fish and Wildlife Service, Region 3, Bloomington, MN. 95 pp.

*5.19.6 – Are wood turtles (*Glyptemys insculpta*) continuing to persist on the WMNF?

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Location and number of individuals per site or estimated population size

Monitoring Frequency

Biennial.

Background and Driver(s)

The monitoring helps confirm whether wood turtles, an RFSS, remain present on the Forest. Monitoring consists of Identifying suitable streams for wood turtles and conducting time-constrained active searches for wood turtles in overwintering pools, root wads, undercut banks, and along shores in identified segments during April and May or in September. Photo documentation of individuals captured helps to determine population trends. Initial surveys look for evidence of turtles (tracks) and follow-up surveys look for nests and evidence of hatched eggs.

Results

Since 2021, we have conducted mark-recapture surveys of wood turtles at three occupied sites on the WMNF. To protect the populations at these sites from illegal collection, we will mask their locations by referring to them as Sites A, B, and C. Table 40 shows the total numbers of unique turtles captured during the most recent survey effort at each site.

Table 40. Numbers of unique wood turtles captured at each site.

Age/sex of captured turtles	Site A	Site B	Site C	All sites
Adult males	21	4	1	26
Adult females	24	2	2	28
Unsexed juveniles	15	7	2	24
Total	60	13	5	78

To estimate the population of adult turtles at these sites, we used closed-population loglinear models, a widely used method among wildlife biologists for estimating population sizes of turtles from mark-recapture survey data. We surveyed each site with sufficient intensity across a complete active season (spring through fall) to allow us to develop models that estimate adult population sizes with good precision (Table 41). We have reported our estimated adult population sizes using the two models that are the best fits for our data:

- Population model "M_0" assumes all turtles have equal capture probability across the survey period.
- Population model "M_h" allows for varying capture probabilities between turtles.

We do not include juvenile turtles in our analyses because their capture probabilities are too low for us to derive meaningful population estimates.

Table 41. Estimates of adult wood turtle population at each site (95 percent confidence intervals in parenthesis).

Population model	Site A	Site B	Site C
M_0 model	50 (45-56)	6 (6-8)	3 (3-4)
M_h model	54 (46-74)	6 (6-11)	3 (3-6)

Based on the M_0 model and the distance of the stream reaches occupied by turtles, we have estimated population density as follows: 44 adult turtles per occupied stream kilometer at Site A, 4.3 at Site B, and 4.4 at Site C.

Site A, which hosts the largest known population on the WMNF, was first surveyed in 2007 (Jones 2009). A follow-up survey was conducted in 2020 to analyze population trends and estimate survival rates. Wildlife staff (Hillman and Jones 2022) determined the population persisted and remained healthy, although more intensive survey work was recommended to shrink confidence intervals for population estimates and better evaluate population trends and survival rates over the long term. To that end, we conducted a more rigorous survey over the course of a full year from September 2023 to September 2024.

Wildlife staff (Hillman and Jones 2022) calculated a minimum adult annual survival rate of 92 percent at this site between 2007 and 2020. In 2023 and 2024, we found three additional turtles captured in 2007 that were missed in 2020; this increased the minimum adult annual survival rate over that time period to 94 percent. This is indicative of a population that is stable.

In addition to this survey effort, we attached radio transmitters to a subset of turtles at each site to learn more about habitat use and movement patterns and better inform the Forest Service on how to protect these populations from future management activities. We radiotracked each turtle weekly for a year over the course of their active seasons and collected habitat data at each location.

At Site A, we equipped 24 turtles with radio transmitters. While most of the tracked turtles spent the whole year on the Forest, three turtles crossed a major state highway onto private land, while one other turtle spent significant time on private land without crossing any roads. Turtles also spent time in areas frequented by recreationists.

We radiotracked a subset of eight Site B and four Site C turtles. While two Site B turtles did travel great distances from the stream and floodplain, they stayed on the Forest. No turtles were tracked to the opposite side of a nearby State highway. The Site C turtles all spent the whole year within the floodplain and very close to the stream. They did not appear to cross any roads or venture away from the Forest.

Discussion

By increasing our survey effort at Site A, we had far more captures and recaptures than we did in 2020, thus allowing us to make a more precise population estimate (54 adults with a 95 percent confidence interval ranging from 45 to 56 using the M_o model) compared to our 2020 estimate (46 adults with a 95 percent confidence interval ranging from 31 to 85 using the M_o model).

Given the size and density of the population, high annual survival rate of adults, presence of juveniles of varying ages, and evidence of continued reproduction, we believe the population at Site A is stable. However, this is the most developed of the three study sites and turtles likely face a variety of anthropogenic pressures. While the population does exist within a few miles of other occupied sites, it may be isolated from them to some degree by the extent of development within the floodplain.

The populations at Sites B and C were discovered more recently and our survey efforts represented the first attempts to learn more about these populations. We determined that both populations are small and likely isolated, although there is evidence of successful reproduction given the presence of juveniles and evidence of mating and nesting activity. Both populations are well-protected from anthropogenic pressures. While Site B's population may be small, a high proportion of captured turtles were juveniles. This is generally indicative of a healthy population and one that may be growing.

Figure 82. Male wood turtle basking on leaf litter on a warm October day.

Recommendations

We recommend conducting intensive mark-recapture surveys at these three sites every 5 to 10 years to analyze trends in population size. While there is no foreseeable need to conduct radiotelemetry again at these sites, it may be worthwhile to use telemetry to monitor individuals if any projects are proposed in the vicinity.

We should continue surveying streams with potential wood turtle habitat as time allows or as projects are proposed near such areas. If any new occupied sites are found, we recommend conducting intensive mark-recapture surveys and radiotelemetry to learn more about these populations so that we can work to ensure their conservation.

References

Hillman, B. and M.T. Jones. 2022. A resurvey of a wood turtle (*Glyptemys insculpta*) population in northern New Hampshire, USA, after 13 years. Canadian Field-Naturalist 136(2):162–166.

Jones, M.T. 2009. Spatial ecology, population structure, and conservation of the wood turtle, *Glyptemys insculpta*, in central New England. Ph.D. thesis, University of Massachusetts, Amherst, MA.

5.19.7 – What is the population trend of sensitive butterfly species on the Forest?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Number of individuals or population size over time

Monitoring Frequency

Every 5 years.

Background and Driver(s)

There are two rare butterflies that occur on the WMNF: the White Mountain arctic (*Oeneis melissa semidea*) and the White Mountain fritillary (*Boloria chariclea montinus*). Both are geographically isolated subspecies that occur only in the White Mountains and are designated RFSS. One of the responsibilities of the Forest's wildlife program is to ensure rare species are conserved, which requires understanding the status of RFSS populations.

This monitoring question responds to the following required monitoring element in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

Unfortunately, surveying these species is difficult. Obtaining accurate quantitative data requires multiple hiking trips through the summer to the tops of alpine peaks. And the White Mountain arctic in particular is very cryptic, blending in with surrounding alpine rocks and reportedly congregating in groups rather than being evenly dispersed throughout suitable habitat. Monitoring has relied on research activities and partnerships with other organizations to ascertain population information.

Monitoring Indicator 1

Number of White Mountain arctic individuals.

Results

The White Mountain arctic is restricted to alpine habitat dominated by Bigelow's sedge in the Presidential Range. Although quantitative population estimates are lacking, it seems apparent that the population has declined during the last century at least. At the beginning of the 20th century, Scudder (1901) characterized it as "one of our commonest butterflies; and though hundreds, perhaps thousands, are annually captured by enthusiastic collectors, mostly within an area of a single square mile, it continues as abundant as ever, and seems better able than the wide-ranging bison to avoid extinction". McFarland (2003) summarized similar comments from two other 19th century naturalists. By 1969, though, numbers seem to have diminished. Anthony (1970) captured 51 individuals over a 10-day period (June 27–July 7) in the Cow Pasture and 169 individuals combined over a week (July 8–15) from the four main Bigelow's sedge "lawns" on Mount Washington and Mount Jefferson. More recent qualitative personal comments from collectors include: "great numbers" in the Cow Pasture along the Auto Road (1979), more than 100 in Alpine Garden (1984), and "approximately 30" in 1995 (summarized by McFarland 2003). McFarland (2003) also counted 31 individuals at various locations over 4 separate days in July 2002 but did not locate any the following year in late July and August. However, at least seven individuals were counted over four dates earlier in 2003 by different observers.

In 2011 and 2012, a more intensive mark-recapture research project was implemented to search for the White Mountain arctic, with 187 individuals captured the first year and 182 the second (Gradish and Otis 2015). In both years, the ratio of males to females caught was approximately 2:1, but only eight recaptures were made in each year, precluding an accurate estimate of population size.

Discussion

Although quantitative calculations of population size are lacking, it seems clear that capturing (or observing) a White Mountain arctic is more difficult today compared to a century ago. Qualitatively, compared to the apparently robust populations of the late 19th and early 20th century, researchers today describe encountering very few adults until finding an area of congregation, where numbers generally did not exceed 15 individuals (McFarland 2003, Gradish and Otis 2015). However, they can still be found in the same sites they have historically occupied and there has been no dramatic decline since the Forest Plan was revised in 2005.

Beyond the obvious threat from the extreme weather conditions these butterflies endure, other potential risks include climate change, atmospheric pollution, ultraviolet light increase from ozone layer depletion, recreation, human development, and collecting (McFarland 2003).

Monitoring Indicator 2

Number of White Mountain fritillary individuals.

Results and Discussion

Like the White Mountain arctic, the White Mountain fritillary is also considered a glacial relict, isolated from several other North American conspecifics. However, the White Mountain fritillary has never been considered abundant. McFarland (2014) summarized Alexander Scudder's 19th century observations describing the rarity of the species, indicating he had never seen more than "a dozen or two specimens" in a day of searching. In 2012, McFarland performed repeated point count surveys over a 4-week period (July 12–August 22) and made 193 visits to 96 points, counting 102 White Mountain fritillaries at 41 different points. The following year, he made 191 surveys at 105 points (July 25–August 25), detecting 40 White Mountain fritillaries at 22 of 105 survey points. An additional 62 individuals were observed between survey points. Based on these data and estimates of the total area of various vegetation communities in which the fritillaries were observed, the total number of White Mountain fritillaries in the Presidential Range alpine zone was extrapolated to be 1,764 individuals, with a 95 percent confidence interval from 1,293 to 2,437 individuals (McFarland 2014).

The New Hampshire Fish and Game Department began a multi-year project in 2018 to determine the host plant for larval White Mountain fritillaries. This has been a key missing piece of this subspecies' life history. Over a 27-day period during the summer, they observed 46 fritillaries (H. Holman, New Hampshire Fish and Game Department, personal communication 2019). The results of this project are pending.

Recommendations

No changes to Forest Plan direction are recommended at this time.

Evaluation of Monitoring Question and Indicator(s)

Determining the population trend of rare species remains an important task, but the logistics of working in the alpine zone through the adult butterfly season continue to be a challenge. Implementing the

quantitative methodology established for this monitoring question will have to rely on opportunistic budget years when funding is available to cover the level of effort needed for data collection or on monitoring and research opportunities conducted by partners.

References

Anthony, G.S. 1970. Field work on the population structure of *Oeneis melissa semidea* (Satyridae) from the Presidential Range, New Hampshire. Journal of Research on the Lepidoptera 7(3):133-148.

Gradish, A.D. and G.W. Otis. 2015. Notes on the demography, life history, and behavior of the White Mountain arctic butterfly (*Oeneis melissa semidea*). Journal of the Lepidopterists' Society 69(2):108-113.

McFarland, K. 2003. Conservation assessment of two endemic butterflies (White Mountain arctic, *Oeneis melissa semidea*, and White Mountain fritillary, *Boloria titania montinus*) in the Presidential Range, alpine zone, White Mountains, New Hampshire. Prepared for the White Mountain National Forest. 42 pp.

McFarland, K. 2014. Distribution and population size an endangered endemic butterfly in the Presidential Range alpine zone, the White Mountain fritillary (*Boloria chariclea montinus*). Final report submitted to the White Mountain National Forest. Laconia, NH. 22 pp.

Scudder, S.H. 1901. A courageous butterfly, *Oeneis semidea*. Psyche 9:197-197.

5.19.8 – What is the population trend of breeding bald eagles (*Haliaeetus leucocephalus*) on the WMNF?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2020.

Monitoring Indicator(s)

- Number of individual bald eagles and size of breeding population

Monitoring Frequency

Annual.

Background and Driver(s)

Bald eagles were once listed as a threatened species. Their famous recovery after the banning of organochlorine pesticides such as dichlorodiphenyltrichloroethane (DDT) in the 1970s is often touted as an example of the effectiveness of the Endangered Species Act.

Following delisting in 1999, the WMNF moved bald eagles to the RFSS list. Continued monitoring of this species after delisting ensures its populations do not slip and trend back towards Endangered Species Act listing. Bald eagle habitat is naturally limited in the WMNF. Suitable habitats include large waterbodies or rivers with ample fish resources and nearby large trees suitable for nesting. The two most likely places for bald eagles to occur are Lake Tarleton (Piermont, New Hampshire) and along the

Androscoggin River near Gorham, New Hampshire. Forest Plan direction includes language to protect critical bald eagle nesting habitat (p. 2-13) and contribute towards recovery (p. 1-9).

This monitoring question responds to the following required monitoring element in 36 CFR 219.12:

> *(5)(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

Past monitoring has consisted of informal visual searches in the two most probable locations for evidence of bald eagle breeding.

Results

Although bald eagles have been periodically sighted in both the Lake Tarleton and Androscoggin River areas, no evidence of any breeding activity has been documented.

Discussion

Bald eagles have clearly rebounded in New Hampshire. The New Hampshire Audubon has monitored bald eagles statewide for decades and has documented a low of zero birds in the mid-1980s to exponential growth since the early 2000s. The New Hampshire population has been doubling every 5 to 7 years, reaching new record highs in 2019 of 72 territorial pairs, 58 incubating pairs, and 81 young successfully fledged (Martin 2019).

Recommendations

Based on the statewide monitoring and the fact that no bald eagles have been found breeding on the WMNF, it seems likely that there are far better breeding sites off the Forest. Breeding bald eagles may someday nest on the Forest, but it is clear that the local population does not need to rely on habitat provided by the WMNF. At the next update of the RFSS list, the Forest may want to consider dropping bald eagles.

Evaluation of Monitoring Question and Indicator(s)

See Discussion and Recommendations above. At the next opportunity, dropping this monitoring item from the formal monitoring guide will likely be proposed. The Forest seems to only support bald eagle habitat that is marginal, at best. This is not particularly surprising given the Forest topography – there is a general lack of large waterbodies and abundant large fish resources in the mountains. Given the rapid expansion of eagles throughout the rest of the state, the fact that no breeding evidence has been documented on the Forest supports that idea.

References

Martin, C. 2019. 2019 New Hampshire bald eagle breeding season results. Unpublished report. New Hampshire Audubon, Concord, NH.

***5.19.9 – What is the population trend of common loons (*Gavia immer*) on the Forest?**

Current Evaluation

Reported 2025.

Previous Evaluation

Reported 2024 (Report Years 2020–2022).

Monitoring Indicator(s)

- Number of individual of adults, chicks hatched, and chicks fledged

Monitoring Frequency

Annual.

Background and Driver(s)

Nest productivity surveys on lakes or ponds where common loon nesting is known or has occurred historically help establish population trends in order to ensure they persist on the Forest. Nesting pairs and chicks fledged are counted during the breeding season (June and July).

The Loon Preservation Committee (LPC) surveys 14 New Hampshire waterbodies annually on the WMNF with data from 2002 to 2024. Volunteers with Maine Audubon help survey common loons at Virginia Lake in Maine and have consistent survey data from 2018 to 2022, utilizing the same data parameters as the LPC. Artificial loon rafts are sometimes placed on waterbodies where predation of chicks is high. The general protocol for placing a loon raft requires 2 straight years that eggs are destroyed or chicks do not survive. Artificial loon rafts provide protection from aerial predators and can be floated out, away from shore, to deter land-based predators. Currently, there are four loon rafts deployed on four separate waterbodies on the Forest. Active breeding territories receive more visits than waterbodies with marginal habitat. The data from 2002 to 2024 reflects yearly estimates for resident common loon abundance.

The data recorded at each waterbody includes observations from trained LPC seasonal field biologists, volunteers, and organizations including the Forest Service. The data recorded are paired adults, unpaired adults, nesting pairs, chicks hatched, chicks surviving, and loon rafts floated. Paired adults refer to two adult loons exhibiting a pair bond and defending a territory for at least 4 weeks. Unpaired adults are an estimated number of adult loons not part of a breeding pair. Nesting pairs are breeding pairs that have attempted to nest as confirmed by the presence of eggs, eggshells, or hatched chicks. Chicks hatched are the number of chicks hatched confirmed by LPC biologists and/or eggshell evidence at the nest. Chicks survived are the number of chicks that survived through August (end of routine monitoring). Rafts floated is the number of loon rafts deployed at a waterbody.

Results

Out of the 14 WMNF waterbodies surveyed in New Hampshire from 2002 to 2024 by LPC, there were 214 paired adults, 48 unpaired adults, 66 nesting pairs, 67 chicks hatched, and 59 chicks survived (Table 42). From 2023 to 2024, there were 36 paired adults, 6 unpaired adults, 9 nesting pairs, 7 chicks hatched, and 7 chicks survived (Table 43). In Maine at Virginia Lake from 2018 to 2022, volunteers recorded 10 paired adults, 0 unpaired adults, 10 nesting pairs, 2 chicks hatched, and 1 chick survived. Looking at the data recorded between 2020 and 2022 for Virginia Lake, 6 paired adults, 0 unpaired adults, 6 nesting pairs, 1 chick hatched, and 1 chick survived. No additional data was recorded at Virginia Lake in 2023 and 2024.

Table 44 shows common loon data from 2021 and 2022 compared with 2023 and 2024. A slight increase in paired adults and nesting pairs was recorded in 2023 and 2024, with a slight decrease in chicks hatched and chicks survived compared to 2021 and 2022.

Table 42. Data collected at 14 WMNF waterbodies in New Hampshire from 2002 to 2024.

Waterbodies	Paired adults	Unpaired adults	Nesting pairs	Chicks hatched	Chicks survived
14	214	48	66	64	59

Table 43. Data collected at 14 waterbodies in New Hampshire from 2023 and 2024.

Waterbodies	Paired adults	Unpaired adults	Nesting pairs	Chicks hatched	Chicks survived
14	36	6	9	7	7

Table 44. Data collected from 2021 to 2024 for all 14 WMNF waterbodies.

Year	Paired adults	Unpaired adults	Nesting pairs	Chicks hatched	Chicks survived
2021	10	8	3	4	3
2022	14	3	5	5	5
2023	18	3	5	4	4
2024	18	3	4	3	3

Discussion

WMNF lakes and ponds are geographically isolated, smaller than other lakes and ponds throughout New Hampshire, and harder to survey, both in ruggedness and remoteness, for regular monitoring by staff and volunteers. The 14 waterbodies on the WMNF that are surveyed yearly by LPC staff and volunteers show a stable population trend over the past 4 years. Other waterbodies on the WMNF could potentially have breeding pairs of adult common loons utilizing territories of a few small ponds near one another where nests, if present, could vary by waterbody yearly. According to John Cooley, senior biologist at LPC, loon population recovery in New Hampshire has seen more occupied territories across the state in the last decade, and this trend has extended to waterbodies on the Forest. LPC has documented new breeding pairs on Hildreth Pond in Warren and on Basin Pond in Chatham, and increased activity at Mirror Lake in Woodstock, and near the Forest on Stinson Lake in Rumney (John Cooley, personal communication 2023).

Recommendations

No change proposed at this time. There is no indication that the population trend of common loons on the WMNF is declining. The data indicates that loons continue to persist on the WMNF. We recommend floating loon rafts on more waterbodies on the Maine portion of the WMNF and surveying often for presence-absence of loons on these smaller, more remote waterbodies.

References

Loon Preservation Committee 2025. New Hampshire Loon Population Survey Data (2007-2024). Loon Preservation Committee, Moultonborough, NH.

Cooley, John. 2023. Personal communication. 22 February. Information regarding breeding pairs of common loons in New Hampshire. Senior biologist for the Loon Preservation Committee.

5.19.10 – What are the effects of cliff-related recreation use on peregrine falcons (*Falco peregrinus*) and their nest success?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Number of active peregrine nests
- Percent of nestlings fledged

Monitoring Frequency

Planned monitoring frequency is every 3 years, but some data collection has occurred every year since the Forest Plan was revised in 2005.

Background and Driver(s)

This monitoring item responds to the following monitoring elements in 36 CFR 219.12:

> *(5)(iv): The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.*

The peregrine falcon was once listed under the Endangered Species Act, primarily as a result of widespread organochlorine pesticide use that led to eggshell thinning and failed reproduction across the continent. Once pesticides such as DDT were banned, peregrine falcon populations slowly began to rebound. The WMNF contains a number of historical cliff nest locations that have successfully produced chicks over many years. However, increasing interest in rock climbing could potentially result in unacceptable disturbance at cliff locations and reduced reproduction. As such, the peregrine falcon remains on the RFSS list and monitoring activity at known nest locations tracks the status of reproductive success.

Peregrine falcon monitoring has been managed by the New Hampshire Audubon and the Maine Department of Inland Fisheries and Wildlife. Volunteers coordinated by these organizations complete the bulk of monitoring, with limited assistance from WMNF staff.

Results and Discussion

Figure 83 shows the total number of active peregrine falcon nests on the WMNF and throughout the rest of New Hampshire over the past decade. WMNF nest sites include those physically on lands managed by the Forest Service or in sufficiently close proximity that WMNF management could affect the nest (e.g., hiking trails nearby).

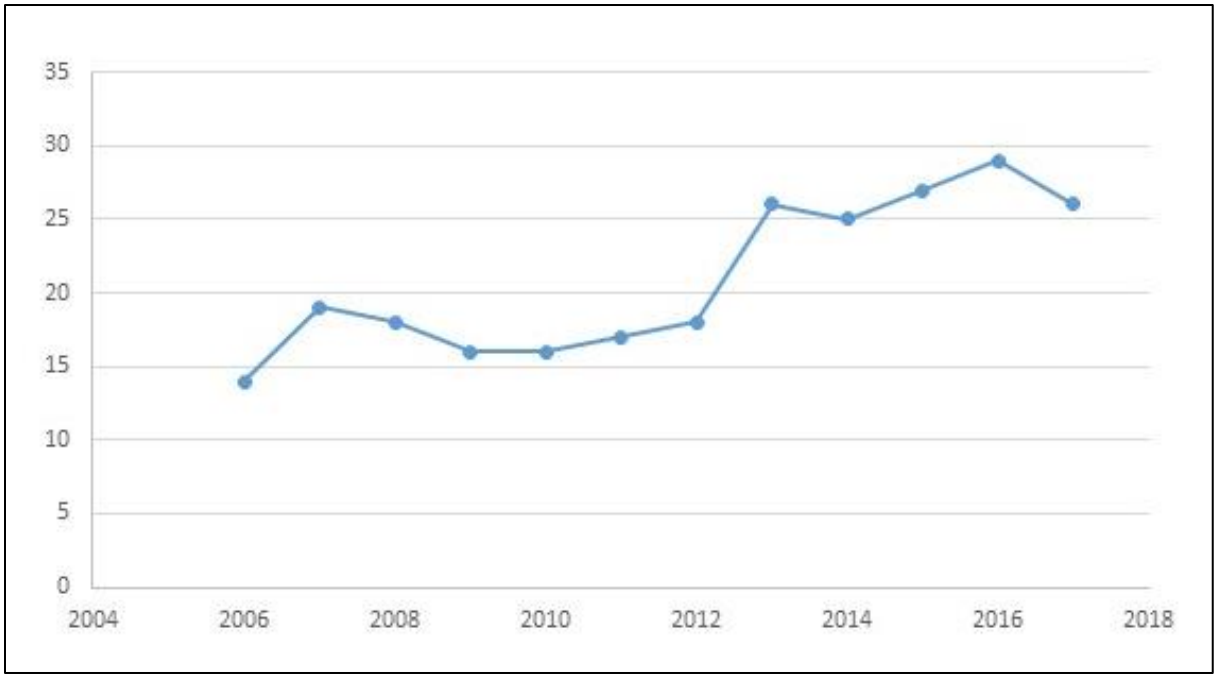

Figure 83. Number of active peregrine falcon nests on the WMNF and in New Hampshire combined from 2004 to 2018.

The total number of active peregrine falcon nests on the WMNF and in New Hampshire has grown since 2006, following increases in prior decades (not shown). Figure 84 summarizes data on active nests. Non-WMNF nests are those occurring elsewhere in New Hampshire (all New Hampshire data is courtesy of Chris Martin, New Hampshire Audubon). Two WMNF nests occur in Maine.

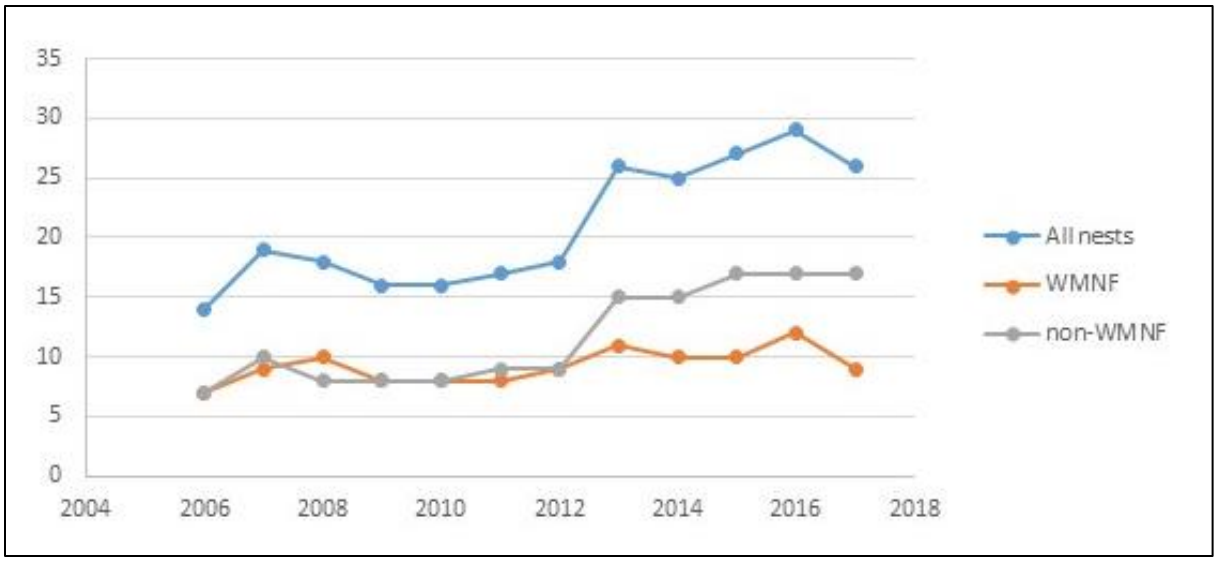

Figure 84. Number of active peregrine falcon nest sites on the WMNF, on non-WMNF lands, and at all locations from 2006 to 2017.

Like many wildlife populations, monitoring shows some year-to-year fluctuations, but the number of active nests on the WMNF has held fairly steady over the last decade, perhaps indicating that suitable habitat on the Forest is saturated. However, there seems to be little correlation in the number of chicks

presumed successfully fledged between WMNF nests and non-WMNF nests (Figure 85). The most chicks were fledged from WMNF nests in 2014, which was one of the lower years on record for non-WMNF nests. Similarly, the highest year for non-WMNF nests (2010) corresponded to a lower-than-average year for WMNF nests. Likely, there are conditions specific to each pair or nest causing the variation. However, the last 3 years were inexplicably the lowest of the decade for WMNF nests. Disturbance from rock climbing would be the most obvious cause for concern, but anecdotal evidence suggests ample support from the local rock-climbing community in response to temporary closure notices around active cliffs.

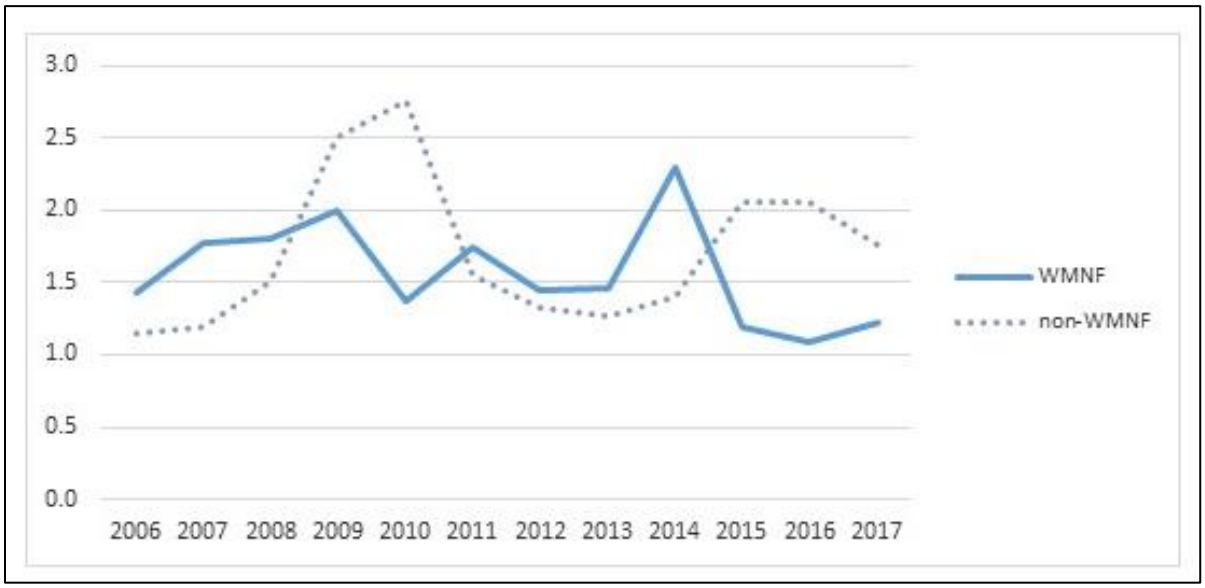

Figure 85. Number of peregrine falcon chicks presumed fledged per active nest from 2006 to 2017 on the WMNF and on non-WMNF lands.

Recommendations

Wildlife populations commonly fluctuate based on a wide range of variables. While the reduction in number of young fledged per nest is cause for attention, it is not yet alarming. Continued monitoring over a few more years would help identify if this indicates a typical fluctuation or a definite downward trend. Analysis of any climbing use data at particular cliffs could also prove insightful.

Evaluation of Monitoring Question and Indicator(s)

Evaluation of this monitoring question using the prescribed indicators continues to provide important information relevant to Forest Management and implementation of the Forest Plan.

References

Martin, C. 2017. Peregrine falcon monitoring data, 2006-2017. New Hampshire Audubon. Concord, NH

5.19.11 – Where are vernal pools on the Forest located and are they continuing to provide suitable habitat?

Current Evaluation

This monitoring question was not reported in 2025.

Previous Evaluation

Reported 2018.

Monitoring Indicator(s)

- Number of egg masses of indicator species per pool

Monitoring Frequency

Because this is a new monitoring item, we are still in early stages of data collection. We have collected 1 year of indicator species inventory on a number of vernal pools. Target of a 3-year cycle.

Background and Driver(s)

Vernal pools are small, natural depressions that temporarily hold water in the spring. They provide critical breeding habitat for certain amphibians, invertebrates, and plants. They may be threatened by development, road construction, or timber harvest that changes the local hydrologic regime through decreased shading over the pool (causing faster evaporation). In addition, changes in precipitation resulting from predicted climate change (e.g., Hayhoe et al. 2007) may cause widespread future reductions in available breeding habitat and resulting population isolation. The Forest Plan includes a number of riparian and aquatic standards and guidelines that specifically restrict certain activities around vernal pools (Forest Plan, pp. 2-24 to 2-26).

This monitoring item responds to the following elements in 36 CFR 210.12:

> *(5)(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems,*
>
> *(5)(vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.*

This monitoring item surveys for activity of five key indicator species: spotted salamander (*Ambystoma maculatum*), blue-spotted salamander (*A. laterale*), Jefferson's salamander (*A. jeffersonianum*), wood frog (*Lithobates sylvaticus*), and fairy shrimp (*Eubranchipus* spp.), consistent with other local vernal pool survey programs (New Hampshire Fish and Game Department 2016, Maine Department of Inland Fisheries and Wildlife and Department of Environmental Protection 2017). In particular, evidence of reproductive activity of the vertebrate species (e.g., presence of egg masses and spermatophores) is targeted to make sure the pools are actually being used for breeding.

Results

Since 2009, WMNF staff have mapped 51 natural pools containing evidence of vernal pool indicator species. Of the five indicator species used on the WMNF, the spotted salamander and wood frog predominate, with at least one of these species found in 100 percent of confirmed vernal pools. Almost 40 percent of the pools had evidence of both species. Egg masses were the most common evidence of species present, being found in 100 percent of spotted salamander pools and 82 percent of wood frog pools. There seemed to be little correlation between species in year-to-year numbers of egg masses (Figure 86).

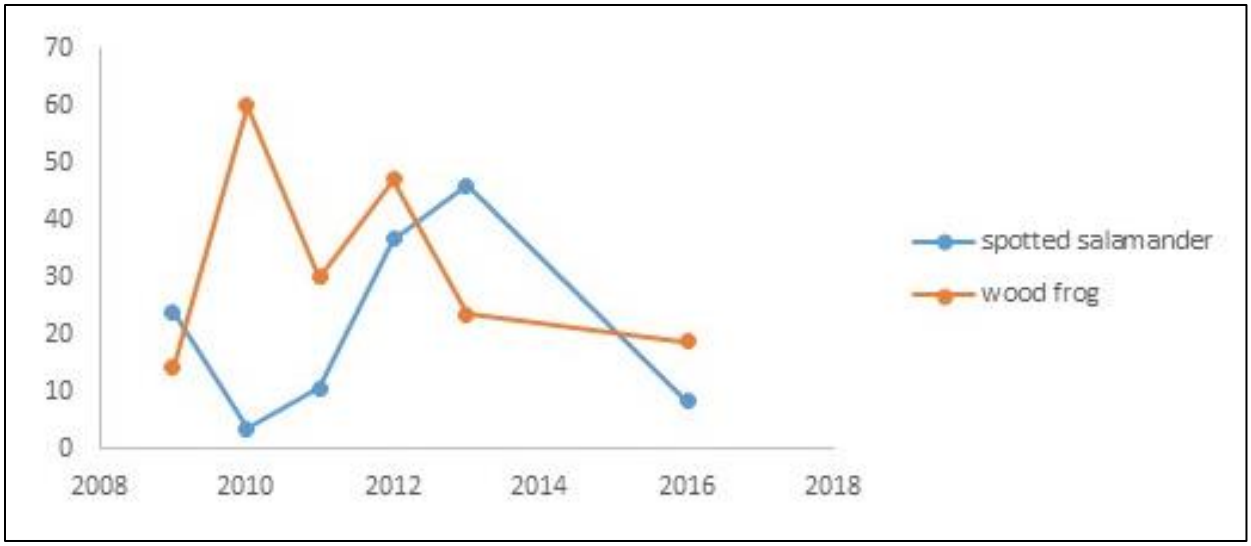

Figure 86. Average egg masses per vernal pool from 2009 to 2016.

However, spotted salamanders appeared to use pools that were slightly deeper than those used by wood frogs (Table 45).

Table 45. Average maximum water depth in inches of WMNF Vernal pools used by spotted salamanders and wood frogs.

Species	2009	2010	2011	2012	2013	2016
Spotted salamander	23	42	32	23	22	51
Wood frog	10	18	24	14	13	20

Overall pool size ranged from as small as 38 square feet to as large as 80,000 square feet, with a median of 2,300 square feet. Observers identified wood frog tadpoles or spotted salamander juveniles in 10 pools, indicating eggs had successfully hatched. Five of these pools were observed prior to May 15, with one as early as April 30.

Discussion

Vernal pool sample sizes are relatively small, and vernal pools were not equally distributed across the Forest, so quantitative conclusions would be premature at this point. However, it seems apparent that spotted salamanders and wood frogs are far more abundant than the other vernal pool indicator species.

Target survey dates of late April and early May were validated to identify pools with egg masses. Initial efforts were simply to identify where vernal pools on the WMNF are located, so they can be considered when projects are proposed nearby. Their small size and the short window in which to confirm presence of indicator species makes them challenging to find. Lidar technology may provide a new tool to more rapidly identify small depressions across large areas, where surveys can then be focused. Initial testing of this new technique shows promise, and we hope to implement it in coming years to document many more vernal pools.

Recommendations

No changes are recommended at this time. Additional future work includes increasing sample sizes to more closely tracking the reproduction success of individual pools to see how frequently eggs fail to hatch due to becoming suspended out of the water from evaporation or lack of rainfall.

Evaluation of Monitoring Question and Indicator(s)

Evaluation of this monitoring question using the prescribed indicators continues to provide important information relevant to forest management and implementation of the Forest Plan.

References

Hayhoe, K., C.P. Wake, T.G. Huntington, L. Luo, M.D. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T.J. Troy, and D. Wolfe. 2006. Past and future changes in climate and hydrological indicators in the U.S. Northeast. Climate Dynamics. 28:381-407.

Maine Department of Inland Fisheries and Wildlife. 2017. Maine state vernal pool assessment form. Maine Department of Inland Fisheries and Wildlife, Bangor, ME. 3 pp.

New Hampshire Fish and Game Department and Maine Department of Environmental Protection. 2016. Identifying and documenting vernal pools in New Hampshire, third edition. M. Marchand, ed. New Hampshire Fish and Game Department, Concord, NH. 88 pp.

***5.19.12 – Are high-elevation ponds supporting RFSS dragonflies?**

Current Evaluation

Reported 2025. This is a new monitoring question.

Previous Evaluation

Results from this monitoring item have not been previously reported.

Monitoring Indicator(s)

Presence-absence of adults in high-elevation breeding habitat.

Monitoring Frequency

Every 10 years.

Background and Driver(s)

In 2023, we added three dragonflies to our RFSS list: The subarctic darner (*Aeshna subarctica*) (Figure 87), sedge darner (*Aeshna juncea*), and ringed emerald (*Somatochlora albicincta*) (Figure 88). All three species have northerly distributions and are found primarily in high-elevation wetlands in the Northeast, including high-elevation ponds on the WMNF. Given the forecasted impacts of climate changes that include warmer temperatures, altered precipitation, and increased disturbance from storm events (U.S. Global Change Research Program 2023), the WMNF population of each species may become, or have already become, disjunct from their contiguous ranges. Therefore, high-elevation wetlands on the WMNF may serve as the last remnants of habitat for these species in the region.

Results

In 2023 and 2024, we surveyed 12 high-elevation ponds at least once during the flight season of adult dragonflies (June–September). The elevations of the surveyed ponds range from approximately 3,100 feet above sea level to just over 5,000 feet. To minimize the need to handle rare dragonflies and trample sensitive habitats, surveys were conducted primarily with a camera and a telephoto lens so that dragonflies could be identified at a distance. We present the results of these surveys in Table 46. At least one of these species was found at 11 of the 12 ponds (92 percent).

Table 46: RFSS dragonfly distribution at 12 high-elevation ponds on the WMNF.

Species	Number (percent) of ponds with documented presence	Minimum elevation	Maximum elevation
Subarctic darner	6 (50)	3,100	4,200
Sedge darner	5 (42)	3,400	4,400
Ringed emerald	6 (50)	3,300	5,000

Discussion

While some of the occupied sites were identified during the New Hampshire Dragonfly Survey (Hunt 2012), many represent newly discovered breeding ponds for these dragonflies. Ponds fringed with herbaceous vegetation, especially sedges, seem to be an important habitat feature for the two darner species.

As climate change continues to impact the WMNF, high-elevation ponds may serve as climate refugia for these dragonflies. Therefore, protecting the few high-elevation ponds that exist on the WMNF will be crucial for these species to persist on the Forest.

Figure 87. Male subarctic darner hovering over a high-elevation pond.

Figure 88. Male ringed emerald basking on vegetation adjacent to a high-elevation pond.

Recommendations

Since all known occupied ponds are easily accessed via popular hiking trails and camping sites, we observed some resource damage during this survey work (primarily trampling of herbaceous vegetation adjacent to the ponds). We have already undertaken several projects to address these issues; we recommend continuing monitoring to ensure resource damage does not worsen.

We recommend conducting presence-absence surveys of all occupied ponds every 10 years to confirm ponds are still occupied and providing adequate breeding habitat. Continued monitoring will also allow us to track changes in species composition due to climate change.

References

Hunt, P.D. 2012. The New Hampshire dragonfly survey: A final report. Report to the NH Fish and Game Department. New Hampshire Audubon, Concord.

U.S. Global Change Research Program. 2023. Fifth National Climate Assessment. Crimmins, A.R., D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T. K. Maycock, eds. U.S. Global Change Research Program, Washington, DC, USA.