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Green Mountain National Forest

Biennial Monitoring and Evaluation Report

Fiscal Years 2017 and 2018

Prescribed fire treatment to maintain wildlife opening on the Manchester Ranger District

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Biennial Monitoring and Evaluation Report
Fiscal Years 2017 and 2018

Green Mountain National Forest

USDA Forest Service, Eastern Region
April 2022

This Biennial Monitoring and Evaluation Report combines monitoring completed in fiscal years 2017 and 2018 for the Green Mountain National Forest Land and Resource Management Plan (Forest Plan) dated 2006. Monitoring and evaluation of forest plans is required by the National Forest Management Act and associated 1982 planning rule (36 CFR 219 dated September 30, 1982). Monitoring consists of mandatory components found in every forest plan, as well as monitoring that is tailored to address specific Green Mountain National Forest resource concerns raised from public involvement and Forest Service interdisciplinary team review. The Green Mountain National Forest monitoring plan is described in Chapter 4 (Monitoring and Evaluation) of the Forest Plan.

New planning regulations went into effect in 2012 (36 CFR 219 dated April 9, 2012). The new rule required every National Forest's monitoring plan must address each of eight resource monitoring elements with at least one monitoring question and associated indicator(s) by May 9, 2016. The Green Mountain National Forest monitoring program was modified in early May 2016 to comply with the 2012 planning rule. Ten existing, modified, or new monitoring questions were specifically selected to address the required monitoring elements, and administrative changes were made to Chapter 4 of the Forest Plan accordingly.

Approval

I have reviewed the *Green Mountain National Forest - Fiscal Years 2017 and 2018 Biennial Monitoring and Evaluation Report* including its findings, conclusions, and recommendations. I find the report meets the intent of both the Forest Plan (Chapter 4) as well as the CFR 219 planning regulations (2012 planning rule).

Digitally signed by JOHN SINCLAIR
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John A. Sinclair — Date
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1. Introduction

Monitoring and evaluation reporting is required by the National Forest Management Act. The Green Mountain National Forest (GMNF) monitoring program was developed following the 1982 planning rule effective September 30, 1982 (36 CFR 219.12(k)). The intent of the monitoring program is to determine how well the GMNF Land and Resource Management Plan (Forest Plan) is being implemented.

Monitoring Program Transition

The monitoring program was modified in May 2016 to comply with the 2012 planning rule dated April 6, 2012. The 2012 planning rule required every National Forest's monitoring plan to address each of eight resource monitoring elements with at least one monitoring question and associated indicator(s). The required monitoring elements include (36 CFR 219.12(a)(5)):

1. The status of select watershed conditions.
2. The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
3. The status of focal species to assess ecological conditions.
4. The status of a select set of ecological conditions that contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
5. The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
6. Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
8. The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.A. 1604(g)(3)c)).

Ten existing, modified, or new questions and their measurement indicators were identified to comply with the 2012 planning rule and reflected in administrative changes to the Monitoring Plan (Chapter 4 of the Forest Plan) in May 2016. Some existing questions were also retained to supplement the required resource element monitoring.

The *Green Mountain National Forest - Fiscal Years 2017 and 2018 Biennial Monitoring and Evaluation Report* documents the results of the monitoring accomplished during fiscal years 2017 and 2018 (October 1, 2016, to September 30, 2018). The report describes monitoring items by resource category, provides data pertaining to the effects and effectiveness of Forest Plan management direction, and discusses various resource management efforts implemented during fiscal years 2017 and 2018. A major part of the report is to determine if the resource outputs, management costs, returns, and environmental objectives were achieved as envisioned in the Forest Plan.

Biennial Monitoring and Evaluation Report Outline

This report is divided into five chapters and multiple appendices:

- Chapter 1 is the introduction providing an overview of the monitoring program.
- Chapter 2 provides monitoring and evaluation results for the monitoring questions addressing the eight required monitoring elements (36 CFR 219.12(a)(5)).
- Chapter 3 provides monitoring and evaluation results for the other monitoring questions retained to help ascertain how well management activities are implementing the Forest Plan and validating the effectiveness of Standards and Guidelines.

- Chapter 4 is a list of the Forest Service staff that provided information for the report.
- Chapter 5 is literature cited to support evaluation for monitoring items.
- Appendices include detailed information to supplement evaluation of various resource monitoring items.

The activities and outputs monitored may be traced to one of three sources:

- The 1982 and 2012 planning rules associated with the National Forest Management Act (36 CFR 219 dated September 30, 1982, and April 9, 2012, respectively) that outline specific activities and outputs to be monitored.
- Forest Plan components (Chapter 4) selected to facilitate comparison between actual conditions and desired future conditions.
- Questions derived from public comments received during Forest Plan revision. Public input is particularly useful for monitoring satisfaction with the resources and services provided by GMNF.

Each monitoring question is addressed in the following format:

- Monitoring Resource Category
- Monitoring Item
- Monitoring Question
- Detailed Monitoring Question
- Monitoring Driver
- Monitoring Activities
- Evaluation and Conclusions
- Recommendations

Monitoring Plan

The modified Chapter 4 of the GMNF Forest Plan (Monitoring and Evaluation, or Monitoring Plan) includes programmatic direction for monitoring and evaluating Forest Plan implementation. Chapter 4 defines the over-arching, strategic questions that must be addressed by the Forest Service through monitoring, including broad timetables and schedules for analysis and reporting.

In addition to direction for monitoring and evaluation, the Forest Plan describes GMNF goals, objectives, and desired future conditions. The Forest Plan allocated land to different management areas, each with unique desired future conditions, major emphasis, and management direction.

Specifically, monitoring and evaluation provides a basis to determine:

- Whether Forest Plan implementation is achieving multiple resource goals, objectives, and desired conditions
- If application of standards and guidelines are effective in maintaining the productivity of the land
- If conditions or demands in the area covered by the Forest Plan have changed significantly enough to require a revision to the Plan

The Forest Plan may also be amended to adapt to new information and changed conditions identified through monitoring and evaluation efforts. Through this adaptive management approach, the Forest Plan is kept current.

Monitoring Implementation Guide

In addition to the programmatic direction provided in the 2006 Forest Plan, Forest Service staff completed the *Monitoring Implementation Guide* (also referred to as the Monitoring Guide) in 2007. The monitoring guide provides more specific procedural guidance to implement the monitoring strategy outlined in the Forest Plan. The guide contains specific monitoring elements, along with methods, protocols, and analytical procedures to be followed. The monitoring guide is a suite of monitoring activities used to help Forest Service staff understand and answer the Forest Plan monitoring questions. Based on information garnered through annual monitoring and evaluation reports, the monitoring guide was updated in 2017 to incorporate suggested changes since 2007. The biennial monitoring and evaluation report for fiscal years 2017 and 2018 is based on the updated guide (*2017 Green Mountain National Forest Monitoring Guide*).

Annual Monitoring Schedule

The *Annual Monitoring Schedule* outlines monitoring items, time frames, roles, and locations for the upcoming year and is linked directly to both the 2006 Forest Plan and the Monitoring Guide. The Forest Service prepares and revises this schedule as necessary as part of the annual work planning process. Some monitoring items are performed or measured annually, whereas others are scheduled with different time intervals that are determined necessary or appropriate for timely and effective evaluation. The schedule was last updated in 2017 and is now incorporated into the 2017 Monitoring Guide.

Biennial Monitoring and Evaluation Reports

The 2012 planning rule changed the requirement for annual monitoring and evaluation reports to a biennial schedule (36 CFR 219.12(d)). The 2017 and 2018 biennial report is the first to reflect this regulation change. Biennial monitoring and evaluation (M&E) reports provide a forum for the review of findings over the two-year monitoring period including:

- What monitoring activities were completed?
- What Forest Plan monitoring questions were addressed?
- How well did the monitoring address those questions?
- Do future monitoring activities need modification?

Comparison of results with those from previous years can identify trends and highlight where management is or is not achieving desired goals. It is during this biennial review that Forest Service staff can determine if changes to the 2006 Forest Plan or the Monitoring Guide are necessary.

Biennial M&E reports are prepared by an interdisciplinary team of Forest Service specialists that incorporate information gathered from various sources including partners, private citizens, and non-profit organizations. The Forest Service is grateful to the people who contribute their monitoring efforts and results and who take an interest in actively participating in GMNF management.

2. Required Monitoring Questions

This chapter includes consideration of the monitoring questions addressing the eight required monitoring resource elements (36 CFR 219.12(a)(5)). Table 2-1 provides the monitoring questions selected to address the required eight monitoring elements from Table 4.1-2 of the modified Chapter 4 of the Forest Plan. It identifies the required resource element, monitoring question, and indicator and measurement that are discussed in this report.

Table 2-1. Required monitoring questions (from Table 4.1-2, Forest Plan, Chapter 4).

Required Element	Monitoring Question	Indicator and Measurement
1. Status of select watershed conditions.	What is the existing status of watershed biological, chemical, and physical integrity on the Forest, and how are our management activities affecting them?	Indicators: • Water quality, biological, and physical attributes Measurements: • Water quality: dissolved oxygen, pH, nitrite, nitrate, total nitrogen, phosphate, temperature, E. coli, turbidity, conductivity, and total dissolved solids • Biological: macroinvertebrate community biometrics, macroinvertebrate percent community composition by major orders, and macroinvertebrate community functional group composition • Physical: stream bankfull channel dimensions (width and depth), substrate composition, substrate embeddedness, canopy cover, streambank condition, immediate upstream use, stream color condition, and wetland hydrology
2. Status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.	To what extent are management actions and natural processes leading to increased structural diversity within forested stands and across forested landscapes, moving areas toward desired objectives identified under Goal 2 of the Forest Plan?	Indicators: • Forest structure • Management actions with forest structure objectives Measurements: • Number of acres and proportion of each forest type in each age class • Number of acres and proportion of harvest acres treated with uneven-aged management • Number of acres treated explicitly to enhance early successional characteristics • Number of acres treated explicitly to enhance late successional characteristics • Number of acres treated with various methods to explicitly enhance the health, longevity, and/or structural diversity of forested stands at the stand and landscape scales
3. The status of focal species to assess the ecological conditions required under § 219.9.	Does the headwater streams ecosystem provide a full array of riparian and aquatic communities and stream channel types supported by the varied physiographic conditions across the Forest?	Indicator: • Brook trout Measurement: Number of wild brook trout per stream mile
4. The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally	What are the population trends for sensitive plants on the Forest and to what extent is management sustaining or enhancing	Indicator: • Population trends for plants listed as Regional Forester Sensitive Species Measurements: • Number of ramets or genets

Required Element	Monitoring Question	Indicator and Measurement
listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.	habitat conditions for populations?	• Percent reproductive • Spatial extent of population • Number of populations of a species Ranked condition of populations
5. The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.	Is the Forest moving toward the desired future condition for Recreation Opportunity Spectrum (ROS) settings?	Indicator: • Recreation opportunity settings Measurement: Trends toward desired future condition
	Are we providing high quality recreation services that meet the expectations of the public?	Indicator: • Visitor satisfaction from National Visitor Use Monitoring (NVUM) Measurement: • Mean visitor satisfaction compared to mean importance to visitor
6. Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.	To what extent are the vegetation components of ecosystems changing over time in the context of climate change, acidic deposition, and non-native invasive species?	Indicators: • Tree health • Ecosystem complexity Measurements: • Biomass productivity, incremental growth, tree survival, and tree decline (foliage density, dieback, crown density) • Changes in vegetation composition, cover, and structure over time
	Are insect and disease levels compatible with objectives for maintaining healthy forest conditions?	Indicator: • Insect or disease infestations Measurements: • Number of outbreaks by species • Acres affected by species
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.	How close are actual resource outputs and services to those projected in the Forest Plan?	Indicator: • Projected outputs for resource activities or practices listed in Table D-5 in the Forest Plan Measurement: • Actual annual outputs for resource activities and practices listed in Table D-5 in the Forest Plan
8. The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).	How are soil quality and productivity changing in response to forest management?	Indicators: • Soil sustainability • Hydrologic function • Soil productivity Measurements: • Amount of forest floor impacted • Amount of topsoil displacement • Severity of rutted, burned, or compacted soil • Severity of platy/massive soil structures, or puddled soil

Monitoring Element 1: Water

Monitoring Item: Forest-wide Water Quality

Monitoring Question: To what extent are environmental stressors and Forest management affecting water quality and the physical features of aquatic, fisheries, riparian, vernal pool, and wetland habitats?

Detailed Monitoring Question: What is the existing status of watershed biological, chemical, and physical integrity on the Forest, and how are management activities affecting them?

Monitor Driver: Forest Plan Goal 4 and associated Objectives.

Monitoring Activities: This monitoring question was derived from modifications to an existing monitoring item to address required Element 1 from the 2012 planning rule (36 CFR 219.12(5)(i)): *The status of select watershed conditions.* This question helps address whether management activities meet the intent of Forest Plan Goal 4, "*Maintain or restore aquatic, fisheries, riparian, vernal pool, and wetland habitats*" (Forest Plan, p. 13). Water quality is one critical component of these resources, and macroinvertebrate populations are an important indicator of water quality.

Water quality is an extremely important component of watershed conditions. Protection and maintenance of aquatic ecological communities dependent on healthy water conditions is a primary goal during implementation of management activities. In addition, maintaining water quality is very important to the public. Public concerns are expressed about water quality on nearly every project involving harvesting, ski area activities, trail improvement, and other projects with substantial soil disturbance.

Monitoring methods consist of collecting water samples and evaluating them in the field or in the lab. Some evaluations, including macroinvertebrate monitoring results, are conducted by the State Water Quality Division. Streams and lakes located 2,500 feet above sea level must meet Vermont's Water Quality Standards for Class A Waters, and streams and lakes below 2,500 feet must meet the standards for Class B Waters. Although water quality on GMNF usually meets or exceed State standards and management activities typically have minor effects on water quality, monitoring of selected streams and ponds each year is warranted because of the importance of this resource.

Ambient stream biomonitoring enables biologists and forestland managers a means of directly measuring the present and long-term biological integrity of stream. Sites are monitored to establish current baseline conditions and to evaluate ongoing or anticipated environmental impacts from logging, acidification, or road and runoff related discharges. Additionally, three high-quality streams within GMNF were selected for long-term monitoring, or "sentinel monitoring," to determine biotic and abiotic changes that can alter a waterbody in the absence of most anthropogenic stressors.

The Vermont Department of Environmental Conservation (VTDEC), Water Quality Division, Biomonitoring and Aquatic Studies Section, partnered with Forest Service staff to monitor macroinvertebrates on GMNF to track long-term trends in biological integrity in fixed reaches. Based on the monitoring data, each stream's biological integrity was determined by comparing its macroinvertebrate community composition to the VTDEC statewide database of streams in reference condition. Additional water chemistry parameters such as pH, alkalinity, nitrogen, phosphorus, aluminum, chloride, turbidity, color, and conductivity were also measured to aid in water quality monitoring.

Fiscal Year 2017

Eight sites were sampled in fiscal year 2017.

The biological community assessment ratings decreased at all three sentinel sites from 2016 to 2017, although they all still fall within VTDEC's expectation, scoring at least "very good-good":

- Bingo Brook's assessment decreased to "Very Good-Good"

  This is its lowest rating since 2011/2012, primarily as a result of an elevated Biotic Index at 3.91 that's well above previous years. This was primarily due to the over-abundance of the mayfly (*Baetis tricaudatus*), possibly due to high precipitation and flow levels through late summer. While a few of the most dominant species had moderate Biotic Index values, many of the taxa at the site were water quality sensitive. The change in Biotic Index was not substantial and all other metrics met reference expectations, allowing a slight boost in the site's overall rating. The physical habitat observations showed no concerns. There is little stream embeddedness or sediment deposition despite its extreme proximity to a well-traveled dirt road. Bingo Brook is moderately sensitive to atmospheric deposition with an alkalinity of 8 milligrams per liter of Calcium Carbonate. Bingo Brook is a Very High Quality Water (VHQW) for macroinvertebrates yet scored only "good" for fish due to the significant presence of non-native rainbow trout found at almost 30 percent of the community. Despite this, the intolerant slimy sculpin dominated the fish taxa at 52 percent, while brook trout represented only 3 percent.

- Smith Brook decreased to "Excellent-Very Good"

  This community nearly met all A1 thresholds and rated "excellent-very good", within reference expectations. The community is primarily made up of enrichment intolerant taxa except for the mayfly. This colonizing species has been found to be hyper-abundant at several GMNF sites evaluated in this report due to the scouring resulting from high precipitation and flows during the late summer and not related to enrichment. This is a low nutrient, low productivity stream as reflected by the limited growth of algae observed in this entirely forested watershed. The *Oligochaeta* did increase slightly but remain low as was the streams embeddedness and levels of fine sediments.

- Winhall River 8.1 decreased slightly to "Very Good"

  The Winhall River 8.1 site is sensitive to acid deposition which has been well-documented, especially during the spring runoff period when the alkalinity is often > 5 mg/l. The aluminum levels may at times reach toxic levels, but the pH and color are generally adequate to prevent this from occurring. Nitrogen values are low but tend to increase during periods of episodic acidification during spring snowmelt. TP appear to be trending upward and it's recommended other nearby waters be evaluated or if a nearby land-use activity might be the cause. This stream is sampled in cooperation with the Forst Service as part of the VTDEC's Sentinel Stream Monitoring Project. This long-term project was designed for seasonal water chemistry sampling and annual biomonitoring as part of VTDEC's Ambient Biomonitoring Network.

The following five additional sites were sampled and rated:

- Flood Brook 6.1 received a rating of "Good-Fair"

  Flood Brook 6.1 was assessed for the first time since a series of sampling events between 2006 to 2008. While the macroinvertebrate condition shows improvement, the dramatic departure from reference expectations in the distribution of functional feeding groups keeps this site from meeting B(2) criteria. It currently scores "good - fair". The species richness has been at the borderline or below VTDEC thresholds during previous sampling events, but both were relatively high in 2017. However, while the community has shown improvements, it's largely made up of

moderately tolerant taxa and the BI remains elevated at 3.78, with collector-filtering caddisflies making up 5 of the 7 most common taxa. About 69 percent of the overall community were collector-filterers; an extremely high number for a SHG stream. There was also a near absence of shredder-detrivore organisms. This absence of shredder-detrivore's has been observed in previous sampling efforts and is indicative of a shift in the fundamental resource base of the benthic community. The biotic compositional shift is almost certainly caused by this sites location just downstream of Hapgood Pond, which is limiting coarse particulate organic matter inputs but increasing fine particulate organic matter inputs to the stream reach. Iron is notably high at 532 ug/l, as were embeddedness at 35 percent and sand/gravel deposition when combined totaled 24 percent. While Nitrogen is low as expected for this stream type nor does the lake appear to be a source of Nitrogen, the TP levels are moderate, and the immediate watershed and/or the lake are the suspected sources.

This is the long-term fishery monitoring site on GMNF. A review of this assemblage is recommended to see if the benthic and fishery community have shown parallel community assessments. Further monitoring is required on this B(2) listed waterbody.

- Hancock Branch 3.9 and Robbins Branch 1.4 received an assessment rating of "Good"
- Bromley Mt Brook received an assessment rating of "Very Good-Good" at River Mile 2.0; and a rating of "Excellent-Very Good" at River Mile 1.6

Fiscal Year 2018

The following 14 sites were sampled and rated in fiscal year 2018.:

- Ball Mountain Book 7.3 rated "Excellent"

  This stream reach was listed as impaired due to acidity, though the impaired segment of Ball Mountain Brook has been under-sampled (last assessed in the late 1980's). All metrics scored easily above A(1) reference thresholds. The stream has a diverse community, dominated primarily by moderately to highly enrichment sensitive mayfly and caddisfly taxa. Water chemistry results suggest the stream may still be mildly acidic in nature (alkalinity = 3.9 mg/L calcium carbonate, pH = 6.27), however the aluminum concentration was relatively low compared to other acid stressed streams sampled in 2018 (65 ug/l), and the community is not showing acute effects of toxicity due to acidity.

- Bear Creek 0.7 rated "Very Good"

  Most of this forested stream (99.9 percent) drains the back side of Stratton Mountain (opposite the ski resort development). The stream is currently on the 303(d) list of impaired waters for acidification. The historically low biological condition at this site has been attributed to acid deposition, with the stream showing critically low alkalinity and pH, and elevated aluminum. While the stream community showed an improved biological condition in 2018, there are still significant signs of acidification (pH = 5.45, gran alkalinity = 1.67).

- Bickford Hollow Brook 0.1 rated "Fair"

  Results indicate trends reflecting a common pattern in streams stressed by acidity. This stream is on the stressed waters list for acidity, with a very low pH (5.74) and alkalinity (1.48mg/l). A fish survey revealed a community of only brook trout, and at least two species must be present to receive an assessment rating. However, brook trout density meets A1 reclassification criteria.

- Bingo Brook 1.8 rated "Excellent"

  All chemical and physical parameters appear to be within normal reference range.

- Bourn Brook 1.6 rated "Very Good"

  This site was sampled for the first time since a series of visits from 1993-1995. Overall, biological metric scores are very close to values seen 25 years ago. The rating increased slightly to "Very Good". Most of the species are moderately to highly water-quality sensitive. While the biological community is of high quality, the pebble count and water chemistry (alkalinity, pH, aluminum) data show that the stream is somewhat acidic with low productivity.

- Branch Pond Brook 0.1 rated "Good-Fair"

  The stream is likely continuing to be limited by acidification; alkalinity was extremely low (1.2 mg/l), and pH was 4.79. Aluminum and iron concentrations (317 ug/l and 532 ug/l, respectively) were also elevated.

- Broad Brook 2.4 rated "Excellent-Very Good"

  This is the fifth time macroinvertebrates have been sampled here since 2012. Metrics are consistent over sampling years. The watershed is predominantly forested (99.2 percent), and the stream has low nutrient concentrations, indicative of a clear healthy stream.

- City Stream 2.0 rated "Very Good"

  Conductivity (144 uS/cm) and chloride (25 mg/l) were both elevated above expected background levels. Despite the watershed being mostly forested, the stream follows Route 9 for most of its length, and its headwaters are in the Prospect Mountain Ski Area.

- Fayville Branch 3.7 rated "Fair"

  This stream is on the impaired waters list for acidity from this sample point to its headwaters and was sampled in 2018 for the first time since 2009. The biological and chemical condition of the stream support that continued status, with low alkalinity (2.12 mg/L) and pH (6.03). Species richness both fall below the B(2) thresholds for a stream of its type. The stream fell below biotic metrics normally expected in a forested upland stream. The single species fish community of Brook Trout at 9.2/100 m2 was unable to be assessed but meets the requirements for A(1) reclassification.

- Lye Brook rated 1.6 "Very Good- Good"

  This stream is on the impaired waters list due to acidity from river mile 2.5 up to its headwaters. This site is below the impaired section, but still had low alkalinity (4.4 mg/L), conductivity (17 uS/cm), pH (6.03), and high total aluminum (393 ug/l), though metrics related to acid sensitivity indicate low stress on the biological community.

- Roaring Brook 0.2 rated "Good"

  Total richness was the only metric at this site that failed to meet B(1) thresholds, though several metrics were below reference level, including Biotic Index, density and species richness. The watershed is primarily forested, an upstream site on GMNF that has been sampled numerous times, however the stream does follow the road for a substantial distance, though chloride, fine sediments and gravel are low.

- Smith Brook 1.3 rated "Excellent-Very Good"

  All chemical and physical parameters appear to be within normal reference range.

- Stamford Brook 0.1 rated "Good"

  This stream had a somewhat lower biological condition that what was previously seen in 2008 and 2013. Specifically, total richness dropped below the A(1) threshold, noticeably lower than previous years, and biotic index was at the B(2) level, limiting the overall assessment to "Good".

- Winhall River 8.1 rated "Very Good- Good"

  Species richness was down in 2018, and were the lowest values ever recorded at this site. A stream gage on the Walloomsac River in Bennington shows that there had been an extended dry period from mid-August to mid-September (though flows generally remained above daily median); the dry period followed by the high flows prior to sampling may have been at least partially responsible for the documented decrease in condition in 2018.

Evaluation and Conclusions: Sentinel sites Bingo, Smith, and Winhall all received a downgraded assessment in 2017 due to natural fluctuations in weather and stream flow. In 2018, Bingo Brook 1.8 rating went up. Smith 1.3 saw no rating change. Winhall 8.1 trended down again, due to a dry period followed by high flows prior to sampling. These natural fluctuations provide a baseline to measure other sites, where management factors influence stream health.

Other key findings include:

- In 2017, a dry period followed by high precipitation and stream flows late summer, resulted in stream scouring events. This lowered biotic index ratings across the forest and resulted in lower ratings. In 2018, some recovery from this was seen.
- GMNF streams are susceptible to acidification due to acid deposition. Bear Creek, Bickford Hollow Brook, Branch Pond Brook and Fayville Branch suggest that these waters continue to be impacted by acidification. It is most likely to occur in the spring, due to seasonal snow melt. This monitoring has shown that stream chemistry stabilizes during summer and fall. Streams appear to be stable and in generally healthy condition with regards to stream chemistry.
- The Winhall River 8.1 total phosphorus appears to be trending upward and it's recommended other nearby waters be evaluated or if a nearby land-use activity might be the cause.
- City Stream 2.0, despite its headwaters being in a ski area, rated "Very Good". Land management is not having significant effect on this stream.

The results of the biological, physical, and chemical monitoring depict a broad picture of healthy streams with limited or no input of pollutants from local sources, although sensitivity to remote sources (such as combustion-related pollutants) varies from site to site. Erosion and deposition were highlighted at some sites through monitoring reporting, but there wasn't an indication that this was resulting in persistent water quality issues. Where acidification is discussed, there is no indication that land management or land use is a strong driver and this appears to be a result of regional impacts outside the scope of management of NFS lands. Managing for the greatest degree of stream and riparia function is the best approach to mitigating these types of effects. In general, monitoring indicates Forest Plan direction including Forest-wide and management area standards and guidelines along with project-specific design features, mitigation measures, and best management practices are conserving high water quality on NFS lands.

Several sites monitored in fiscal years 2017 and 2018 have been monitored multiple times, going as far back as 1994. There is discussion in VTDEC reporting that longer term monitoring of sites seems to demonstrate recovery from stressors because of broader environmental improvements related to the Clean Air Act. Long-term analysis of biological and chemical parameters may provide some insight into changes related to regional and national trends related to air quality and shifts in climate and continued monitoring for current parameters should likely be continued. However, these parameters may not be the most effective at characterizing the effects of local land management on water quality.

Recommendations: Consider changes to this monitoring question and measurement indicator that would more readily demonstrate water quality conditions at the forest-wide scale. Specifically, since a Forest Plan Goal 4 objective states management will "*Meet or exceed all State Water Quality Standards,*

including biotic standards", modification of monitoring indicators should be derived from State measurement criteria (such as water quality classifications, waterbody impairment status, and approved Total Maximum Daily Loads for impaired waterbodies).

Monitoring Element 2: Vegetation

Monitoring Item: Forest Structure

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent are management actions and natural processes leading to increased structural diversity within forested stands and across forested landscapes, moving areas toward desired objectives identified under Goal 2 of the Forest Plan?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: This new monitoring question was developed from combining the intent of several existing monitoring questions (including early successional habitat, late successional forest habitat, and uneven-aged management monitoring items) to address required Element 2 from the 2012 planning rule (36 CFR 219.12(5)(ii)): *The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.* Forest structure is a key ecosystem characteristic that is important for restoring and maintaining the abundance and distribution of native species. Forest Plan Goal 2 is to "*Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals*" (Forest Plan, p. 10). Age class objectives associated with even-age systems are identified in Tables 2.2-2 and 2.2-3 (Forest Plan, pp. 11-12), while the objective for managed uneven-age forest structure is a minimum of 20 percent of lands suitable for timber management (Forest Plan, p. 12).

Not knowing how age class diversity is changing could have serious consequences for meeting viability objectives for species that rely on certain age classes. Active forest management has the largest and quickest influence on age class diversity compared to natural processes. Timber harvesting activities and other silvicultural treatments are tracked using the Forest Service Activity Tracking System (FACTS). FACTS manages information about activities related to fire/fuels, silviculture, special funding, range vegetation improvement, and invasive species used by all levels of the Forest Service. Field Sample Vegetation data is also tracked in the FSVeg system, which is updated to reflect treatments once completed. These systems can provide reports summarizing the number of acres and proportion of harvest acres treated with uneven-aged management (selection, groups, irregular shelterwood); the number of acres treated explicitly to enhance early successional characteristics (clearcutting, patch cutting, shelterwood); then number of acres treated explicitly to enhance late successional characteristics; and the number of acres treated with various methods (thinning, improvement) to explicitly enhance the health, longevity, and/or structural diversity of forested stands at the stand and landscape scales. This data can be used to monitor the progress made toward desired age class and structure objectives. There is some error associated with this data entry and consistency of activity classification, however the data is sufficient for tracking overall trends.

Evaluation and Conclusions: Table 2-2 provides a summary of the treatments over the past five years (2014 to 2018) added to treatments implemented from 2006 to 2013 that have contributed toward moving age class diversity toward the objectives identified in Table 2.2-2 in the Forest Plan.

Table 2-2. Acres treated from 2006 to 2018 to move age class distribution toward Forest Plan objectives (Forest Plan Table 2.2-2, and pp. 11 to 12).

Age Class Objectives	Acres treated from 2006-2013[1]	Acres treated from 2014-2018[2]	Total acres treated[3]
Create regenerating age classes	543	640	1,183
Improve health and longevity	941	933	1,874
Uneven-age management	2,027	993	2,960
All treatments	**3,511**	**2,566**	**6,017**

Source: Fores Service data

[1] Acres from 2013 monitoring report (7-year trend)

[2] Acres from Forest Service Activity Tracking System (FACTS)

[3] 237,985 acres represent federal lands suitable for timber harvesting that have suitability data; 2,380 represents one percent of these lands.

Approximately 6,017 acres of timber harvest has occurred since 2006. This total treatment area is less than three percent of total suitable lands on GMNF. Between 2006 and 2013, an average of 501 acres were treated annually. This level of management increased slightly between 2014 and 2018 to 513 acres per year. At this level, the effects of management on overall age class distributions are minimal, with natural processes, succession, and the aging of forests having a much greater effect. Some natural disturbance has taken place on the landscape, however no large scale, stand replacing disturbance has been documented. Most natural disturbance has been small-scale, creating gaps and contributing to more diverse forest structure at the stand level as forests age.

Table 2-3 shows the comparison of the existing age class distribution as of 2013 across all federal lands and lands suitable for timber management with the existing condition documented in the Forest Plan Final Environmental Impact Statement (Final EIS) and Forest Plan age class objectives. The percentage of forestland in the regenerating age class (0 to 9 years) is well below Forest Plan objectives across all habitat types for suitable lands, and minimal progress has been made toward these objectives. Forest Plan objectives range from 5 to 20 percent across habitat types. In 2006, less than 1 percent of suitable forestland was in the regenerating age class. All that area has now aged into the young age class. Since 2006, less than 1 percent of suitable lands has been harvested using even-age regeneration methods. Management implemented since 2006 has allowed the area in the regenerating forest habitat type to remain somewhat stable on suitable lands but is not increasing it or moving it toward target levels.

The percentage of forestland in the young forest habitat type is also well below Forest Plan objectives across all habitat types for suitable lands and has been steadily decreasing as forests age. The level of harvesting on GMNF has not been sufficient to move toward Forest Plan objectives or to maintain 2006 levels. Forest Plan objectives for young forest in suitable lands range from 15 to 55 percent across habitat types. The target range for northern hardwood, which is the most common habitat type on GMNF, is 30 to 50 percent. In 2006, approximately 11 percent of suitable forestland was in the young age class. By 2013 the estimate decreased to 8 percent. That proportion of young forest habitat is now approximately 5 to 6 percent and continues to decrease.

The percentage of suitable forestland in the old age classes is also departing from Forest Plan objective levels across all habitat types. The area represented by this age class is increasing as mature forests age into old forests, and management has been insufficient to alter this trend. There has been a corresponding decrease in the percentage of mature forest, since there is not enough young forest aging to compensate. Forest Plan objectives range from 3 to 40 percent for old forest across habitat types. The target range of northern hardwood is 5 to 30 percent. In 2006, approximately 18 percent of suitable forestland was in the old age class, and by 2013 the estimate increased to 30 percent. That trend has continued, and the

percentage of old forest is now exceeding the high end of the target ranges specified in the Forest Plan. Overall, the area occupied by old forest has roughly doubled since 2006.

Table 2-3. Comparison of existing age class distribution in 2013 across all federal lands and lands suitable for timber management with the existing condition documented in the FEIS and Forest Plan Age Class Objectives.

Habitat Type	Age Class (years)		2013 Existing Condition (all NFS lands)[1]		2013 Existing Condition (suitable)[2]		Existing Condition 2006 Plan[3]		Forest Plan Objectives
	yrs	*class*	*ac*	*%*	*ac*	*%*	*ac*	*%*	*%*
Northern Hardwood	**0-9**	**Regen.**	**0**	***0***	**0**	***0***	**1,192**	***<1***	5-10
	10-59	Young	26,880	*9*	21,237	*11*	34,786	*12*	30-50
	60-119	Mature	197,703	*67*	137,193	*73*	217,755	*76*	35-50
	120+	**Old**	**69,641**	***24***	**29,439**	***16***	**34,144**	***12***	5-30
Mixedwood	**0-9**	**Regen.**	**12**	***<1***	**12**	***<1***	**336**	***1***	5-15
	10-39	Young	1,802	*4*	1,628	*6*	2,303	*6*	15-40
	40-99	Mature	21,140	*50*	14,520	*53*	24,389	*63*	35-55
	100+	**Old**	**19,670**	***46***	**11,331**	***41***	**11,463**	***30***	5-40
Softwood	**0-9**	**Regen.**	**49**	***<1***	**49**	***1***	**83**	***<1***	5-15
	10-39	Young	1,113	*5*	1,039	*11*	1,862	*8*	15-40
	40-99	Mature	11,971	*51*	5,385	*57*	14,864	*60*	35-55
	100+	**Old**	**10,473**	***44***	**2,843**	***31***	**7,933**	***32***	5-40
Aspen	**0-9**	**Regen.**	**18**	***2***	**18**	***3***	**89**	***1***	10-20
	10-39	Young	392	*51*	354	*67*	NA	*NA*	45-55
	40-59	Mature	35	*5*	15	*3*	NA	*NA*	25-35
	60+	**Old**	**318**	***42***	**141**	***27***	**NA**	***NA***	3-5
Birch	**0-9**	**Regen.**	**0**	***0***	**0**	***0***	**0**	***0***	5-15
	10-49	Young	377	*3*	260	*13*	1,120	*10*	45-55
	50-79	Mature	2,368	*17*	669	*34*	1,949	*17*	30-40
	80+	**Old**	**11,000**	***80***	**1,060**	***53***	**8,218**	***72***	3-5
Oak	**0-9**	**Regen.**	**0**	***0***	**0**	***0***	**37**	***1***	5-15
	10-59	Young	173	*4*	173	*5*	265	*7*	45-55
	60-99	Mature	1,603	*35*	1,353	*41*	1,453	*41*	30-40
	100+	**Old**	**2,820**	***61***	**1,780**	***54***	**1,794**	***51***	5-10
All Types		**Regen.**	**79**	***<1***	**79**	***<1***	**1,737**	***<1***	
		Young	30,736	*8*	24,691	*11*	40,336	*11*	
		Mature	234,821	*62*	159,134	*69*	260,410	*71*	
		Old	**113,922**	***30***	**46,594**	***20***	**63,552**	***18***	

[1] These acres do not include the 464 acres of regenerating age class harvested between 2007 and 2013 that have not been entered into Forest Service databases to date.
[2] Applies only to federal lands suitable for timber management
[3] Documented in Table 3.5-7, p. 3-67 of the Forest Plan Final EIS; aspen and birch are combined in this table; new regeneration harvests in this period focused on aspen; it is impossible to attribute acres in other age classes to each type so all are assigned to birch.

In addition to age class targets by habitat type, the Forest Plan includes targets for the proportion of suitable lands managed using uneven-aged silvicultural methods. These include single tree selection, group selection and irregular shelterwood methods. Forest Plan objectives include the use of uneven-aged harvesting for approximately 24 percent of management in the first decade of Forest Plan implementation. Since 2006, approximately 49 percent of timber harvest treatments have used these methods. Uneven-aged harvests can increase structural diversity, increase habitat diversity, and enhance late successional characteristics within stands. These are all positive outcomes in terms of creating structural diversity, however these systems do not provide even-age regenerating and young forest habitat. These younger habitats are in decline and support a suite of native wildlife species, many of which are in regional decline.

Proposed and Probable Practices included in Appendix D of the Forest Plan, estimate that timber harvest would occur on 40,550 acres during the first decade of Forest Plan Implementation. Over the first 12 years of Forest Plan implementation, timber harvest occurred on approximately 6,017 acres. This is approximately 12 percent of planned harvest levels. For the timber harvest that has been implemented, even-aged regeneration harvest has been represented at a much smaller proportion of harvest than planned.

These management trends are generally moving GMNF toward older and more uneven-age forest structure. Increased structural diversity in uneven-aged stands and the development of old forest can be beneficial for habitat diversity. The aging of forests and treatments that enhance late successional characteristics create forest habitats with large trees, abundant dead and downed wood, and canopy gaps. The complex structure of these forests results in diverse habitats, many of which are not present in younger forests. However, both young and old forest conditions are needed to maintain an ecologically functional landscape. Even-aged regeneration harvest is not being implemented at the rate needed to reverse a declining trend in regenerating and young forest and to reach a level that supports native species that require young forest. The use of even aged regeneration methods has been decreasing at the landscape scale. Without the establishment of larger patches of early successional habitat over the next 50 or more years, a whole suite of early successional species strongly associated with this habitat will continue to decline.

Management trends also have potential consequences for forest health and resilience to climate change. Relatively homogenous, even-aged stands resulting from agricultural abandonment in the early 1900s make up a large proportion of GMNF. The maturing of these even-aged stands and the lack of diversity present in these forests are risk factors for forest health. Increasing stressors include native and non-native insects and diseases, invasive plants, invasive earthworms, pollution and atmospheric deposition. These stresses are compounded by climate change. These risks can be mitigated by increasing structural diversity and sustaining productivity and growth at the stand and landscape level.

The level of timber harvesting on GMNF since 2006 has not been sufficient to move age class distributions toward Forest Plan objectives, or even to prevent further departure from these objectives. Forest Service staff should look at opportunities to increase the number of acres treated using all methods to move age class distributions toward Forest Plan objectives, or at least to slow the departure. Proposed treatments should seek to increase habitat diversity and increase resilience to increasing stressors, using the best available science. Even-aged regeneration harvest should be emphasized to slow the decline of regenerating and young forest habitat, and the decrease of overall habitat diversity on the landscape. Where even-aged regeneration is not used in mature and old forest classes, intermediate treatments should be emphasized to increase resilience, growth and productivity while reducing forest health risks.

Recommendations: No recommended change to this monitoring question.

Monitoring Element 3: Aquatic Ecosystems

Monitoring Item: Focal Species (Brook Trout)

Monitoring Question: Are the ecological sustainability and diversity of natural communities present and functioning on the GMNF?

Detailed Monitoring Question: Does the headwater streams ecosystem provide a full array of riparian and aquatic communities and stream channel types supported by the varied physiographic conditions across the Forest?

Monitoring Driver: Forest Plan Goal 4 and associated Objectives.

Monitoring Activities: This new monitoring question was developed specifically to address required Element 3 from the 2012 planning rule (36 CFR 219.12(5)(iii)): *The status of focal species to assess the ecological conditions required under 36 CFR 219.9*. For context, 36 CFR 219.9 is a reference to the planning rule section on ecological conditions to provide for a diversity of plant and animal communities. Focal species are defined as a small subset of species whose status permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area (36 CFR 219.19). Focal species are selected based on their functional role in ecosystems.

Brook trout (*Salvelinus fontinalis*) was selected as the GMNF focal species for monitoring because there is a strong tie to ecosystem conditions that can't be better monitored using more direct indicators. It also enables the monitoring effort needed to achieve meaningful results within staffing and budget capabilities. Brook trout is a native cold-water species in GMNF headwater streams. Monitoring brook trout populations provides a method to assess overall headwater stream ecosystem integrity. The resulting status of populations can ultimately demonstrate the severity of all habitat stressors collectively. Monitoring sites can be measured over time at the same locations to provide quantifiable scientific data. Also, monitoring can be invaluable in guiding sustainable management and answering ecosystem health questions. Surveys can be done anytime except winter, but best in late summer.

The headwater streams ecosystem has been identified as a priority for monitoring because high quality surface waters fill an essential niche in overall ecosystem health and provide important habitat for a richly biodiverse community of aquatic dependent species. The desired conditions for this ecosystem emphasize the extent to which water quality, riparian area conditions, and watershed health will be maintained and/or restored. Maintenance of water quality and riparian area conditions is an important part of restoring, protecting, maintaining, and enhancing biological and ecological diversity.

On average, the headwater ecosystems containing instream and riparian habitats provide a full array of conditions to support brook trout on GMNF. However, measuring "Brook Trout per Mile" may not be the most effective measure to expand to habitat condition. There are also trends that suggest the number of brook trout per mile is decreasing over time, larger fish are becoming more rare, and the number of young brook trout accounts for a larger percent of the total population.

Each year Forest Service staff monitor sites across GMNF. The average brook trout per mile is calculated from a group of sample sites that are considered representative of GMNF watersheds. The number of trout captured at sample site is expanded by a multiplier to create the trout per mile statistic. These data are collected using electro fishing survey methods. Some sites are sampled each year, while others are done on a three-year rotation. Monitoring has resulted in a dataset going back to 1988.

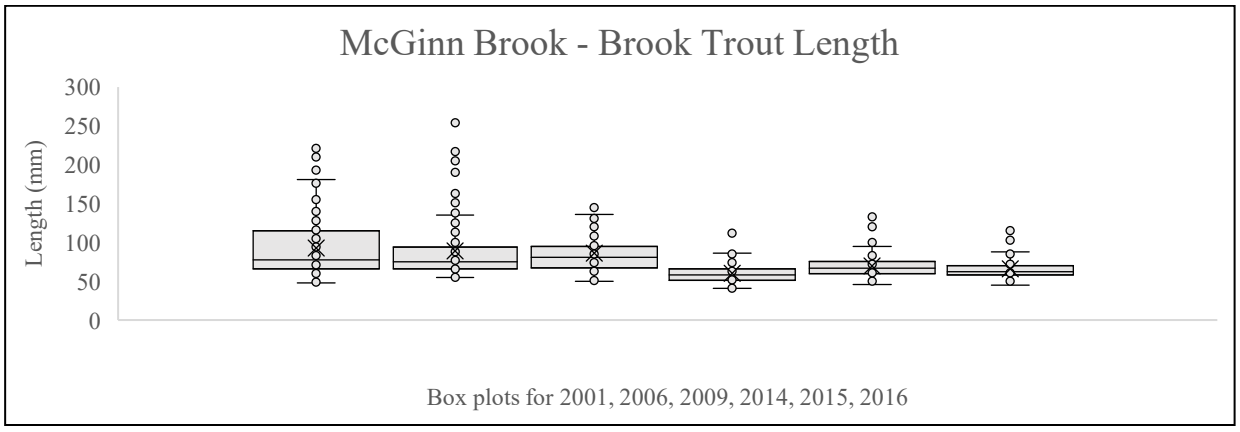
Evaluation and Conclusions: There are 63 Hydrologic Unit Code (HUC) 12 Watersheds located on GMNF. Of those 63, only 7 are listed as functioning at risk by the Watershed Classification Framework (USDA Forest Service 2011), the remaining 56 are functioning properly. The majority of the seven functioning at risk watersheds are listed for flow alteration. Flow alteration, while problematic lower in a watershed, does not tend to impact headwater ecosystems and is not likely to adversely impact brook trout. It is thought that conditions for brook trout have improved in the State overall and on GMNF as state and federal laws protect watershed resources. In general, water quality has improved over time, and many areas have returned to a forested condition. Unfortunately, brook trout have declined across most of their historic range and have been increasingly restricted to headwater streams (Hudy et al 2008).

Annual fish population monitoring data suggest that brook trout are maintaining populations across all monitored streams, and in all drainages. There is, however, a high degree of variability between years and sights in terms of observed brook trout numbers, and trends over time. There are no streams monitored on GMNF where brook trout have disappeared from a sample reach.

Annual variability is to be expected in natural systems where sampling conditions cannot be replicated in each sample period, in this case year to year. This has been demonstrated for "Vermont Estimates" of young of the year (YOY) (Kirn 1997). In "Evaluation of Wild Brook Trout Populations in Vermont" the authors refer to trends from 1950 to 2017 excluding YOY brook trout due to the variability in that age class. Stream temperature and water level can greatly affect the number of brook trout that are captured in a given sample period (Hudy et al 2008); any will directly impact the estimated trout per mile.

To demonstrate this variability, consider data from McGinn Brook on the Manchester Ranger District as an example (Figure 2-1) which displays a high degree of variability in the data from 2001 to 2016. Notice the decrease in larger fish (greater than 150mm) after 2009. The average length of brook trout has decreased over time while the number of fish sampled has fluctuated between 76 and 153. In 2001, the average length of a fish sampled in McGinn Brook was 93 millimeters (mm) and the maximum length was 221mm, compared to 66mm average length and 120mm maximum length in 2016.

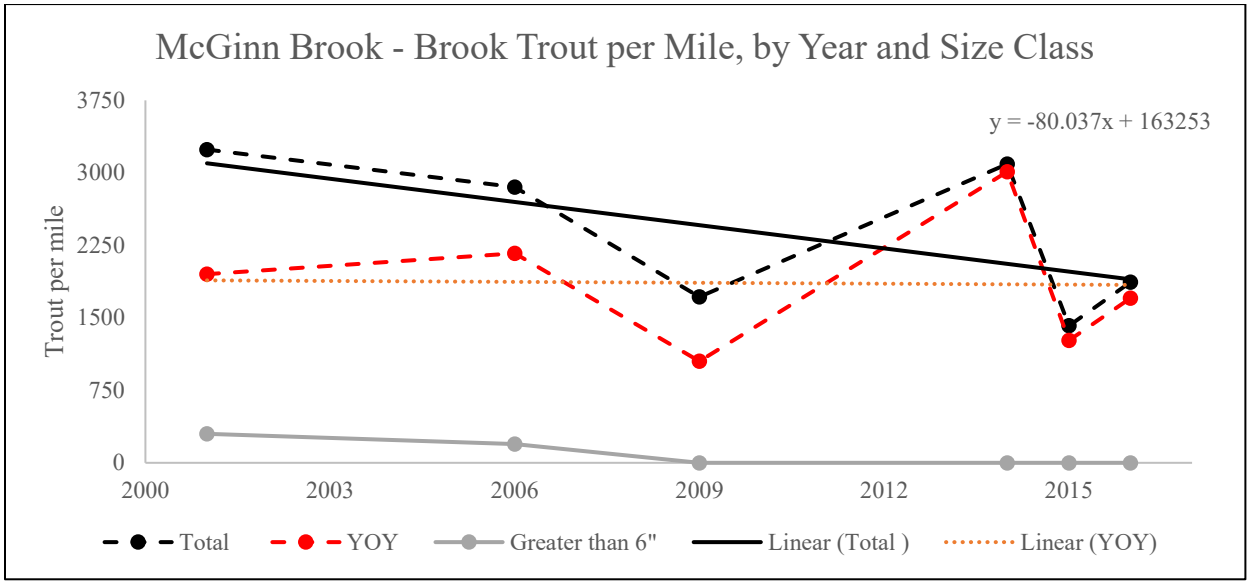
Figure 2-1. *McGinn Brook, brook trout length frequency data 2001 to 2016.*



Beyond variability, there are also trends in estimated brook trout per mile and changes in the length frequency distribution of brook trout in McGinn Brook that suggest declines. Brook trout larger than 6 inches (>150mm) disappear from the observations after 2006. When a decline of the average and maximum lengths is observed it is assumed there are fewer older fish. While not statistically significant (Single Factor ANOVA of length data 2001-2016 ($F(5,722) = F0.911104$, $p = 0.47$), the loss of all larger fish in the sample is biologically significant.

Figure 2-2 displays brook trout per mile by year for McGinn Brook. The black dashed line is total brook trout, the red dashed line is young of the year, and the solid gray line is brook trout greater than 6 inches. The solid black line is the trend line for total brook trout per mile. Notice the lack of large fish and that YOY are responsible for the majority of all fish sampled after 2009. The space between the dashed lines represents all fish that are not YOY. When brook trout per mile is plotted for the estimated total, young of the year (YOY), and greater than 6-inch size class (>150mm), there is a negative trend (slope = -80.037) for all size classes and the larger than 6-inch class disappears after 2006. Young of the year brook trout then accounts for most of the total estimated brook trout per mile statistic.

Figure 2-2. *McGinn Brook brook trout per mile by year.*

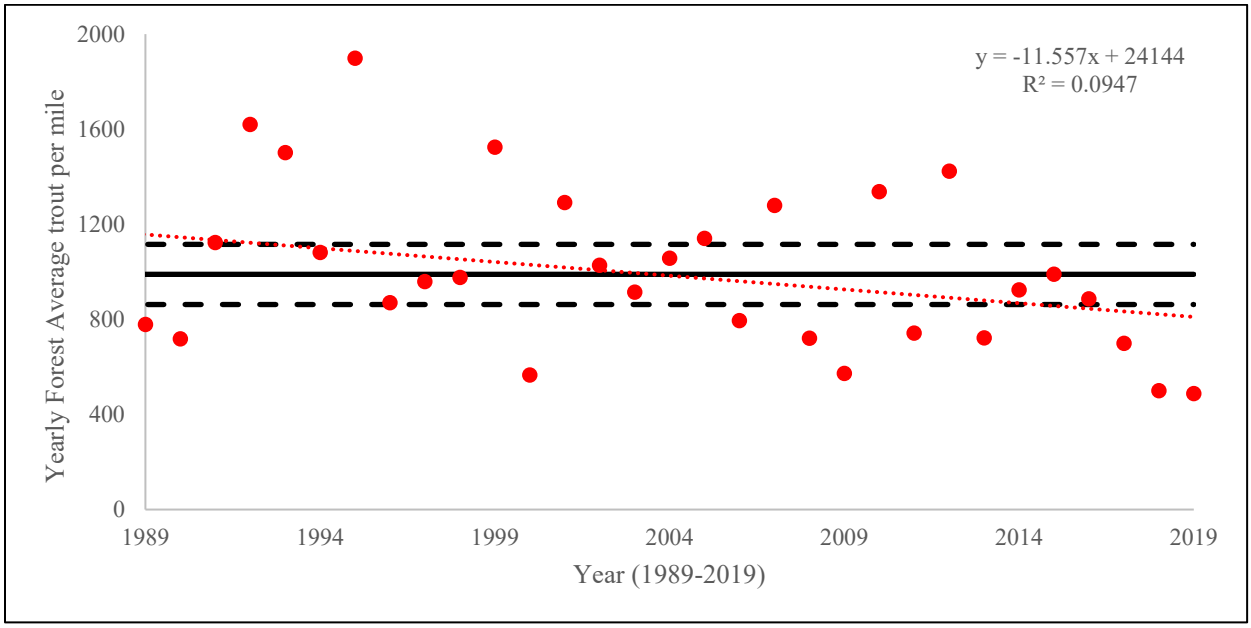


Forest Average Brook Trout Per Mile

Figure 2-3 displays the average brook trout per mile across all sites by year (1989 to 2019). There is an overall negative trend in the data. The mean, indicated by the solid black line, is 989. The upper- and lower-95 percent confidence intervals for that mean, indicated by the black dashed lines, are 1,115.5 and 862.5 respectively. The range of yearly trout per mile was 488.4 to 1,898. The red dotted line is the trendline for the regression equation for the linear regression of average trout per mile by year. It's worth noting that the trend for this equation is negative (-11.57), the p-value for the regression is 0.08659, and the R^2 value is 0.9473. This suggests that there is a weak direct relationship between the number of trout per mile (decreasing) by year, and that 95 percent of the variability in these data is explained by the change in time. The p-value's significance is greater than 0.05, however it is worth noting that a p-values significance demonstrates a low amount of evidence for the trend, not *no evidence.* The equation from the linear regression expresses there are fewer brook trout on average across all sites each year. If the number of brook trout per mile is used as a surrogate of habitat, these data suggest there is a slight trend in habitat decline indicated by the average.

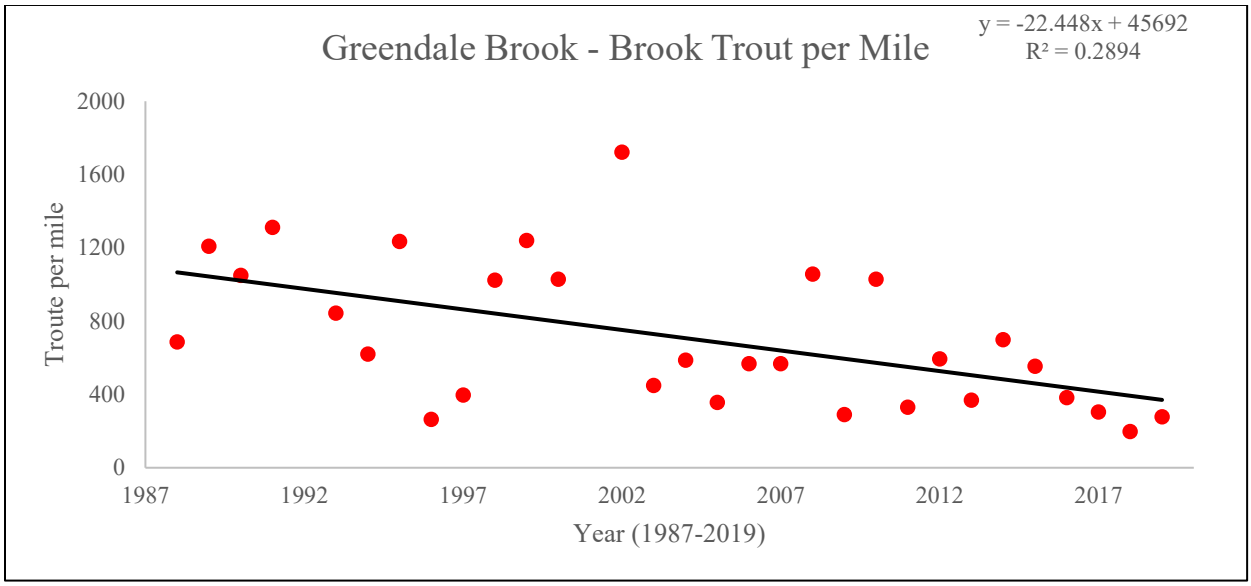
Using the forest average across all sites creates issues with the assumption that the effort of collecting data was similar each year, and the average brook trout per mile is equally representative for each year. This may not be the case. To overcome the issues with assumptions, individual stream data were assessed.

Figure 2-3. *Forest average brook trout per mile, 1989 to 2019.*



Monitoring data from Greendale Brook reveals a similar trend over time (Figure 2-4). The regression line is negative (-22.5), and that roughly 24 percent in the variation of brook trout per mile is explained by time. The p-value is significant at 0.004. Greendale is one of the "cleaner" datasets for brook trout per mile and the data does not contain outliers.

Figure 2-4. *Greendale Brook brook trout per mile year.*



Bingo Brook demonstrates variability in data and an overall negative trend if outlier data are removed. In Figure 2-5, the trend for the regression equation is essentially flat. There are two points in the data that have high leverage on the rest of the data (2010-501, 2012-831). Removing those two points produces a negative slope that is also significant (Figure 2-6). The solid black line is the trend line for the regression equation. The dotted black line indicates two standard deviations above the mean (rough measure of outliers).

Figure 2-5. *Bingo Brook brook trout per mile with outlier data.*

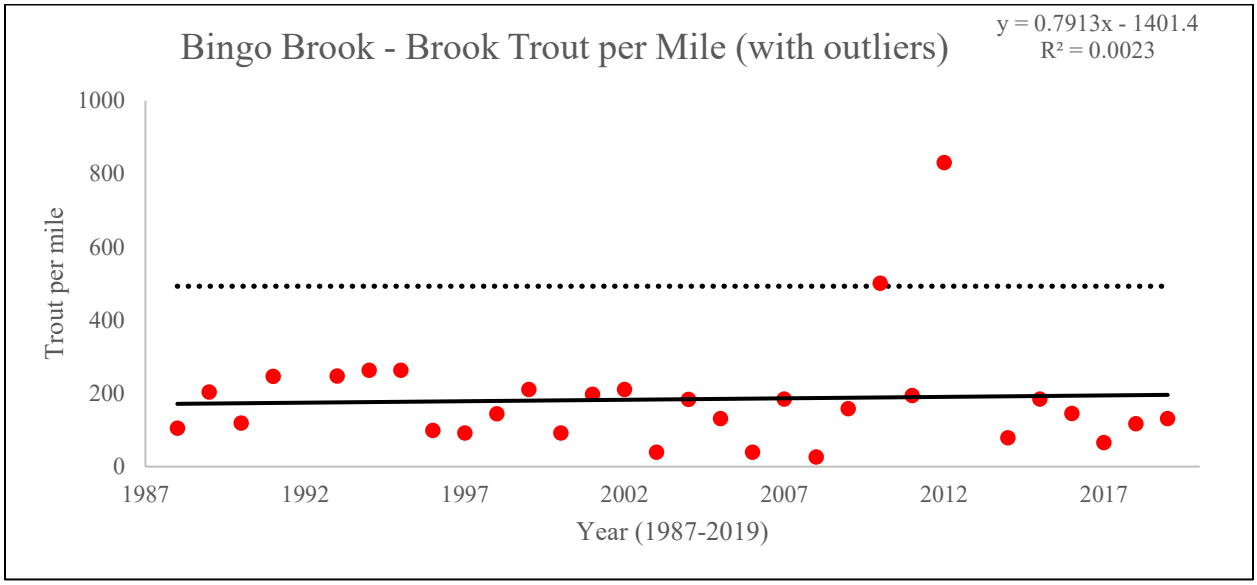
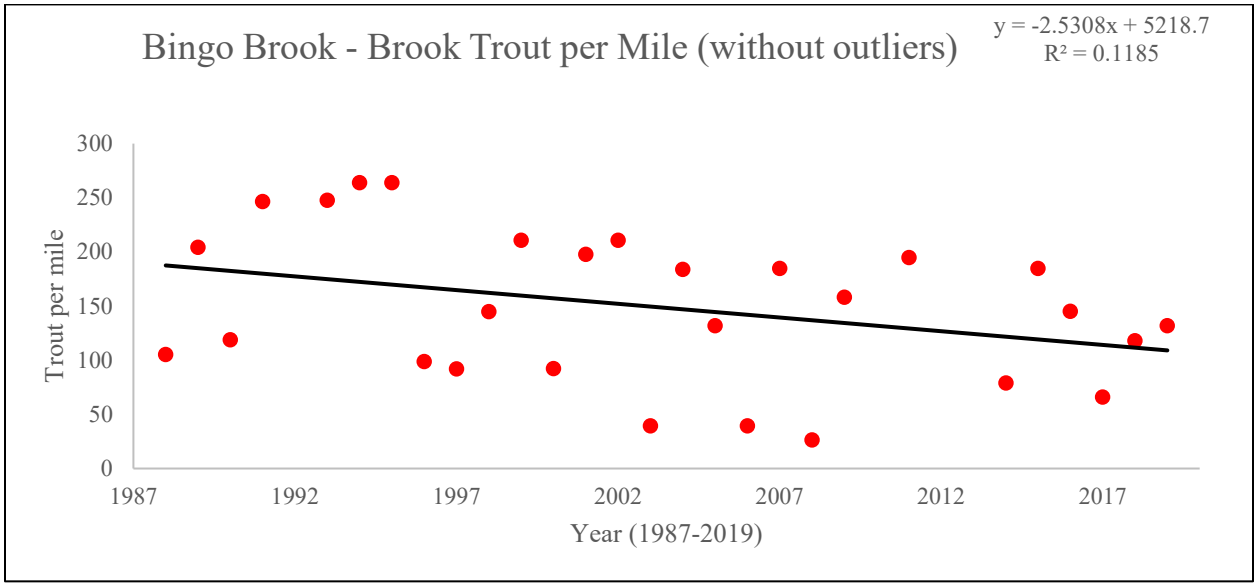


Figure 2-6. *Bingo Brook brook trout per mile without outlier data.*



Monitoring data from Michigan and Utley brooks (Figures 2-7 and 2-8) show these streams have a positive trend in the slope of the regression line suggesting an increase in brook trout per mile over time, 14.5 and 9.0 respectively. For Michigan Brook, the regression of brook trout per mile by year was not significant, p-value = 0.1737. For Utley Brook, the regression of brook trout per mile was significant, p-value = 0.0214. For both drainages, YOY accounts for a majority of the observations in the dataset.

Figure 2-7. *Michigan Brook brook trout per mile.*

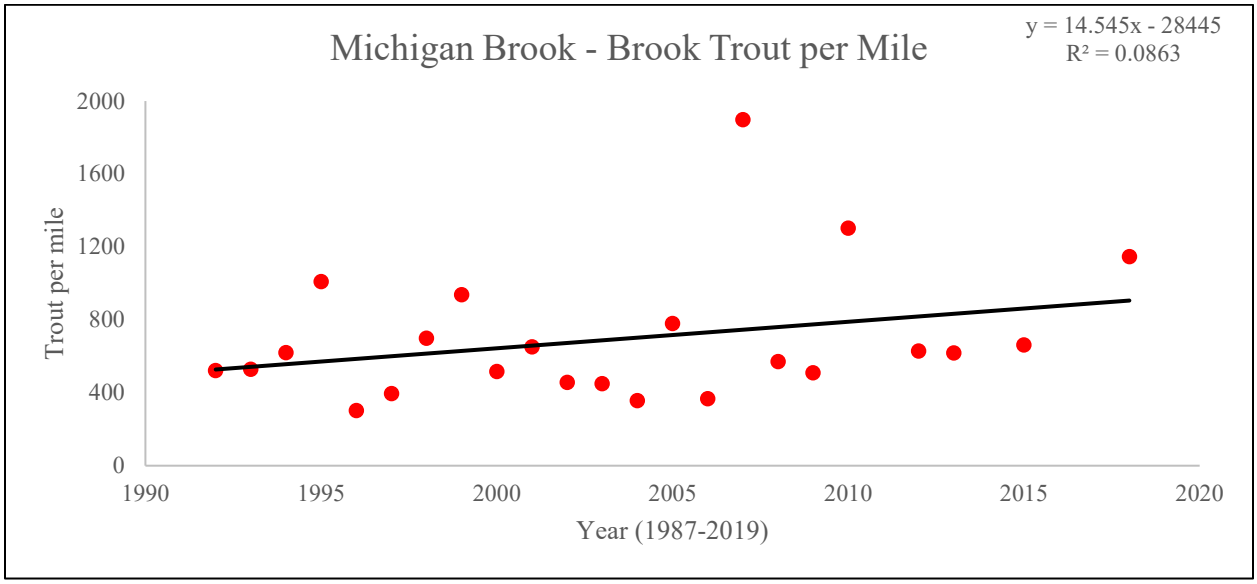
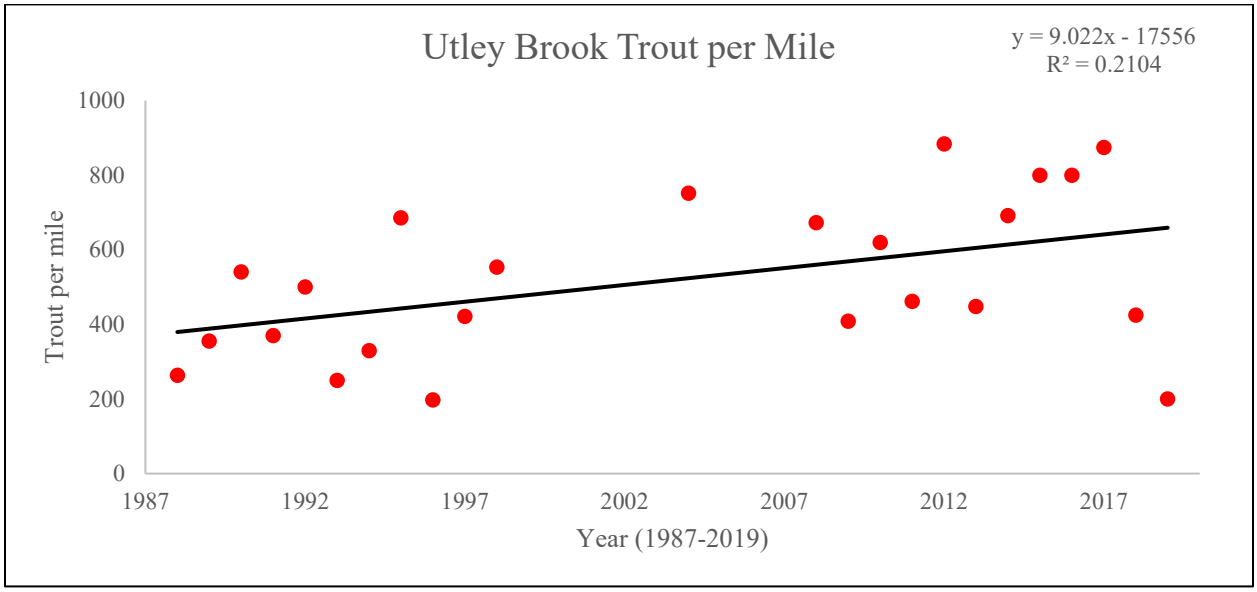


Figure 2-8. *Utley Brook brook trout per mile.*



Figures 2-9 and 2-10 show how monitoring data from the West Branch of the White River is another example demonstrating the complexity of using "Brook Trout Per Mile" as a measurement indicator. This sample reach on the West Branch has undergone substantial changes over time. Flooding, gravel extraction, and restoration activities have changed the aquatic habitat for better and worse. Ideally, the numbers would track impacts to the system. For instance, after restoration following stream damage from tropical storm Irene in 2011 there would be an increase in trout per mile that would demonstrate a change to a more positive mean. To some extent a case could be made for a response in brook trout numbers post disturbance; from 2011 to 2018 the data shows a decline in brook trout post gravel extraction (negative disturbance and a positive increase post restoration. However, the following years demonstrate below average brook trout per mile. The linear regression model produces a regression equation that would

produce a net gain in brook trout per each additional year, however, the p-value for this model is 0.4242 and not significant.

Figure 2-9. *West Branch brook trout per mile.*

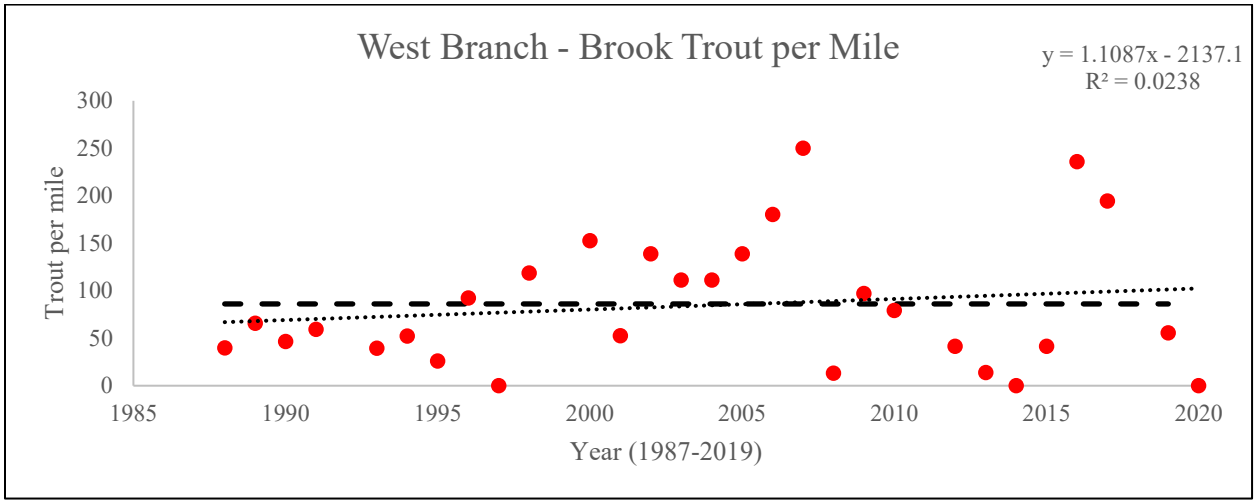
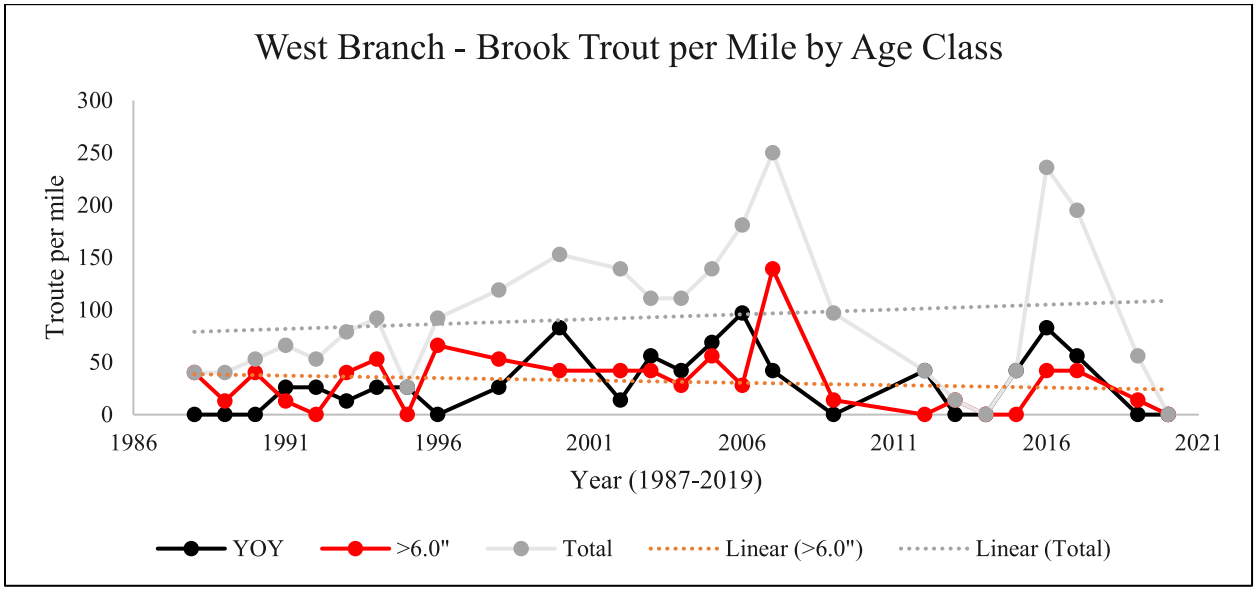


Figure 2-10. *West Branch brook trout per mile by age class.*



Brook trout per mile also excludes any information regarding the structure of the population. In many of the previous examples, an increase in YOY brook trout was responsible for higher values. Looking at the McGinn Brook length frequency data (Figure 2-1), the larger fish (older age classes) have dropped off over time.

Other Salmonids

Many GMNF streams now support other trout species. Rainbow trout (*O. mykiss*), and brown trout (*S. trutta*) have been introduced across Vermont. These competing species will impact brook trout populations and may need to be considered if monitoring continues to use brook trout per mile as a

surrogate for habitat health. There is little evidence that introduced trout are further expanding their distribution, however they are occupying similar habitats and may compete for resources.

Average brook trout per mile is not a good indicator of whether the headwater streams ecosystem provides a full array of riparian and aquatic communities and stream channel types supported by the varied physiographic conditions across GMNF. Moving forward, the use of an alternative measurement indicator is recommended. Forest Service staff have length weight data that could be used to understand a condition factor for brook trout. Cone demonstrated that traditional measures of condition can be biased and ultimately suggested the use of regression analysis (Cone 1989). Additionally, YOY could be removed from the estimation of the "brook trout per mile" indicator.

Recommendations: An alternative indicator should be considered for this monitoring question to encompass a combination of data. The State of Vermont already has a process of ranking stream condition called the Ambient Biomonitoring Network that covers a suite of indicators. This type of robust measure is more appropriate to address this monitoring item.

Monitoring Element 4: Rare Plants Population

Monitoring Item: Sensitive Plant Population Trends

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: What are the population trends for sensitive plants on GMNF? To what extent is management sustaining or enhancing habitat conditions for populations?

Monitor Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: This existing monitoring item question was selected to address required Element 4 from the 2012 planning rule (36 CFR 219.12(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.* For context, 36 CFR 219.9 is a reference to the planning rule section on ecological conditions to provide for a diversity of plant and animal communities. This section provides for the identification of species of conservation concern, which is *a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area* (36 CFR 219.9(c)).

Although species of conservation concern are not anticipated to be identified for GMNF until the Forest Plan is revised, the focus on plant species listed as Regional Forester Sensitive Species (RFSS) is a good alternative approach to meet the intent of this monitoring element. Regional Forester Sensitive Species are those that have been identified to have population viability as a concern as evidenced by: 1) significant current or predicted downward trends in population numbers or density; and 2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. This question was selected to address this monitoring element from the existing monitoring program because it provides a practical means to determine how well habitat for sensitive species is managed to provide for healthy and viable populations across the landscape. The indicator and measurements have been modified to provide more meaningful information based on new available literature.

This question ties directly to addressing Forest Plan Goal 2 to "*Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals*" (Forest Plan, p. 10). It is a Forest Plan objective to protect critical habitat and key habitat features upon which RFSS depend. Agency policy provides direction to develop and implement management practices to ensure that sensitive species do not become threatened or endangered because of Forest Service actions (Forest Service Manual 2670). Management decisions must not result in loss of sensitive species viability or create significant trends toward federal listing.

The RFSS list for plants was updated in 2017 and now includes 105 vascular and 2 nonvascular plant species (Appendix B, Table B-2). Ten vascular and 16 nonvascular species were removed from the 2011 RFSS list, and 28 vascular species were added. Vascular species that were dropped from the list were those that: 1) had not been found in 30 or more years; 2) were determined to be misidentified and wrongly added to the list; or 3) were determined to be more common than previously thought. Nonvascular species were removed from the list if it was determined that they were adequately protected by protecting their habitats, and their habitats were likely to remain protected.

Monitoring data collected for each rare plant population and stored in NRIS TESP-IS, the Forest Service corporate database for botanical data, includes: 1) number of ramets or genets, 2) percent reproductive, 3) spatial extent of population, 4) number of populations of a species, and 5) ranked condition of populations. At times the available taxa list in NRIS does not keep up with species tracked; data for those taxa are stored in a spatial layer, called "Rare Plants not in NRIS". In addition, the GMNF botany program and the state Vermont Natural Heritage Inventory (VNHI) program informally share one staff member. Data collected by that person for any rare plant populations either monitored or newly discovered on GMNF is entered into the VNHI spatial database and given back to the Forest Service in an updated GIS layer once a year. This shared data management benefits the State by keeping them informed about rare plant trends on GMNF, and it benefits the Forest Service since labor-intensive data entry occurs as part of the work conducted by VNHI staff.

Monitoring efforts for fiscal years 2017 and 2018 are listed below, and monitoring trends for each species are summarized in Appendix B, Table B-3. Uncommon or rare non-RFSS plants newly found or monitored will be evaluated for possible inclusion on the RFSS list during the planned fiscal year 2022 list update.

Fiscal Year 2017

- 49 out of 106 vascular plants (80 sites/populations) monitored
- 1 nonvascular plant monitored (1 site/population)
- 31 uncommon or rare non-RFSS vascular and 1 nonvascular plants monitored (39 and 1 sites/populations, respectively)

Fiscal Year 2018

- 62 out of 106 vascular plants (82 sites/populations) monitored
- 1 nonvascular plant monitored (1 site/population)
- 22 uncommon or rare non-RFSS vascular plants monitored (22 sites/populations)

In addition to monitoring known populations of RFSS, botanical inventory is undertaken to search for new populations, either in response to proposed ground-disturbing projects, or to learn more about supportive habitat on NFS lands. In fiscal years 2017 and 2018 botanical inventory for rare plants occurred in the following locations, and simultaneously included inventory for non-native invasive plants (NNIP):

Fiscal Year 2017 (1,445.2 acres)

- 126.5 acres were searched for six different rare plant species that were either historical or had not been found recently; none were found.
- 203 acres were inventoried in the Robinson Integrated Resource Project on the Rochester Ranger District. Three new RFSS populations were found: glade fern (*Diplazium pycnocarpon*), bog chickweed (*Stellaria alsine*), and crooked-stem aster (*Symphyotrichum prenanthoides*), and several NNIP were found.
- 1,115.7 acres were inventoried in the Somerset Integrated Resource Project on the Manchester Ranger District; new populations/subpopulations of eastern dwarf mistletoe (*Arceuthobium pusillum*) and low water-milfoil (*Myriophyllum humile*) were found.

Fiscal Year 2018 (1,437.3 acres)

- 1,437.3 were inventoried for the Somerset Integrated Resource Project; new populations/subpopulations of eastern dwarf mistletoe (*Arceuthobium pusillum*), shore sedge (*Carex lenticularis*), long-bract green orchis (*Dactylorhiza viridis*), and northeastern bladderwort (*Utricularia resupinata*) were found.

Evaluation and Conclusions: The Forest Plan (Goal 2, p. 10) directs management to "*maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals*". Forest-wide Standards and Guidelines for Rare and Unique Biological Features (Forest Plan, p. 30) require a periodically updated list of all threatened, endangered, and sensitive species (Standard S-1) and investigating all project sites for threatened, endangered, and sensitive species (Standard S-2).

Monitoring shows management activities are meeting Forest Plan Goal 2 and following standards by having rare plant and inventories completed in the Robinson and Somerset Integrated Resource Project areas, and in miscellaneous small project areas (acres not included above). Forest Plan direction is also followed by monitoring known rare plant occurrences on a cyclical basis; formerly aimed for a five-year cycle, but as the botany program of work has increased, switched to a seven-year cycle for terrestrial plants, and a ten-year cycle for aquatic plants in remote high elevation ponds.

In addition to monitoring existing RFSS occurrences and inventorying for new populations, NNIP treatments benefitted RFSS or other rare plants that occur along Forest Road 233 in the Natural Turnpike project area, along roads in the Upper White River Integrated Resource Project area, in several sections of the South of Route 9 Integrated Resource Project area, in two maintained wildlife openings along the Appalachian Trail, and at the Richville Road restoration site. See the Non-native Invasive Species monitoring item for detailed information regarding NNIP treatments.

After three years of monitoring activities for plants on the RFSS list, identified trends are as follows:

- 36 vascular plant species are apparently stable, or in some cases increasing, although there may be annual fluctuations.
- 35 vascular are unable to be assessed, because no populations were monitored in the past two years.
- 10 vascular plant species are apparently declining. Of these, butternut trees (Juglans cinerea) occur in many places on the GMNF and are known to be dying from the butternut canker; there is little we can do to change the course of that disease. Another three have encroaching NNIP, and one of these is also threatened by ATV use in the area. Four others may be declining as the canopy closes at their sites. One is an orchid appears and disappears unpredictably and may be affected by whatever is happening with its mycorrhizal associations. One other may be affected by changes in hydrology, often brought on by beaver activity.

- 16 vascular species and both nonvascular species have uncertain trends:
    - For one nonvascular and three vascular species, more extensive surveys area needed to determine the true extent of the population
    - For one nonvascular and five vascular species, identification is problematic, making it difficult to population size
    - Three vascular species may be vulnerable to site maintenance and or lack of maintenance
    - One vascular specie may be vulnerable to stochastic changes in small populations
    - Four vascular species were not found for a variety of other reasons, making it difficult to assess trends

Recommendations: No recommended change to this monitoring question. Species-specific recommendations are provided in Appendix B, Table B-3.

Monitoring Element 5: Recreation

Monitoring Item: Equity

Monitoring Question: Is the Forest providing recreation equity to serve a diverse public?

Detailed Monitoring Question: Is there disproportionate utilization of recreation resources by demographic?

Monitor Driver: Forest Plan Goal 12 and associated Objectives.

Monitoring Activities: This existing monitoring item question was selected to address required Element 4 from the 2012 planning rule (36 CFR 219.12(5)(v)): *The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.* The GMNF is a popular recreation destination in Vermont, as well as regionally in the Northeast. Historically the role of GMNF has been to provide high-quality scenery and opportunities for dispersed recreation such as hiking, horseback riding, hunting, fishing, and camping in undeveloped settings. The GMNF also provides multiple recreation opportunities in predominantly natural settings within a region of dense populations and urban settings.

The existing Recreation Opportunity Spectrum (ROS) monitoring item question was selected to address monitoring element 5 during the monitoring transition process. The ROS is a planning tool used to identify and evaluate the supply of recreation settings on national forests based on actual on-the-ground conditions. Five ROS classes are currently inventoried on the GMNF (Urban, Rural, Roaded Natural, Semi-primitive Motorized, and Semi-primitive Non-motorized). Measuring trends from existing to desired ROS was anticipated to be an effective measure to determine how well management activities are achieving forest visitor satisfaction and desired recreation objectives specific to Forest Plan, Goal 12, "*Provide a diverse range of high-quality, sustainable recreation opportunities that complement those provided off National Forest System lands*" (Forest Plan, p. 15). Monitoring for this question was envisioned to compare inventoried ROS settings at the time of Forest Plan revision with the inventory after 5 and 10 years of plan implementation.

It was determined ROS setting methodology to measure visitor satisfaction and progress toward meeting recreation objectives required data that was not readily available. Thus, the ROS monitoring question was difficult to address and has never been reported since it was initially developed in 2006. Only projects which have a positive effect toward the desired ROS, or no effect at all, are approved for implementation with site specific environmental analysis. Without a complete inventory of the existing ROS settings, it is not feasible to determine the amount of change which has occurred. To better address this monitoring

element, the ROS setting monitoring question has been replaced with the Equity monitoring item included in this report. Forest Service staff are more readily able to address this monitoring question by comparing demographic data from the National Visitor Use Monitoring (race/ethnicity, age, socioeconomic status, disability, gender) with average census data for the counties represented by survey respondents.

This monitoring compares data from the U.S, Forest Service National Visitor Use Monitoring (NVUM) program conducted on the Green Mountain and Finger Lakes National Forests to 2010 U.S. Census data to examine whether there is disproportionate utilization of recreation resources on NFS lands.

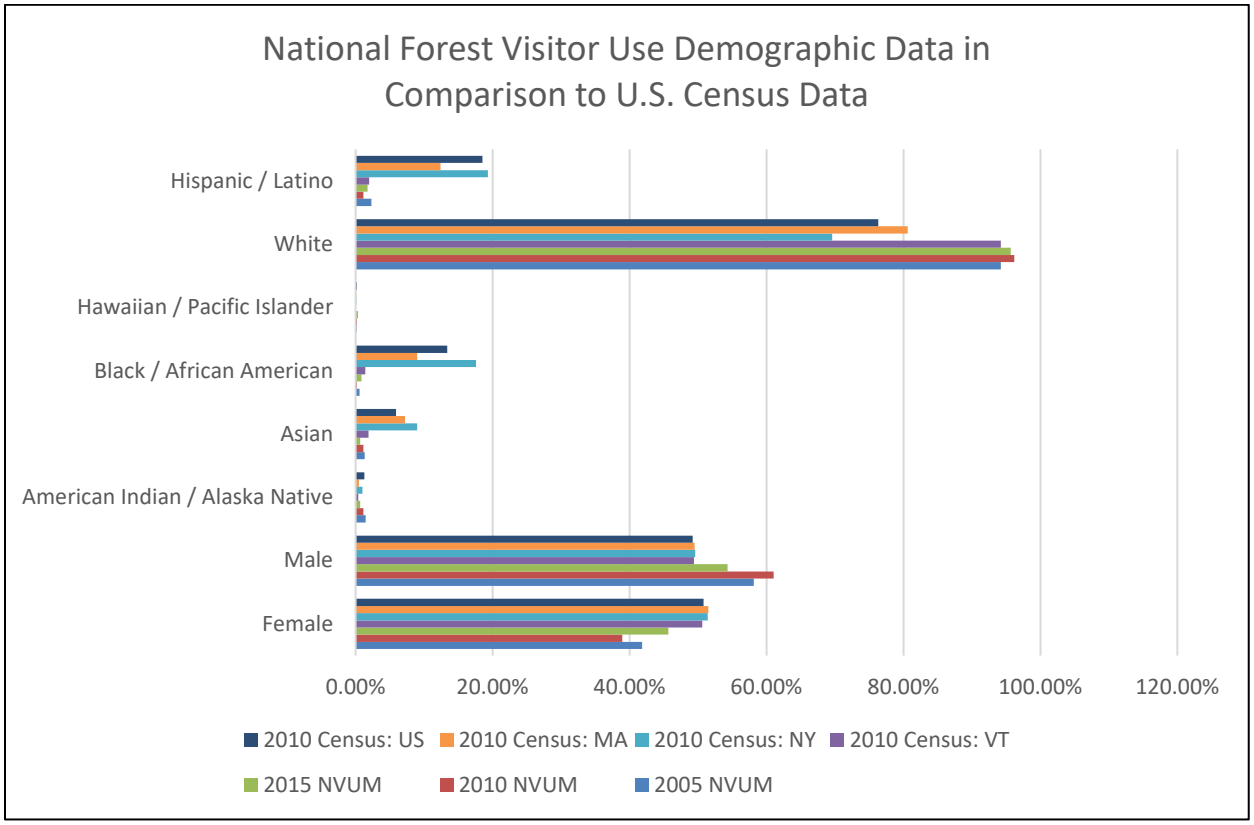
National forest visitation data for racial and ethnic minority and non-minority user groups was obtained from the NVUM program (USDA Forest Service 2018a, b and c). Visitor inventories are conducted on a five-year cycle; the most recent datasets from 2005, 2010 and 2015 were utilized for this study. The NVUM data was then compared with 2010 demographic data obtained from the U.S. Census Bureau (US Census Bureau 2010) for Massachusetts, New York, Vermont, and the United States. The difference between NVUM (percent Forest Visitor Minority) and U.S. Census (percent Minority) was computed.

Evaluation and Conclusions: This information is the same as the evaluation and conclusions found in the *GMNF Fiscal Years 2014, 2015, and 2016 Annual Monitoring and Evaluation Report* since it is based on the same 2015 NVUM data.

It is important to discuss the limitations associated with this analysis before discussing the results. The comparison between U.S. Census and NVUM datasets considered Census populations from the national average as well as Census populations from the three states representing the majority of NVUM responders: Massachusetts (approximately 10 percent of responders); New York (approximately 10 percent of responders); and Vermont (approximately 50 percent of responders); however, national forest visitation estimates represent all visitors regardless of the distance they traveled.

Figure 2-11 shows the percentage of National Visitor Use Monitoring (NVUM) responders reporting by gender and race/ethnicity in comparison to U.S. Census Bureau 2010 data population percentages for Massachusetts, New York, Vermont and the United States (three states representing the majority of NVUM responders). Monitoring results suggest an inequity gap wherein racial minorities are not utilizing Green Mountain and Finger Lakes National Forests' recreation opportunities at the same rate as their white counterparts. The percent of NVUM responders reporting as Black/African American, Asian, and Hispanic/Latino are consistently below Census population percentages for Massachusetts, New York, Vermont and the United States with the exception of 2005 Hispanic/Latino NVUM responders exceeding the percentage of Vermont Census data (2.32 percent Hispanic/Latino NVUM responders and 2 percent Hispanic/Latino Vermont population by Census) (USDA Forest Service 2018a, b and c and US Census Bureau 2010).

Figure 2-11. *National Forest Visitor Demographic Comparison to U.S. Census Data.*



National Visitor Use Monitoring responders identifying as female gender also showed National Forest visitation estimation percentages below Census data (Table 2-4).

Table 2-4. National Visitor Use Monitoring (NVUM) percent visitation by reported gender in comparison to 2010 U.S. Census Bureau data from the national average as well as census populations from the three states representing the majority of NVUM responders.

Gender	2005 NVUM	2010 NVUM	2015 NVUM	2010 Census: VT	2010 Census: NY	2010 Census: MA	2010 Census: US
Female	41.85%	38.94%	45.67%	50.60%	51.40%	51.50%	50.80%
Male	58.15%	61.06%	54.33%	49.40%	49.60%	49.50%	49.20%

The results from monitoring suggest there is disproportionate utilization of forest recreation opportunities for many racial and ethnic minority groups, demonstrating the need for the Forest Service to identify and evaluate strategies that would enhance greater racial and ethnic inclusion in outdoor recreation. There is also a need to better refine measures to encourage diversity and inclusiveness in local decision-making and planning processes to best serve all our publics and to sustain future relevance of the agency (Flores, et al 2018).

Recommendations: Consider refining measurement indicators for this monitoring question to better track forest user diversity and inclusiveness.

Monitoring Element 5: Recreation

Monitoring Item: Recreation Visitor Satisfaction

Monitoring Question: To what extent have objectives been attained?

Detailed Monitoring Question: Are we providing high quality recreation services that meet the expectations of the public?

Monitor Driver: Forest Plan Goal 12 and associated Objectives.

Monitoring Activities: This existing monitoring item question was selected to address required Element 4 from the 2012 planning rule (36 CFR 219.12(5)(v)): *The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.* The National Visitor Use Monitoring (NVUM) program provides science-based estimates of the volume and characteristics of recreation visitation to the National Forest System, as well as the benefits recreation brings to the American public. The measure for visitor satisfaction is the "mean visitor satisfaction" from the NVUM compared to "the mean importance to the visitor". 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.

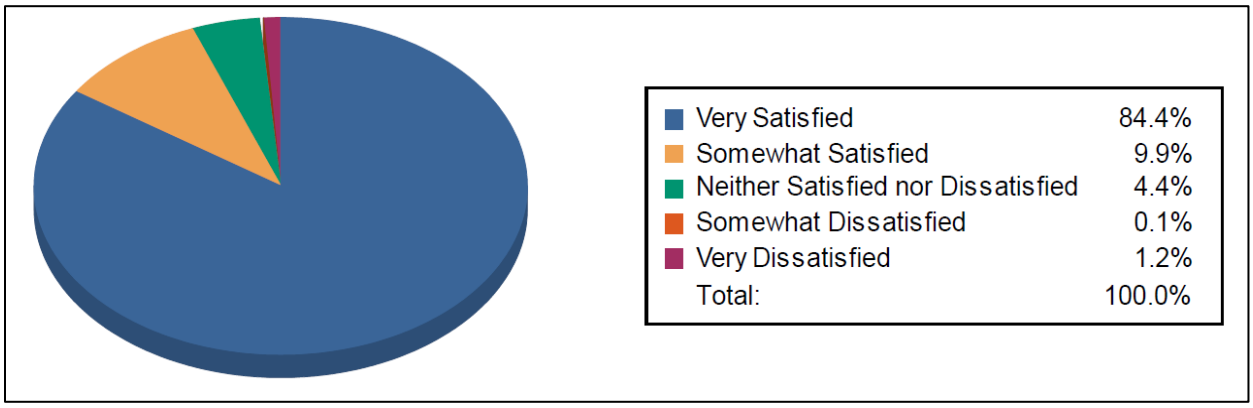
The NVUM program provides reliable information about recreation visits to NFS lands at the national, regional, and forest level. The NVUM program has two concurrent goals. First, to produce estimates of the volume of recreation visitation to National Forests and Grasslands. Second, to produce descriptive information about that visitation, including activity participation, demographics, visit duration, measures of satisfaction, and trip spending connected to the visit. Specific NVUM protocols, terminology, limitations, data, annual reports, and other information is available at: https://www.fs.usda.gov/about-agency/nvum/

National Visitor Use Monitoring (NVUM) data is collected and reported on a five-year cycle. To assess visitor satisfaction, recreation visitors were asked through the NVUM program to provide an overall rating of their visit to the national forest, on a 5-point Likert scale, ranging from not important to very important. Visitors rated both the importance and performance (satisfaction with) of these elements.

Evaluation and Conclusions: This information is the same as the evaluation and conclusions found in the *GMNF Fiscal Years 2014, 2015, and 2016 Annual Monitoring and Evaluation Report* since it is based on the same 2015 NVUM data. Most visitors (84.4 percent) to GMNF report they are "very satisfied" with their overall National Forest experience (Figure 2-12).

In respect to providing high-quality recreation services, NVUM monitoring looks at the satisfaction elements most readily controlled by managers. These are aggregated into four categories: developed facilities, access, services, and visitor safety and the site types sampled are aggregated into three groups: developed sites (includes both day use and overnight developed sites), dispersed areas, and designated Wilderness. The "Percent Satisfied Index (PSI)" identifies the proportion (percentage) of elements and sites with a numerical rating of 4 or 5, equivalent to the percent of all recreation customers who are satisfied with agency performance. The agency's national target for this measure is 85 percent. Table 2-5 displays the aggregate PSI scores for GMNF.

Figure 2-12. *Percent of National Forest Visits by Overall Satisfaction Rating.*



Developed recreation sites met user expectations to a very high degree with satisfaction indices showing between 89.8 and 98.3 percent satisfaction rate with developed facilities, access, services and feeling of safety. Visitors to undeveloped areas on GMNF feel that access and the feeling of safety also met their expectations very well (90.6 and 95.8 percent, respectively); however, visitors to undeveloped areas are less satisfied with developed facilities (77.5 percent) and services (82 percent). Visitors to Congressionally Designated Wilderness had expectations met for developed facilities (95.7 percent), services (85.5 percent) and the feeling of safety (97.8 percent); however, visitor satisfaction dropped below the agency's national target of 85 to 80.7 percent for access to GMNF wilderness (Table 2-5).

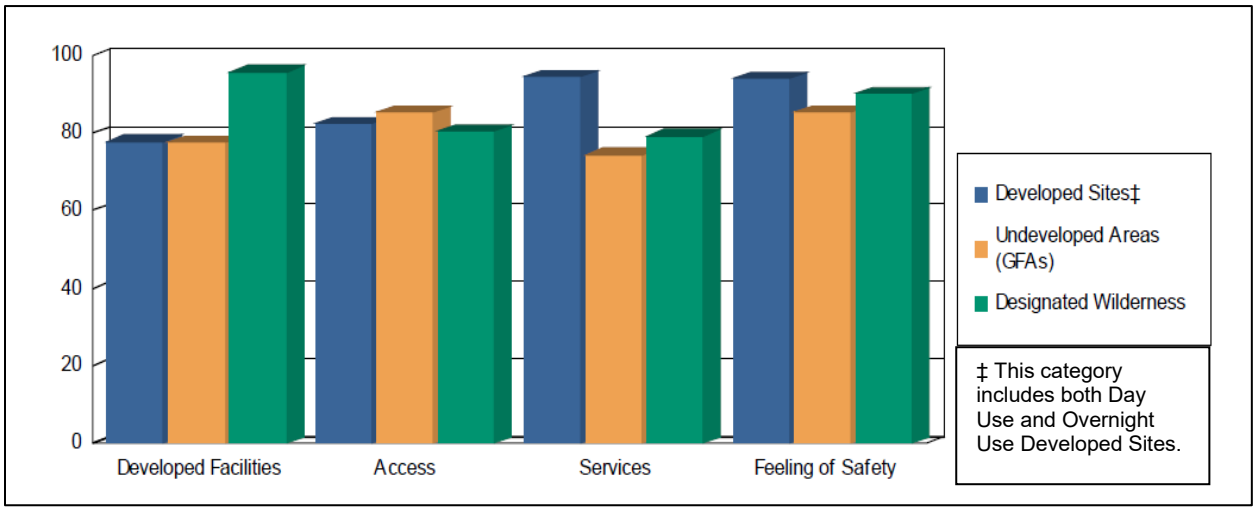
Table 2-5. Percent Satisfied Index[1] scores for aggregate categories from 2015 survey data.

Satisfaction Element	Satisfied Survey Respondents (%)		
	Developed Sites[2]	Undeveloped Areas	Designated Wilderness
Developed Facilities	89.8	77.5	95.7
Access	89.8	90.6	80.7
Services	96.0	82.0	85.5
Feeling of Safety	98.3	95.8	97.8

[1] This is a composite rating. It is the proportion of satisfaction ratings scored by visitors as good (4) or very good (5). Computed as the percentage of all ratings for the elements within the sub-grouping that are at or above the target level, and indicates the percent of all visitors that are reasonably well satisfied with agency performance.
[2] This category includes both Day Use and Overnight Use Developed Sites.

The NVUM results also identify 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, known as the "Percent Meet Expectations (PME)." 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. Figure 2-13 shows all scores rated above 70 percent, suggesting there is no significant gap between public desires and agency performance. Additional details from the NVUM results indicate PME scores would increase if efforts focused on improving: 1) restroom cleanliness in overnight developed recreation areas; and 2) parking lot conditions serving as access to wilderness.

Figure 2-13. *Percent Meets Expectations Scores.*



Recommendations: No recommended change to this monitoring question.

Monitoring Element 6: Forest Health

Monitoring Item: Tree Health

Monitoring Question: To what extent are the vegetation components of ecosystems changing over time in the context of climate change, acidic deposition, and non-native invasive species?

Detailed Monitoring Question: How is tree health and vegetation composition and structure changing over time under the influence of various environmental stressors? Are long-lived tree species able to maintain productivity over long rotations? Are forested ecosystems developing increased structural complexity over time as would be expected in aging forests?

Monitor Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: This existing monitoring item question was selected with some modifications to address required Element 6 from the 2012 planning rule (36 CFR 219.12(5)(vi)): *Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area*. The Long-term Ecosystem Monitoring Project (LEMP) is the foundational source for data monitoring for the long-term health of the forest ecosystem. It was intended to measure changes at the scale of the plan area and detect changes related to climate change and forest health. LEMP monitoring data has not been sufficient to address this monitoring item question in a meaningful manner.

Evaluation and Conclusions: Not available.

Recommendations: This monitoring question should be removed from the monitoring program.

Monitoring Element 6: Forest Health

Monitoring Item: Increase of Destructive Insects and Diseases

Monitoring Question: Are insect and disease levels compatible with objectives for maintaining healthy forest conditions?

Detailed Monitoring Question: To what extent have destructive insects and disease organisms increased?

Monitor Driver: Forest Plan Forest-wide Pests, Diseases, and Non-Native Invasive Species Standards and Guidelines.

Monitoring Activities: This existing monitoring item question was selected to address required Element 6 from the 2012 planning rule (36 CFR 219.12(5)(vi)): *Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area*. Insect and disease represent a potentially major stressor in the ecosystem. It is important to monitor both individual outbreaks of insect and disease as well as trends that may indicate ecosystem stress resulting from climate change, acid deposition or other factors. It is necessary to adapt management practices to achieve long-term forest management goals considering ongoing and future anticipated ecosystem stressors.

A variety of monitoring activities are conducted at the State and Forest level by several different agencies and organizations. Forest staff review this data and cooperate with partners to assess forest health conditions, and then supplement observations made during inventory and management activities.

Fiscal Year 2017

Monitoring efforts during fiscal year 2017 are summarized in Table 2-6.

Table 2-6. Fiscal year 2017 insect and disease monitoring.

Insect or Disease Agent	Organization & Date of Monitoring	Type of Monitoring Effort
Forest tent caterpillar, saddled prominent, gypsy moth, oak leaf tier, balsam wooly adelgid and dieback or mortality from beech bark disease, Septoria leaf spot, cankers and other unknown agents.	Vermont Department of Forests, Parks and Recreation, aerial survey summer 2017. Northeastern Area State & Private Forestry, Forest Health Protection, USDA Forest Service, aerial survey June 21 and 22, 2017.	Annual aerial detection surveys of forest health conditions on GMNF.
Insects, disease or events harmful to sugar maple trees.	Northeastern Area State & Private Forestry, Forest Health Protection, USDA Forest Service, May 17-19; June 21-22; and September 19-21.	Sugarbush surveys, on the ground field surveys, site visits.
Sugar maple general health and decline, tree health and pest populations.	Vermont Department of Forests, Parks and Recreation, University of Vermont, Forest Ecosystem Monitoring Cooperative.	Field surveys, long-term monitoring plots.

The USDA Forest Service Forest Health Protection and Vermont Department of Forests, Parks and Recreation (FPR) staff conduct aerial and ground surveys to detect forest damage, map late season defoliators and assess general forest conditions. On June 20 and 21, Forest Service staff conducted an aerial survey over GMNF. An FPR survey covering the rest of Vermont, to map forest tent caterpillar defoliation and general forest conditions, was flown between June 21 and August 23. In 2017, 98,555 acres of forest damage were sketch mapped during statewide Aerial Detection Surveys. This represents

just over two percent of Vermont's forestland and is similar to the area mapped in 2016. Defoliation by forest tent caterpillar and white pine needle damage accounted for 61 percent and 17 percent, respectively, of the area mapped. The Forest Health Protection 2017 aerial detection survey resulted in the mapping of approximately 2,623 acres of damage throughout, and adjacent to the forest. The 2017 acreage was significantly down from the 11,223 acres mapped in 2016. A total of 1,045 acres were mapped as white pine discoloration, and 1,045 acres of forest tent caterpillar defoliation in the northern hardwoods which doubled from the 477 acres mapped in 2016. White pine discoloration dropped significantly from 10,677 acres mapped in 2016.

Populations of the native forest tent caterpillar (FTC) increased statewide in 2017, with 60,588 acres of defoliation mapped during statewide aerial surveys. This accounts for roughly two percent of the northern hardwood forest in Vermont. Defoliation was mapped in every county and total acres more than doubled compared to 2016. Defoliation on GMNF was more localized.

In addition to the annual aerial survey, a satellite driven change detection tool called Forest Disturbance Monitor is being used throughout the season to flag potential areas of pest activity. The disturbance monitor is updated every eight days. The Forest Health Technology Enterprise Team has developed a new Forest Health Advisory System utilizing data from the 2013-2027 National Insect and Disease Forest Risk Assessment. The advisory system derives forest insect and disease summaries by National Forest and National Park which can be used as announcements, bulletins, or online links

Annual monitoring of the special use areas used for maple tapping (Sugarbush leases) was completed by Forest Health Protection staff in 2017. There are six tapping sites located in 5 towns (Stockbridge, Pomfret, Wilmington, Mt. Tabor and two in Lincoln). The annual monitoring consists of six criteria: two growing season site visits for visual inspection of conditions; pheromone trapping for damaging insects; insect egg mass surveys during outbreaks; taphole closure assessment; root starch reserve measurements; and using the Aerial Detection Survey to see if any damaging agents are active in the area around the sugarbushes. The sites were visited May 17 to 19; June 21 and 22; and September 19 to 21. Pheromone traps for FTC were deployed, as well as traps for saddled prominent (SP). Root starch samples were collected from November 7 to 9, and the samples processed December 5. The evaluations indicated that sugarbush special use areas are in a generally healthy condition, although one site suffered some forest tent caterpillar damage. Saddled prominent was not a major threat in 2017; maple leaf cutter and leaf spot diseases were the more common pests found, and FTC still the biggest concern. Based on pheromone trapping and egg mass surveys, the State of Vermont is forecasting increased defoliation from forest tent caterpillar in 2018.

Sugar maple tree health, based on the amount of twig dieback, remained high in 2017 with slight decline. Approximately 90 percent of trees were rated as having low dieback (less than 15 percent), compared to 95 percent in 2016. Dry conditions in 2016 may have been a factor in reduced tree health in 2017. Data was collected on the 30 monitoring plots formerly part of the North American Maple Project (NAMP). Annual measurement of sugar maple forest stands is by the State of Vermont and University of Vermont to determine tree condition, trends and possible causes of sugar maple decline. The variation in within-season timing of measurements is assessed using same plot design as in the National Forest Health Monitoring Program (NFHM). Initially this effort was part of a cooperative monitoring program with other states and Canada, since 2002 Vermont has measured these plots independently for internal use.

Fiscal Year 2018

Monitoring efforts during fiscal year 2018 are summarized in Table 2-7.

Table 2-7. Fiscal year 2018 insect and disease monitoring.

Insect or Disease Agent	Organization & Date of Monitoring	Type of Monitoring Effort
Forest tent caterpillar, saddled prominent, gypsy moth, oak leaf tier, balsam wooly adelgid and dieback or mortality from beech bark disease, Septoria leaf spot, cankers and other unknown agents.	Vermont Department of Forests, Parks and Recreation aerial survey July 9-30. Northeastern Area State & Private Forestry, Forest Health Protection, USDA Forest Service, aerial survey June 21 and 22, 2018.	Annual aerial detection surveys of forest health conditions on GMNF.
Insects, disease or events harmful to sugar maple trees.	Northeastern Area State & Private Forestry, Forest Health Protection, USDA Forest Service, June 27-29, 2017.	Sugarbush surveys, on the ground field surveys, site visits.
Sugar maple general health and decline, tree health and pest populations.	Vermont Department of Forests, Parks and Recreation, University of Vermont, Forest Ecosystem Monitoring Cooperative.	Field surveys, long-term monitoring plots.

An FPR survey to map forest tent caterpillar defoliation and general forest conditions in the rest of Vermont, was flown between June 21 and August 23. Approximately 128,872 acres of forest damage were sketch mapped during statewide aerial detection surveys. This represents just under three percent of Vermont's forestland, and an increase from the 98,555 acres mapped in 2017. Defoliation by forest tent caterpillar (FTC) and white pine needle damage accounted for 55 percent and 32 percent, respectively, of the area mapped. The Forest Health Protection staff completed an aerial detection survey for GMNF on June 21 and 22. Approximately 2,833 acres of damage were mapped throughout, and adjacent to the forest. This is similar to the 2,623 acres mapped in 2017. A total of 1,392 acres were mapped as white pine discoloration, and 1,386 acres of FTC defoliation in the northern hardwoods.

The emerald ash borer (EAB) was detected in Orange County, VT in February 2018. Vermont became the 32nd state with confirmed infestations although EAB has not yet been detected on GMNF. White pine needle disease and discoloration continues to be widespread. Populations of FTC continued to be high, especially in north-central and northeastern Vermont, however defoliation on GMNF was more localized.

Annual monitoring of the special use areas used for maple tapping (Sugarbush leases) was completed by Forest Health Protection for 2018. The six tapping sites were visited from June 27 to 29 (same sites visited in 2017). The evaluations indicated that sugarbush special use areas are in a generally healthy condition, although one site suffered some FTC damage. Saddled prominent was not a major threat in 2018; maple leaf cutter and leaf spot diseases were the more common pests found, and forest tent caterpillar still the biggest concern.

Sugar maple tree health, based on the amount of twig dieback, remained high in 2018. Approximately 93 percent of sugar maples were rated as having low dieback (less than 15 percent), nearly the same as in 2017 (90 percent) on the 30 monitoring plots formerly part of the North American Maple Project (NAMP).

Evaluation and Conclusions: Insect and disease levels at present do not impact the ability to maintain forested conditions and objectives, or outputs of forest products. Insect epidemics and resulting population numbers vary greatly from year to year, resulting from a combination of susceptible host habitats, favorable weather conditions, and previous year population levels. Individual tree mortality within mature stands increases as the forest ages. Since Forest Plan revision, annual harvest has been well below the annual Allowable Sale Quantity set by the Forest Plan (see the Outputs Accomplished - Volume and Acres of Timber Offered and Sold monitoring item) and average stand age is increasing. In

2018 there were no significant outbreaks detected from any major insect pests on GMNF. Dieback from beech bark disease was the most extensive damage observed.

Monitoring of forest tent caterpillar should be prioritized given recent high populations. Monitoring should be increased including the establishment of trap trees. Increasing red pine mortality should also be monitored and salvage opportunities evaluated accordingly. Forest Service staff should continue to monitor insect and disease activities, and review data from available aerial and ground detection monitoring efforts.

Fiscal Year 2017

Hardwood defoliation levels were similar in 2017 to 2016. Forest tent caterpillar defoliation was most widespread, and populations increased, however damage on GMNF was localized. White pine needle damage and beech bark disease were again widespread on GMNF. The hemlock woolly adelgid (*Adelges tsugae*) has been positively identified in Vermont just south of GMNF and is considered a pest of concern, however nearby infestations are not spreading quickly. Other non-native insects and diseases that have not been identified in Vermont include Asian longhorned beetle, winter moth, and the agents that cause oak wilt, thousand cankers disease, and sudden oak death. The sugarbush special use areas are generally healthy, although some forest tent caterpillar damage has been observed on some sites. Saddled prominent was not a major threat in 2017; maple leaf cutter and leaf spot diseases were the more common pests found, and forest tent caterpillar the biggest concern.

Fiscal Year 2018

Hardwood defoliation increased somewhat in 2018. Maple defoliators were the most commonly observed, including forest tent caterpillar, maple webworm, and maple leaf skeletonizer. Forest tent caterpillar defoliation was most widespread, and populations increased again in 2018, however damage on the GMNF was localized. White pine needle damage and beech bark disease were again widespread on GMNF. The emerald ash borer was confirmed in Vermont, but although not yet detected on GMNF, it is expected to spread onto NFS lands within the next 2 to 3 years. The sugarbush special use areas are again generally healthy, although some forest tent caterpillar damage has been observed on some sites. Saddled prominent was not a major threat in 2018, but there was continued defoliation caused by maple trumpet skeletonizer, maple leaf cutter, and maple webworm.

Recommendations: No recommended change to this monitoring question.

Monitoring Element 7: Program Management

Monitoring Item: Outputs Accomplished - Other Resources

Monitoring Question: How close are actual outputs and services to projected outputs and services?

Detailed Monitoring Question: How do actual outputs compare to those projected in Forest Plan Appendix D, Proposed and Probable Practices, specifically related to heritage, recreation, roads, vegetation, rare, ecological, wildlife, and fisheries resources?

Monitor Driver: Forest Plan Goal 1 and associated Objectives.

Monitoring Activities: This existing monitoring item question was selected to address required Element 7 from the 2012 planning rule (36 CFR 219.12(5)(vii)): *Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.* This question was selected because it provides an excellent means to measure how well Forest Service management activities are

influencing the local and regional economy through implementation of the Forest Plan. It also provides a full array of multiple use management activities needed to implement Forest Plan direction. Table D-5 in Appendix D of the Forest Plan provides an estimate of the proposed and probable management practices expected during the first two decades of Forest Plan implementation, as well as estimates of the goods and services provided by GMNF. This schedule of management practices provides information and direction to achieve the desired future conditions set out in the Forest Plan goals and objectives.

There were numerous outputs and services provided by GMNF during fiscal years 2017 and 2018. These outputs are displayed in Table 2-8.

Evaluation and Conclusions: Management of GMNF entered the second decade of Forest Plan implementation in fiscal year 2016. Although Appendix D, Table D-5 of the Forest Plan provides estimated measure of unit activity outputs to work toward desired conditions and management objectives for the first decade of Forest Plan implementation (2006 to 2015), these estimated outputs are repeated for the second decade (2016 to 2025). For this report, a summary of total resource output for each management activity during the first decade of Forest Plan implementation is provided in Table 2-8 for context. The monitoring resource outputs are then provided for 2017 and 2018 so they can be compared with amounts estimated for the second decade.

Table 2-8. Estimated and actual outputs achieved in fiscal years 2017 and 2018 (Forest Plan Appendix D, Proposed and Probable Practices).

Activity or Practice	Unit of Measure	Estimated Amount (Decades 1 and 2)[1]	Total Amount Achieved FY 2006-2015	Amount Achieved FY 2017	Amount Achieved FY 2018	Total Amount Achieved FY 2016-2018
Heritage Resource Protection						
Inventoried Acres	Acres	2,000 to 4,000	46,890	Unavailable	2,600	2,600
New Sites Identified	Sites	10 to 40	140	0	1	1
New Sites Evaluated	Sites	2 to 7	29	0	0	0
Sites Monitored	Sites	30 to 60	270	45	27	72
Recreation Resources						
Trail Improvement	Miles	10 to 20	22	0	10.4	11.4
Trail Rehabilitation	Miles	200 to 400	194	264.3	281.6	584.1
Trail Maintenance	Miles	9,050	2,853	299.1	305.2	1,071
Wilderness Managed[2]	Areas	30 to 50	42	0	0	0
Roads Management						
Rights-of-Way Acquisition	Rights-of-Ways	40	4	0	0	0
Maintain Local Roads	Miles	100 to 200	778	82.5	78.2	245.4
Restore Local Roads	Miles	10 to 20	67	3.8	2	9.2
Reconstruct Local Roads	Miles	5 to 10	5.1	3.8	2	9.2
Construct Local Roads	Miles	0 to 5	0.1	0	0	0

Activity or Practice	Unit of Measure	Estimated Amount (Decades 1 and 2)[1]	Total Amount Achieved FY 2006-2015	Amount Achieved FY 2017	Amount Achieved FY 2018	Total Amount Achieved FY 2016-2018
Maintain Arterial and Collector Roads[3]	Miles	40 to 80	97.3	17.8	7.4	43
Decommission Local Roads	Miles	5 to 10	15	0	0	0
Vegetation Management						
Hardwood Selection Cuts	Acres	8,366	1,829	257	2,152	2,544
Hardwood/Oak Shelterwood Regeneration	Acres	11,496	400	79	29	108
Hardwood/Oak Shelterwood Removal	Acres	3,240	91	0	32	32
Hardwood Clearcut	Acres	2,376	75	25	0	77
Hardwood/Oak Thin	Acres	9,000	1,067	93	0	156
Hardwood Stand Improvement	Acres	2,650	577	5	19	53
Softwood Shelterwood Regeneration	Acres	2,814	48	0	5	5
Softwood Selection Cuts	Acres	1,444	347	27	0	65
Softwood Clearcut	Acres	10	155	9	40	108
Softwood Thin	Acres	1,000	134	8	0	13
Softwood Stand Improvement	Acres	700	193	0	0	0
Softwood Planting	Acres	350	71	0	0	0
Release Softwood from Hardwoods	Acres	1,700	86	0	0	0
Clearcut Hardwoods for Softwoods	Acres	90	2	0	0	0
Plant Softwoods for Conversion	Acres	500	42	0	0	0
Clearcut Aspen	Acres	146	14	0	0	0
Clearcut Hardwoods for Aspen Regeneration	Acres	725	186	46	11	67
Total Selection Cuts	Acres	9,810	2,348	284	215	672
Total Shelterwood Regeneration	Acres	14,310	409	79	34	113

Activity or Practice	Unit of Measure	Estimated Amount (Decades 1 and 2)[1]	Total Amount Achieved FY 2006-2015	Amount Achieved FY 2017	Amount Achieved FY 2018	Total Amount Achieved FY 2016-2018
Total Shelterwood Removals	Acres	3,240	182	0	32	32
Total Clearcut	Acres	3,347	465	25	45	137
Total Thin	Acres	10,000	1,237	101	0	169
Total Stand Improvement	Acres	3,350	1,241	5	19	53
Total Release	Acres	1,700	194	15	100	216
Total Planting	Acres	850	112	27	0	27
Hardwood Sawtimber Cut	MMBF[4]	110	9.3	1.6	0.7	2.8
Softwood Sawtimber Cut	MMBF	10	6.3	0.6	1.2	2.7
Combined Sawtimber	MMBF	120	15.6	2.2	1.9	5.5
Hardwood Roundwood Cut	MMBF	41	14.1	3.1	1.8	6.6
Softwood Roundwood Cut	MMBF	3	4.3	0.5	0.8	1.8
Combined Roundwood	MMBF	44	18.4	3.6	2.6	8.4
Total Timber Cut	MMBF	164	33.9	5.8	4.5	13.9
Monitor condition of sites and species under special forest product permits	Sites	All	All	All	All	All
Rare or Outstanding Ecological Resources						
Monitor known rare or outstanding ecological, biological, or geological features	Sites	All (129+)	141	0 (features for plants)	0 (features for plants)	5
Inventory for TES[5] species and rare or outstanding natural communities	Acres	4,000	10,363	1,445 (plants)	1,437 (plants)	3,824 (plants)
Prepare conservation plans for each rare or outstanding area	Sites	20	0	0	0	0
Establish RNAs	Sites	2	0	0	0	0
Wildlife, Fisheries, and Rare Plant Resources						
Protect known occurrences of TES species	Sites	All	All	All	All	All

Activity or Practice	Unit of Measure	Estimated Amount (Decades 1 and 2)[1]	Total Amount Achieved FY 2006-2015	Amount Achieved FY 2017	Amount Achieved FY 2018	Total Amount Achieved FY 2016-2018
Protect, and where feasible, improve or restore habitat conditions for TES plants, and for TES animals of riparian and wetland habitats.	Sites	All	All	All	All	All
Protect important habitat sites for TES bats	Hibernacula	All hibernacula	All known hibernacula protected during project implementation	All known hibernacula protected during project implementation	All known hibernacula protected during project implementation	All known hibernacula protected during project implementation
Protect important habitat sites for TES bats	Roost trees	Adequate numbers of roost trees	TES bats are not summer habitat limited; all known maternity areas are protected during project implementation	TES bats are not summer habitat limited; all known maternity areas protected during project implementation	TES bats are not summer habitat limited; all known maternity areas protected during project implementation	TES bats are not summer habitat limited; all known maternity areas protected during project implementation
Protect nesting TES bird species from disturbance	Active nest sites	All	Extent unknown; review project by project; Forest actions complied with Migratory Bird Treaty Act (MBTA)	Extent unknown; review project by project; Forest actions complied with MBTA	Extent unknown; review project by project; Forest actions complied with MBTA	Extent unknown; review project by project; Forest actions complied with MBTA
Monitor known occurrences of TES species	Sites / Populations	All	All	49 of 106 vascular plants (80 sites/ populations) & 1 nonvascular plant (1 site/ population) monitored	62 of 106 vascular plants (82 sites/ populations) & 1 nonvascular plant (1 site/ population monitored)	Not applicable
Update conservation assessments for RFSS	Species	All	0	0 for RFSS plants	0 for RFSS plants	0 for RFSS plants
Oak Released from Hardwoods, and Oak and Oak-Pine Habitat Restored/ Improved	Acres	2,000	51	96	28	129
Mow Upland Wildlife Openings	Acres	2,000	682[6]	370	136	754
Non-Commercial Clearcutting of	Acres	2,000	0[6]	0	0	0

Activity or Practice	Unit of Measure	Estimated Amount (Decades 1 and 2)[1]	Total Amount Achieved FY 2006-2015	Amount Achieved FY 2017	Amount Achieved FY 2018	Total Amount Achieved FY 2016-2018
Aspen and Paper Birch						
Burn Upland Wildlife Openings	Acres	5,000	0[6]	75	314	389
Burn Marshes	Acres	250	316	0	0	0
Other Wildlife Habitat Improvement	Acres	250	2,182	1,632	497	3,212
Stream Habitat Restored/ Improved	Miles	50	58[7]	60	27	162.9
Lake Habitat Restored/ Enhanced	Acres	10	459[7]	0	0	220
Fish Habitat Monitored	Sites	80	175	9	9	28
Fish Passage Restored	Road Crossing	10	24	7	4	15

[1] These numbers represent the sum of annual activities in years 1 through 10 (2006 to 2015) and repeated for years 11-20 (2016 to 2025).
[2] Wilderness managed to standard.
[3] Town jurisdiction roads accessing National Forest System land maintained through road cooperative agreements.
[4] Million board feet
[5] Threatened, endangered, and sensitive (Regional Forester Sensitive Species) species.
[6] Does not reflect 2012 and 2013 accomplishments (7,694 acres of terrestrial habitat restored or enhanced), because acres are not differentiated between GMNF and FLNF activities, nor do they break out specific treatment types (e.g., between mowing upland openings and other wildlife habitat improvement).
[7] Does not reflect 2012 and 2013 accomplishments (400 acres of lake habitats restored or enhanced; and 131 miles of stream habitats restored or enhanced) because amounts are not differentiated between GMNF and FLNF activities.

Recommendations: No recommended change to this monitoring question.

Monitoring Element 8: Soils

Monitoring Item: Soil Quality Standard Compliance

Monitoring Question: Are the effects of Forest management, including prescriptions, resulting in significant changes to productivity of the land?

Detailed Monitoring Question: How are soil quality and productivity changing in response to forest management?

Monitor Driver: Forest Plan Goal 3 and associated Objectives.

Monitoring Activities: This new monitoring question was developed specifically to address required Element 8 from the 2012 planning rule (36 CFR 219.12(5)(iii)): *The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)).* For context, U.S.C. 1604(g)(3)(C) is a reference to the section of the National

Forest Management Act specifying guidelines for land management plans to achieve the goals which "*insure research on and (based on continuous monitoring and assessment in the field) evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land*".

The intent of monitoring Element 8 is to focus on key ecosystem characteristics in the plan area related to soils and soil productivity. Forest Plan Goal 3 is to "*Maintain or restore the natural, ecological functions of the soil*" (Forest Plan, p. 13). The objectives for this goal are to minimize the adverse impacts on soils from management activities; and restore natural soil processes and functions on degraded soils.

Soil quality is defined as the capacity of the soil to function within ecosystem boundaries to sustain biological productivity, maintain or enhance water quality, and support human health and habitation. It is assumed that to maintain soil quality, the most important and understood soil properties must be protected including soil organic matter, aeration (porosity), moisture, and productivity (ability to support plant growth). When soil quality is reduced, the soil is less capable of restoring, protecting, maintaining and enhancing above and below-ground biological and ecological diversity. Soil productivity is one aspect of soil quality. It is defined as the inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities.

The Forest Soil Disturbance Monitoring Protocol (FSDMP) examines the quantity, severity, and distribution of soil disturbance within project areas (Page-Dumroese 2009). Presence of bare soil, rutting, compaction, erosion, and other observations are used to estimate effects of management activities on soil productivity. Soils with increased disturbance have greater losses in soil productivity. Monitoring can provide feedback to land managers on the effects of management and inform future management actions. Measurement indicators used for this report include topsoil displacement, bare soil, erosion, rutting, compaction, and mixed topsoil/subsoil; and "Soil Disturbance Class and Percent" of area where soil quality standards are met.

Soil Disturbance Monitoring/Soil Quality Monitoring

Timber sale units monitored in fiscal years 2017 and 2018 include 12 before and 42 after harvest activities (Table 2-9). Pre-monitoring is done up to 3 years before harvest begins and post-harvest monitoring 1 to 3 years after harvest. Harvest prescriptions include improvement, selection with gaps, thinning, permanent wildlife opening, and clearcut. Data was collected to give a 70 percent confidence level, with a 20 percent confidence interval. In fiscal years 2017 and 2018, 54 units were monitored covering approximately 732 acres: Dorset-Peru and Upper White River Integrated Resource Projects, and the Gilmore Aspen project. These acres also included the Finger Lakes Invasive Pest Strategy located on the Finger Lakes National Forest. Most units monitored were in the Dorset-Peru and Upper White River Integrated Resource Project areas, and Nordic project area. Only three units were in the Gilmore Aspen project area, and one in the Robinson Integrated Resource project area. Units were in the following timber sales: Beattie Hill, Cobb Hill, Country Road, Old Manchester, School, Grouse, Mad Tom, Gilmore Aspen, Albee, North Branch, Cook Brook, Old Cemetery, Texas, Upper White, Pumphouse, Tucker Brook, Sunnyside, and Souphouse.

Based on observed soil disturbance, monitoring points were each assigned to a disturbance class ranging from 0 (no disturbance) to 3 (so disturbed that soils will not recover without restorative action) (Page-Dumroese 2009, USDA Forest Service 2009).

Table 2-9. Units monitored in fiscal years 2017 and 2018.

Project Name	Timber Sale Name	Sale Unit(s)
Pre- Harvest		
Dorset-Peru	Mad Tom	8
Dorset-Peru	Pumphouse	8
Dorset-Peru	Sunnyside	1, 14
Finger Lakes Invasive Pest Strategy	Burnt Butcher	4, 6, 10, 12, 13, 15
Gilmore Aspen	Gilmore Aspen	4, 7
Upper White River	Albee	5
Post-Harvest		
Dorset-Peru	Cook Brook	3, 7, 9, 10
Dorset-Peru	Mad Tom	13, 18
Dorset-Peru	Pumphouse	1, 3, 16
Gilmore Aspen	Gilmore Aspen	3
Nordic	Country Road	2, 3, 6, 7
Upper White River	Grouse	3, 7, 9, 18
Upper White River	Texas	2, 15, 18, 19, 22
Upper White River	Tucker Brook	1, 3, 5
Upper White River	Upper White	3, 15, 13B

Evaluation and Conclusions:

Pre-Harvest Monitoring

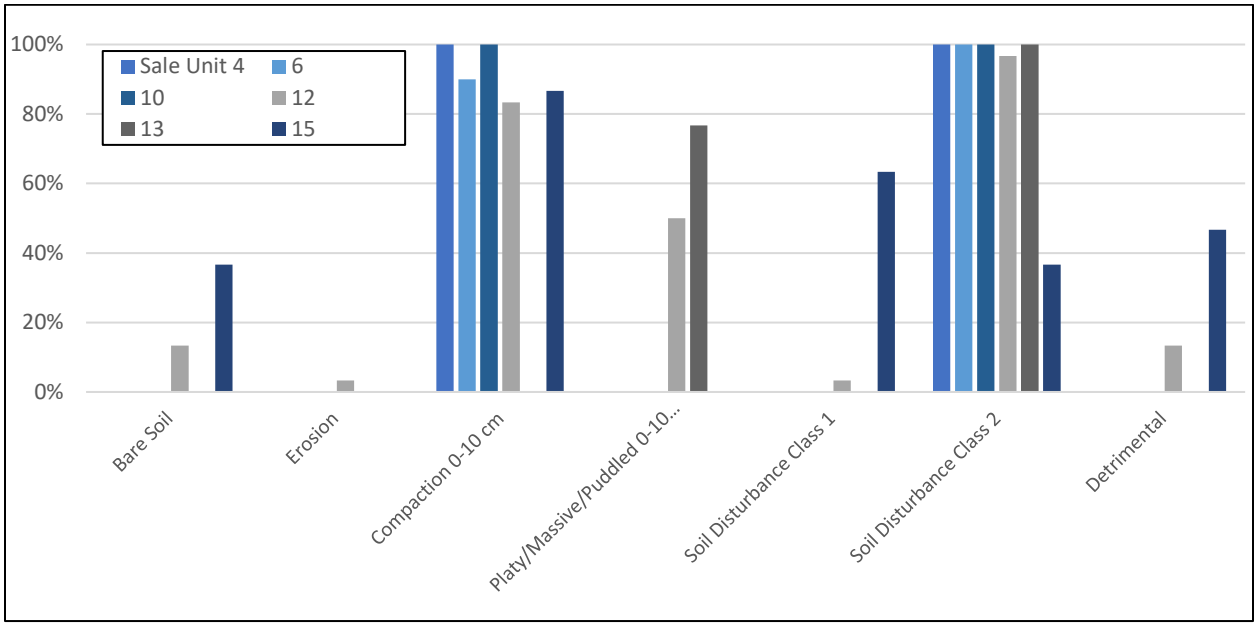
Dorset-Peru

In the Dorset-Peru Integrated Resource Project (IRP) area, four pre-harvest units were monitored. Bare soil and erosion were observed in an average of 1.7 percent of the harvested area, with no rutting or compaction observed. Class 0 disturbance was found in 79.0 percent of the area monitored, Class 1 in 19.3 percent, Class 2 in 1.7 percent, and no Class 3 disturbance was observed. Detrimental disturbance occurred in 1.7 percent of the area monitored. Soil quality standards (SQS) for the Dorset-Peru IRP state less than 5 percent of partially harvested area will contain Class 2 and Class 3 disturbance and less than 20 percent of the area in clearcut and shelterwood units will contain Class 2 or Class 3 disturbance (USDA Forest Service 2010). All four pre-monitored units in Dorset-Peru IRP have disturbance below those thresholds. These observations reflect prior land management.

Finger Lakes Invasive Pest Strategy (FLIPS)

Six pre-harvest units were monitored (Figure 2-14). No rutting was observed. No compaction or platy/massive/puddled soil structure was observed deeper than 10 centimeters. The soil disturbance class was either 1 or 2 for all observed points, with only Unit 15 having a significant amount of land-just over 60 percent, with Class 1 soil disturbance. Topsoil displacement was observed at every monitoring point, and mixed topsoil/subsoil was observed at nearly every point, mainly because of earthworm activity, which is widespread throughout the Finger Lakes National Forest, since nearly all the land was cultivated for row crops before recent reforestation. Detrimental disturbance was found on only two units (Units 12 and 15), due mainly to the presence of bare soil. The units selected are representative of all the units in the FLIPS project.

Figure 2-14. *Soil Disturbance before harvest in Finger Lakes Invasive Pest Strategy sale units.*



Gilmore Aspen

Two pre-harvest units were monitored in the Gilmore Aspen Project area. Mixed topsoil/subsoil was observed in 69.2 percent of the area (all of Unit 4, and none in Unit 7). Bare soil, rutting, erosion, or soil compaction were not observed. All observed areas had Class 0 disturbance, with no detrimental disturbance observed.

Upper White River

One unit was monitored in the Upper White River IRP area (Albee 5). Bare soil covered an average of 3.3 percent of the area, and topsoil displacement covered 3.3 percent, with no erosion, rutting, compaction, or mixed topsoil/subsoil observed. All the soil observed had Class 0 soil disturbance, with no detrimental disturbance observed. Soil Quality Standards for the Upper White River IRP state that less than 15 percent of the harvested area will have detrimental disturbance. The only pre-monitored unit in the Upper White River IRP is below this threshold before harvest.

Post Harvest Monitoring

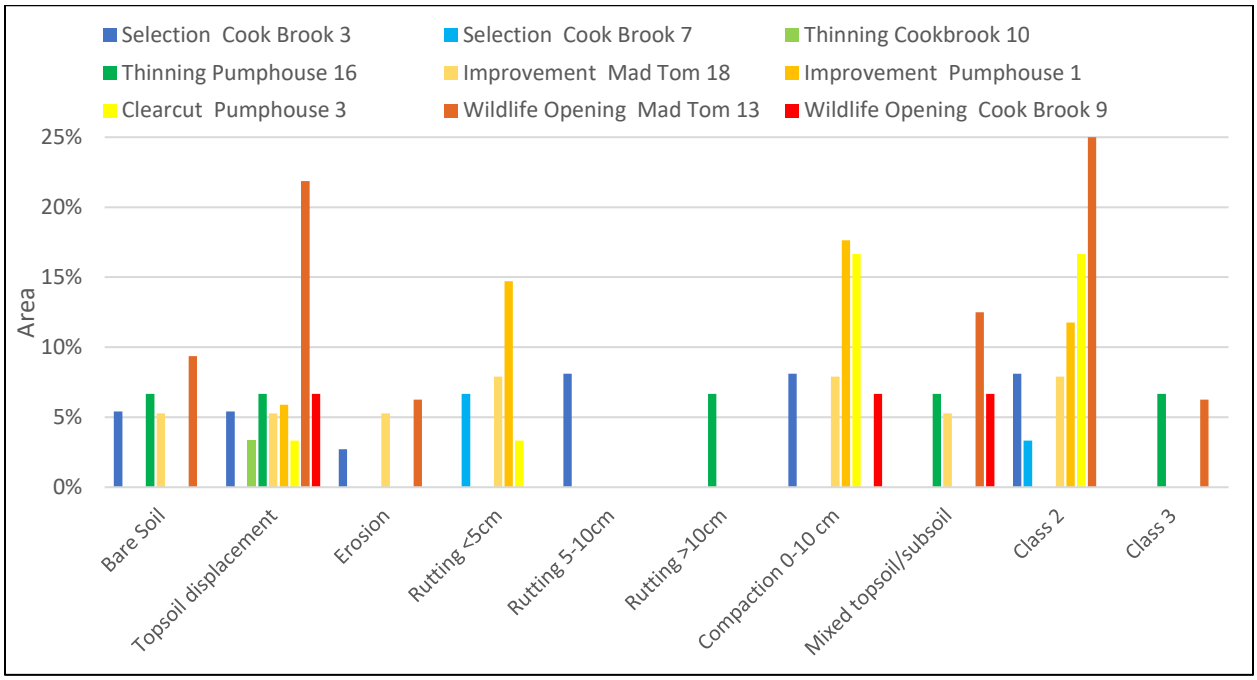
Dorset-Peru

In the Dorset-Peru IRP area, 9 harvested units were monitored (Figure 2-15). In the clearcut unit not in a permanent wildlife opening, no bare soil or erosion was observed. Topsoil displacement was observed on 3.3 percent of the harvested area. Ruts shallower than 5 centimeters deep covered 3.3 percent of the harvested area, with no deeper ruts observed. Soil was compacted less than 10 centimeters deep in 16.7 percent of the harvested area, with no deeper compaction observed. Class 0 soil disturbance was found in 26.7 percent of the unit, while 56.7 percent had Class 1, 16.7 percent had Class 2, and 0 percent had Class 3 disturbance. Detrimental disturbance was not observed.

Within the six units with partial harvests, an average of 2.1 percent of the area had bare soil, 4.2 percent had topsoil displacement, and 0.7 percent had erosion. Rutting less than 5 centimeters deep was observed to be over 2.9 percent of the harvested area, rutting between 5-10 centimeters deep on 2.2 percent, and deeper rutting on 0.7 percent of the area monitored. Compaction 0-10 centimeters deep was observed at 5.6 percent of the area, with no deeper compaction observed. Class 0 soil disturbance covered 44.5

percent of the area, 33.7 percent Class 1, 4.5 percent Class 2, and 2.1 percent Class 3. Detrimental disturbance was observed on 0–15.8 percent of each unit, with an average of 2.1 percent of the area having detrimental soil disturbance. Only Mad Tom 18 had detrimental disturbance on more than 15 percent of the unit, due to the presence of erosion and deep slash.

Figure 2-15. *Soil disturbance observed in Dorset-Peru IRP sale units.*



Soil quality standards for the Dorset-Peru IRP were established to maintain acceptable levels of disturbance after harvest. The threshold for units with partial harvest (intermediate cut, improvement, or thinning) is less than 5 percent of each sale area with disturbance class 2 or 3. Clearcuts or shelterwood require less than 20 percent of each sale area to have disturbance Class 2 or 3 to comply with the Soil Quality Standards (USDA Forest Service 2010).

Two of the three sale areas with partial harvest units monitored do not appear to meet the soil quality standard threshold of less than 5 percent with Class 2 or 3 disturbance (Figure 2-16). The two units monitored in the Pumphouse sale have an average of 7.8 percent in Class 2 and 2.3 percent in Class 3, for a total of 10.0 percent having Class 2 or 3 soil disturbance. Mad Tom 18, an improvement cut, exceeds the Soil Quality Standards threshold of 5 percent, with an average of 7.9 percent of the unit monitored having Class 2 disturbance.

All three sales with clearcut units monitored appear to meet the Soil Quality Standards threshold of less than 20 percent with Class 2 or 3 disturbance (Figure 2-17), with Class 2 disturbance only observed in Pumphouse 3, and no Class 3 disturbance observed. Only one clearcut unit from each sale was monitored. Looking at all past monitoring within a timber sale will give a more accurate picture than only examining data from the past two years in future monitoring reports.

Pumphouse and Mad Tom sales make up 49.5 out of the 149.9 acres of partial harvests monitored in the Dorset-Peru IRP. This represents 67.0 percent of the sale area monitored with partial harvests complying with project soil quality standards. All the 45.4 acres of clearcut monitored met the Soil Quality Standards.

Figure 2-16. *Average area of partial harvest (thinning, improvement, or selection) sales with Soil Disturbance Class 2 or 3 in the three timber sales monitored in the Dorset-Peru IRP. Soil Quality Standards for Dorset-Peru require no more than 5 percent of each sale area in units with partial harvests have Class 2 or Class 3 soil disturbance. The threshold is shown with a black line.*

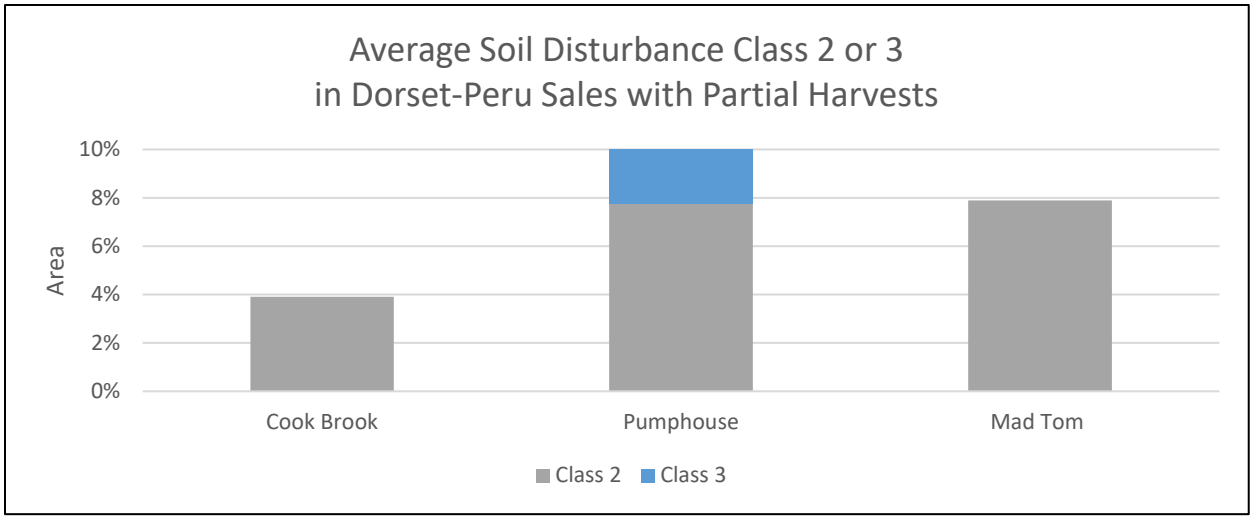
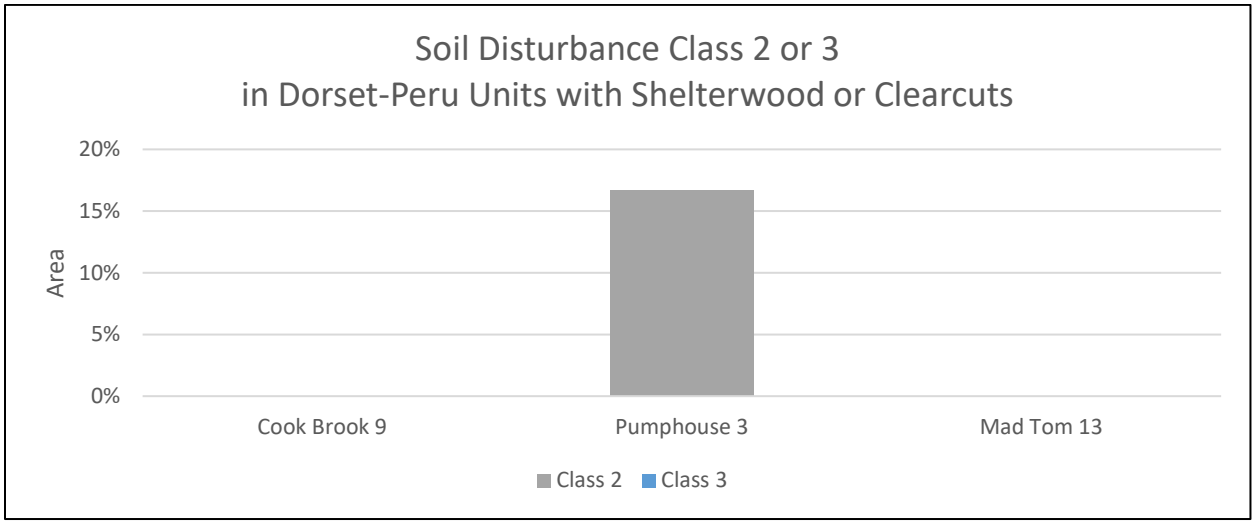


Figure 2-17. *Area in Dorset-Peru clearcut sales with Soil Disturbance Class 2 or 3. Soil Quality Standards for Dorset-Peru state that no more than 20 percent of each sale area in units with shelterwood or clearcut will have Class 2 or Class 3 soil disturbance. The threshold is shown with a black line.*



Gilmore Aspen

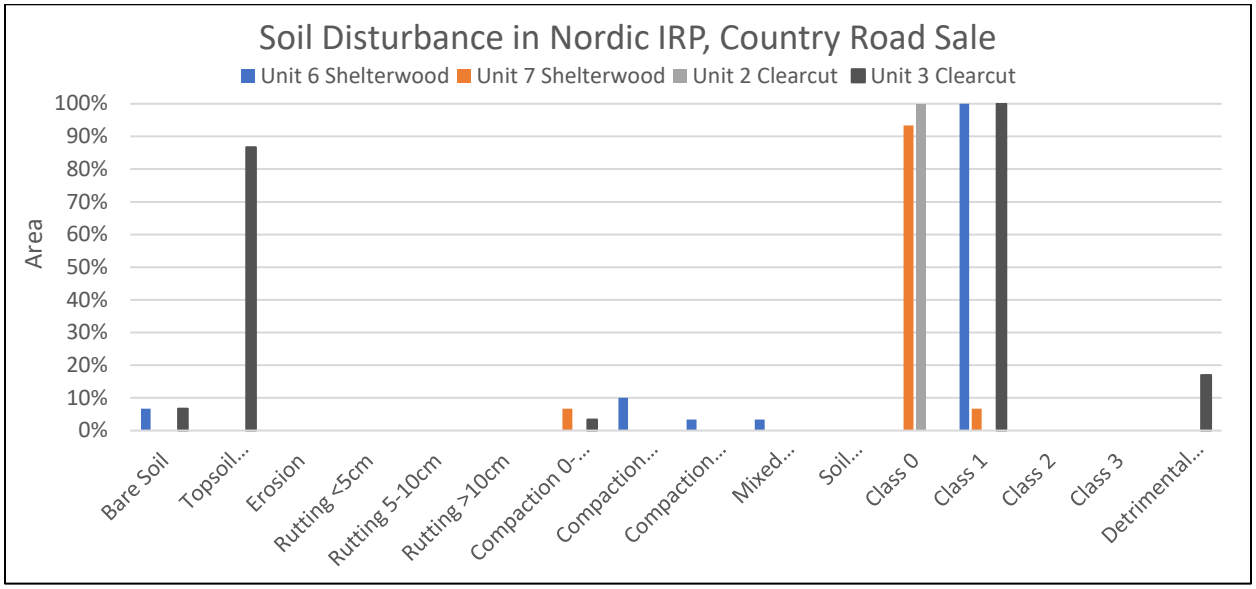
One unit was monitored in the Gilmore Aspen project area (Unit 3). Bare soil covered 76.7 percent of the harvested area and signs of erosion covered 30.0 percent of the harvested area. Ruts shallower than 5 centimeters in depth covered 3.3 percent of the harvested area, and no deeper ruts were observed. Soil was compacted less than 10 centimeters deep in 10.0 percent of the harvested area, with no deeper compaction observed. Mixed topsoil/subsoil was observed in 83.3 percent of the unit. Class 2 soil disturbance covered 80.0 percent of the unit, and Class 3 16.7 percent of the unit.

Soil Quality Standards for the Gilmore Aspen project require less than 15 percent of the harvested area in each sale area to be detrimentally disturbed. This sale does not appear to meet the standard, with detrimental disturbance covering 76.7 percent of the unit, due to the presence of bare soil.

Nordic

In the Nordic Project area, four units were monitored, all in the Country Road sale (Figure 2-18). Bare soil was observed on an average of 5.7 percent of the area monitored. Topsoil displacement was only observed in Unit 3, on 86.7 percent of the unit. Rutting was not observed. Compaction less than 10 centimeters deep covered 2.6 percent of the sale area monitored, compaction 10 to 30 centimeters deep covered 2.9 percent of the area, and compaction more than 30 centimeters deep covered 1.0 percent of the area. Mixed topsoil/subsoil covered 1.0 percent of the sale area. Class 0 soil disturbance covered 13.9 percent of the area, Class 1 86.1 percent, and no points were observed with Class 2 or 3 soil disturbance.

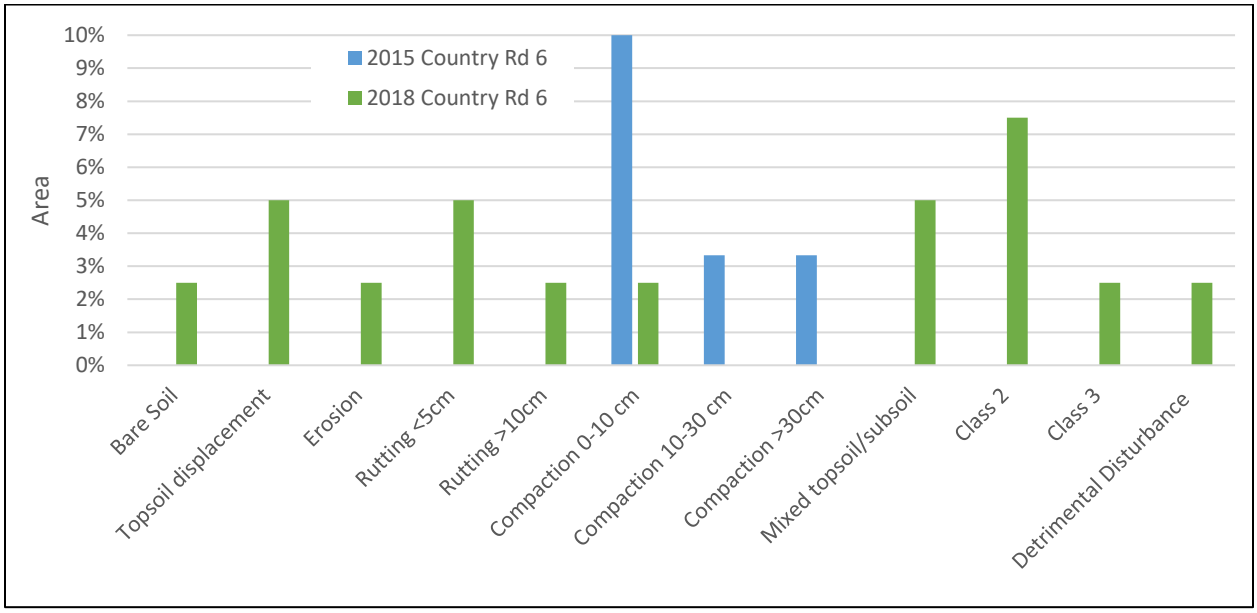
Figure 2-18. *Soil disturbance in Nordic Project, Country Road sale units.*



Pre-monitoring data was collected in Country Road Sale Unit 6 one year before harvest began (Figure 2-19). Most measures of soil disturbance were observed to increase, while soil compaction at three depths was observed more often after harvest than before. For each unit, at least 30 and up to approximately 40 observations are taken on a random transect. In 2015, compaction within the top 10 centimeters of the soil surface was observed at three of the 30 points monitored, and in 2018, it was only observed at one out of the 40 points monitored. In 2015, compaction deeper than 10 centimeters was observed at one monitoring point and was not observed in 2018.

Detrimental soil disturbance covered approximately 9.6 percent of the area monitored in the Country Road sale after harvest, mostly due to excessive slash accumulation. The entire monitored area complies with the 15 percent threshold for detrimental soil disturbance for each sale.

Figure 2-19. *Soil Disturbance observed in Country Road 6 sale unit one year before and two years after harvest activities.*



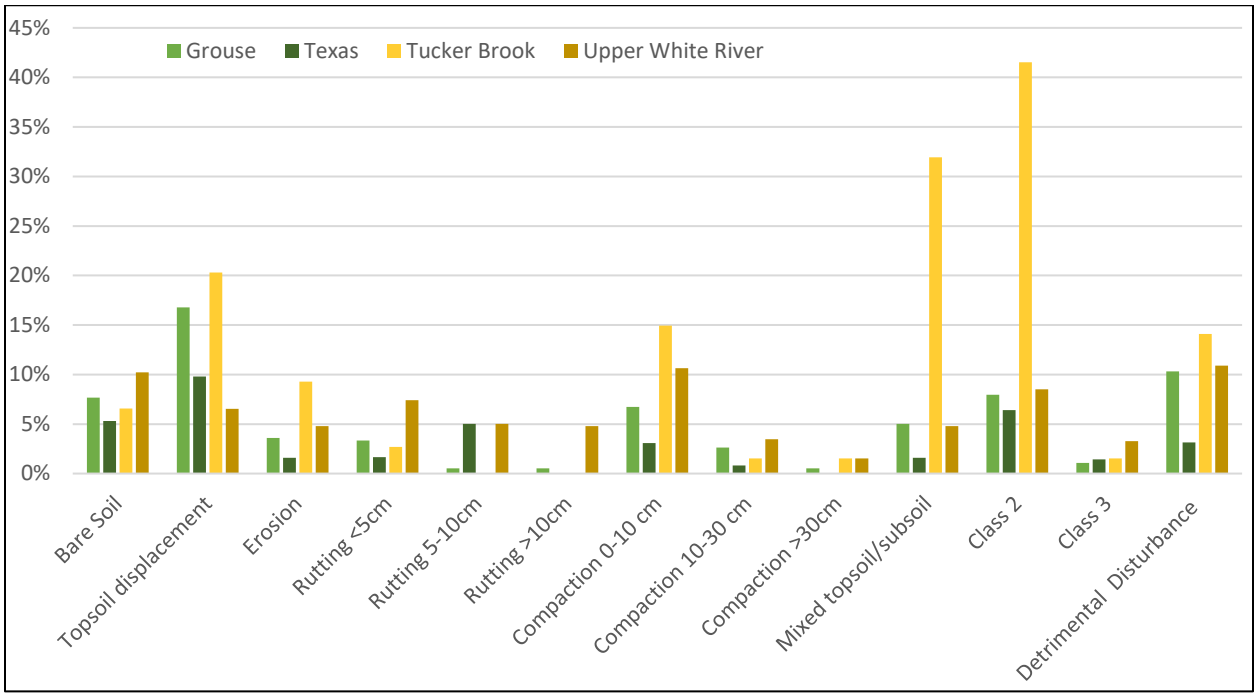
Upper White River

Fifteen units were monitored in the Upper White River IRP area, in four timber sales (Figure 2-20). In Grouse, bare soil covered 7.7 percent of the harvested area, topsoil displacement covered 16.8 percent, and erosion covered 3.6 percent. Ruts shallower than 5 centimeters covered 3.3 percent of the harvested area, rutting between 5- and 10-centimeters 0.5 percent, and ruts deeper than 10 centimeters in 0.5 percent. Soil was compacted less than 10 centimeters deep in 6.7 percent of the harvested area, 10 to 30 centimeters deep in 2.6 percent, and deeper than 30 centimeters in 0.5 percent of the harvested area. Soil in 59.0 percent of the harvested area had Class 0 disturbance, 31.9 percent had Class 1, 7.9 percent had Class 2, and 1.1 percent had Class 3 disturbance. Detrimental disturbance occurred in 10.3 percent of the monitored area.

In the Texas sale units, bare soil covered 5.3 percent of the harvested area, topsoil displacement covered 9.8 percent, and erosion covered 1.6 percent. Ruts shallower than 5 centimeters covered 1.7 percent of the harvested area, rutting between 5–10 centimeters 5.0 percent, and no deeper rutting was observed. Soil was compacted less than 10 centimeters deep in 3.1 percent of the harvested area, 10 to 30 centimeters deep in 0.8 percent, and no deeper compaction was observed. Soil in 29.3 percent of the harvested area had Class 0 disturbance, 62.9 percent had Class 1, 6.4 percent had Class 2, and 1.4 percent had Class 3 disturbance. Detrimental disturbance occurred in 3.2 percent of the monitored area.

In Tucker Brook sale units, bare soil covered 6.6 percent of the harvested area, topsoil displacement covered 20.3 percent, and erosion covered 9.3 percent. Ruts shallower than 5 centimeters covered 2.7 percent of the harvested area, with no deeper ruts observed. Soil was compacted less than 10 centimeters deep in 14.9 percent of the harvested area, 10 to 30 centimeters deep in 1.5 percent, and deeper than 30 centimeters in 1.5 percent of the harvested area. Mixed topsoil/subsoil was observed in 31.9 percent of the area. Soil in 10.8 percent of the harvested area had Class 0 disturbance, 46.1 percent had Class 1, 41.5 percent had Class 2, and 1.5 percent had Class 3 disturbance. Detrimental disturbance occurred in 14.1 percent of the monitored area.

Figure 2-20. *Average soil disturbance in each Upper White River IRP timber sale. The detrimental disturbance threshold for sales in the Upper White River IRP is less than 15 percent of each sale area with detrimental disturbance, shown with a black line.*



In Upper White IRP sale units, bare soil covered 10.2 percent of the harvested area, topsoil displacement covered 6.5 percent, and erosion covered 4.8 percent. Ruts shallower than 5 centimeters covered 7.4 percent of the harvested area, rutting between 5- and 10-centimeters 5.0 percent, and ruts deeper than 10 centimeters in 4.8 percent. Soil was compacted less than 10 centimeters deep in 10.6 percent of the harvested area, 10-30 centimeters deep in 3.5 percent, and deeper than 30 centimeters in 1.5 percent of the harvested area. Soil in 44.2 percent of the harvested area had Class 0 disturbance, 44.0 percent had Class 1, 8.5 percent had Class 2, and 3.3 percent had Class 3 disturbance. Detrimental disturbance occurred in 10.9 percent of the harvested area.

Figure 2-21 shows pre-monitoring data collected in 2015 compared to post harvest data collected in 2018 for Unit 3 in the Grouse sale which was harvested with the selection method. With average detrimental disturbance lower than 15 percent in each timber sale (Figure 2-22), 100 percent of the sales monitored in the Upper White River IRP comply with the soil quality standards.

Soil Quality Standards for all timber sales monitored during fiscal years 2017 and 2018 appear to have been met in all but the one unit monitored in the Gilmore Aspen sale, the one clearcut monitored in Mad Tom sale, and the one clearcut monitored in the Pumphouse sale. These make up approximately 57 acres of the 527 acres monitored, or 10.8 percent of the area monitored (Figure 2-22). When sale units do not meet Soil Quality Standards, productivity of soils may be negatively impacted. However, this analysis is not conclusive since for each of the three sales where soil disturbance is higher than defined thresholds, only one sale unit was monitored. In future years, data is needed from more units, and monitoring reports should include all available data from prior years in addition to the data collected during the two-year monitoring period.

Figure 2-21. *Soil Disturbance in Grouse 3 before and after selection harvest.*

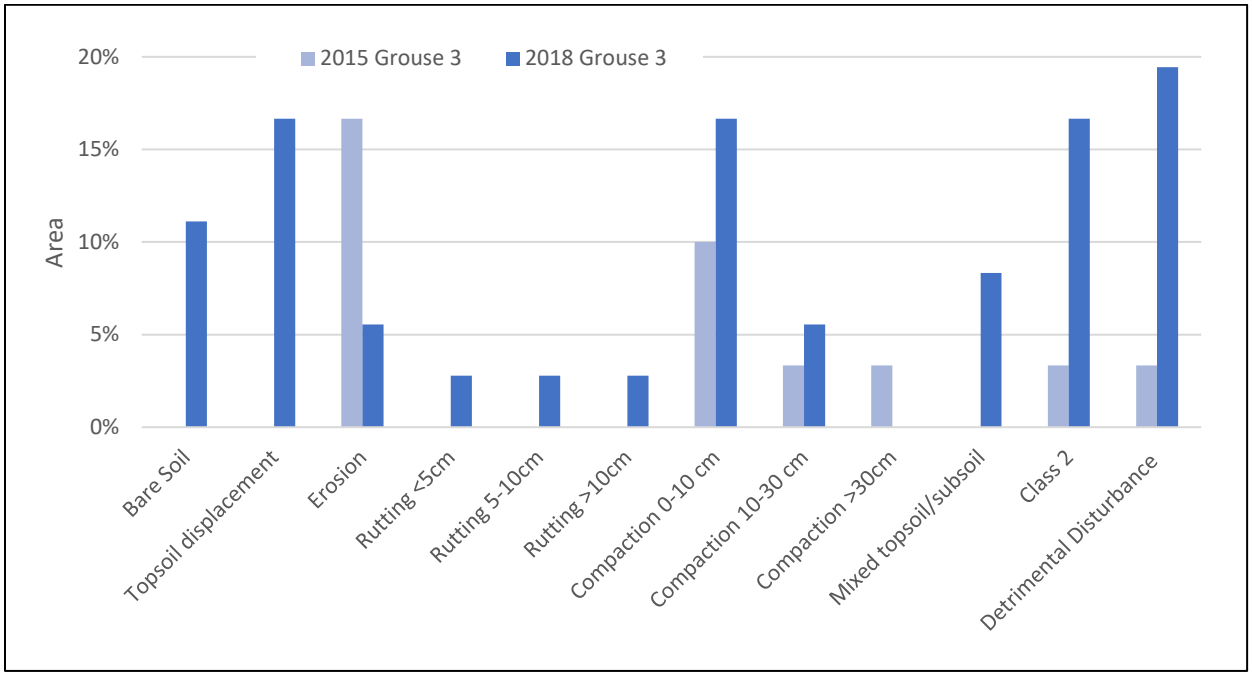
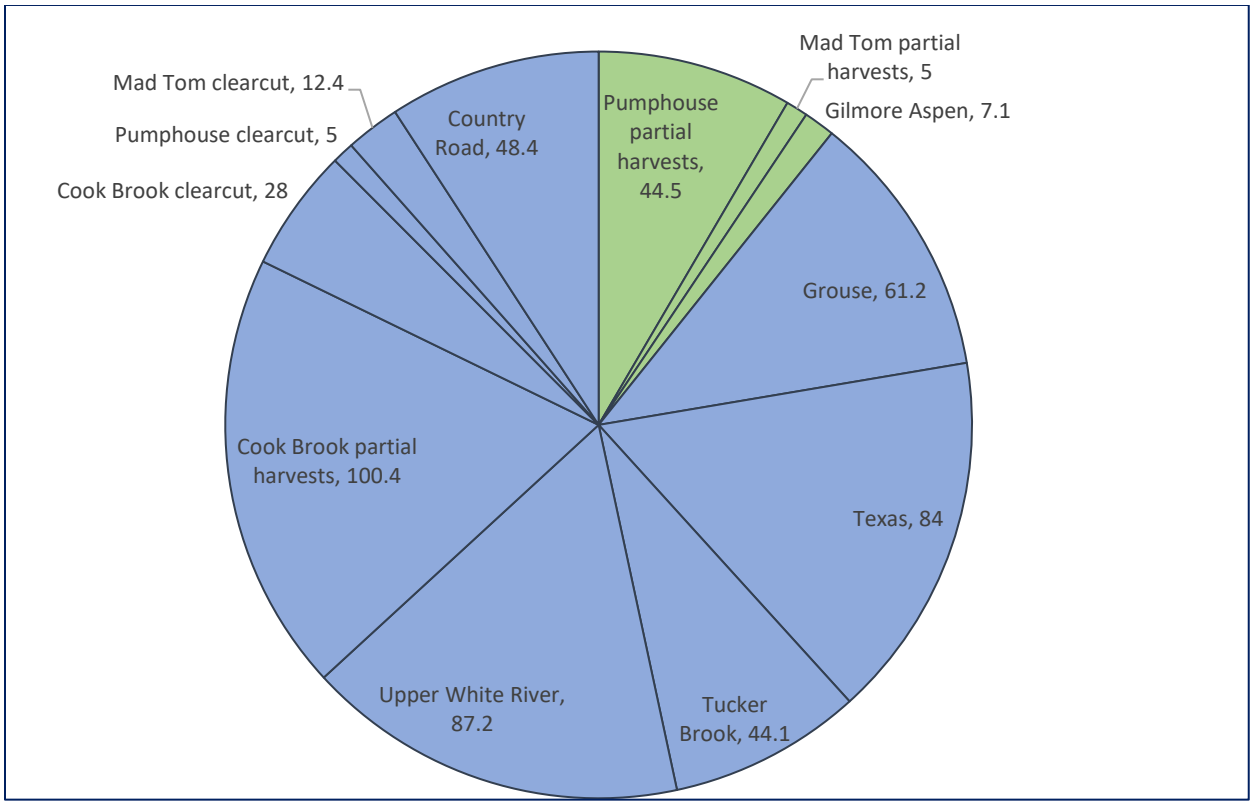


Figure 2-22. *Timber sales meeting Soil Quality Standards are shown in blue, and those not meeting them are shown in green. Acres monitored in each sale follow the sale names.*



Recommendations: No recommended changes to this monitoring question.

3. Other Monitoring Questions

Table 3-1 provides other monitoring questions retained to help ascertain how well management activities are implementing the Forest Plan and validating the effectiveness of Standards and Guidelines. While none of these were selected to address required monitoring elements, the Forest Service will continue to include them in the monitoring program (as budgets and staffing permit) and the results will be used to improve the Forest Plan or refine management activities when deemed necessary. Details regarding their indicators, measurements and monitoring protocol can be found in the 2017 Monitoring Guide.

Table 3-1. Other monitoring questions (from Table 4.1-3, Forest Plan, Chapter 4).

Forest Plan Goal	Monitoring Questions
Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals (Goal 2)	To what extent do Forest Service management activities contribute toward restoration and maintenance of habitat for native and desirable non-native species?
	To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?
Monitor air quality and the effects of atmospheric deposition on the forest ecosystem (Goals 2-8, 12, 13)	To what extent are air quality and atmospheric deposition affecting sensitive components of the forest ecosystem?
Maintain or restore the natural, ecological functions of the soil (Goal 3)	Are the effects of Forest Service management resulting in significant changes to productivity of the land?
Maintain or restore aquatic, fisheries, riparian, vernal pool, and wetland habitats (Goal 4)	To what extent are environmental stressors and Forest management affecting water quality, quantity, flow timing, and the physical features of aquatic, fisheries, riparian, vernal pool, and wetland habitats?
Provide a diverse range of high-quality, sustainable recreation opportunities that complement those provided off National Forest lands (Goal 12)	Is the quality of the Forest Service trail system being improved through operation and maintenance?
Manage designated Wilderness consistent with the Wilderness Act of 1964, and subsequent legislation (Goal 13)	How are Wilderness areas trending to meet the national Wilderness stewardship performance?
Provide a diverse range of information and education opportunities (Goal 19)	In what way is the Forest Service providing information and education opportunities that enhance the understanding of the Green Mountain National Forest?
Manage eligible Wild and Scenic Rivers consistent with the Wild and Scenic Rivers Act and subsequent legislation.	To what extent are eligible Wild and Scenic Rivers managed to preserve their outstandingly remarkable values?
Provide protection and stewardship for significant heritage resources on the Green Mountain National Forest (Goal 16)	To what extent have objectives been obtained and Standards and Guidelines applied for heritage resource site protection and management?

Air

Monitoring Item: Air Particulate

Monitoring Question: To what extent are air quality and atmospheric deposition affecting sensitive components of the forest ecosystem?

Detailed Monitoring Question: What is the composition of particles in the air, and how are the levels of particulates changing over time?

Monitor Driver: Forest Plan Goal 5 and associated Objectives.

Monitoring Activities: Forest Service staff monitors visibility, which is an Air Quality Related Value (AQRV), near the GMNF Class I area. The Class I area in GMNF is the Lye Brook Wilderness Area, as designated by the Clean Air Act Amendments of 1977.

To measure for the visibility AQRV, Forest Service staff maintains an IMPROVE (Interagency Monitoring of Protected Visual Environments) site on Mount Snow, near the Lye Brook Wilderness Area. The IMPROVE site consists of an aerosol visibility monitor, measuring speciated fine particulate matter. On a national scale, managing for visibility impairment in Class I areas is being done, in part, due to the 1990 amendments to the Clean Air Act. The 1990 amendments noted numerous sources of air pollution were contributing to regional haze, which affects Class I areas. Regional haze is defined as visibility impairment caused by the cumulative air pollution emissions from numerous sources over a wide geographic area. Some of the common fine particulates that can impair visibility include sulfates, nitrates, organic material, elemental carbon (soot), and soil. The initial Regional Haze Rule was proposed by the U.S. Environmental Protection Agency (EPA) in 1997 and was finalized in 1999. Under this rule, all states are required to submit implementation plans for improvement of visibility in Class I areas to EPA. The Forest Service has been active in reviewing these state implementation plans across the United States. Monitoring has focused on reviewing the state implementation plans that have the greatest likelihood of affecting GMNF Class I area air quality.

Evaluation and Conclusions: The IMPROVE site has been in operation since the 1990's. Figure 3-1 demonstrates how standard visual range has dramatically improved for the haziest 20 percent days at the Lye Brook IMPROVE site from 1993 through 2018 (FED 2021). Increased visibility, or standard visual range, is a direct result of less air pollution, or haze, being visible to the human eye and is measured using the term deciview. The deciview, a unit of measure of haze, or "haze index," is a measure of visibility derived from light extinction that is designed so that incremental changes in the haze index correspond to uniform incremental changes in visual perception, across the entire range of conditions from pristine to highly impaired. The haze index, in units of deciviews (dv), is calculated directly from the total light extinction. From 1993 to 2007, visibility on the haziest 20 percent days in Lye Brook Wilderness was in the range of about 22 to 26 dv, which is approximately the equivalent to a 25 to 40 km standard visual range. By 2018, the visibility on the haziest 20 percent days was 15 dv, or about 85 km standard visual range. This improvement over 15 years more than doubled how far one can see on the haziest 20 percent days due to fewer particles/less pollution in the air.

The composition of particulates of pollutants which cause visibility degradation at the Lye Brook wilderness IMPROVE site is shown in Figure 3-2. The primary pollutant causing approximately 75 percent of this reduced standard visual range, or haze, on the 20 percent worst days, from 1993 to 2007 was ammonium sulfate. The precursor (sulfur dioxide emissions) that led to these levels of ammonium sulfate in the atmosphere above Lye Brook Wilderness Area has been reduced, in part, due to federal Clean Air Act requirements. By 2018, ammonium sulfate levels had reduced dramatically at the Lye Brook wilderness site and contributed to less than 40 percent of the reduced standard visual range. This helps to explain the improvements in air quality over the past decade.

Atmospheric deposition, as measured by wet precipitation, is measured in Bennington, VT, approximately 25 km southwest of Lye Brook wilderness, by the City of Bennington and the State of Vermont. Figure 3-3 shows the change in acidity (measured as pH) for the years of 1993 through 2018. Acidity of wet deposition over this time has changed almost one pH unit, which means the wet precipitation is almost ten times less acidic in 2018 as compared to 1993 (NADP 2021). This data is

similar to the data collected at the IMPROVE site as both data sets are showing improvements in air quality.

Figure 3-1. *Reductions in haze/speciated fine particulate matter at Lye Brook Wilderness Area from 1993 to 2018 using the haze index, in deciview (dv) units.*

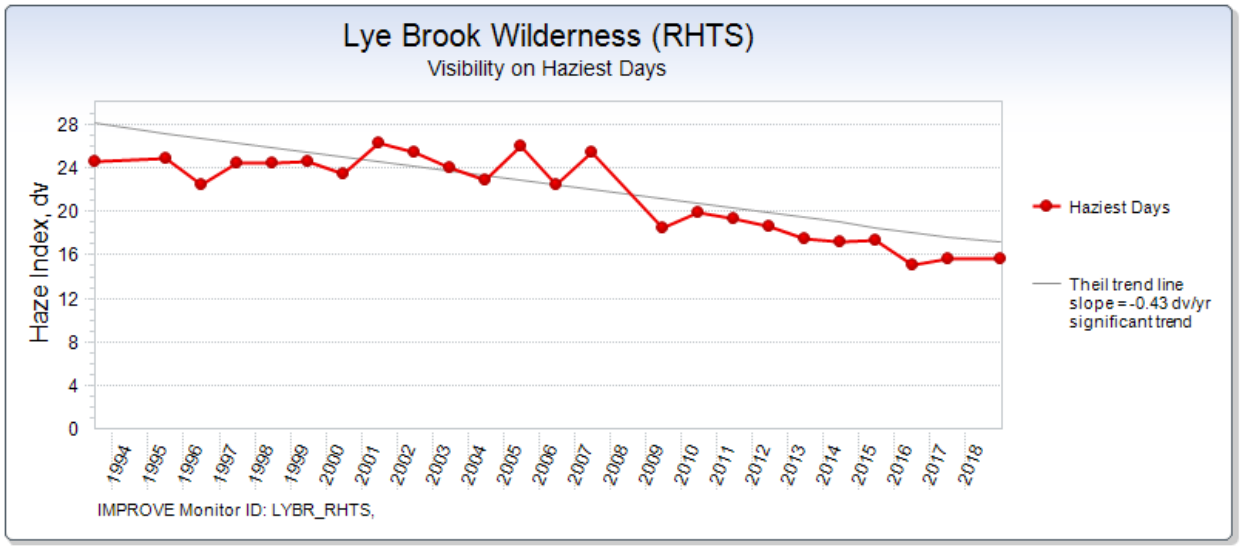


Figure 3-2. *The composition of particulates of pollutants which cause visibility degradation at the Lye Brook IMPROVE site is shown. Dramatic reductions in ammonium sulfate (in yellow) can be seen over time.*

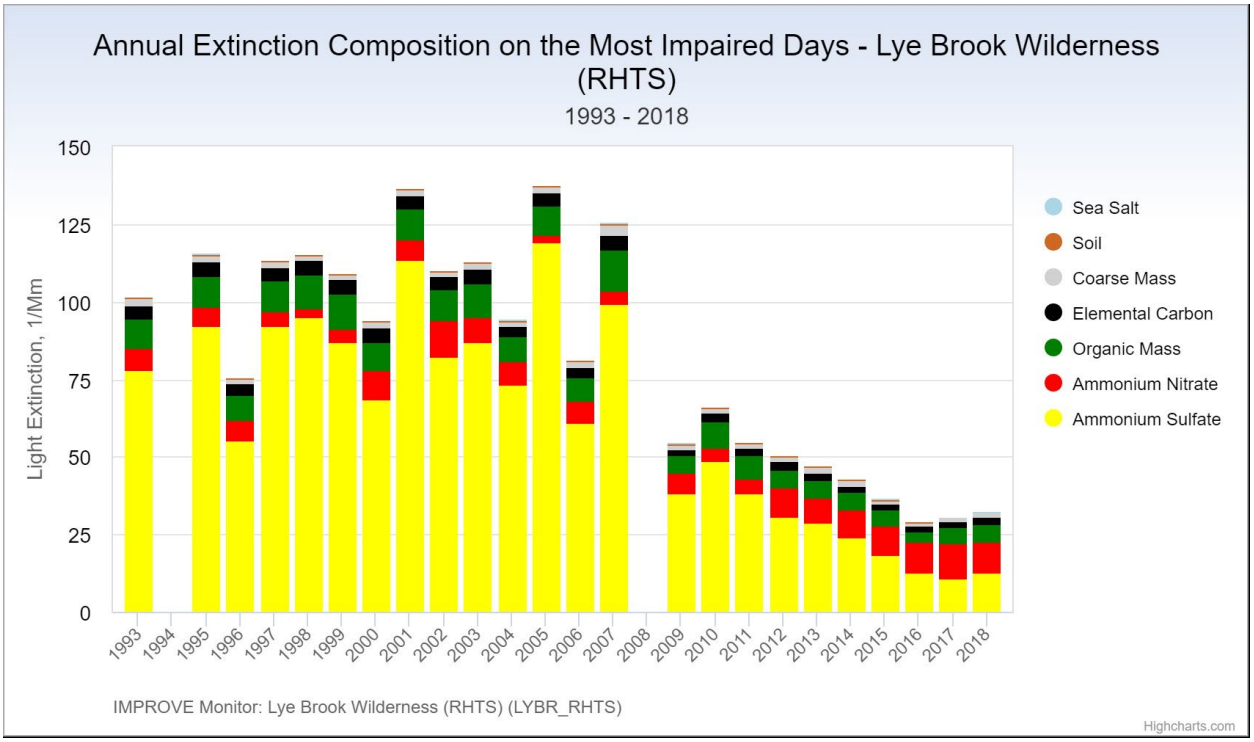
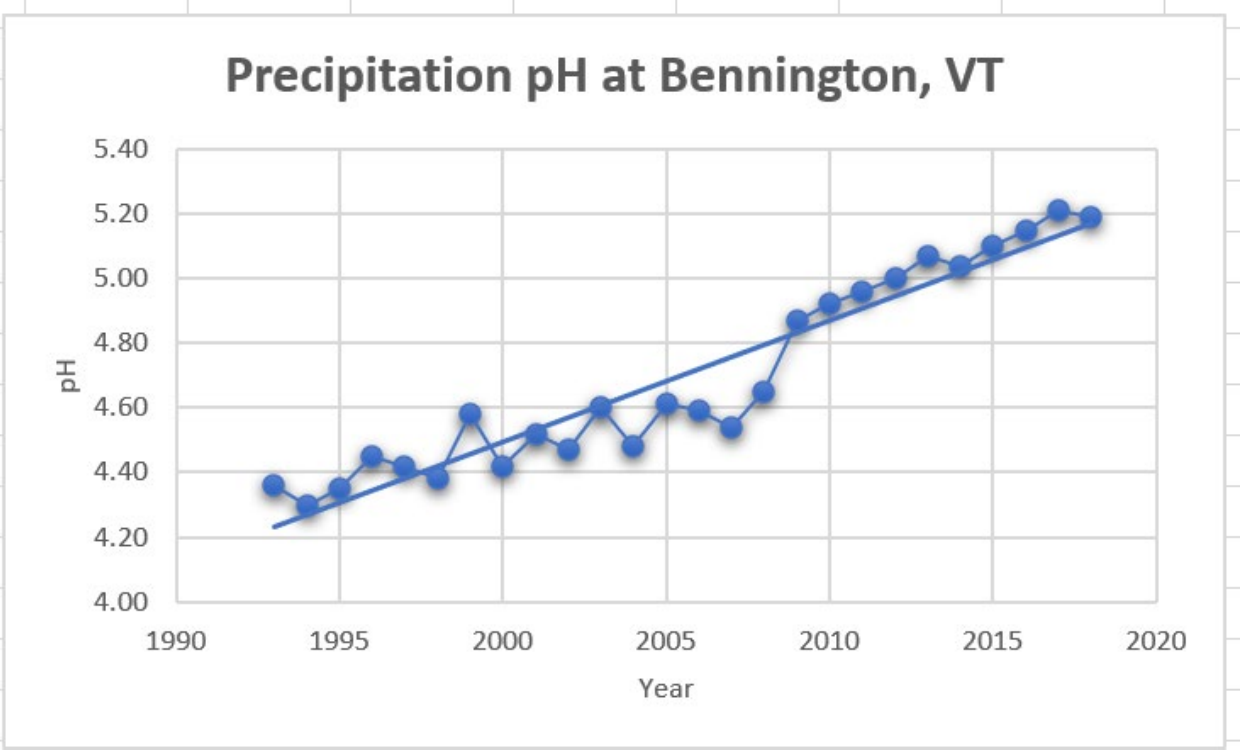


Figure 3-3. *Annual volume-weighted mean concentrations in standard pH units for the NADP/NTN site in Bennington, VT (NADP 2021).*



Air particulate monitoring should continue on GMNF as part of Federal rules requiring state and federal agencies to work together to improve visibility in Class I areas, such as Lye Brook Wilderness Area, so that natural background conditions are achieved by 2064. This protocol does not address to what extent air quality and atmospheric deposition are affecting sensitive components of the forest ecosystem. Effects on sensitive components of forest ecosystems are addressed in several other monitoring questions.

Recommendations: No recommended change to this monitoring question.

Aquatic Ecosystems

Monitoring Item: Fish Habitat and Stream Channel Stability

Monitoring Question: To what extent is Forest management affecting water quality, quantity, flow timing, and the physical features of aquatic, fisheries, riparian, vernal pool, and wetland habitats?

Detailed Monitoring Question: How are fish habitat and stream channels changing over time?

Monitoring Driver: Forest Plan Goal 6 and associated Objectives.

Monitoring Activities: Geomorphic assessment data were not collected or are not available for this monitoring period.

Evaluation and Conclusions: Although monitoring specific to this question according to the Forest Plan Monitoring Guide was not completed, there are additional indicators that help provide an understanding of stream condition on GMNF. Water quality data from fiscal years 2017 and 2018 generally describe

stream systems that are in functional and resilient conditions. However, information related to the predominant ages of forest stands surrounding streams supports an understanding that woody material recruitment into stream channels is likely still reduced relative to the potential of those habitats. A lesser volume of woody debris in streams is associated with decreased hydrologic and habitat complexity, altering responses to high flows and the quality of habitat to aquatic species. Forest Plan direction provides for a buffer around streams in which trees will be able to age and eventually be incorporated into stream processes over time. Forest Service staff also occasionally perform or support activities that actively add woody material to streams to provide the associated instream functions.

As indicated in the *Fiscal Year 2011 Annual Monitoring and Evaluation Report*, Level III monitoring is not likely to provide the best assessment of stream health at the Forest scale. Detailed Level III monitoring can help determine condition changes at a given site over time, but Forest Service staff do not have the financial and technical capability, even with partner support, to adequately evaluate whether plan components are effective and appropriate. Stream geomorphic assessments do not provide information whether management is effective in maintaining or achieving progress toward Forest Plan goals, objectives and desired conditions.

Recommendations: Consider removing this monitoring question from the monitoring program or find an alternative to address monitoring related to Forest-wide Goal 6 in the Forest Plan.

Aquatic Ecosystems

Monitoring Item: Fish and Aquatic Organism Passage

Monitoring Question: To what extent have Standards and Guidelines been applied?

Detailed Monitoring Question: Are culvert rehabilitation projects resulting in improved fish passage at stream crossings? Are road construction and maintenance activities resulting in improved or replaced culverts designed to transport water, sediment, and debris, and allow free movement of resident aquatic life?

Monitoring Driver: Forest Plan Goals 2 and 4, associated Objectives, and Forest-wide Fisheries Standards and Guidelines.

Monitoring Activities: Neither course filter surveys nor crossing-specific mark recapture or electrofishing was completed during this monitoring period. However, all stream crossing structure replacements were assessed and planned according to the U.S. Forest Service Stream Simulation approach (USDA Forest Service 2008). This includes projects completed by partners on non-NFS lands with Forest Service funds to support increased connectivity with GMNF fishery habitat to adjacent habitats.

Evaluation and Conclusions: No specific monitoring for this question occurred during fiscal years 2017 and 2018. However, the strength and effectiveness of the Stream Simulation approach along with casual observations by Forest Service staff indicate that crossings installed or upgraded using the Stream Simulation principals are sufficient for improving stream crossing structures' ability to allow for passage of fauna as well as water, sediment, and debris during high flows. During this monitoring period, 11 stream crossings (e.g., culverts or bridges) were restored or improved. In general, Forest Plan direction including Forest-wide and Management Area standards and guidelines along with project-specific design features, mitigations, and best management practices appear to be ensuring that functionality of stream crossings is being maintained or improved on GMNF.

Recommendations: Quantitative monitoring may be unnecessary for answering this monitoring question, at least at the landscape level. The development of the U.S. Forest Service Stream Simulation approach along with the lengthy discussion included within the document are evidence that it is well known that poorly designed or maintained stream crossings lead to degradation of aquatic and riparian habitat connectivity as well as stream function. Because this research has shown that the effects of these practices are known, there is no need to retain a monitoring question and associated indicators to verify such effects. Instead, monitoring could be focused on the presence and condition of stream crossing structures. This could more easily demonstrate impacts to or changes in stream habitat connectivity.

Standardized or quantitative culvert surveys and fish population surveys, as currently specified in the Monitoring Guide, can help expand upon the understanding of how well or poorly a crossing structure may be functioning, but are likely not necessary to answer the specific monitoring question being posed. Other surveys, however, can help improve this understanding as well, such as the U.S. Forest Service Best Management Practices (BMPs) Monitoring Protocols, Proper Functioning Condition assessment, or Multiple Indicator Monitoring. It is suggested that the Monitoring Guide be updated to primarily utilize qualitive, rapid assessments to answer the monitoring question, with additional surveys being used to supplement as needed or as available.

Aquatic Habitat

Monitoring Item: Sedimentation/Substrate Embeddedness

Monitoring Question: To what extent have Objectives been attained?

Detailed Monitoring Question: Are substrate embeddedness and sedimentation levels within the range described in the Forest Plan and providing high quality spawning and rearing habitat for native fish species and macroinvertebrates?

Monitoring Driver: Forest Plan Goal 4 and associated Objectives.

Monitoring Activities: Ambient biomonitoring data collected by the State with support from the Forest Service during this monitoring period includes embeddedness and simplified substrate size information (Table 3-2). These data are not specific to riffle/run or spawning habitat, but may provide some insight on stream bed conditions across GMNF during fiscal years 2017 and 2018 (Figures 3-4 and 3-5).

Table 3-2. Ambient biomonitoring data for fiscal years 2017 and 2018.

Stream	Date	% Fine	% Embeddedness
Ball Mountain Brook 7.3	9/6/2018	9	15
Bear Creek Brook 0.7	9/6/2018	0	5
Bickford Hollow Brook 0.1	9/4/2018	5	35
Bingo Brook 1.8	10/4/2011	0	60
Bingo Brook 1.8	10/2/2012	1	30
Bingo Brook 1.8	9/17/2013	2	15
Bingo Brook 1.8	9/4/2014	5	10
Bingo Brook 1.8	9/2/2015	3	20
Bingo Brook 1.8	9/8/2016	3	15
Bingo Brook 1.8	8/31/2017	8	20
Bingo Brook 1.8	9/12/2018	0	10
Bourn Brook 1.6	9/19/2018	0	10
Branch Pond Brook 0.1	9/6/2018	0	45

Stream	Date	% Fine	% Embeddedness
Broad Brook 2.4	9/26/2012	0	3
Broad Brook 2.4	10/1/2013	0	5
Broad Brook 2.4	9/9/2015	0	30
Broad Brook 2.4	9/14/2016	0	15
Broad Brook 2.4	9/5/2018	0	50
Bromley Mountain Brook 1.6	9/19/2017	30	45
Bromley Mountain Brook 2.0	9/18/2017	27	40
City Stream 2.0	9/4/2018	4	55
Fayville Branch 3.7	9/6/2018	0	30
Flood Brook 6.1	9/16/2017	5	35
Hancock Branch 3.9	8/31/2017	0	10
Lye Brook 1.6	9/19/2018	4	5
Roaring Brook 0.2	9/5/2018	0	45
Robbins Branch 1.4	10/4/2011	1	10
Robbins Branch 1.4	8/31/2017	1	12
Smith Brook 1.3	10/11/2011	0	20
Smith Brook 1.3	10/2/2012	0	25
Smith Brook 1.3	9/17/2013	4	10
Smith Brook 1.3	9/4/2014	7	5
Smith Brook 1.3	9/3/2015	0	18
Smith Brook 1.3	9/8/2016	1	10
Smith Brook 1.3	8/31/2017	1	5
Smith Brook 1.3	9/12/2018	0	25
Stamford Brook 0.1	10/2/2013	1	5
Stamford Brook 0.1	9/4/2018	3	15
Winhall River 8.1	10/14/1992	0	Not available
Winhall River 8.1	9/19/1994	0	Not available
Winhall River 8.1	9/19/1995	0	Not available
Winhall River 8.1	9/26/1996	0	Not available
Winhall River 8.1	9/28/2004	5	Not available
Winhall River 8.1	9/18/2008	1	Not available
Winhall River 8.1	9/30/2009	0	Not available
Winhall River 8.1	9/23/2010	0	Not available
Winhall River 8.1	10/7/2011	7	5
Winhall River 8.1	6/12/2012	5	25
Winhall River 8.1	9/27/2012	4	10
Winhall River 8.1	10/15/2013	5	15
Winhall River 8.1	9/30/2014	6	25
Winhall River 8.1	9/9/2015	0	30
Winhall River 8.1	9/20/2016	0	15
Winhall River 8.1	9/18/2017	2	20
Winhall River 8.1	9/19/2018	4	15

Figure 3-4. *Recent and historic stream substrate data.*

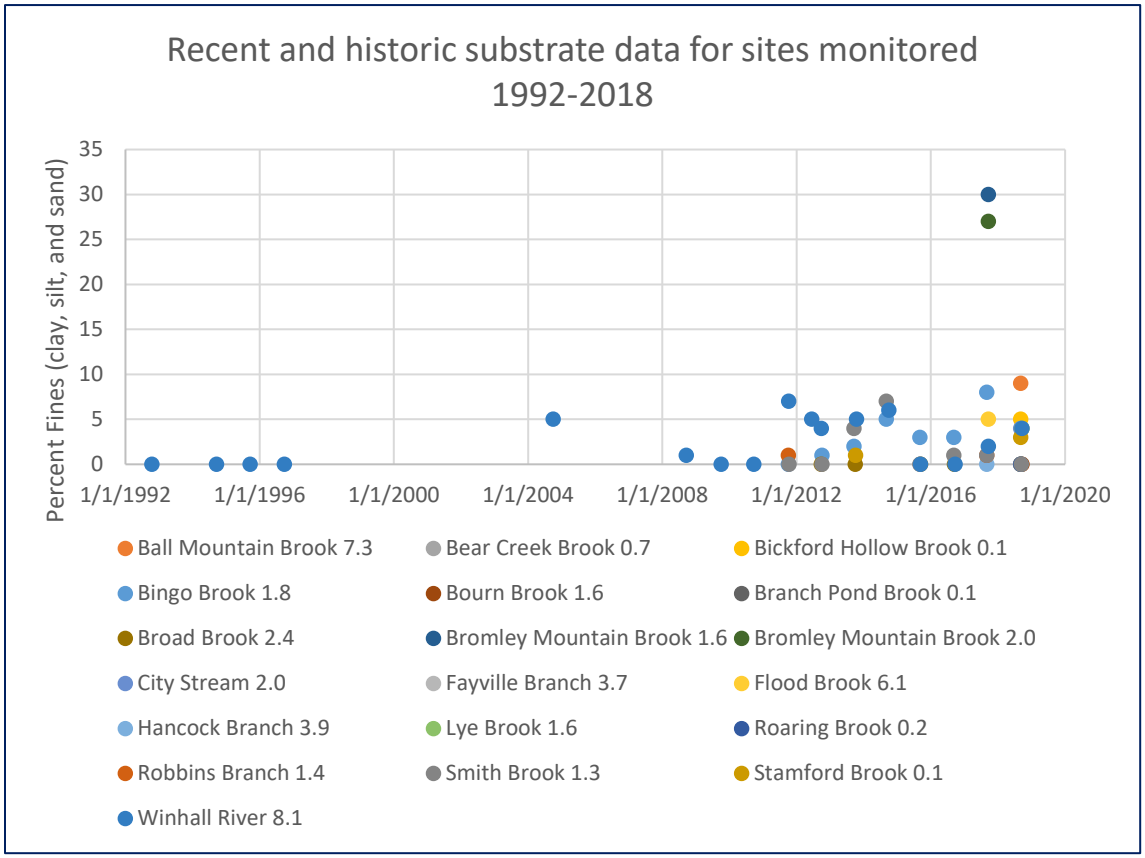
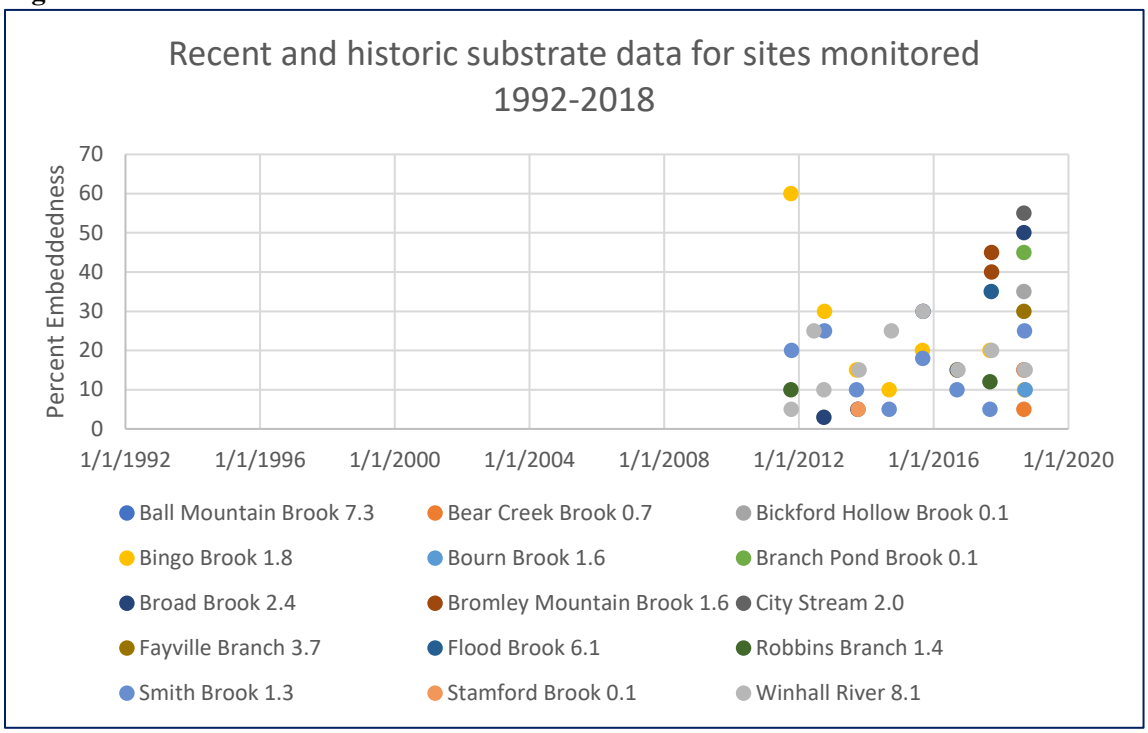


Figure 3-5. *Recent and historic stream substrate data.*



Evaluation and Conclusions: These monitoring results indicate that percent fines are almost exclusively below 10 percent, meeting the Forest Plan objective of percent fines less than 20 percent. The only exceptions are Bromley Mountain Brook 2.0 (27 percent in 2017) and Bromley Mountain Brook 1.6 (30 percent in 2017). Bromley Mountain Brook 1.9 also exceeded the objective in 2016 indicating that this site is of potential concern and should be assessed for management needs related to sedimentation. Additionally, only two sites exceeded the 50 percent embeddedness Forest Plan objective: Bingo Brook 1.8 (60 percent in 2011 just after Tropical Storm Irene, but between 15 and 30 percent from 2012 to 2018) and City Stream 2.0 (55 percent in 2018). Aside from a few outliers, these data seem to support this Forest Plan direction including Forest-wide and Management Area standards and guidelines along with project-specific design features, mitigations, and best management practices appear to be ensuring that quality of fish spawning and rearing habitat is being maintained or improved on GMNF.

Stream substrate monitoring is not likely to provide the best assessment of stream health at the forest-wide scale. Stream substrate can help determine condition changes at a given site over time, but the Forest Service does not have the financial and technical capability, even with partner support, to adequately evaluate whether plan components are effective and appropriate and whether management is effective in maintaining or achieving progress toward Forest Plan goals, objectives, and desired conditions based on this monitoring technique.

Recommendations: Consider removing this monitoring question from the monitoring program or develop an alternative to address monitoring related to Forest-wide Goal 4 in the Forest Plan.

Monitoring Item: Water Temperature in Streams

Monitoring Question: To what extent is Forest management affecting water quality, quantity, flow timing, and the physical features of aquatic, fisheries, riparian, vernal pool, and wetland habitats?

Detailed Monitoring Question: Are summer water temperatures in upland streams suitable to maintain native fish species and have they changed over the planning period?

Monitoring Driver: Forest Plan Goal 4 and associated Objectives.

Monitoring Activities: Stream temperature data were collected using thermographs (such as continuous temperature loggers) in fiscal years 2017 and 2018. The Monitoring Guide indicates that stream temperature would be assessed from the last week of May (assumed to be May 25) through the last week of October (assumed to be October 31). There were 24 sites monitored in 2017 (14 had data for the full monitoring period), and 17 sites monitored in 2018 (11 had data for the full monitoring period). One additional site was monitored in 2018, but was missing most of the monitoring period due to vandalism and has been removed from analysis. Table 3-3 indicates which streams had temperature data collected (broken out by year), the start and end date for data collection at a site within a year (some truncated to show just the beginning and end dates relative to the monitoring period), whether data were collected for the entire monitoring period (May 25 through October 31 of a given year), the average maximum daily temperature for any days within the monitoring period, and the total number of days within the monitoring period with a maximum temperature greater than 70 degrees Fahrenheit. Note that the 2017 data have not undergone a Quality Assurance and Quality Control (QA/QC) process to ensure that data are representative of wetted conditions (for example, some values may represent air temperature rather than water temperature), whereas the 2018 data have undergone a QA/QC process and some sites have had small amounts (one or two days) of questionable data removed.

Table 3-3. Stream temperature data for fiscal years 2017 and 2018.

Site Name	Year	Start Date	End Date	Full Period (5/25-10/31)	Season Average Max	# Days w/ Max >70
Battenkill MS1	2017	1/1/2017	11/14/2017	Yes	63.0	9
Bolles Control	2017	1/1/2017	11/29/2017	Yes	55.2	0
Broad Brook FS Boundary	2017	1/1/2017	11/29/2017	Yes	57.0	0
Castle Brook MS 1	2017	7/7/2017	12/4/2017	No	63.6	22
Deer Cabin MS1	2017	6/30/2017	11/21/2017	No	58.1	0
Deerfield Above Harriman	2017	7/20/2017	12/1/2017	No	63.7	19
Deerfield FS Boundary	2017	7/20/2017	12/1/2017	No	64.6	27
Deerfield Upper	2017	7/7/2017	12/4/2017	No	61.5	9
Deerlick MS1	2017	6/30/2017	11/27/2017	No	57.7	0
East Branch Deerfield Somerset Outlet	2017	6/30/2017	12/1/2017	No	51	0
Farnum MS1	2017	1/1/2017	11/6/2017	Yes	58.7	0
Flood Brook Above Hapgood	2017	1/1/2017	7/5/2017	No	57.0	0
Flood Brook Below Hapgood	2017	1/1/2017	11/6/2017	Yes	62.9	8
Flood Brook Sentinel	2017	1/1/2017	11/6/2017	Yes	59.0	0
Glastenbury MS1	2017	6/30/2017	11/21/2017	No	58.9	0
Griffith Control	2017	1/1/2017	11/6/2017	Yes	57.7	0
Grout Pond Outlet	2017	1/1/2017	11/14/2017	Yes	67.8	75
Jenny Coolidge MS2	2017	1/1/2017	11/6/2017	Yes	59.8	0
McGinn MS1	2017	1/1/2017	11/6/2017	Yes	56.8	0
Mettawee Headwaters	2017	1/1/2017	11/6/2017	Yes	55.8	0
Mt Tabor Contol	2017	1/1/2017	11/6/2017	Yes	60.1	0
Rake Branch MS1	2017	6/30/2017	12/6/2017	No	63.8	24
Utley MS1	2017	1/1/2017	11/6/2017	Yes	58.7	0
Winhall River	2017	1/1/2017	11/14/2017	Yes	60.9	1
Bingo Brook Sentinel QA/QC	2018	5/25/2018	10/31/2018	Yes	60.2	6
Broad Brook FS Boundary QA/QC	2018	6/8/2018	10/31/2018	No	58.4	0
Deer Cabin MS1 QA/QC	2018	1/1/2018	12/31/2018	Yes	59.1	1
Deerlick MS1 QA/QC	2018	5/25/2018	10/31/2018	Yes	58.3	0
Farnum MS1 QA/QC	2018	5/25/2018	10/15/2018	No	60.7	3
Flood Brook Below Hapgood QA/QC	2018	5/25/2018	10/15/2018	No	67.9	55
Flood Brook DS of Farnum Brook QA/QC	2018	5/25/2018	10/31/2018	Yes	61.6	18
Griffith Control QA/QC	2018	1/1/2018	12/31/2018	Yes	58.6	0
Grout Pond Outlet QA/QC	2018	5/25/2018	10/31/2018	Yes	69.0	96
Jenny Coolidge MS2 QA/QC	2018	1/1/2018	12/31/2018	Yes	59.6	4
McGinn MS1 QA/QC	2018	1/1/2018	12/31/2018	Yes	57.4	0
Mettawee Headwaters QA/QC	2018	5/25/2018	10/31/2018	Yes	56.0	0
Mt Tabor Control QA/QC	2018	6/13/2018	10/31/2020	No	60.7	9
Tunnel Brook QA/QC	2018	5/25/2018	10/31/2018	Yes	57.7	0
Utley MS1 QA/QC	2018	5/25/2018	10/15/2018	No	61.5	5
Winhall River Sentinel QA/QC	2018	5/25/2018	10/31/2018	Yes	61.8	18

Evaluation and Conclusions: For fiscal years 2017 and 2018 combined, the seasonal average daily high across all sites was around 60 degrees and ranged from 51 degrees on East Branch Deerfield at the Somerset Outlet to 69 degrees at the outlet of Grout Pond. For both years combined, the average number of days exceeding 70 degrees was 10.2, ranging from 0 to 96. Two sites, however, record the temperature of water flowing off the top of lakes/ reservoirs and represent uncharacteristically high temperatures (Grout Pond Outlet and Flood Brook Below Hapgood). Grout Pond Outlet had an average daily maximum temperature of 67.8 in 2017 and 69 in 2018 (total days exceeding 70 degrees were 75 and 96, respectively). Flood Brook Below Hapgood had an average daily maximum temperature of 62.9 in 2017 and 67.9 in 2018 (total days exceeding 70 degrees were 8 and 55, respectively). Although these numbers are important for managing fish populations in these locations and may warrant management considerations, they are not representative of overall conditions.

Excluding these two outliers, the average daily maximum temperatures is 59.2 (ranging from 51 to 64.6) and the average number of days exceeding 70 degrees is 4.4 (ranging from 0 to 27). There were 14 sites, excluding the outliers mentioned above, that recorded one or more days of temperatures exceeding 70 degrees in one or both years.

In general, stream temperature data indicate that stream temperature conditions conducive to fish population health are being maintained at most sites. The two sites with the highest temperatures are influenced by waterbodies that would be expected to influence water temperature, although management of these structures may be addressed to mitigate their influence on downstream temperatures. In at least one case (Hapgood Pond), Forest Service staff are taking steps to identify possible options to improve water management at the site for both sediment and temperature impacts downstream. Consistent with the Forest Plan, management activities should continue to make efforts to address discrete impacts to stream temperature while managing for overall watershed and stream function and health to allow for the greatest resiliency against the effects of climate change.

Other sites which exceed 70 degrees for many days per year may warrant additional attention to determine if management actions are leading to the adverse conditions or if variations in weather and climate are the driving force.

Although stream temperature is a critical metric for describing potential stress on fish populations, it may not be a useful leading indicator for the impacts of land use management on aquatic habitats. Except where certain discrete land uses are likely to impact stream temperature (such as decreased shading or degraded groundwater-surface water interaction processes), stream temperature will be primarily dictated by forces outside the control of land managers (such as weather and climate). Because of this, monitoring stream temperature may be useful to show seasonal, annual, decadal, or longer-term patterns in aquatic stream habitat and it may be useful in informing what fish species are likely to persist (or not) in a given stream segment or system. However, because any activity likely to measurably impact stream temperature would tend to be rare and occur at a large scale, it may not be particularly useful to monitor the impacts of most of the activities permitted by the Forest Plan on stream temperature. Stream temperature at certain sites potentially more sensitive to climate or long-term monitoring sites may be more useful in interpreting the impacts that climate change may have on the planning area.

Recommendations: Consider removing this monitoring question from the monitoring program or develop an alternative to address monitoring related to Forest Plan Goal 4.

Fire

Monitoring Item: Fire Agreements

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Questions: How many agreements for fire management have been developed and maintained with outside partners?

Monitoring Driver: Forest Plan Goal 21 and associated Objectives.

Monitoring Activities: There is one active Vermont Annual Operating Plan. There were 35 local cooperator agreements in place, but they all expired in fiscal year 2017.

Evaluation and Conclusions: Local agreements allow agency fire managers and cooperators to communicate resource needs more effectively and allow for compensation for equipment and personnel used during suppression activities. Cross-boundary training increases through existing agreements. The current Annual Operating Plan with the state of Vermont allows for resource sharing with state agency staff.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Hazardous Fuels

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent have hazardous fuels been reduced?

Monitoring Driver: Forest Plan Goal 21 and associated Objectives.

Monitoring Activities: Approximately 830 acres were treated with prescribed fire during fiscal years 2017 and 2018. Reporting accomplishments through NRM FACTS spatial provides information for small burn units and illustrates the moderate complexity and excessive time of implementing safe prescribed fire with current restraints of Forest Plan standards and guidelines.

A weighted rating system to analyze effectiveness and benefits of prescribed fire use for management of existing permanent openings has been developed and completed. Using AGOL Survey123, site visits are conducted to answer questions from both the implementer and planner standpoints such as ease of implementation, fire adapted plant community present, size, special features, vista, non-native invasive plant, and overlap of high use recreation among others.

Evaluation and Conclusions: While Forest Plan standards and guidelines, project specific mitigation measures, and best management practices are followed during implementation of hazardous fuels prescribed fire activity, it is notable that such constraints can sometimes impede effective and safe implementation of prescribed fire. Overall, hazardous fuel reduction activities have not been successful to meet wildlife opening maintenance objectives. Some consideration to increase prescribed fire ease of implementation would be to use existing containment features beyond stand delineation so firefighters can safely and confidently apply fire at the moderate intensity needed to achieve objectives.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Prescribed Fire and Wildland Use Fire

Monitoring Question: Prescribed fire and wildland fire for resource benefit: What are the effects of management practices using fire as a resource tool?

Detailed Monitoring Question: Did wildland fires managed for resource benefit and prescribed fires successfully meet objectives set forth in the Forest Plan and the Fire Management Plan? Did the fire function as a natural ecosystem process to restore and/ or maintain natural plant communities? Are the forests actively reintroducing fire into historically fire adapted landscapes?

Monitoring Driver: Forest Plan Goal 6 and associated Objectives, and Forest-wide Fire Management Standards and Guidelines.

Monitoring Activities: There were no wildland fires managed for resource benefit during fiscal years 2017 and 2018.

For prescribed fire management activities, select wildlife openings have been monitored using a composite burn index to measure burn severity on a given resource, and species of interest abundance. In addition to plant response, duff and substrate consumption along with scorch height and tree mortality have been monitored with accompanying ocular plot photos.

Notable fire adaptation highlights from fire effects monitoring include:

- Collaboration across resource program areas have illustrated prescribed fire effects to increase abundance of Common milkweed (*Asclepius syriaca*) and Marsh milkweed (*Asclepius incarnata*) across several Rochester Ranger District wildlife openings managed with prescribed fire.
- While not yet implemented with prescribed fire during the fiscal years 2017 and 2018 monitoring period, it is noteworthy to report the establishment of the integrated monitoring program to the Dome landscape oak restoration on the Manchester Ranger District where fuels and silviculture have established a formal monitoring plan to guide adaptive management in oak habitat.

Evaluation and Conclusions: Forest Service staff are actively planning the reintroduction of fire into historically fire adapted landscapes on a small scale and is considering opportunities to expand reintroduction of fire to the landscape where fire adapted criteria is met. Reference data from LANDFIRE and local research in pine-oak forests are being utilized across fuels and ecology to find suitable sites.

Often times constraints are placed on prescribed fire to protect a given resource under the assumption fire poses a risk and ought to be excluded. However, considering monitoring data across program areas should emphasize fire as a natural process in areas with fire history or fire adapted plan communities to adjust resource protection standpoints. Complying with some standards and guidelines with such resource protection standpoints paired with the already restrictive small window of opportunity to implement prescribed fire poses challenges for fire to serve as an effective natural ecosystem process.

Future management options should consider areas of historical fire regime (reference LANDFIRE) along with current fire science and research to plan future management where prescribed fire would otherwise be excluded. Reviewing prescribed fire monitoring reports illustrates how burn plan prescriptions may be written and carried out to achieve specific objectives. Intentional application of fire through a combination of fuels and atmospheric conditions and cross-program implementation planning has the potential to deliver the desired burn severity. Integration across program areas are needed in order to use prescribed fire monitoring in adaptive management going forth.

Program managers should also consider increasing prescribed fire unit sizes to further support reintroducing fire to the landscape and in return reduce the unlikely event of an unplanned ignition. Increasing prescribed fire activities on the landscape will reduce the availability of fuels and decrease the fire behavior and intensity for wildfires that do occur. The fire effects will be lessened from wildfire due to the reintroduction of fire in a planned and controlled setting through prescribed burning. Development of a Fire Danger Operating Plan will aid in wildfire response activities between agencies and cooperators.

Recommendations: No recommended changes to this monitoring question.

Monitoring Item: Wildfire Occurrence

Monitoring Question: To what frequency do wildfires occur?

Detailed Monitoring Questions: How many wildfires occurred on NFS land? How many total acres? How many human-caused wildfires? How many wildfires in the Wildland Urban Interface (WUI)? Is there a Fire Danger Operating Plan in place?

Monitoring Driver: Forest Plan Goal 21 and associated Objectives.

Monitoring Activities: There were four fires on NFS lands during fiscal years 2017 and 2018 for a total of five acres affected. All fires were human caused.

Evaluation and Conclusions: Wildfire suppression activities were effective and met all associated Forest Plan goals and objectives. Human-caused fires are the leading cause of wildfires on NFS lands and occur annually. Through prescribed fire implementation, fire management is reducing the fuel loading thus reducing the availability of fuels for combustion in the event of an unplanned ignition. These activities along with continued public education on the hazards of wildfires will likely keep wildfire size, intensity, and occurrences lower.

Recommendations: No recommended change to this monitoring question.

Heritage

Monitoring Item: Heritage Resource Program Objectives

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Have Heritage Resource program management objectives related to: backlogged site evaluations; meeting curation guidelines; developing a Geographic Information Systems (GIS) model for prehistoric site locations; increasing partnerships for Section 110 activities; consulting with State Historic Preservation Officers (SHPO) and Tribes; and incorporating heritage components into historic building management plans been addressed?

Monitoring Driver: Forest Plan Goal 16 and associated Objectives.

Monitoring Activities:

Fiscal Year 2017
Very little data was recorded due to a gap in the Forest Archaeologist position.

Fiscal Year 2018

Approximately 2,600 acres of intensive survey occurred for the Robinson Integrated Resource Project (IRP) and 867 acres of broad scale survey for the South of Route 9 IRP. No new archaeological sites were evaluated against the National Register of Historic Places criteria, however shovel testing at each site identified during the survey gathered valuable information needed for assessing Criterion D. Ongoing partnerships continued with the University of Vermont's Consulting Archaeology Program and the Vermont Archaeological Society, to analyze artifacts and catalog them using CFR 79 curation standards and guidelines. A total of four outreach and stewardship opportunities were conducted involving archaeological site tours and public presentations.

Evaluation and Conclusions: Forest Service staff met Section 110 Heritage Program Managed to Standard (HPMtS) goals from the outreach and stewardship projects conducted in fiscal year 2018. Progress has been made in moving GMNF towards 100 percent inventory of cultural resources, however during the 2017 and 2018 monitoring period there was little to no progress in addressing deferred maintenance on historic properties. Due to a transition in the Forest Archaeologist position and a lack of readily available data for this report, it is unclear how much tribal consultation occurred.

Continued partnerships and outreach with local historical societies and the Vermont Archaeological Society are important for the recurring interest received from volunteer opportunities. Consultation efforts with State and Federally recognized tribes need to be improved to ensure their project-specific concerns are being met and they are receiving Forest-wide representation.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Heritage Resource Site Protection

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Have Heritage Resources across GMNF been inventoried and protected?

Monitoring Driver: Forest Plan Goal 16 and associated Objectives.

Monitoring Activities: Cultural resources on the Rochester/Middlebury Ranger Districts were monitored in fiscal years 2017 and 2018 to assess their condition and identify resources that require protection from management activities proposed in the Robinson IRP. In total, 45 cultural resources from fiscal year 2017 and 27 cultural resources from fiscal year 2018 were monitored and had their site forms updated. None of the sites were identified as having a significant change in condition, except one. A historic wooden splash dam was not located and was likely destroyed due to run off damage from Tropical Storm Irene in 2011. In addition, maintenance activities occurred in 2018 at two cemeteries to address vegetation encroachment and head stone damage repairs.

Evaluation and Conclusions: Cultural resource monitoring forms were prepared for each archaeological site identified during the monitoring surveys to highlight current or potential impacts to the resource. No sites were identified in need of immediate on-site vegetation or erosion management. Since the historic splash dam was destroyed by a recent flooding event, the site can no longer be evaluated. Based on the fiscal year 2018 monitoring results, there needs to be an emphasis on cultural resources within active streams to monitor and record damage from flooding events.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Heritage Resource Standards and Guidelines

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Have heritage resources within the "Areas of Potential Effect" of GMNF-sponsored projects (undertakings) been protected and managed according to Forest Plan Standards and Guidelines?

Monitoring Driver: Forest Plan Goal 16 and associated Objectives.

Monitoring Activities: During fiscal years 2017 and 2018 a minimum of 38 projects were reviewed in accordance with Section 106 of the National Historic Preservation Act (NHPA). These projects included but were not limited to: special use permits, trail relocation and maintenance, bridges and culverts, wetland restorations, apple tree releases and timber sales. Projects with a determination of No Adverse Effect were protected from management activities through project specific design features, mitigation measures or exclusion boundaries. Mitigation measures were also added to a number of sites associated with the Robinson IRP and South of Route 9 IRP. Twenty-five historic sites received exclusionary flagging from timber sales associated with the Robinson IRP in fiscal year 2018. No data was available during the 2017 and 2018 period indicating that monitoring occurred post-implementation of any projects.

Evaluation and Conclusions: A review of project activities is necessary for compliance with the NHPA and allows for historic properties to be identified and design features/mitigation measures applied prior to project implementation. Post-project monitoring efforts provide the necessary data to confirm site protection mitigation measures were followed and provides opportunity to adjust mitigations needs for future projects to reduce potential effects to the resource. Since no post-project monitoring occurred during this monitoring period, it is unknown whether prior protective measures were followed appropriately.

Recommendations: No recommended change to this monitoring question.

Human Dimensions

Monitoring Item: Contract Sizes to Local Economies

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: What is the range of dollar amounts and board feet in contracts? Who has been awarded the contract?

Monitoring Driver: Forest Plan Goal 17 and associated Objectives.

Monitoring Activities: The monitoring and reporting frequency for this question is 5 years. This report covers the 5-year period from fiscal years 2014 to 2018. The Forest Service provides an annual bid monitoring report which is sent to the Regional Forester at the end of each fiscal year. This report analyzes changes and trends in bidding, bid values and the bidders for timber sales offered each year. Data required for bid monitoring and for tracking timber sales comes from Timber Sale Accounting (TSA) system reports. Volumes are reported in hundred cubic feet (CCF) as well as thousand board feet (MBF). Volumes and targets are officially reported in CCF.

Evaluation and Conclusions: From fiscal years 2014 to 2018, there were 18 separate timber sales sold on GMNF which were awarded to 9 different bidders. Sales ranged in volume from 42 to 5,881 CCF. Individual contract values ranged from $420 to $573,412 (Table 3-4). The average contract size was 3,318 CCF and the average value was $156,438. Successful bidders consisted of logging companies (44 percent), sawmills (40 percent) and other entities (16 percent). Of the successful bidders, all but two are headquartered in Vermont and approximately 75 percent are based in communities within or adjacent to GMNF. With only a few exceptions, harvest operations on these timber sales were completed by companies based in communities and towns within or adjacent to GMNF.

Table 3-4. Contract value distribution by fiscal year (FY).

Contract Size (value)	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	Total
$301 - $10,000	0	1	2	1	1	5
$10,001 - $100,000	1	0	1	3	0	5
$100,001 - $1,000,000	2	2	2	1	1	8

Forest Service staff strive to offer timber sales geographically distributed throughout GMNF and in a range of sizes to provide economic benefits to different towns and businesses of various sizes. Sales over the last five years have been largely concentrated on the Manchester Ranger District, but about 22 percent of sales were located on Middlebury/Rochester Ranger Districts. New projects being planned, including the Robinson Integrated Resource Project on Rochester Ranger District, and the Early Successional Habitat Project on Manchester Ranger District, will help provide a better geographic distribution of sales in the future. Sale sizes have varied, and over one third of sales offered were less than $10,000 in value (Table 3-4). Although smaller contracts did attract bids from some smaller businesses, these businesses typically were not successful in winning bids even on smaller sales.

Forest Service staff do not track the marketing of wood after it has been sold and removed. There is no data collected on GMNF to provide estimates of wood volume used for various products or processing locations. Data collected by the State of Vermont and published by North East State Foresters Association (NESFA 2013) shows roughly 60 percent of wood harvested in Vermont is processed in the state. Anecdotal evidence would support that a similar percentage of wood harvested on National Forest System (NFS) lands is processed in the state. Most of the wood being exported is softwood being processed in Canada and pulpwood being processed in New York. The local economic benefits of timber harvested on NFS lands are strongly tied to local and regional markets for wood. These markets are constantly changing largely in response to broader national and international economic trends.

The most significant challenge to providing economic benefits to local and regional economies is the overall level of timber harvest on GMNF. The amount of timber sold and harvested each year remains well below the levels allowed by the Forest Plan and averages less than 25 percent of the Allowable Sale Quantity (see Outputs Accomplished - Volume and Acres of Timber Offered and Sold monitoring item). These reduced levels of harvest result in the creation of fewer direct and indirect jobs related to timber harvesting and processing. Less overall harvest also results in fewer timber sale contracts being offered each year, and longer durations between contracts in or near individual communities.

Increased levels of timber harvest on the Forest would create increased economic benefits locally and regionally. Forest Service staff should continue to work internally and with Regional leadership to seek opportunities to continue to increase annual timber offerings. Forest Service staff should also continue to offer sales in a range of sizes and to distribute them geographically and over time, to distribute economic benefits. Sales should have a mix of products, including sawtimber, pulpwood, fuelwood, and other product types.

All the businesses that have purchased timber sales since 2014 are considered small businesses according to standards set by the Small Business Administration. These businesses are competitive in bidding on the varied sizes of sales being offered on GMNF. Smaller sales cost more to prepare and administer in meeting annual targets and accomplishing Forest Plan management objectives. Forest Service staff should continually evaluate the costs and benefits of offering small sales to determine how best to balance economic opportunities for the smallest businesses with other objectives and consider viable offers of even smaller sales (less than 500 CCF) for these businesses.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Other Agencies, Organizations, and Groups Coordination

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Has the Forest Service improved communication and collaboration with federal and State agencies, regional commissions, town governments, and other local organizations?

Monitoring Driver: Forest Plan Goal 20 and associated Objectives.

Monitoring Activities: Not reported for fiscal years 2017 and 2018. This question was removed from the monitoring program based on recommendations from the *Fiscal Years 2014, 2015, and 2016 Annual Monitoring and Evaluation Report* because its intent is redundant with the Partnerships Maintenance and Enhancement monitoring item question.

Evaluation and Conclusions: Not applicable.

Recommendations: Not applicable.

Monitoring Item: County Income by Employment Sector

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent is the GMNF contributing to the economic health of local economies?

Monitoring Driver: Forest Plan Goal 17 and associated Objectives.

Monitoring Activities: No monitoring was conducted for this question for fiscal years 2017 and 2018.

Evaluation and Conclusions: Not applicable.

Recommendations: Consider removing this question from the monitoring program beginning 2019 because it is too difficult to track accurately to provide meaningful economic information.

Monitoring Item: Forestry Education Sites

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Were sites established on the Forest for forestry education?

Monitoring Driver: Forest Plan Goal 19 and associated Objectives.

Monitoring Activities: Not reported for fiscal years 2017 and 2018. This question was removed from the monitoring program based on recommendations from the *GMNF Fiscal Years 2014, 2015, and 2016 Annual Monitoring and Evaluation Report* because its intent is redundant with the Teacher Professional Development in Forest Stewardship monitoring item question.

Evaluation and Conclusions: Not applicable.

Recommendations: Not applicable.

Monitoring Item: Partnerships Maintenance and Enhancement

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Are partnerships active and effective on GMNF and are Forest Service personnel participating in partnership activities?

Monitoring Driver: Forest Plan Goal 18 and associated Objectives.

Monitoring Activities: The following measurement indicators are used to address this monitoring question:

1. Number of formal partnership agreements (inter-agency, Challenge Cost Share, Memorandums of Understanding)
2. Number of Forest Service staff participating in outside organizations in official capacity (representing Forest Service interests)
3. Evaluation (narrative) of how the partnership has been effective in helping the Forest Service meet Forest Plan Goals and Objectives
4. Number of person-hours contributed by partnerships

Agreements with partners, such as challenge cost-share agreements and participating agreements, are recorded for the Green Mountain and Finger Lakes National Forests (combined) in the Natural Resource Management database, including partner cash, non-cash and in-kind contributions (Table 3-5). Reporting contributions from partner agreements is a consistent, accurate method for reporting contributions; however, it is recognized that this does not account for all annual volunteer hour contributions. Volunteer hours are reported inconsistently and there is no accurate way to depict annual volunteer contributions currently for GMNF. Similarly, there is no consistent data collection effort to document and quantify the number of partners engaged in any given year given many partners may informally collaborate with the Forest Service outside of a signed agreement.

Table 3-5. Partner agreement contributions in New York and Vermont from fiscal years 2017 and 2018.

Fiscal Year	Non-Federal Contributions	Other Federal Contributions	State Contributions	Total
2017	$616,986	$43,000	$0.00	$662,003.00
2018	$702,917	$98,512	$0.00	$803,447.00
Total	$1,319,903.00	$141,512.00	$0.00	$1,465,450.00

In addition to monitoring agreements, individual and group volunteer contributions were recorded over this monitoring period (Table 3-6).

Table 3-6. Volunteer contributions in New York and Vermont from fiscal years 2017 and 2018.

Fiscal Year	Number of Volunteers	Total Hours Contributed	Equivalent Fund Contribution	Percent of Full-Time Employee Contributed
2017	43	7,768	$187,519.52	4.32
2018	21	5,220	$128,881.80	2.90
Total	64	12,988	$316,401.32	7.22

Evaluation and Conclusions: Forest Service staff have maintained, expanded and enhanced formal and informal partnerships in recent years and continue to successfully meet management objectives through financial and other agreements. Engagement continues with many partners through regular e-mails, mailings, phone conversations and in person meetings. Partnerships continue to be active / valued and many if not all Forest Service program areas communicate with partners on a frequent basis.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Teacher Professional Development in Forest Stewardship

Monitoring Question: In what way is the Forest Service providing information and education opportunities that enhance the understanding of the GMNF?

Detailed Monitoring Question: Did teacher professional development in Forest stewardship occur?

Monitoring Driver: Forest Plan Goal 19 and associated Objectives.

Monitoring Activities: The measurement indicators for this monitoring question are the number of teachers trained, and number of programs offered. Programs designed to provide teacher emphasis on conservation can help toward Forest Plan goals and objectives related to social and economic sustainability.

Evaluation and Conclusions: Forest Service staff continue to provide annual teacher and student development and programming to educate the next generation of National Forest users. This work comes in several forms including outreach to teachers and schools, and providing in-person programming delivered by Forest Service staff. In addition, agreement and funding opportunities and natural resource programming to cooperating partner organizations occur annually. Forest Service programs continue to provide Forest Stewardship education through community events. It is estimated that about a dozen programs per year are provided to educate teachers, students, partners, and the public.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Payments to Towns

Monitoring Question: To what extent have Objectives been attained?

Detailed Monitoring Question: What was the amount paid to each GMNF town through PILT, 25% fund or Secure Schools. What type of communications have occurred on this topic with each town?

Monitoring Driver: Forest Plan Goal 17 and associated Objectives.

Monitoring Activities: There are two types of federal payments reaching municipalities that have NFS lands: 1) Payments in Lieu of Taxes; and 2) Public Law 106-393, Secure Rural Schools and Community

Self-Determination Act of 2001, reauthorized in 2008. Payments in lieu of taxes funds are directed to towns, and the Public Law 106-393 funds are directed to school districts.

Evaluation and Conclusions: See Appendix A for specific federal payment information for each GMNF town. All towns have access to specific payment amounts as soon as they are released.

Recommendations: No recommended change to this monitoring question.

Invasive Species Population

Monitoring Item: Non-native Invasive Species

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: To what extent are non-native invasive species impacting other Forest resources?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives, and Forest-wide Pests, Diseases, and Non-Native Invasive Species Standards and Guidelines.

Monitoring Activities: The impact of non-native invasive plants (NNIP) on GMNF has been monitored by surveying the extent of infestations in areas prioritized to protect, or in areas most likely to be sources of seeds or plant propagules that could be dispersed to areas to be protected. It also includes monitoring any treatments. All data was gathered using the USDA Forest Service Natural Resources Information System (NRIS) protocol, to be entered into the NRM (Natural Resources Manager) corporate database. All sites monitored provide baseline information that can be used during ongoing implementation of the Forest-wide Invasive Plant Control Project approved in 2010.

Botanical inventory occurred in the following locations:

Fiscal Year 2017 (1445.2 acres)

- 126.5 acres were searched for six different rare plant species that were either historical or had not been found recently.
- 203 acres were inventoried for the Robinson Integrated Resource Project (IRP), Rochester Ranger District.
- 1115.7 acres were inventoried for the Somerset IRP, Manchester Ranger District.

Fiscal Year 2018 (1437.3 acres)

- 1437.3 acres were inventoried for the Somerset IRP, Manchester Ranger District.

Of the six surveys for rare plants not found recently, no new infestations were found. Three sites had previously known infestations, and three had none.

At the end of the 2017 field season, there were 400 mapped infestations documented to occur in the Robinson IRP area, an increase from the 372 of mapped infestations at the end of the 2016 field season. Wild chervil continues to be the most widespread, but goutweed and Japanese knotweed are also prevalent, and harder to control than wild chervil. Most NNIPs continue to occur along edges such as roads, trails, and rivers, or along access points such as trailheads and parking lots, with very few in forest interiors. However, many of the species that are now primarily on the edges have the potential to establish

in the woods, given the opportunity. An example is Japanese barberry; if it established in forest interiors, it could limit ground flora diversity and provide ideal microsites for deer ticks.

At the end of the 2018 field season, there were 60 infestations documented to occur in the Somerset IRP area; this is considerably fewer infestations than in the Robinson IRP, which may be partially due to the relative remoteness of much of the IRP. Most of the infestations occur along roads, trails, or access points, rather than forest interior. Species found were goutweed, garlic mustard, wild chervil, Japanese barberry, narrowleaf bittercress, knapweeds, autumn olive, glossy buckthorn, honeysuckles, purple loosestrife, wild parsnip, Japanese knotweed, and multiflora rose. Most abundant was wild chervil; honeysuckle, purple loosestrife, and wild parsnip were also relatively common. All four of these species are most problematic in open areas, where they have the potential to limit biodiversity and affect wildlife habitat diversity by altering available habitat structure and food sources.

Small infestations were treated by a combination of hand-pulling, digging, and spot herbicide applications in the following locations:

Fiscal Year 2017 (105.4 acres)

- Much of the work involved hand-pulling wild chervil on roadsides in the Natural Turnpike and Upper White River IRP areas (Rochester/Middlebury Ranger Districts), but some manual NNIP control also occurred in the South of Route 9 and Dorset-Peru IRP areas (Manchester Ranger District). (52.1 acres).
- Herbicide treatments (foliar spot spray and cut stump applications) occurred in the South of Route 9 IRP area and in maintained wildlife openings along the Appalachian Trail (53.3 acres).

Fiscal Year 2018 (51 acres)

- Much of the work involved foliar spot sprayed herbicide in the South of Route 9 IRP area and in maintained wildlife openings along the Appalachian Trail (14.4 acres).
- Hand-pulling wild chervil continued on roadsides in the Natural Turnpike and Upper White River IRP areas; other NNIP were manually controlled in the Robinson and Dorset-Peru IRP areas, at a maintained wildlife opening along the Appalachian Trail, at Grout Pond, and at the Richville Road restoration site in Manchester. VYCC worked with staff in most of these areas. (35.4 acre).
- Small infestations were controlled using new experimental methods (1.2 acres):
    - A small infestation of Japanese barberry was flame-weeded along a new trail on Rochester Ranger District.
    - A slightly larger infestation of woody NNIP was controlled by grazing goats in a maintained wildlife opening along the Appalachian Trail.

Evaluation and Conclusions: While monitoring (botanical inventories/surveys) indicated the extent of NNIP infestations, Forest Service staff do not currently have a means of quantifying the effect of NNIP on other resources. Monitoring protocols were otherwise efficient and easy to use and allow assessing the short-term effectiveness of the treatments. Foliar spot-spraying woody species is generally effective if the infestation is treated at least two or three years in a row, although common buckthorn is less easily killed than other woody NNIP. The same method used on garlic mustard is minimally effective, most likely due to the extensive seed bank. Cutting woody NNIP is temporarily effective at knocking back these shrubs and needs to be followed by foliar spot spray of regrowth. Hand-pulling wild chervil is labor intensive but generally effective for a year although needs to be repeated annually due to the extensive seed bank in the soil.

Forest Plan Goal 2 (Forest Plan, p. 10) directs management to "*Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals*". Management activities monitored comply with this direction by having rare plant

and non-invasive plant inventories completed at rare plant sites and in Integrate Resource Project areas. Knowing what NNIP are present, along with what rare plants occur there that need protection, allows the effective development of treatment plans. Management activities also comply with Forest Plan direction (Forest Plan Forest-wide Standards and Guidelines, Pests, Diseases, and Non-Native Invasive Species Standard S-1, p. 33) by implementing mitigation measures developed during Integrated Resource Project analysis.

Monitoring shows it is never enough to treat infestations just once, and sometimes even two times is not adequate. The reasons for this vary; in some cases, the treatment method is simply not 100 percent effective, and in other cases, the method might be effective, but there is an abundant NNIP seed source in the soil. It is also very difficult to prevent new infestations that can arrive at a site by several means, including wind, rain, wild and domestic animals, and human activity of all kinds.

Despite NNIP control challenges, monitoring guide measures, indicators, and methodology appear to be working, although they only assess the extent of infestations and effectiveness of treatments, not the impact on other resources. Impact on other resources may be best assessed qualitatively by specialists who manage other resources. For example, a silviculturist may recognize reduced tree seedling regeneration in a forest heavily infested with garlic mustard, and a wildlife biologist may notice decreased habitat quality in a maintained opening infested with multiflora rose.

Recommendations: No recommended change to this monitoring question.

Lands

Monitoring Item: Special Uses

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: Is the Forest improving its administration of existing authorizations?

Monitoring Driver: Forest Plan Goal 1 and associated Objectives, and Forest-wide Special Uses Standards and Guidelines.

Monitoring Activities: Data for special use permits is consolidated for the Green Mountain (Vermont) and Finger Lakes (New York) National Forests and is found in the Special Uses Database System (SUDS). Information for this report was obtained by pulling the fiscal year-end Administered to Standard report. SUDS contains six elements that can feed into determining if a permit is administered to standard: is the authorization current, are fees calculated, has a bill been issued, is insurance current, has the permit area been inspected on the appropriate schedule, and have performance evaluations been conducted on the appropriate schedule (Table 3-7).

Table 3-7. Special use permit authorization and Administered to Standard Report for the Green Mountain and Finger Lakes National Forests for fiscal years 2017 and 2018.

Monitoring Items	Fiscal Year	
	2017	2018
Permit Authorizations to Standard	103	116
Permit Authorizations not to Standard	34	19
Percent Permits to Standard	**81.1%**	**85.9%**

Evaluation and Conclusions: The Forest is improving the administration of existing authorizations. A transition in Lands Special Uses staff occurred in 2016 enabling steady progress to reduce a backlog of permit administration needs.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Land Ownership Adjustment

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent has the GMNF land base been adjusted through purchase, exchange, transfer, interchange, boundary adjustment and donation?

Monitoring Driver: Forest Plan Goal 22 and associated Objectives.

Monitoring Activities: Conservation partners, state and local colleagues, and interested citizens have provided tremendous assistance in identifying lands from willing sellers that would benefit the National Forest System. Land adjustment activities are recorded in the Landownership Adjustment Data System (LADS), including the acquisition of parcels, the donation of parcels to the federal government, the exchange of land, and the conveyance of land. The LADS system recorded three land adjustment activities for fiscal years 2017 and 2018 (Table 3-8).

Table 3-8. GMNF land adjustments for fiscal years 2017 and 2018.

Fiscal Year	Type of Case	Town	Tract #	Acres	Management Area	Notable Features
2017	Purchase	Warren	918	132.3	Diverse Backcountry	Conserves frontage along the Mad River
2017	Purchase	Manchester	315	34	Diverse Forest Use	Conserves a section of the Appalachian/Long Trail
2018	Purchase	Dorset	282	40	Diverse Forest Use	Conserves a section of a feeder trail to the Appalachian/Long Trail and a segment of Mad Tom Brook
Total Acres				**206.3**		

Evaluation and Conclusions: A total of 206.3 acres were added to the National Forest System land base for various conservation purposes (Table 3-8). This meets the intent of Forest Plan Goal 22 to "*Meet anticipated future needs and opportunities on public lands and improve management effectiveness of the National Forest through adjustment of land ownership"* (Forest Plan, p. 18).

Recommendations: No recommended change to this monitoring question.

Program Management

Monitoring Item: Costs of Plan Implementation

Monitoring Question: How close are actual costs to projected costs?

Detailed Monitoring Question: To what extent is the Forest Service providing a mix of products, services, and amenities?

Monitoring Driver: Forest Plan Goal 1 and associated Objectives.

Monitoring Activities: Table 3-9 displays the targets that were achieved on the Green Mountain and Finger Lakes National Forests in fiscal years 2017 and 2018, and the estimated cost for achieving that target. Information is presented as a collective report for both National Forests because the information is tracked regionally in a combined report.

Table 3-9. Fiscal years 2017 and 2018 target accomplishments and estimated cost.

Target Activity	Amount Accomplished Fiscal Year 2017	Estimated Cost Fiscal Year 2017	Amount Accomplished Fiscal Year 2018	Estimated Cost Fiscal Year 2018
Inventory and Monitoring				
Annual monitoring requirements completed	All items	Not available	All items	Not available
Inventory data collected or acquired to standard	All items	Not available	All items	Not available
Forest Planning				
Amendments Underway	0	$ 0	0	$ 0
Facilities				
Forest administrative and other facilities maintained to standard	20 facilities	$ 158,749	20 facilities	$ 39,004
Recreation sites managed to standard	117 sites	$ 148,200	118 sites	$ 154,360
Hazardous Fuels				
Treated with prescribed fire to reduce the risk of catastrophic wildland fire	971 acres	$ 103,897	1,411 acres	$ 126,990
Lands				
Land Acquisitions/adjustments	166.3 acres	Not available	40 acres	Not available
Boundaries marked	13.5 miles	$ 130,856	16.5 miles	$ 77,044
Non-Recreation Special use permits administered to standard	103 permits	$ 107,322	116 permits	Not available
Non-Recreation Special use applications processed	31 applications	$ 40,011	20 applications	Not available
Rights of Way acquired	0 easements - acquired with a land acquisition	$ 0	0 easements - acquired with a land acquisition	$ 0
Vegetation and Watershed				
Forest vegetation established	414 acres	$ 82,800	384 acres	$ 76,800
Timber stand & genetic tree improvement	15 acres	$ 3,000	100 acres	$ 20,000
Treated annually for noxious weeds and invasive plants	388.5 acres	$ 86,698	494.7 acres	$ 132,904
Range land vegetation improved	1102 acres	$ 31,975	1215 acres	$ 35,032
Soil and Water resource acres improved	377 acres	$ 84,349	362 acres	$ 931,999

Target Activity	Amount Accomplished Fiscal Year 2017	Estimated Cost Fiscal Year 2017	Amount Accomplished Fiscal Year 2018	Estimated Cost Fiscal Year 2018
Wildlife, Fish and Threatened, Endangered and Sensitive Species				
Lake habitats restored or enhanced	218 acres	$ 10,127	239 acres	$ 58,835
Stream habitats restored or enhanced	26.5 miles	$ 1,702,906	21.4 miles	$ 888,786
Terrestrial habitats restored or enhanced	3,708 acres	$ 262,370	3,816 acres	$ 213,746
Recreation				
Heritage assets managed to standard	Not available	Not available	Not available	Not available
Recreation site capacity operated to Standard	874,040 PAOT days	$ 148,200	907,680 PAOT days	$ 154,360
Number of interpretive & conservation education plans implemented	1 Plan	$ 60,000	1 Plan	$60,000
Recreation special use authorizations administered to standard	42 permits	$ 0	32 permits	Not available
Recreation Special use applications processed	11 applications	$ 0	14 applications	Not available
Trails improved to standard	0 miles	$ 0	10.4 miles	$184,965
Trails maintained to standard	306.1 miles	$ 152,200	317.2 miles	$167,569
Wilderness Areas managed to standard	0 areas	$ 64,498	0 areas	$ 63,980
Roads				
Roads decommissioned	0 miles	$ 450,726	0 miles	$513,774
High clearance roads maintained	12.1 miles		8.3 miles	
Passenger car roads improved	2.88miles		1.3 miles	
Passenger car roads maintained	70.4 miles		69.9 miles	
Lands covered by motor vehicle use map (MVUM) – includes development of the GM MVUM	408,972 acres	Not available	408,972 acres	Not available
Timber				
Timber volume sold	11,181 ccf[1]	$ 1,164,000	6,637 ccf[1]	$ 1,264,000

[1] CCF = hundred cubic feet; to convert CCF to thousand board feet (MBF) multiply by 0.62 (CCF x 0.62 = MBF).

Evaluation and Conclusions: Tracking costs of Forest Plan implementation activities provides program managers unit cost information that is helpful in the development of work plans and out-year planning. Over an extended period, tracking these costs can be used to develop management activity unit cost trend information enabling managers to make more informed decisions about the costs of management activities.

Recommendations: Consider removing this question from the monitoring program because monitoring project costs is not strongly tied to any Forest Plan component and it does not provide enough meaningful or accurate information to warrant its retention.

Monitoring Item: Desired Future Condition

Monitoring Question: What are the effects of management practices prescribed by the 2006 Forest Plan?

Detailed Monitoring Question: What activities have occurred in management areas? How have these management actions helped to achieve the desired future condition of the management area? Have activities occurred that detract from the desired future condition of the management area?

Monitoring Driver: Forest Plan Goal 1 and associated Objectives, and Forest Plan Management Area direction (management area major emphasis and desired future conditions).

Monitoring Activities: The total number of GMNF projects approved in fiscal years 2017 and 2018 to implement the Forest Plan is provided in Table 3-10 by the level of analysis required by the National Environmental Policy Act (NEPA). The list of projects approved for each fiscal year is provided in Table 3-11.

Table 3-10. Number of projects approved for implementation in fiscal years 2017 and 2018.

National Environmental Policy Act – Level of Analysis	FY 2017	FY 2018
Record of Decision (EIS – Environmental Impact Statement)	0	0
Decision Notice (EA – Environmental Assessment)	1	0
Decision Memo (CE – Categorical Exclusion)	18	15
Letter To the File (CE – Categorical Exclusion)	10	8
Supplemental Information Report	3	1
Total Projects Approved	**32**	**24**

Table 3-11. List of GMNF projects approved for implementation in fiscal years 2017 and 2018.

Project Name (alphabetical order)	Location[1]	NEPA Level[2]	FY Approved	Project Description
Annual Mowing of Richville Road Openings	Man RD	DM	2017	Issue a special use permit to mow upland openings on Richville Road (hay removed for livestock use). Mowing will be restricted unless field surveys conducted prior to mowing incorporates mitigation measures necessary to protect nesting birds.
Apple Tree Release Additions - Manchester Ranger District	Man RD	DM	2017	Release of newly identified apple trees in stands across the Manchester Ranger District.
Apple Tree Release - Manchester Ranger District	Man RD	DM	2017	Release apple trees throughout portions of Manchester Ranger District.
Bald Mountain Trail Relocation	Man RD	DM	2018	Relocate a 0.4-mile section of the Bald Mountain Trail to a more sustainable route within the Glastenbury Wilderness.
Blueberry Hill Sucker Brook Bridge Replacement	Mid RD	LTF	2017	Replacement of existing bridge and relocate system trail to accommodate new location downstream.

Project Name (alphabetical order)	Location[1]	NEPA Level[2]	FY Approved	Project Description
Blueberry Lake Bike Trail	Roc RD	SIR	2017	Add additional bike trail per Blueberry Lake Site Additions and Restoration Project Decision Memo dated August 2011.
Branch Pond Trail Relocation	Man RD	DM	2017	Relocate Branch Pond Trail in Lye Brook Wilderness to circumnavigate wet areas.
Camp Keewaydin O&G Permit Reissuance	Roc/Mid RD	LTF	2017	Issue a temporary outfitter/guide special use permit not to exceed 1 year to summer camp for day hiking and backpacking on NFS lands.
Camp Keewaydin Priority Use Outfitter & Guide Special Use Permit	Mid RD	DM	2018	Issue long term special use permit for day hiking and backpacking on multiple trails. Camp Keewaydin has had annual permits for these activities for a number of years.
Camp Keewaydin Right of Way Special Use Permit	Mid RD	DM	2018	Reissue special use permit for trail system and shelter.
Chittenden Brook Hut Special Use Permit	Roc RD	DM	2018	Issue a special use permit to VT Hut Association to allow construction and use of a 3-season hut at site 16 in Chittenden Brook Campground.
Clarendon Shelter Privy Construction Project	Roc RD	LTF	2018	Construct one moldering privy for the Clarendon Shelter located along the Appalachian Trail/Long Trail (AT/LT) in Shrewsbury. Includes the construction of footpath access between the new privy and the AT/LT and the Clarendon Shelter.
Clearwater Sports Outfitter & Guide Special Use Permit	Roc RD	DM	2018	Reissue special use permit for paddleboard clinics and lessons on Blueberry Lake, and renting paddleboards and kayaks.
Confluence Outfitter & Guide Special Use Permit	Mid RD	LTF	2018	Issue temporary special use permit for 3 to 5 day backpacking, canoeing, snowshoeing, mountain biking, xc skiing trips. Group size would be 1-12 participants with 2-4 staff leaders. In the Wilderness, group size would not exceed 10, including staff. Groups would use primitive camps as well as us trail shelters and campgrounds.
Danby-Mt. Tabor F.D. #1 Ball Field Park or Playground Special Use Permit	Man RD	DM	2018	Reissue special use permit for 4 acre tract for use as sports field including mowing, repair and upkeep of the chain-link backstop fence, and the wooden plank and telephone pole benches.
Endurance Society Special Use Permit	Roc/Mid RD	DM	2017	Issue 5-year special use permit to authorize annual runner/x-country ski endurance races on existing trails.
Equestrian Trail Designation Additions	Man RD	LTF	2017	Expand designated equestrian trail system to be maintained by VT Trail Trotters. Includes FT385 from the intersection with FT388 to the intersection with FT391, and FT391 from the above intersection to FR73 at West Branch trail head and FT390. The proposal would add approximately 13 miles to the system.
Forest-wide Bridge Replacements	Forest-wide	DM	2017	Replacement of trail bridges across the Forest. Replace 8 trail bridges on pedestrian, mountain bike, cross country skiing and snowmobile trails. Includes 100 feet of trail relocation for one bridge.

Project Name (alphabetical order)	Location[1]	NEPA Level[2]	FY Approved	Project Description
Forest-wide Maple Tapping Special Use Permit Reissue	Forest-wide	DM	2017	Reissue special use permit for 6 separate existing maple tapping operations across the Forest.
Forest-wide Trail Maintenance	Forest-wide	LTF	2018	Routine maintenance of all Forest trails identified at Level I and Level II as defined in 2009 Trail Maintenance Letter to File.
FR70 & FR74 Gate Installation	Man RD	LTF	2017	Install newly fabricated road gates at the beginning of FR70 and FR74.
FT404 Big Branch Trail Decommission	Man RD	LTF	2017	Decommission trail by removing the sign, scarifying the trail tread, install check dams or water bars, and place rail fencing at the beginning of the trail tread in the Big Branch Overlook site to discourage use. Remove trail from National Forest Trail System.
Glastenbury Bridges Replacement	Man RD	LTF	2017	Remove and replace bridge along FT 375 snowmobile trail. Includes stream bank abutment work.
Goshen Gallop Long Term Special Use Permit	Mid RD	DM	2018	Reissue Recreation Event special use permit for 5 years for 5K and 10K cross-country trail runs by up to 160 participants and 50 spectators on NFS trails adjacent to Blueberry Hill Inn.
Green Mountain Power 2017 Construction/ Reconstruction Projects	Forest-wide	DM	2017	Two projects bringing power to 1) private parcels in the towns of Readsboro and Woodford, including the installation of 4 utility poles and approximately 1,180 feet of powerline; and 2) reconstruction of 2 utility poles and approximately 300 feet of power line in the town of Bristol.
Green Mountain Power Master Special Use Permit Renewal	Forest-wide	DM	2018	Renewal of existing special use permit for multiple ROWs across the Forest. Also includes permit transfer from CVPS to Green Mountain Power.
Green Mountain Rock Climbing Priority Special Use Permit	Mid RD	DM	2018	Issue 10-year permit for activities at Chittenden Reservoir, Lefferts Pond and Deer Leap.
Green Mountain Rockclimbing Priority Special Use Permit	Mid RD	LTF	2017	Issue a priority use special use permit not to exceed one year to conduct guided rock climbing and hiking on NFS land.
Homerstone Meadow Bridge Replacement	Man RD	LTF	2017	Remove and replace old bridge along Forest Trail 323, class 3 snowmobile trail.
Jeff Cohen Vendor Special Use Permit	Roc RD	LTF	2018	Issue special use permit to sell smoothies at Blueberry Lake parking area on weekends, weather permitting, from approximately 1000 to 1700 in late spring - fall. All material would be removed daily, and area will be cleaned and raked. Permit term is 1 year.
John Izzo Priority Special Use Permit	Mid RD	DM	2017	Issue 5-year Recreation Event special use permit for an Endurance Race in the Moosalamoo Area.
Kennett Cultivation Special Use Permit Reissue	Roc RD	DM	2017	Reissue special use permit for cultivation for several fields along the White River.

Project Name (alphabetical order)	Location[1]	NEPA Level[2]	FY Approved	Project Description
Killeen ROW Special Use Permit	Roc RD	LTF	2018	Issue special use permit for wheeled vehicle access to private lands. The road has been covered under a permit to the previous owner. The permit term will be 20 years. The ROW is 197 feet long x 20 feet wide (approximately .04 miles).
Killington Mountain Guides Outfitter & Guide Special Use Permit Reissuance	Roc RD	LTF	2017	Reissue temporary (<1 year) special use permit for rock climbing at Deer Leap.
Killington Town River Road Loop Trail Special Use Permit Reissue	Roc RD	DM	2018	Reissue special use permit for the operation and maintenance of the 0.3 mi. piece of the Tow4-mileillington's 4-mile River Road Loop Trail that is on NFS land.
Korzun Grazing Special Use Permit	Roc RD	DM	2018	Issue a special use permit for year-round livestock area for grazing on approximately 4.9 acres west and 4.9 acres east of Lottery Road in the Town of Shrewsbury, VT. There will be no structures, and maintenance would include fence repair, seasonal cutting of brush/weeds. Permit term would be 10 years.
Lefferts Pond Day Use Parking and Accessibility Upgrades	Mid RD	DM	2017	Construct accessible fishing pier, parking area for about 35 cars and widen existing Forest Road 412 to access Lefferts Pond Day Use Area.
Maher FLPMA Road Special Use Permit	Roc RD	DM	2017	Issue road and/or special use permit for wheeled vehicle access during appropriate times of the year, and snowmobile use during the winter on including portions of FR62, FR62A.
Moosalamoo Pump Trail	Mid RD	SIR	2017	Construct 1.5-mile mountain bike pump track at Moosalamoo Campground. SIR of the Moosalamoo Campground DM since it is within the same location.
Mount Snow Disc Golf Course and Mountain Bike Race Event	Man RD	DM	2017	Develop 9 target course on existing ski trails or service roads with tee box and target baskets. Also includes approving use of trails for downhill mountain bike race event scheduled for summer 2018.
Mount Snow Long John Trail Updates	Man RD	SIR	2017	Review new information pertaining to trail length, blasting rock and northern long eared bat tiered to the 2010 Long John Trail DM.
Mount Snow Miscellaneous Trail Widening	Man RD	LTF	2018	Multiple trail improvement activities at Mount Snow Ski Area.
Mountain Meadows Special Use Permit Re-issuance	Roc RD	DM	2018	Reissue 10-year permit to operate and maintain existing Nordic trail system. The trail system is comprised of approximately 10.9 miles of trails, of which 1.4 miles, or 13%, is on NFS land. The permit term would be for 10 years.
Peak Priority Special Use Permit	Roc/Mid RD	DM	2017	Issue 5-year permit to authorize annual runner endurance race on existing trails.
Prospect Mountain Nordic Trail Improvement	Man RD	DM	2018	Upgrade and repair Nordic trails. Includes cutting about 10 trees, install culverts and widen/relocate trails.

Project Name (alphabetical order)	Location[1]	NEPA Level[2]	FY Approved	Project Description
Prospect Mountain Sale Permit	Man RD	LTF	2018	Issue 10-year permit to new owner with no change to terms and conditions from previous owner permit.
Red Pine Landowners Association Road and Green Mountain Power Powerline Special Use Permits	Man RD	DM	2017	Issue road permit to Red Pine Landowners Association to access private land inholdings; and issue permit to Green Mountain Power to bury powerline along road.
Regional Forester Sensitive Species List Update	Forest-wide	SIR	2018	Reviewed existing all ongoing projects in light of the updated Regional Forester Sensitive Species list.
Rikert Nordic Center Special Use Permit Reissuance	Mid RD	DM	2017	Reissue ski trail special use permit to Rikert Nordic Center for approximately 3 miles of cross-country trails.
Sargent Log Landing Special Use Permit	Man RD	DM	2018	Issue special use permit to skid logs from a 20-acre private tract on an existing woods road to an existing landing, then haul over the existing woods road to Town Highway 18.
South of Route 9 IRP	Man RD	EA	2017	Multiple resource project to implement Forest Plan goals and objectives in the area south of Route 9.
Sugarbush Village Chairlift Replacement	Roc RD	DM	2017	Replace Village Chair lift at Sugarbush Ski Area. Upgrade to fixed grip quad. Possible increase in comfortable carrying capacity.
Ten Kilns Bridge 4 Replacement	Man RD	LTF	2018	Remove and decommission the current Ten Kilns 4 Trail Bridge and construct a new 28-foot-long trail bridge and abutments.
Tucker Johnson Shelter Reconstruction & Appalachian Trail Relocation	Roc RD	DM	2017	Reconstruct Tucker Johnson Shelter that was destroyed by fire in March 2011. Includes construction of a short trail between the shelter and new privy.
VT Adaptive Ski & Sport (VASS) Endurance Race Special Use Permit	Roc RD	DM	2017	Issue 5-year permit to authorize annual runner/horse endurance race on existing snowmobile trail crossing AT corridor.

[1] Man RD = Manchester Ranger District; Roc RD = Rochester Ranger District; Mid RD = Middlebury Ranger District; Roc/Mid RD = Rochester and Middlebury Ranger Districts

[2] EA = Environmental Assessment; DM = Categorical Exclusion (Decision Memo); Categorical Exclusion (Letter to the File); SIR = Supplemental Information Report.

Evaluation and Conclusions: There were a total of 52 projects approved for Forest Plan implementation in fiscal years 2017 and 2018. An additional 4 project decisions were reviewed with supplemental information reports. All projects were designed and found to be consistent with Forest Plan direction including goals, objectives, and forest-wide and management area standards and guidelines. Collectively, these projects have moved existing conditions toward desired future conditions according to each management area direction where they are located.

Recommendations: No recommended changes to this monitoring question.

Monitoring Item Name: Standards and Guidelines - Implementation and Effectiveness Monitoring

Monitoring Question: To what extent have Standards and Guidelines been applied?

Detailed Monitoring Question: Are standards, guidelines, and mitigation measures being implemented on projects consistent with Forest Plan and project NEPA direction? Are these measures effective at achieving the desired results? Are there other measures that could be more effective?

Monitoring Driver: Forest Plan Forest-wide and Management Area Standards and Guidelines.

Evaluation and Conclusions: The Forest Plan states that Forest-wide Standards and Guidelines (S&Gs) apply to all National Forest System lands for the purpose of protecting or managing forest resources. There are also S&Gs specific to each management area. Standards and Guidelines are designed to achieve Forest Plan goals and objectives and minimize or negate the effects of a management action or land use. Additional design features and mitigation measures have also been developed for site specific projects during the environmental analysis process to further protect resources or lessen impacts.

Monitoring project implementation during or after completion determines if projects have been implemented as designed and whether they have achieved the desired results. Monitoring projects also determines whether Forest Plan S&Gs, and project specific design features and mitigation measures have been implemented and whether they have protected resources as intended. Although this level of monitoring is completed by resource specialists as they visit project sites throughout the year, they also visit sites as a monitoring team on scheduled dates to discuss the interdisciplinary approach to assess implementation effectiveness.

Although no scheduled site reviews occurred during fiscal years 2017 and 2018, this report includes the results from the November 5 and 6, 2015 interdisciplinary team monitoring field review of Manchester Ranger District projects. This field review was inadvertently not included in the *GMNF Fiscal Years 2014, 2015, and 2016 Annual Monitoring and Evaluation Report*.

Each project visited was evaluated using a set of questions designed to answer the following Forest Plan implementation monitoring questions:

1. Did the project move the area or resource toward the Forest Plan desired future condition and/or meet the intent of the purpose/need from the decision document? Did the project accomplish what it was planned to achieve?
2. If no, what is it about the project that did not move toward the desired future condition or achieve what it was planned to do? How could the project be improved to do so?
3. Was the project implemented as designed?
4. If no, what was changed and what was the reason for the change? Were the changes effective, and within the project scope of the analysis and decision including mitigation measures? Were the changes reviewed, reported or documented?
5. Were Forest Plan standards and guidelines followed during project preparation and implementation?
6. If no, what is it about the project that did not meet Forest Plan standards and guidelines and how could it be improved to do so?
7. Should the Forest Plan standards and guidelines be changed or improved as a result of the implementation of this project?
8. If yes, how and why should it change?

9. Were the mitigation measures and/or design criteria included in the project decision followed during project preparation and implementation?
10. If no, what is it about the project that did not include required mitigation measures and/or design criteria and how could it be improved to do so?
11. Were the mitigation measures and/or design criteria effective and achieve their desired intent?
12. If no, what changes or improvements should be made so that they are more effective?
13. Were the applicable Forest Plan standards and guidelines, mitigation measures and/or design criteria included in the project contract or force account instructions, or reviewed with partners or Forest Service staff implementing the project?
14. If no, how could this process be improved?
15. Are there any other specific resource concerns identified from monitoring this project?

Except for limited circumstances highlighted below, all projects monitored during the interdisciplinary field visits were found to have Forest Plan S&Gs, and project design features and mitigation measures implemented effectively to achieve their desired level of protection to resources.

Monitoring timber sale activity associated with the Nordic project on the Manchester Ranger District harvested in summer 2015 revealed some deviation from recreation trail protection specified in project mitigation measures. Several sections of the Catamount Trail transecting the sale unit harvested were not returned to pre-harvest activity conditions. Some visual quality guidelines were also not followed as planned although deviation was agreed between the timber sale administrator and Recreation staff due to problems with trees blown down that were initially retained along the road.

There was no identified need to modify S&Gs or recommended changes to Forest Plan components from routine monitoring efforts conducted by resource specialists or during the interdisciplinary site reviews.

Recommendations: No change to the monitoring question.

Recreation

Monitoring Item: Effects of Vehicle Use Off Roads

Monitoring Question: Is the use of vehicles off roads causing considerable adverse effects on resources or other forest visitors? How effective are forest management practices in managing vehicle use off roads?

Monitoring Question: What is the effect of snowmobile use on the quality of recreation experienced by other forest users?

Monitoring Driver: Regulatory requirements (36 CFR 295) state that use of vehicles off roads shall be planned, implemented and monitored to protect resources and visitors from considerable adverse effects, promote public safety, and minimize conflicts with other uses of National Forest System lands

Monitoring Activities: From fiscal years 2014 to 2018, monitoring of off-road vehicle use continued in conjunction with routine law enforcement patrols. Off-road vehicle use includes summer off-highway vehicles (OHVs), including all-terrain vehicles (ATVs) and utility terrain vehicles (UTVs), as well as winter over-snow vehicles (snowmobiles). As patrols and trail condition inventories document incidents or the issuance of notices of violation, the incidents are recorded and entered into the Law Enforcement and Investigation Management Attainment and Reporting System (LEIMARS) database. Retrieved data

can be used to show trends; however, the number of incidents fluctuates depending on the availability of law enforcement and forest protection officer personnel.

Evaluation and Conclusions: This monitoring measures the change in law enforcement incidents and violations utilizing data entered over the ten-year period of 2006 to 2018 for the Green Mountain and Finger Lakes National Forests (Figures 3-6 and 3-7). Data indicate trends and provide baseline quantitative data to which monitoring can be added annually. Data are separated into "incidents" (includes warnings and visual identification of a violation) and "violations" where somebody receives a citation for the infraction.

The data shows an overall decreasing trend from 2006 to 2018 for OHV incidents and violations. The reasons for this trend is unclear, but could be the result of: 1) a decreased field presence of law enforcement personnel; 2) better understanding from the public due to improved education, signing and barrier control efforts; 3) increased partner collaboration to help address unauthorized use and to better align public demand for snowmobile and off-highway vehicle trails with approved and designated National Forest System trails. In addition, Forest Service staff have been making a focused effort to include mitigation measures in site specific projects to deter unauthorized vehicles through public collaboration and education, and installation of signing and engineering controls such as gates, stiles and boulders.

The data shows fluctuating levels of snowmobile incidents and violations from 2006 to 2018. This is likely the result of varying levels of law enforcement personnel, including Forest Protection Officers, and fluctuating capacity to provide weekend snowmobile patrols on GMNF.

Figure 3-6. *Law Enforcement Incidents and Violations for Over-Snow Vehicles between 2006 and 2018.*

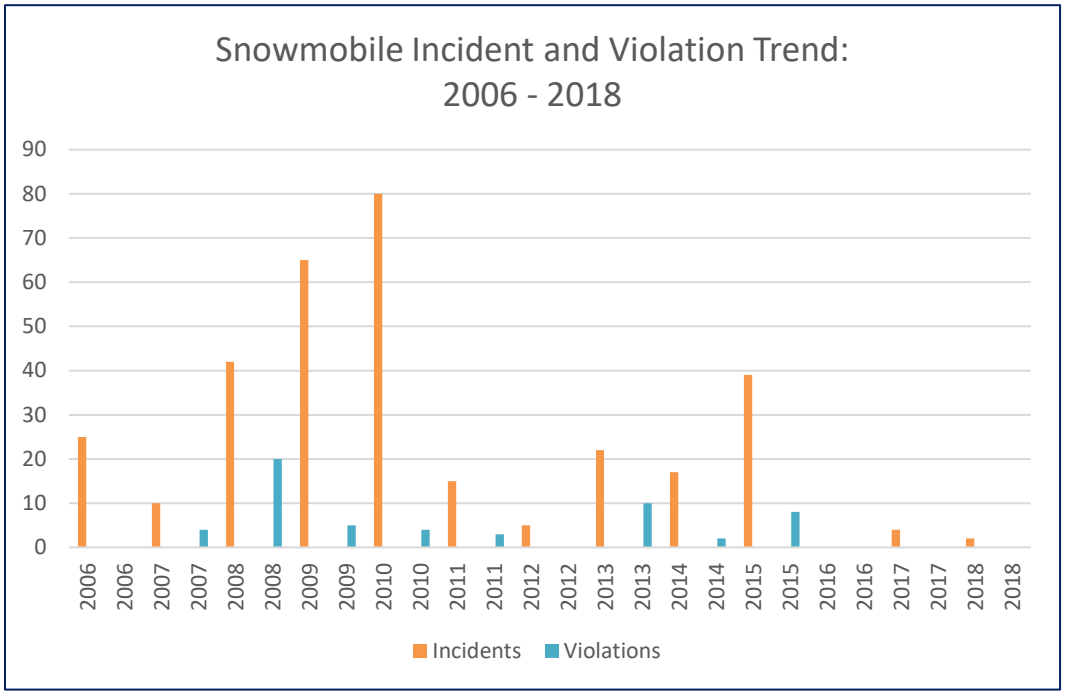
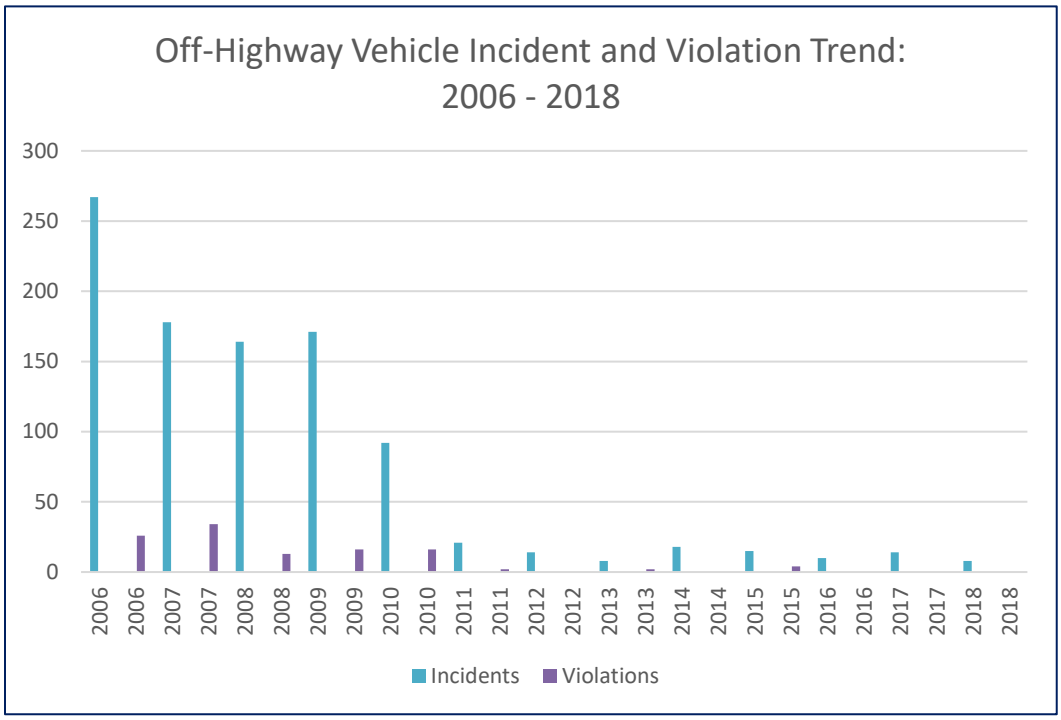


Figure 3-7. *Law Enforcement Incidents and Violations for Off-Highway Vehicles between 2006 and 2018.*



Recommendations: More qualitative data such as narratives based on site specific project analyses and monitoring can improve monitoring conclusions. Consider refining methods of collecting and analyzing data so that summer off-highway vehicle and over-snow vehicle incidents are accurate and mapped with GIS, including distinguishing between incidents in Vermont and New York.

Monitoring Item: Recreation Facility Maintenance

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Monitoring Question: Is the Forest reducing deferred maintenance on developed recreation facilities and sites. Is the Forest increasing the number of recreation facilities that are maintained to standard.

Monitoring Driver: Forest Plan Goal 12 and associated Objectives.

Monitoring Activities: This monitoring question measures percentage managed to standard and trends; however, annual reports for 2017 and 2018 were not generated to identify the deferred maintenance nor the number of recreation facilities managed to standard during this monitoring period.

Evaluation and Conclusions: Not available.

Recommendations: No recommended change to this monitoring question. Ensure annual reports are generated to capture deferred maintenance on developed recreation facilities and the number of recreation facilities managed to standard for future reporting efforts and trend data.

Monitoring Item: Scenic Integrity Objectives

Monitoring Question: To what extent have Objectives been attained?

Monitoring Question: Has the Forest transitioned from the current Visual Management System to the Scenery Management System?

Monitoring Driver: Forest Plan Goal 15 and associated Objectives.

Monitoring Activities: The transition to managing for scenic integrity objectives from using the Visual Management System to the Scenery Management System (SMS) has not been completed.

Evaluation and Conclusions: Competing priorities and inadequate staff and skills have delayed the transition to the SMS. Forest Service staff should continue to explore opportunities, including the Enterprise Program, to transition to the SMS as soon as practical.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Trail Maintenance

Monitoring Question: Is the quality of the Forest Service trail system being improved through operation and maintenance?

Detailed Monitoring Question: Is the amount of deferred maintenance on the GMNF trail system being reduced?

Monitoring Driver: Forest Plan Goal 12 and associated Objectives.

Monitoring Activities: This monitoring measures total deferred maintenance divided by total system trail miles for GMNF; however, annual reports for 2017 and 2018 were not generated to identify the deferred maintenance nor National Forest Trail System miles during this monitoring period.

Evaluation and Conclusions: Not available.

Recommendations: No recommended change to this monitoring question. Ensure annual reports are generated to capture deferred maintenance and trail mileage data for future reporting efforts.

Monitoring Item: Trends in Trail Partnerships

Monitoring Question: To what extent have Objectives been attained?

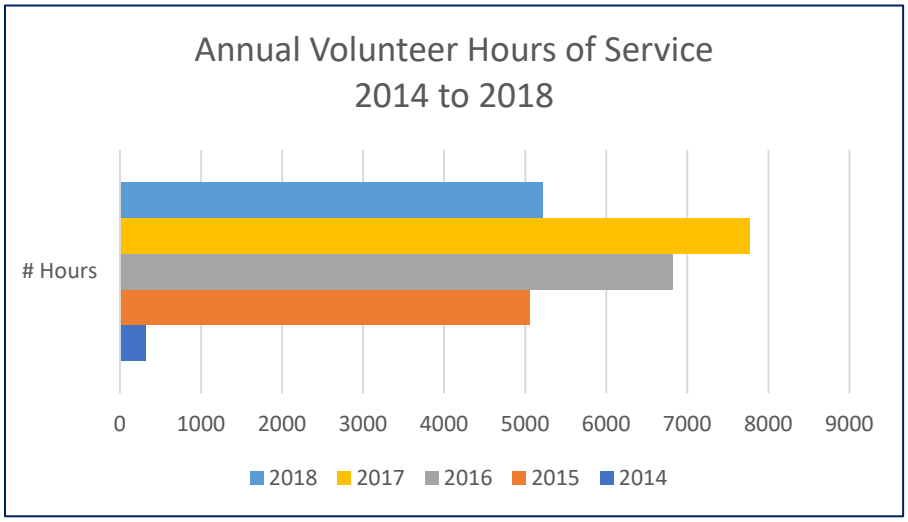
Detailed Monitoring Question: How well is the Forest using partnerships to assist in the operations and maintenance of the Forest trail system?

Monitoring Driver: Forest Plan Goal 12 and associated Objectives.

Monitoring Activities: Forest Service staff and partners collect volunteer data annually, including demographic figures, total volunteer numbers, hourly contributions, and more. This data is compiled and reported nationally through the Volunteer & Services Reporting system for both individual and group volunteers on the Green Mountain and Finger Lakes National Forests.

Evaluation and Conclusions: Figure 3-8 depicts annual volunteer contributions (total hours) over the three-year period from fiscal years 2014 to 2016. Annual volunteer contributions rose sharply from 320 total hours in 2014 to 6,821 hours in 2016. The reason for this trend is unclear but could be the result of increased Forest Service partner/volunteer engagement as well as improved reporting. Additionally, several large projects were implemented in 2016; these projects had consistent social media presence with organized volunteer events resulting in an outpouring of volunteer support.

Figure 3-8. *Annual Volunteer Contributions (Hours) on the Green Mountain and Finger Lakes National Forests from 2014 to 2018.*



Recommendations: No recommended change to this monitoring question.

Monitoring Item: Visual Quality Objectives

Monitoring Question: To what extent have Objectives been attained?

Detailed Monitoring Question: Is the Forest being managed in accordance with the visuals standards and guidelines found in the Forest Plan and are the visuals standards and guidelines and any additional site specific design criteria effective in helping to meet the VQOs (Visual Quality Objectives)?

Monitoring Driver: Forest Plan Goal 15 and associated Objectives.

Monitoring Activities: Annual monitoring trips provide the opportunity to review project implementation and adherence to Forest Plan Visual Quality standards and guidelines as well as project-specific design criteria and mitigations. During the monitoring trips, resource staff determine if the VQOs were met and if not met, discuss what could have been done to achieve VQO and/or what could be done toward meeting VQO.

Additionally, ongoing field reviews identify visual concerns from project implementation and major storm events as well as opportunities to enhance visual resources.

Evaluation and Conclusions: Based on available documentation, annual monitoring trips did not identify any projects that failed to adhere to VQOs.

Recommendations: No recommended change to this monitoring question.

Soils

Monitoring Item: Soil and Water Standards and Guidelines, Mitigation Measures, and Best Management Practices

Monitoring Question: To what extent have Standards and Guidelines (S&Gs) and Mitigation Measures been applied? How often are Best Management Practices (BMPs) implemented and effective?

Detailed Monitoring Question: Were Soil and Water S&Gs, mitigation measures, and BMPs implemented on selected projects, and were they effective in protecting the soil, water and wetland resources?

Monitoring Driver: Forest Plan Goals 3 and 4, and associated Objectives, and Forest-wide Soil, Water, and Riparian Area Protection and Restoration and Management Area Standards and Guidelines.

Monitoring Activities:

Current Indicator and Corresponding Measurement

1. Are Forest Plan Standards and Guidelines being followed? What percentage of the time are they implemented?
2. Of the Mitigation Measures that are put into place, what percentage of the time are they being implemented?
3. Best Management Practices for water quality management on NFS lands, implementation and effectiveness ratings.

In fiscal years 2017 and 2018, soil monitoring activities measured the implementation and effectiveness of Forest Plan Standards and Guidelines (S&Gs) designed to control erosion, prevent sedimentation, protect wetlands, and maintain soil and water quality. Periodic visits were made to active timber sale areas (during and after harvest), recreation, construction, and road maintenance projects, and special use permit sites to determine whether Forest Plan S&Gs and mitigation measures were implemented and effective in minimizing soil erosion, stream sedimentation, and impacts to wetlands and water quality. Sites were selected for review for various reasons: randomly, because of the presence of concern, or because an issue or noncompliance had been reported.

This monitoring also helps determine whether Forest Plan Goals 3 and 4 are being achieved (maintain or restore the natural ecological functions of the soil; and maintain or restore aquatic, fisheries, riparian, and wetlands, respectively). Soil ecological functions include the ability of the soil to store water, provide a substrate for plant growth, filter pollutants, and store carbon.

Monitoring was completed by Forest Service soil scientists or soil technicians. Tree harvest activities have a high potential to impact soil, water, and wetland resources, so harvesting continues to be the major emphasis of the monitoring program (Table 3-12).

Table 3-12. Soil and water quality monitoring locations in fiscal years 2017 and 2018.

2017 Monitoring	2018 Monitoring
Country Road Timber Sale (Payment Unit 4)	Grouse Timber Sale (Payment Unit 22)
Pumphouse Timber Sale (Payment Units 5 and 11)	Texas Timber Sale (Payment Unit 7)
Cookbrook Timber Sale	Roaring Brook Timber Sale (Payment Unit 11, landings)
Grouse Timber Sale (roads/culvert)	Mad Tom Timber Sale (skid trail)

Evaluation and Conclusions: Table 3-13 shows the results of BMP effectiveness ratings from sites monitored in fiscal years 2017 and 2018.

Table 3-13. Best Management Practices for water quality management on NFS lands, implementation and effectiveness ratings.

Site Name	Monitoring Activity	Implementation	Effectiveness	Composite
Apple Orchard, Stand 111	Use of Prescribed Fire	Fully	Effective	Undetermined
Johnson Pasture, 16	Grazing Management Site	Marginal	Marginal	Poor
Backbone Horse Camp	Pack and Riding Stock Use Areas	Fully	Not Effective	Poor
Grouse Lane	Completed Construction/ Reconstruction or Operation & Maintenance of Parking Areas	Fully	Effective	Excellent
Terry Berry Wetland Restoration	Completed Aquatic Ecosystem Improvements	Fully	Effective	Excellent
Blueberry Patch Campground	Developed Recreation Sites	Marginal	Effective	Good
Mount Snow, Fallen Timbers	Ski Run Operation and Maintenance	Marginal	Mostly	Fair
Forest Road 42 (Bingo Road)	Road Operation and Maintenance	Fully	Marginal	Fair
Mad Tom Stewardship (Unit 13)	Mechanical Site Treatments	Marginal	Effective	Good
Texas Stewardship Service Project	Mechanical Site Treatments	Mostly	Effective	Excellent
Pumphouse Timber Sale (Unit 1)	Mechanical Site Treatment	Mostly	Not Effective	Poor

Outside of BMP Program monitoring, regular field inspections were made to determine whether Forest Plan S&Gs and mitigation measures were followed during implementation of management activities.

Fiscal Year 2017

Out of 17 sites monitored, 3 had S&G, design criteria, mitigation measure, or BMP noncompliance:

- Cook Brook Sale, Peru, VT: Skidder operation occurred within a stream buffer. Logs were also piled within buffer. Sawdust was observed within the buffer as well, mixed with the snow. Operators were notified to stay out of the buffer in the future and spread sawdust uphill of the landing, away from the stream, to avoid transport into the stream during spring snowmelt.
- Camp Capella: A perennial stream was running down a 6-ft length of trail. Restoration work suggested

Fiscal Year 2017

Out of 15 sites monitored, 4 had S&G, design criteria, mitigation measure, or BMP noncompliance:

- Grouse Timber Sale, Hancock, VT: Stream crossing and buffering AMP noncompliance. Logging slash in the stream was removed from stream bed afterward.

- Sunnyside Sale, Dorset Peru IRP: A log landing was located within a wetland buffer, a S&G noncompliance. Corrective action was to not use corner of landing within the buffer. Excessive rutting from skidder operation was also identified. Corrective actions were to smooth and install water bars.

Forest Plan S&Gs were followed at approximately 75 percent of the units monitored. Overall impacts to soil, water, and wetland resources were small in magnitude, duration, and extent. Erosion, stream sedimentation, and wetland disturbance were not often observed. When incidents of noncompliance occurred, they were corrected when possible and used as learning opportunities to change future management.

Recommendations: No recommended change so this monitoring question.

Terrestrial Ecological Units

Monitoring Item: Ecological Type Mapping and Representation

Monitoring Question: To what extent have Objectives been attained?

Detailed Monitoring Question: To what extent are ecological types on the Forest represented within the ecological reference area network? To what extent do ecological types recognized on the Forest accurately represent the diversity of ecosystems and potential natural vegetation on the Forest?

Monitoring Driver: Forest Plan Goal 6 and associated Objectives.

Monitoring Activities: The Forest Plan supports the notion that ecological processes and systems are to be maintained on GMNF within the desired ranges of variability (Forest Plan, Goal 6, p. 14). This goal includes the objective to manage at least five percent of each ecological type present on GMNF for old growth characteristics. Managing a proportion of each type in a way that allows natural disturbance processes to regulate forest types and forest structure ensures that the full range of variation in ecological systems on GMNF can be supported.

To address representation of ecological types in the network of reference areas, ecological types were defined in the GMNF Forest Plan Environmental Impact Statement (FP EIS) in three ways:

1. Landtype Associations (LTAs) represent landscape-sized units defined by broad patterns of vegetation in combination with the physical environment. LTAs include groupings of Ecological Land Unit Groups (ELUGs), and are nested within the biophysical regions of Vermont (such as valley bottoms LTA or mountain slopes LTA within the Northern Green Mountains; Table 3.11-3, FP EIS, p. 3-236).
2. ELUGs represent groups of ecological types defined by unique combinations of soil conditions and late-successional vegetation expected to be at a particular site due to geology, soils, topography, existing vegetation, and land use history (such as subalpine forest, mid-elevation slope forest, low rocky slope and crest forest; Table 3.11-4, FP EIS, p. 3-237).
3. Major Forest Communities are similar to habitat types defined in the Forest Plan. They consist of groupings of forest types that are classified by foresters for inventory purposes. For example, northern hardwoods include typical beech-birch-maple forests as well as forests dominated by beech and red maple, and those dominated by sugar maple, basswood, and ash (Table 3.11-5, FP EIS, p. 3-237).

The FP EIS ensures that old growth characteristics are allowed to develop on GMNF by representing these ecological types in the “Reference Area Network”, a grouping of management areas and other

conditions that "…provide ecological reference or benchmark conditions for baseline monitoring and research, provide refuge for rare species, and provide some ecological conditions or functions that are not otherwise available across the landscape" (GMNF FP EIS p. 3-227). Areas that do or will provide these conditions for GMNF comprise the Reference Area Network (RAN) and include:

- Wilderness Management Area (MA)
- Remote Backcountry Forest MA
- Existing and Candidate Research Natural Area MA
- Ecological Special Area MA
- Alpine/Subalpine Special Area MA
- Robert T. Stafford White Rocks National Recreation Area MA
- Eligible Wild Rivers MA
- Unsuitable lands

In addition to monitoring adequate representation, another objective associated with this monitoring item was to revise the GMNF ecological classification system to ensure it represents the latest science and understanding of ecological classification and natural communities in the Green Mountains of Vermont. If there are ecosystems not captured or well-characterized in the classification system, then they may not be adequately represented in the RAN.

Updates to Ecological Classification

In 2009, the Forest Service developed an action plan for revising the current ecological classification system on GMNF. Two precursors were identified that would need to exist prior to this revision: 1) the development of a till model for till chemistry, and 2) the acquisition of LiDAR coverage of GMNF. The GMNF staff are also working closely with the White Mountain National Forest (WMNF) staff as they revise and update their ecological classification system using LiDAR and computer modeling, which is promising to reduce the amount and intensity of field sampling required for a revision to their system.

The State of Vermont Natural Heritage Inventory Program also continues to inventory, map, and classify natural communities across the State, and has updated and revised many natural community types and groups since the 2013 analysis. Until Forest Service staff completes a revision of the ecological classification system for GMNF, this report evaluates and uses a variety of existing ecological types and natural communities as it monitors representation in the RAN.

For this report, the acreage and proportion analyzed is based on three ecological classifications:

1. USDA Forest Service Ecological Subsections
2. TNC Modeled Community Ecosystems

   As in the previous (2013) analysis, "Modeled Community Ecosystems" developed by The Nature Conservancy (TNC) were used in place of the ELUGs considered in the FP EIS. The TNC community ecosystem map is available online for download at: www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/mapsdata/Pages/default.aspx
   While these modeled ecosystems have not been field validated on GMNF, they make use of the same base ecological units used in the FP EIS representation analyses (that formed the basis of Ecological Land Unit Groups or ELUGs), and cover the entire state of Vermont (which the ELUGs did not).

3. GMNF Forest GIS stand data

   GMNF Forest GIS stand data were used for calculation of Major Forest Community proportions and distribution, which are broadly conceived habitat types similar to those described in the FP EIS and used in landscape-scale analysis for large projects on GMNF (Habitat Management Unit analysis).

Representation Analysis

This report documents an updated analysis to quantify representation of ecological units in the RAN based on GMNF ownership at the end of fiscal year 2018. The following three factors affect this analysis and can lead to different proportions than those documented in the FP EIS (Section 3.11, pp. 3-226 to 3-254); these revisions affect both the relative proportion of ecological types on GMNF and the acres and delineation of the RAN, which includes unsuitable stands:

- Adjustment of management area allocation and stand delineation corrections or updates can change the size and delineation of the RAN.

  Forest Service staff completed resolution of some longstanding errors associated with the boundaries of Big Branch and Peru Peak Wilderness areas, which also affected some shared boundaries of White Rocks National Recreation Area. These adjustments to the RAN were incorporated into this analysis.

  In addition, corrections were made during 2013 to 2018 to several geographic data layers that represent GMNF ownership, management area delineation, stand delineation, and classification of unsuitable lands. These corrections are ongoing and will continue for the foreseeable future; the Forest Service generally has the capacity to make these corrections only in areas where sizable management actions are under consideration.
- New acquisitions or land disposals can change the abundance and distribution of ecological types.

  During fiscal years 2006 to 2018, approximately 8,563 acres were added to GMNF and 7 acres were disposed (surplus or exchange), for a change of approximately 8,556 acres of NFS lands added since the representation analysis was conducted for the FP EIS.

  Since the previous analysis in 2013, there were seven land acquisitions totaling 683 acres added to GMNF. The newly acquired acreage is included in the Ecological Subsections and Ecological Systems analyses. Stand data has been created for one of those acquisitions (11 acres); therefore, the newest acquisitions will be mostly absent (98 percent) from the Major Forest Communities calculation which relies on stand data.
- New classifications of ecological types can change the analysis of what is being represented in the RAN.

  An update and recodification of USDA Forest Service ecological units took place in 2007:
  - Map (Cleland et al. 2007)
  - Description (McNab et al. 2007)

  These 2007 classifications were used in this analysis. The 2013 analysis used subsection classifications developed prior to the 2007 update. Another USDA Forest Service ecological classification revision is underway currently with publication expected in summer 2022.

  TNC Modeled Community Ecosystems data were updated in 2010 for the Connecticut River Floodplain Forest only, so there are likely to be minor spatial adjustments on part of GMNF since the data used in the 2013 analysis. The ecological classification types remain the same.

  Major Forest Community data are updated as GMNF updates stand data alongside landscape-scale management consideration (Integrated Resource Projects). Therefore, updates have

occurred on portions of GMNF since the 2013 analysis, however, classification of ecological types remains consistent.

Evaluation and Conclusions: The entire GMNF is within the Adirondack-New England Mixed Forest – Coniferous Forest – Alpine Meadow Province (M211; >99 percent) and the Northeastern Mixed Forest Province (211; <0.1 percent; Table 3-14). Biophysical regions and the Ecomap subsections roughly correspond to groupings of similar areas, for example, the Southern Green Mountain biophysical region is comprised primarily of the Southern Green Mountain and the Berkshire-Vermont Upland subsections; and the Taconic Mountains subsection is primarily comprised of the Taconic Mountains and Vermont Valley biophysical regions. Since the boundaries of these designations do not align in many places and one designation is not nested within the other, results of this analysis are presented by subsection only.

The Southern Green Mountain and Northern Green Mountain subsections together comprise 95 percent of GMNF; while the four smallest subsections together make up only 5 percent of GMNF and are located on the Forest's eastern and western edges. LTAs continue to be represented in the RAN above the Forest Plan threshold of five percent for each Subsection-LTA except one which is not represented; the rest of the Subsection-LTAs are represented at levels of 15 percent or more (Table 3-14). The unrepresented Precambrian Plateau within the relatively very small Taconic Mountains subsection was not a category in the 2013 analysis results. About half of this subsection-LTA is part of a 2015 acquisition (added to GMNF since the previous analysis); since the remainder is in portions of GMNF acquired prior to 2013, the new category can also be attributed to an LTA mapping revision. The Precambrian Plateau LTA comprises more than 53,000 acres within the Southern Green Mountain subsection, with 41 percent of those acres represented within the RAN.

Table 3-14. Representation of Landtype Associations (LTAs) by Ecological Subsections in the GMNF and Reference Area Network (RAN), 2018.

Landtype Association by Ecological Subsection	LTA on GMNF[1] (acres)	LTA Proportion of GMNF (%)	LTA in RAN (acres)	Proportion of GMNF LTA within RAN (%)
Southern Green Mountain (M211Cd)		**70**		
Bedrock Hills	93,978	23	38,590	41
Mountain Slopes	62,102	15	30,365	49
Precambrian Plateau	53,951	13	22,322	41
Upper Mountain Slopes/Mountaintops	30,852	8	24,367	79
Valley Bottom Riverine and Lakeside Floodplain	8,406	2	5,659	67
Vermont Escarpment	34,924	9	19,459	56
Northern Green Mountain (M211Ca)		**25**		
Bedrock Hills	6,230	2	1,640	26
Mountain Slopes	64,712	16	27,196	42
Upper Mountain Slopes/Mountaintops	31,641	8	29,019	92
Valley Bottom Riverine and Lakeside Floodplain	300	<1	252	84
Taconic Mountains (M211Cb)		**2**		
Bedrock Hills	827	<1	190	23
Enriched Mid-Elevation Slopes	1,111	<1	1,082	97
Low Rolling Upland	546	<1	80	15
Mountain Slopes	5,511	1	1,728	31
Precambrian Plateau	9	<1	0	0

Landtype Association by Ecological Subsection	LTA on GMNF[1] (acres)	LTA Proportion of GMNF (%)	LTA in RAN (acres)	Proportion of GMNF LTA within RAN (%)
Upper Mountain Slopes/Mountaintops	1,754	<1	1,456	83
Valley Bottom Riverine and Lakeside Floodplain	216	<1	154	71
Berkshire-Vermont Upland (M211Cc)		**2**		
Bedrock Hills	3,383	1	634	19
Mountain Slopes	4,441	1	2,957	67
Upper Mountain Slopes/Mountaintops	290	<1	278	96
Southern Piedmont (M211Bb)		**<1**		
Dissected Low to Mid-Elevation Calcareous Metamor	1,806	<1	1,698	94
Temperate Hills of Southeastern Vermont	787	<1	652	83
Water-Deposited Glacial Sediments Major Streamways	47	<1	40	85
Champlain Glacial Lake and Marine Plains (211Ec)		**<1**		
Low Rolling Upland	264	<1	82	31
Marine-Lacustrine-Glaciofluvial Coarse Sediments	56	<1	17	30
Valley Bottom Riverine and Lakeside Floodplain	23	<1	23	100
Valley Floor Glacial Lake/Marine Plains	4	<1	4	98
TOTAL	**408,171**		**210,646**	**52**

Source: McNab et al (2009), Forest GIS data (2018-2022)
[1]Acres are less than the total federal ownership acreage due to exclusion of large bodies of water like Chittenden Reservoir (M211Cd Lake/Reservoir, 733 acres).

Representation of modeled ecological systems within the RAN is above 30 percent for all 31 ecological systems (Table 3-15). The largest classification, Laurentian-Acadian Northern Hardwood Forest: typic, comprises 61 percent of GMNF. The remaining ecological systems all individually comprise less than ten percent of GMNF. Most changes from the 2013 results can be attributed to corrections and adjustments to Forest spatial data and stand and Wilderness boundaries.

Table 3-15. Representation of The Nature Conservancy's Ecological Systems within the GMNF Reference Area Network (RAN).

Ecological System (ES)	ES on GMNF	ES Proportion of GMNF	ES in RAN	Proportion of GMNF ES within RAN
	(acres)	(%)	(acres)	(%)
Acadian-Appalachian Alpine Tundra	3	<1	3	100
Acadian-Appalachian Montane Spr-Fir-Hardwood Forest	23,614	6	21,875	93
Acadian Low Elevation Spruce-Fir-Hardwood Forest	10,608	3	5,590	53
Acadian Sub-boreal Spruce Flat	1,682	<1	958	57
Appalachian (Hemlock)-Northern Hardwood Forest: drier	2	<1	2	100
Appalachian (Hemlock)-Northern Hardwood Forest: moist-cool	910	<1	460	51
Appalachian (Hemlock)-Northern Hardwood Forest: typic	4,026	1	1,346	33
Boreal-Laurentian-Acadian Acidic Basin Fen	992	<1	917	92
Central Appalachian Alkaline Glade and Woodland	19	<1	19	100
Central Appalachian Dry Oak-Pine Forest	288	<1	179	62

Ecological System (ES)	ES on GMNF	ES Proportion of GMNF	ES in RAN	Proportion of GMNF ES within RAN
	(acres)	(%)	(acres)	(%)
Central Appalachian Pine-Oak Rocky Woodland	27	<1	23	85
Laurentian-Acadian Acidic Cliff and Talus	4,379	1	3,342	76
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp	389	<1	242	62
Laurentian-Acadian Calcareous Cliff and Talus	1,413	<1	1,279	91
Laurentian-Acadian Calcareous Rocky Outcrop	1,306	<1	883	68
Laurentian-Acadian Floodplain Forest	26	<1	20	77
Laurentian-Acadian Freshwater Marsh	3,190	1	2,742	86
Laurentian-Acadian Northern Hardwood Forest, high conifer	23,570	6	12,882	55
Laurentian-Acadian Northern Hardwood Forest: typic	246,128	61	114,757	47
Laurentian-Acadian Northern Hardwoods Forest: moist-cool	16,155	4	9,124	56
Laurentian-Acadian Pine-Hemlock-Hardwood Forest: moist-cool	375	<1	211	56
Laurentian-Acadian Pine-Hemlock-Hardwood Forest: typic	14,093	3	4,877	35
Laurentian-Acadian Red Oak-Northern Hardwood Forest	28,374	7	11,084	39
Laurentian-Acadian Wet Meadow-Shrub Swamp	1,213	<1	968	80
N. Appalachian-Acadian Rocky Heath Outcrop	9,374	2	6,511	69
North-Central Appalachian Acidic Cliff and Talus	619	<1	572	92
North-Central Appalachian Acidic Swamp	9	<1	4	44
North-Central Appalachian Circumneutral Cliff and Talus	97	<1	94	97
North-Central Interior and Appalachian Rich Swamp	128	<1	47	37
North-Central Interior Wet Flatwoods	8	<1	5	63
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	10,750	3	6,574	61
TOTAL	**403,767**		**207,590**	**51**

Source: The Nature Conservancy (2006-2010), USFS GIS data.
[1]Acres are less than the >408,000 acres of federal ownership due to exclusion of acreage in waterbody, agricultural, and developed ecological system classes.

Major forest communities continue to be represented within the RAN at well above 20 percent for all communities (Table 3-16). Since these are broadly conceived habitat types, this is not surprising. Most of the aspen/birch is represented by paper birch forests in old clearcuts that are now in many of the Wilderness areas. Compared with the 2013 analysis, the acreage classified as hemlock-pine on GMNF is lower but the proportion of that acreage within the RAN is higher. The acreage of spruce-fir is similar on GMNF but the proportion within the RAN is higher. Stand data have not been generated for the majority of land acquired (672 of 683 acres = 98 percent) since 2013 so those lands are largely excluded from the major forest communities analysis. Shifts in proportion of forest communities in GMNF and within the RAN can be attributed to corrections and adjustments to stands due to more recent inventories and corrections.

Table 3-16. Representation of major forest communities within the GMNF Reference Area Network (RAN), 2018.

Major Forest Community (MFC)	MFC on GMNF[1]	MFC Proportion of GMNF (%)	MFC in RAN	Proportion of MFC in RAN (%)
	(acres)	(%)	(acres)	(%)
Aspen/Birch	14,967	4	12,821	86
Northern Hardwood	282,137	74	134,962	48
Mixedwood	57,672	15	26,278	46
Oak/Pine/Hardwoods	6,010	2	2,434	40
Hemlock-Pine	4,299	1	2,412	56
Spruce-Fir	17,460	5	12,140	70
Softwood Swamp	775	<1	734	95
TOTAL	**383,321**		**191,780**	**50**

Source: Forest stand and GIS data
[1]Acres are less than the >408,000 acres of federal ownership due to incomplete inventory data, some new acquisitions that have not been inventoried, and the exclusion of openings.

Based on current information, a range of ecosystems and processes on GMNF continues to be represented within the RAN at greater than five percent, as required by the Forest Plan. All ecological units analyzed that are represented at all in the RAN are represented at greater than five percent, with most represented at greater than 20 percent. This level of representation helps to ensure that a portion of most of GMNF ecosystem types are protected from direct human modification and allowed to develop structural complexity over time. In the context of changes due to climate and non-native invasive plants (NNIP), these reference ecosystems provide baseline conditions for long-term monitoring of environmental change. Some of these ecosystems are represented and monitored via the GMNF Long-term Ecosystem Monitoring Project (LEMP) plots, which are measured every 10 years. Smaller patch ecosystems that are considered rare or significant on GMNF are monitored more regularly for condition and threats.

Of all the ecological classifications considered, only the Precambrian Plateau within the Taconic Mountains Subsection was not represented within the RAN; all other classifications exceed the required 5 percent within the RAN. The 9 acres of Precambrian Plateau within the Taconic Mountains Subsection can be field validated for type and evaluated for their condition and quality. Once this is done, Forest Service staff will determine the best way to conserve this type, given the condition and quality of the sites and the surrounding landscape. Small patches surrounded by agricultural or developed lands or lands that are young, infested with NNIP or forest pests or intensively managed may require restoration and therefore may not be good candidates for the RAN.

The most pressing challenge in representing ecosystems within the RAN is in classification of ecosystems. Most of the classifications for ecosystems smaller than landscapes rely on existing vegetation. While it is relatively straightforward to model or inventory ecosystems based on vegetation, particularly with new remote sensing technology, existing vegetation on GMNF is generally a product of past land use and disturbance history. The history of forest change is extensive and dramatic for Vermont and GMNF, and the ecosystems and the RAN are a product of that history. Ecosystem components besides vegetation, such as terrain, aspect, elevation, soils, and geology, can be very useful in defining ecological units that are relatively static compared to vegetation. Forest Service staff will incorporate characterization of these “enduring features” as part of its ecological classification efforts, as these delineations are most likely to remain evident despite climate change and land use history. As vegetation shifts with climate change, ensuring the full range of these enduring features is represented within the RAN will increase the likelihood that the RAN will continue to represent the full range of natural

communities as well. Until Forest Service staff complete the revision of its ecological classification system, the best solution for representing ecosystems in the RAN is to analyze a variety of classifications.

Representation of ecological types in the RAN continues to be important to monitor, particularly considering the changing climate. The abundance and distribution of species is expected to change with time because of changes in temperature and precipitation patterns. It will be important to continue to monitor how ecological types are changing over the next 100 years in terms of composition, structure, and function, and adjust management accordingly, including representation and spatial distribution of the RAN. Having representation of all types within a RAN ensures that baseline conditions are retained so they can be monitored and compared to management activities outside the RAN and to regional trends in species movements and natural community changes.

New classifications that identify ecological units not represented within the RAN (such as the one Subsection/LTA), should be more extensively field validated. Forest Service staff should work with TNC and other partners to field validate and adjust the models as information is gathered.

Continued efforts at updating and improving existing ecological classifications will be important to document and define baseline conditions and detect changes in vegetation composition and structure. GMNF staff should work with Natural Resources Conservation Service, WMNF, and other partners to use remote sensing technology like LiDAR and LANDSAT imagery along with geospatial modeling to delineate enduring features that can then be sampled in the field to gather associated vegetation data. Analysis of this data can be used to revise mapping of enduring features and to create maps of ecological units. Final ecological units should be hierarchically nested so that at least two scales are represented (landscape and land unit), which would then be combined with current stand inventory to evaluate representation of ecosystems within the RAN. Longer term, TEUI mapping will serve as a broad scale update consistent across NFS units and beyond. Once the classification has been updated, the Long-term Ecosystem Monitoring Program (LEMP) plots should be evaluated to determine if there are any ecological units that are not being monitored over the long-term; any such units should be prioritized for establishment of long-term monitoring plots. Forest management designations should ensure appropriate representation of final ecological units in the RAN.

Recommendations: No recommended change to this monitoring question.

Terrestrial Wildlife Population

Monitoring Item: Bicknell's Thrush

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: What is the population trend of Bicknell's thrush on the National Forest System lands and adjacent lands?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: Bicknell’s thrush (*Catharus bicknelli*) is identified as a sensitive species (2017 Regional Forester Sensitive Species list). All site-specific project analyses include a biological evaluation to ensure sensitive species viability and to preclude trends toward endangerment that would result in the need for Federal listing.

Bicknell's thrush is considered one of North America's most rare and vulnerable songbird species due to limited habitat for breeding and significant habitat loss on its wintering grounds. Regionally, Bicknell's thrush populations have been declining across New England for many years. Their breeding habitat includes dense and stunted balsam fir-red spruce forests found at high elevations (>2,800 feet), which on GMNF mostly occur along the spine of the Green Mountains. The Vermont Center for Ecostudies (VCE) is the primary monitor of Bicknell's thrush breeding activity. Mountain Birdwatch (MBW) is the monitoring project for Bicknell's thrush and nine other bird species that breed in montane habitats across New England and in parts of the Catskill and Adirondack Mountains. The MBW project engages numerous volunteers to conduct bird surveys along designated routes at fixed locations that are surveyed every year. Each route is surveyed once each June, when Bicknell's thrushes can be detected by sight and sound in their breeding habitat. Each route typically covers six sample points; individual birds are counted by species and any nesting data are collected. There are ten established routes on GMNF, primarily on the Long Trail and/or the Appalachian Trail from Glastenbury Mountain north to Mt. Ellen.

Evaluation and Conclusions: Vermont Center for Ecostudies (VCE) biologists and volunteers and surveyed established GMNF routes during fiscal years 2017 and 2018. However, the effort between the years was not even. In 2017, only two sites were surveyed whereas in 2018, eight routes were surveyed. Bicknell's thrushes were detected in both years, and in 2018 most of the routes recorded this species. Two years of data are not enough to determine trends in Bicknell's populations on GMNF, especially given the difference in monitoring efforts. However, these data are important as part of the larger, regional Bicknell's thrush data set. VCE has recently used data from the northeast, including data collected on GMNF, to test predictions of Bicknell's population size and patterns of abundance and have published their results (Hill and Lloyd 2017).

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Common Loon

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: Do we have common loons on/near the National Forest System lands? Are they nesting? Are they nesting successfully? Do they need protection or habitat management?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: Common Loon (*Gavia immer*) is identified as a sensitive species (2017 Regional Forester Sensitive Species list). All site-specific project analyses include a biological evaluation to ensure sensitive species viability and to preclude trends toward endangerment that would result in the need for Federal listing.

Common loons are monitored across the state by Vermont Center for Ecostudies (VCE) biologists and volunteers. Additional technical support is provided by the Vermont Fish and Wildlife Department. Monitoring includes watching loons and collecting data on loon distribution, abundance, nesting success, and chick survival. Common loons are also monitored through a VCE-sponsored citizen science annual event called Loonwatch, which provides data for determining a statewide population estimate, and includes information on breeding and territorial pairs and presence of non-breeding loons. Ponds, lakes and reservoirs on GMNF are included in both monitoring efforts. Forest Service staff contribute to data collection for loons by participating in Loonwatch and by monitoring loon activity when visiting water bodies on GMNF.

As part of loon nest monitoring, VCE assesses the level of protection needed from potential disturbance on nests on each water body. Where a loon nest is prone to human disturbance, predation from terrestrial animals, and/or disturbed by fluctuating water levels (on regulated lakes), VCE provides a nesting raft as an alternative to natural nest sites. On GMNF, three nesting rafts were used in the current monitoring period. Additional protection for each raft was provided through the placement of warning sign buoys.

Evaluation and Conclusions: VCE has continued to collect important common loon data on GMNF. Volunteers are the primary loon observers at GMNF nesting ponds during the breeding season and for Loon Watch. Overall, VCE's monitoring efforts have been instrumental for understanding loon population dynamics across Vermont, including on GMNF.

The number of nesting loons in Vermont has risen steadily over the last 32 years, indicating that common loons are still finding new water bodies to occupy. On GMNF, loon nesting in fiscal year 2017 proved to be a high point of loon chick production, where ten chicks were produced from six nests. Loon nesting decreased in fiscal year 2018, but the number of chicks produced (1.25 chicks surviving per territorial pair) was still above the average for all of Vermont. The difference in nesting between fiscal years was due to the lack of nesting attempts by loon pairs on two long-term GMNF nesting ponds. In both years, observers continued to note the presence of non-nesting loons on one specific pond, recording a single loon during each observation.

Loons often choose the same type of nest site each year. On GMNF, loons nest on islands, in marshes, along shorelines and on nesting rafts. An additional nesting raft was used in fiscal year 2017 for a pair attempting to nest for the second time. This was in a location where human presence was frequent; the raft gave the pair an opportunity to nest in a more secluded location.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Peregrine Falcon

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: What is the population trend of peregrine falcons on the National Forest System lands and adjacent lands?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: American perigrine falcon (*Falco peregrinus anatum*) is identified as a sensitive species (2017 Regional Forester Sensitive Species list). All site-specific project analyses include a biological evaluation to ensure sensitive species viability and to preclude trends toward endangerment that would result in the need for Federal listing.

Audubon Vermont coordinates peregrine falcon monitoring and management efforts in partnership with the Vermont Department of Fish and Wildlife, private and public landowners, and citizen scientists across Vermont. Forest Service staff and citizen scientists (volunteers) monitor known and possible nesting cliffs on GMNF and adjacent land. The monitoring period for falcons begins in late winter, when falcons migrate back to cliff sites, and continues through the fledging of chicks in mid-summer. Observers document if falcons are present; if and when they successfully nested; and how many chicks survived to fledging. There are two GMNF cliff sites that are accessed by hiking trails. Both trails have seasonal

closures, which are critical to protecting falcons from human disturbance. One of the trails was randomly monitored by Forest Service staff in 2018 to assess trail closure effectiveness.

Evaluation and Conclusions: Vermont has seen steady population growth of peregrine falcons. Falcon data from GMNF are an important part of the annual state-wide falcon population evaluation. Forest Service staff and volunteers observed falcons at five known nesting sites on or near GMNF during fiscal years 2017 and 2018. Even though nesting success varied among the sites, young falcons fledged from two nests in 2017 (five fledglings) and from three nests in 2018 (six fledglings). This is a strong reason why monitoring is important every year; even at cliff sites where falcons have nested consistently over the years, there can be disturbance from predators, weather, and humans, which can cause territorial pairs fail to start a nest or to lose their nests later in the season. Observers strongly suspected that nest failure at one GMNF location in 2017 was due to disturbance by road construction below the cliff.

Two GMNF cliff trails were closed to human visitors, and during observation periods, these trails were monitored for violation of the closures. Many of the hikers encountered were aware of and supportive of the trail closure. Collaborating with Audubon Vermont and the Vermont Fish and Wildlife Department on monitoring has been essential to understanding the dynamics of falcon nesting on the GMNF. By following the current Forest Plan standards and guidelines, habitat on GMNF has been able to contribute to the sustainability of the Vermont falcon population.

Recommendations: No recommended change to this monitoring item.

Monitoring Item: Threatened, Endangered, and Sensitive Bats

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: Are management actions adequately protecting ecological conditions required by threatened, endangered, and sensitive (TES) bat species known to occur on National Forest System lands?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: Indiana bat (*Myotis sodalist*) is a federally listed endangered species. Northern long-eared bat (*Myotis septentrionalis*) was federally listed as threatened in April 2015. All projects must comply with Endangered Species Act consultation requirements prior to implementation to ensure Indiana bat and northern long-eared bat protection. Eastern small-footed bat (*Myotis leibii*), little brown (*Myotis lucifugus*), and tri-colored bat (*Perimyotis subflavus*) are identified as sensitive species (2017 Regional Forester Sensitive Species list). All site-specific project analyses include a biological evaluation to ensure sensitive species viability and to preclude trends toward endangerment that would result in the need for Federal listing.

Anabat surveys were conducted in fiscal years 2017 and 2018, but the data has never been completely synthesized. This data could be used to determine presence of an individual at the sampling location. Mist net surveys have not been completed during these years. With white nose syndrome (WNS) on the landscape it is unlikely that mist netting will occur until species rebound from their population losses.

Evaluation and Conclusions: Anabat survey results do not adequately address this monitoring question posed for protecting ecological conditions required for TES bats on the landscape. Evaluating the effectiveness of Forest Plan Standards and Guidelines, and project specific design criteria and mitigation

measures are a better indicator to determine if management activities are protecting TES bats. Any surveys short of pretreatment and post treatment units would not provide detailed answer for the monitoring question. With current directions based on WNS and population declines, mist netting without a specific biological purpose is unlikely to occur.

Recommendations: Consider changing the detailed monitoring question to "Are bats continuing to persist on the landscape?" and develop measurement indicators accordingly to more meaningfully determine what extent Forest Service management activities contribute toward population viability for native and desired non-native species.

Monitoring Item: Herptile Sensitive Species

Monitoring Question: To what extent are Forest Service management activities contributing toward population viability for native and desired non-native species?

Detailed Monitoring Question: What are the population trends of wood turtle, Jefferson salamander, blue-spotted salamander, and four-toed salamander on National Forest System and adjacent lands? Do they need protection or habitat management?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives.

Monitoring Activities: Blue-spotted salamander (*Ambystoma laterale*), four-toed salamander (*Hemidactylium scutatum*), Jefferson salamander (*Ambystoma jeffersonianum*), spotted turtle (*Clemmys guttata*), and wood turtle (*Glyptemys insculpta*) are identified as sensitive species (2017 Regional Forester Sensitive Species list). All site-specific project analyses include a biological evaluation to ensure sensitive species viability and to preclude trends toward endangerment that would result in the need for Federal listing.

Monitoring for sensitive herptile species on GMNF is done mostly through a variety of conservation partners, including the Vermont Center for Ecostudies (VCE), the Vermont Fish and Wildlife Department, and the Vermont Reptile and Amphibian Atlas Project. Biologists from these organizations administer various herptile data collection projects, all of which engage citizen scientists to contribute data to state-wide and regional data sets. Forest Service staff have not conducted any specific surveys targeting herptile species, however, data has been contributed to the Vermont Herp Atlas and to VCE's Vernal Pool Mapping Project and Atlas of Life. Recently, some GMNF vernal pools have been investigated for use by pool-breeding salamanders, where individuals and egg masses of each species were counted by VCE biologists. Habitat integrity was also evaluated. In general, Forest Service biologists and technicians conduct informal herptile surveys while completing reviews of proposed management projects. Table 3-17 shows the data from the Vermont Herp Atlas and including for within and surrounding NFS lands.

Table 3-17. Sensitive herptile species documented presence on GMNF and surrounding lands.

Species	Documented on Forest	Documented Off Forest	Previous 3 Years
Blue-spotted salamander	0	70	100
Four-toed salamander	0	43	28
Jefferson salamander	1	21	16
Wood turtle	2	85	111

Evaluation and Conclusions: Based solely off these data it is hard to get an accurate picture of the population and population trend because of yearly influence of weather, precipitation, survey effort, and

other factors that could cause numbers to be inflated or deflated. By observing the data provided, wood turtle and blue-spotted salamander populations were down, or declining but four-toed and Jefferson salamander populations were up. From data included in these data sets and informal in-house surveys, Forest Service biologists are aware of important habitats on GMNF supporting a variety of herptile species. Herptiles are only mentioned once in the Forest Plan as examples of species that may live in or utilize seasonal pools. In general, these species have been adequately protected by minimizing impacts to ecosystems they utilize from application of Forest Plan standards and guidelines, and project specific design criteria and mitigation measures.

Recommendations: Add spotted turtle (*Clemmys guttata*) to the list of herptiles in the detailed monitoring question.

Vegetation

Monitoring Item: Forest-wide Habitat Composition

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent are management actions and natural processes moving Forest composition toward desired objectives in table 2.2-1 of the revised Plan?

Monitoring Driver: Forest Plan Goal 2 and associated Objectives. Specifically, the objective that states management should address composition objectives found in the Forest Plan Table 2.2-1.

Monitoring Activities: Timber harvesting activities and other silvicultural treatments are tracked using the Forest Service Activity Tracking System (FACTS). FACTS manages information about activities related to fire/fuels, silviculture, special funding, range vegetation improvement, and invasive species used by all levels of the Forest Service. Field Sample Vegetation data is also tracked in the FSVeg system, which is updated to reflect treatments once completed. These systems can provide reports summarizing the number of acres and proportion of harvest acres treated with uneven-aged management (selection, groups, irregular shelterwood); the number of acres treated explicitly to enhance early successional characteristics (clearcutting, patch cutting, shelterwood); then number of acres treated explicitly to enhance late successional characteristics; and the number of acres treated with various methods (thinning, improvement) to explicitly enhance the health, longevity, and/or structural diversity of forested stands at the stand and landscape scales. This data can be used to monitor the progress made toward desired age class and structure objectives. There is some error associated with this data entry and consistency of activity classification, however the data is sufficient for tracking overall trends.

Evaluation and Conclusions: Composition objectives (Forest Plan, Table 2.2-1, p. 11) represent long-term ecological tendencies of forest landscapes, with adjustments to manage aspen-birch, oak, and permanent upland opening habitats at, or slightly higher than, current levels. Because changes in forest composition take time, even with management, these composition objectives may take decades or even centuries to achieve. The Forest Plan identifies a desire to conduct vegetation management in a way that supports the natural transition of forested ecosystems toward composition that is more suited to the natural tendencies of the sites within which they are found. Table 3-18 provides long-term habitat type composition objectives as provided in the Forest Plan, Table 2.2-1.

Most of GMNF had been cleared at least once by the end of the nineteenth century, and much of it was farmed or grazed. Most red spruce was cleared or preferentially harvested, and few mature trees were left to provide seed except in the steepest or more inaccessible sites. As a result, most of the area regenerated to northern hardwoods or its variants, as noted in Table 3-18 where northern hardwoods accounted for 76

percent of the habitat present on GMNF at the time the Forest Plan was revised in 2006. About half of this northern hardwood habitat falls on sites that are more suited for softwoods or conifers like red spruce and hemlock, for instance sites that are cold, moist, with either poorer drainage or shallow soils. Forest inventory and research findings have indicated that softwood regeneration is slowly becoming established and competing well on suitable sites throughout the region. This trend may allow softwood and mixedwood habitat types to increase over time through natural processes. These processes can be facilitated and enhanced through forest management activities.

Table 3-18. Habitat type long-term composition objectives for all GMNF lands (Forest Plan, Table 2.2-1).

Habitat Type	Current (2006) (% Forest)	Objective (% Forest)
Northern Hardwoods	76	30-40
Mixedwood	10	45-55
Softwoods	7	15-25
Aspen - Birch	3	1-5
Oak	1	1-5
Permanent Upland Openings	1-2	1-5
Wetlands	1-2	1-2

In addition to facilitating transitions from hardwoods to mixedwood and softwoods, long-term composition objectives include maintaining and increasing habitat types that are short-lived or uncommon and have high value for a variety of wildlife and plant species. These include aspen, paper birch, and other early successional hardwoods, forests dominated by or mixed with oak, and upland openings. Without management intervention, it is likely that most of these habitats would become quite rare on GMNF; the abundance of these habitats was documented in the Forest Plan Final Environmental Impact Statement (pp. 3-62 to 3-64) to have declined over time.

Table 3-19 provides a summary of the treatments from 2006 to 2013 together with more recent treatments from 2014 to 2018 that have contributed toward moving habitat composition toward Forest Plan objectives. Although there has been progress made for each habitat type, the level of management on GMNF since 2006 has not been sufficient to make notable or detectable progress toward Forest Plan composition objectives. Total acres managed to promote any one habitat type represents less than one percent of the total GMNF area. Timber harvest and other management activities continue to provide opportunities to facilitate shifts in habitat composition toward desired objectives but will ultimately only supplement natural shifts that will occur over time for habitats like northern hardwoods, mixedwood, and softwoods.

Table 3-19. Acres treated from 2006 to 2018 to move habitat composition toward Forest Plan objectives.

Habitat Objective	Acres Treated 2006 to 2013	Acres Treated 2014 to 2018	Total Acres Treated
Maintain and enhance mixedwood and softwood habitats	2,104	445	2,549
Maintain and create aspen-paper birch habitat	308	143	451
Enhance and restore oak habitat	221	129	350
Maintain and enhance upland opening habitat[1]	4,596	1,983	6,579
Create new upland opening habitat	126	305	431
Convert non-native softwood plantations to native habitats	173	160	323

Source: Forest Service data

[1] Includes acres maintained more than once during analysis period. Total upland opening area was 3,064 at the end of 2018.

For oak and aspen, the level of activity to promote these habitats is not keeping pace with the aging and decline of stands of these species. Most aspen stands are now either mature or over-mature, and once they start to decline, they quickly die and are replaced by species expected to live two to three times as long. Aspen is the most likely habitat to fall below the one percent lower threshold in the Forest Plan composition objectives over the next 50 years at the current level of treatment.

Oak stands are also aging, and the trees species growing below oak overstories tend to be northern hardwood species, particularly beech affected by beech bark disease, along with maple and birch species. Oak trees are relatively long-lived and many of these stands will retain oak in the overstory for decades, however shade tolerant northern hardwood understories will continue to develop and maintaining oak on these sites will become increasingly difficult and impractical. At the current rate of management, it is likely that most of existing oak stands on GMNF will be replaced by northern hardwoods over time and the proportion of forest dominated by oak will slowly decrease. Potential habitat for oak species is projected to increase under various climate change scenarios; however, forest stand dynamics and succession is expected to play a larger role in determining future forest types. Oak stands with well-developed northern hardwood understories are already on a trajectory toward those species in the absence of continued disturbance or management.

The area of upland opening habitat has increased by 431 acres since 2006 with the total area by the end of 2018 at 3,064 acres. This habitat is the result of the maintenance and establishment of several hundred openings throughout GMNF. Not all openings are treated annually; some are treated by mowing or burning every two to three years, while others may only be treated once every five to ten years. Given the costs and staffing needed to maintain openings, it is expected that permanent upland openings will be maintained at or below the one percent level, however continuous management has prevented a decrease in this habitat and has even allowed for some progress toward objective levels.

The level of management since 2006 has not been sufficient to make detectable progress in shifting composition at the forest-wide scale, however management has made progress at the stand, project and sub-watershed level. Management has also slowed or prevented further departure from target conditions for uncommon habitat types such as aspen/birch, oak, and upland openings. Continued efforts should include opportunities to increase the overall number of acres treated using a variety of treatment methods. These treatments can increase compositional diversity and enhance uncommon habitat types. Even-aged regeneration harvest should be emphasized to slow the decline of aspen/ birch forest habitat, and the decrease of overall habitat diversity on the landscape.

Recommendations: No recommended change for this monitoring question.

Monitoring Item: Outputs Accomplished - Volume and Acres of Timber Offered and Sold

Monitoring Question: How close are actual outputs and services to projected outputs and services?

Detailed Monitoring Question: How do actual outputs compare to those projected in Appendix D, Proposed and Probable Practices, specifically related to timber offered and sold?

Monitoring Activities: Forest Activity Tracking System (FACTS) and Timber Sale Accounting (TSA) reports were used to monitor timber offered and sold along with the type of timber harvesting practices used to implement the Forest Plan.

Evaluation and Conclusions: Forest Plan Goal 8 and associated Objectives.

The Forest Plan average annual Allowable Sale Quantity (ASQ) is the maximum amount of timber volume that may be offered and sold during Decade 2 (2016 to 2025), expressed on an annual basis. The annual average ASQ for GMNF is 19.7 million board feet (MMBF). The annual amount of timber sold may exceed 19.7 MMBF as long as the decadal ASQ (197 million board feet) is not exceeded. Table 3-20 displays the volume of timber offered and sold for fiscal years 2017 and 2018 compared to the annual average and decadal ASQ. The amount of timber sold annually during this time period remains well below the average annual ASQ. There has been a total of 17.37 MMBF of timber sold from 2016 to 2018 which is 3.7 percent of the decadal ASQ.

Table 3-20. Timber volume offered and sold for fiscal years 2017 to 2018.

Fiscal Year	Timber Volume Sold (MMBF[1])	Percent of Annual Average ASQ (19.7 MMBF)	Percent of Decadal ASQ (197 MMBF) of Total Harvest
2017	7.01	36	3.6
2018	4.12	21	2.1
2016-2018[2]	17.37	n/a	3.7

[1] Million board feet.
[2] Fiscal year 2016 was the start of Decade 2 of Forest Plan implementation which reset the 197 MMBF decadal ASQ.

For context, Table 3-21 displays the actual acres harvested during Decade 1 of Forest Plan implementation (2006 to 2015) compared to Forest Plan estimated annual management practices (Forest Plan, Appendix D, Table D-4). Forest Plan estimated annual management practices acres are different for Decade 2 of Forest Plan implementation (2016 to 2025). Table 3-22 displays the actual acres harvested in fiscal years 2017 and 2018 compared to Forest Plan estimated annual management practices acres for Decade 2.

Table 3-21. Actual acres for fiscal years 2006 to 2015 compared to Decade 1 Forest Plan estimated management practices (2006 to 2015).

Estimates of Management Practices	Planned Annual Acres in Decade 1[1]	Total Acres Harvested 2006-2015	Average Annual Acres Harvested 2006-2015	Percent of Planned Annual Acres
Even-aged Regeneration Harvest[2]	1,750	1,124	112.4	6.4
Even-aged Intermediate Harvest	1,324	1,551	155.1	11.7
Uneven-aged Harvest	981	2,348	234.8	23.9
Total Harvest	**4,055**	**5,023**	**502.3**	**12.4**

[1] 10-year annual average of Decade 1 (2006-2015) acres from Forest Plan, Appendix D, Table D-4.
[2] Includes clearcut, shelterwood and shelterwood removal harvest methods.

Table 3-22. Actual acres for fiscal years 2017 to 2018 compared to Decade 2 Forest Plan estimated management practices (2016 to 2025).

Estimates of Management Practices	Planned Annual Acres in Decade 2[1]	Acres Harvested by Fiscal Year		Percent of Planned Annual Acres by Fiscal Year	
		2017	2018	2017	2018
Even-aged Regeneration Harvest[2]	1,676.4	113	117	6.7	7.0
Even-aged Intermediate Harvest	2,065.3	106	19	5.1	0.1
Uneven-aged Harvest	1,138.1	284	215	2.5	18.9
Total Harvest	**4,879.8**	**503**	**351**	**10.3**	**7.2**

[1] 10-year annual average of Decade 2 (2016-2025) acres from Forest Plan, Appendix D, Table D-4.
[2] Includes clearcut, shelterwood and shelterwood removal harvest methods.

The amount of timber sold and harvested each year remains well below the levels allowed in the Forest Plan. It is not likely that management practices will approach Forest Plan estimates over the Decade 2 ten-year period unless harvest activities increase. Continued low harvest levels inhibit management ability to meet other objectives such as those related to desired forest type age class and composition, or contributions to the local and regional timber-based economy.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Rare or Outstanding Natural Areas

Monitoring Question: To what extent have Forest Plan Objectives been attained?

Detailed Monitoring Question: To what extent are rare and outstanding biological, ecological, or geological features on the GMNF being protected, maintained, or enhanced?

Monitoring Driver: Forest Plan Goal 7 and associated Objectives.

Monitoring Activities: Rare or uncommon natural communities recognized as significant are listed in Appendix C, Table C-1). Every year, Forst Service staff visit and monitor several sites with special features. At each site staff collect field notes addressing the condition and quality of the site and/or rare plant populations. In general, because these sites have been inventoried and evaluated in the past, notes highlight distinctive features, new information that had not previously been collected (for instance, GPS coordinates of special features), and changes in size, disturbance levels, and conditions of the surrounding landscape. These notes are then incorporated into site reports and/or rare plant reporting forms that are prepared during the winter months.

The GMNF Ecology program does not have records of sites with special features monitored during fiscal years 2017 and 2018, attributable to a key position vacancy. Although no formal monitoring was documented, the following activities occurred:

- Forest Service wilderness staff removed human impacts (arranged branches and toilet paper) at Big Branch Pond. No other monitoring records were found for Ecological Special Area sites within wilderness.
- Vermont Natural Heritage Inventory (VNHI) visited sites at Bristol Cliffs, French Hollow, and Castle Meadow.

Evaluation and Conclusions: The GMNF ecology and wilderness programs were limited in capacity (key positions vacant) during this reporting period. This impacted both the amount of site monitoring and record keeping.

Over the past several years VNHI has been both increasing its numbers of visits to sites that haven't been monitored recently and updating its mapping information on significant natural communities based on new state-wide inventory information. There is now a substantial amount of new information on sites of ecological significance in the State that was not analyzed during the revision of the Forest Plan. While in the past the State has focused its efforts on rare and uncommon natural communities, over the past few years the focus has started to include important and high-quality examples of more common natural communities like Northern Hardwood Forest and Montane Yellow Birch-Red Spruce Forest. Some of the significant examples of these communities occupy hundreds to thousands of acres, and occur in and out of protected Forest Plan Management Areas. Forest Service staff have not yet analyzed or developed a strategy for maintaining the quality and integrity of these sites in the context of forest management.

Reviving cooperation between the Ecology program and other GMNF programs, individuals, and VNHI will make it more likely that most existing and new sites will be monitored within 10 years of their last visit, and some will be monitored on the 5-year monitoring cycle identified for these areas. Some sites have received repeated visits to relocate rare plants or to respond to natural disturbances or proposed activities, which does reduce the number of new sites monitored each season. In some cases, Forest Service staff have adjusted monitoring cycles to reflect level of concern: for instance, monitoring of the Mount Tabor Work Center Swamp is planned to be more frequent as it has portions dominated by ash and may be particularly vulnerable to emerald ash borer. In another case, Lye Brook Headwaters is so remote and inaccessible that it is unlikely to be impacted by human use or non-native invasive plants, thus the monitoring cycle has been adjusted to 10 years for that site.

Existing monitoring protocols continue to be effective and demonstrate the importance of gathering precise GPS coordinates for special features and rare plant populations so they can be relocated efficiently. Compiling, maintaining, and updating the data gathered during these monitoring efforts continues to be a challenge. Coordinating among individual monitors could also be improved to avoid duplication and leverage the capacity of program areas and organizations to conduct monitoring more strategically based on complementary skills.

Monitoring results to date suggest that impacts to the integrity of ecologically significant sites and features are most often associated with recreational uses. A stronger relationship between recreation, law enforcement, and ecology staff is important to effectively mitigate some of these impacts. Forest Service staff have been relatively successful at mitigating these impacts through cooperation between program areas. Impacts of recreation use on special area integrity are particularly notable at waterbodies. The level of tree-cutting and user-created campsites has increased steadily over the past 30 years, as noted by monitoring over that time period. Another round of monitoring is planned for fiscal year 2022 at several ponds, including Branch Pond. Upon completion of that monitoring, it is hoped a plan will be developed to reduce the impacts of this use on the integrity of this important high elevation pond. The Forest Service ecology, recreation, and wilderness programs have turned over personnel, but mutually desire to strive toward a close working relationship so that management of recreation use within these special areas can support their ecological integrity.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Stocking Level

Monitoring Question: Are harvested lands adequately restocked according to Plan goals?

Monitoring Question: Are lands adequately restocked within five years of a regeneration harvest or site preparation activities?

Monitoring Driver: The National Forest Management Act requires suitable timberlands are adequately restocked following harvest (16 USC 1604(g)(3)(E)(ii)).

Monitoring Activities: Monitoring protocols and procedures are well established and are consistent with Forest Service Handbook (Forest Service Handbook 2409.17, Silvicultural Practices). Reforestation success is measured on new plantations or harvested stands in years one, three, and five (if needed) following the planting or other regeneration effort. Successful reforestation is assured when new stands are certified as “free to grow” by year five. Stocking surveys are conducted using 1/700 and 1/100 acre sized circular plots on which all seedlings and saplings are tallied. A plot is considered stocked if at least

one acceptable tree seedling or sapling occurs is found. The plot data is summarized providing the total stocking percentage for each stand. Stocking surveys were conducted for all stands harvested with even-aged and/or uneven-aged regeneration methods. Survey results were reported in the FACTS database.

Forest Service staff completed first year evaluation (stocking) surveys for stands regenerated through timber harvesting on 491 acres, and 437 acres; and completed final third year evaluation surveys on 183 acres, and 151 acres in fiscal years 2017 and 2018, respectively. All units were certified as fully stocked. For natural regeneration survival examinations, all sampled stands were stocked adequate, acceptable seedlings or saplings to be considered moving towards reforestation certification.

Evaluation and Conclusions: Review of evaluation surveys completed during the monitoring period indicates that reforestation efforts underway continue to be sufficient to meet stocking certification for all units within the required timeframes.

Recommendations: No recommended change to this monitoring question.

Monitoring Item: Sustainability of Special Forest Product Gathering

Monitoring Question: To what extent have Objectives been attained?

Detailed Monitoring Question: What types and quantities of special forest products are being gathered annually that require a permit? What products are not allowed to be gathered, and what products are being evaluated for gathering at levels requiring a permit (commercial or personal use)? What products are being gathered at levels that may be unsustainable.

Monitoring Driver: Forest Plan Goal 8 and associated Objectives.

Monitoring Activities: Forest Service staff monitor the quantity and type of permitted special forest products. In addition, the Forest Health Protection Program of the Forest Service's State and Private Forestry branch regularly monitors the maple tapping areas to evaluate the health of the maple trees and to determine if any adjustments to, or suspensions of, operations are required. Illegal tree cutting and removal is tracked annually on GMNF. Often this is related to illegal firewood removal, although it also includes cutting trees around campsites as well as the occasional theft of valuable timber. Firewood removal is monitored during regular patrols conducted by Law Enforcement and Forest Protection Officers. Table 3-23 shows the special forest product permits issued by product for fiscal years 2017 and 2018.

Table 3-23. Special forest product permits issued in fiscal years 2017 and 2018.

Product	Quantity	
	Fiscal Year 2017	Fiscal Year 2018
Maple sap	8,732 taps	8,732 taps
Firewood	242 cords	242 cords
Christmas trees	552 trees	552 trees
Boughs	0	0
Seedlings	0	0
Saplings	0	0
Wild apples	840 pounds	840 pounds
Fungi	600 pounds	600 pounds

Fiscal Year 2017

GMNF staff monitored maple sap permit areas, and no significant compliance issues were noted. Forest Health Protection (FHP) staff visited six maple sap permit areas to assess any impacts of tapping. The annual monitoring consists of six criteria: Two growing season site visits for visual inspection of conditions; pheromone trapping for damaging insects; insect egg mass surveys during outbreaks; taphole closure assessment; root starch reserve measurements; and using the Aerial Detection Survey to see if any damaging agents are active in the area around the sugarbushes. Overall, the sugarbush areas are in a healthy condition. Health indicators including root starch and taphole recovery indicated that all sites were healthy, and that maple sap harvest continues to be sustainable at these sites. FHP staff detected no significant incidence of forest pests at the sites.

Fiscal Year 2018

GMNF staff monitored maple sap permit areas and no compliance issues were noted. FHP staff visited six maple sap permit areas to assess any impacts of tapping. Overall, the sugarbush areas continue to be in a healthy condition. Pheromone traps for forest tent caterpillar were deployed, as well as traps for saddled prominent. In 2018 there were no insect outbreaks, so egg mass surveys were not conducted.

Evaluation and Conclusions: The number of maple tapping and Christmas tree permits issued annually has steadily increased since Forest Plan revision. Permits for other products are stable at relatively low levels although firewood permits decreased compared to fiscal year 2016.

Firewood

Firewood permit volume varies from year to year, with annual levels between 200 and 500 cords. Forest Service staff continue to evaluate opportunities for additional firewood harvesting to meet demand. Several factors support the sustainability of this increased use, including 1) timber harvesting on GMNF is well below the Allowable Sale Quantity established in the 2006 Forest Plan; 2) the focus of firewood harvesting is on readily accessible dead and down trees; and 3) an increasing abundance of dead and dying trees due to the increasing age of the forests.

Christmas Trees

The requests for Christmas tree permits rose dramatically between fiscal years 2010 and 2013, however the permit numbers stopped rising in fiscal year 2014 and have become more variable. Demand for permits seems to vary based on economic conditions and retail Christmas tree prices. Press releases and the extent to which they receive exposure also varies from year to year and appears to affect demand.

The availability of young softwood trees continues to increase as hardwood forests growing on sites more suited for softwood trees start to see more abundant softwood seedlings and saplings establish in these stands. It is anticipated that harvest will be sustainable because in terms of absolute numbers it is a very small amount compared to the numbers of small softwood trees available and will not make a detectable difference in the composition of GMNF or the ability to meet composition objectives. In areas with moderate numbers of softwood saplings, they generally occur in amounts of 100 to 300 trees per acre. Cumulatively therefore, the levels of Christmas tree harvesting occurring over the monitoring period have been affecting less than 2 acres per year, distributed across the entire GMNF.

Maple Sap

The number of taps sold for the six existing permitted maple tapping areas is now over 6,000. There have been very few compliance issues on maple tapping permit areas. The addition of additional maple tapping areas if requested would be limited primarily by administrative capacity.

Other Products

Requests for special forest products other than those noted above at levels requiring permits continue to be very limited. Occasionally Forest Service staff receive queries about gathering products such as ginseng, leeks, and fiddleheads, as well as other plants. Ginseng is a protected plant on GMNF so is not allowed for gathering. Leeks, fiddleheads, and other plants gathered in small quantities for personal use do not require a permit. Quantities collected for personal use are not monitored.

Recommendations: No recommended change so this monitoring question.

Water

Monitoring Item: Forest-wide Water Quantity and Flow

Monitoring Question: To what extent are environmental stressors and Forest management affecting water quantity and flow timing?

Monitoring Question: What is the existing status of water quantity and flow timing on National Forest System lands, and how are our management activities affecting them?

Monitoring Driver: Forest Plan Goal 4 and associated Objectives.

Monitoring Activities: Water quantity and flow timing data were not collected or not available for fiscal years 2017 and 2018. Data available from the U.S. Geological Survey stream gaging network are minimal across GMNF and not representative of stream flow and timing issues that may influence management of streams.

Evaluation and Conclusions: Although data were not collected for this monitoring question, Forest Service staff did not permit any management activities that were likely to degrade processes related to stream flow quantity or timing. Such activities could include large-scale conversion of land use and land cover types (such as forested lands to agricultural lands) or installation of a dam. During this monitoring period, no dams were removed which would restore more natural processes related to stream flow quantity and timing. Forest Service staff have, however, undertaken some activities that may change movement of water across the landscape due to the actions of beaver. In some cases, management activities seek to limit the impact of beaver by artificially moderating dam and pond elevations through pond leveling devices. In other cases, the location of beaver dams is managed through beaver bafflers, or beaver activity is naturally increased through continued recovery of native plant communities and natural aquatic and riparian processes.

Monitoring stream discharge (quantity and timing) across GMNF is not within the financial and technical capability Forest Service programs, even with assistance from partners. Given the limited capacity for monitoring stream discharge, this monitoring question does not appear to be well suited to help decide whether management is meeting Forest Plan direction, or what impacts climate change may have on forest resources. Related indicators such as regional precipitation and temperature patterns may be appropriate in addressing the climate-related stressors but are not likely useful in determining whether plan components are effective and appropriate and whether management is effective in maintaining or achieving progress toward Forest Plan objectives and desired conditions.

Recommendations: Consider removing this monitoring question from the monitoring program.

Wild and Scenic Rivers

Monitoring Item: Wild and Scenic Rivers

Monitoring Question: To what extent are eligible Wild and Scenic Rivers managed to preserve their outstandingly remarkable values?

Detailed Monitoring Question: Are management activities within the eligible National Wild & Scenic River management area consistent with the Outstandingly Remarkable Values for which each river segment was determined eligible?

Monitoring Driver: Forest Plan Eligible Wild, Scenic, and Recreational Rivers Management Area direction.

Monitoring Activities: Monitoring for consistency with managing Wild and Scenic Rivers to preserve each river's outstandingly remarkable values occurs through National Environmental Policy Act (NEPA) review of proposed actions for activities that may be occurring within the Eligible Wild & Scenic River Management Area. All activities proposed in the Eligible Wild & Scenic River Management Area were consistent with Forest Plan direction for maintaining the attributes making each river eligible for future designation.

Annual monitoring trips also provide the opportunity to review project implementation and adherence to Forest Plan standards and guidelines as well as project-specific design criteria and mitigations. During the monitoring trips, resource staff review preservation of the outstandingly remarkable values associated with eligible Wild, Scenic and Recreation Rivers and discuss if not preserved, what could have been done differently and/or what could be done to retain eligibility.

Evaluation and Conclusions: Available documentation, annual monitoring trips, field reviews, and NEPA decisions did not identify any projects that failed to preserve the outstandingly remarkable values for eligible Wild, Scenic and Recreation Rivers.

Recommendations: No recommended change to this monitoring question.

Wilderness

Monitoring Item: Wilderness Areas Managed to Standard

Monitoring Question: To what extent have Objectives been attained?

Monitoring Question: How are wilderness areas trending to meet the national Wilderness Stewardship Performance??

Monitoring Driver: Forest Plan Goal 13 and associated Objectives, and Wilderness Area Management Area direction.

Monitoring Activities: Table 3-24 shows the Congressionally designated wilderness areas on GMNF. Management is guided by Forest Plan direction for the Wilderness Management Area (Forest Plan, p. 49 to 53).

Table 3-24. GMNF designated wilderness.

Wilderness Area	Acres
George D. Aiken	5,060
Lye Brook	17,718
Peru Peak	7,672
Bristol Cliffs	3,775
Breadloaf	25,237
Big Branch	6,767
Joseph Battell	12,333
Glastenbury	22,425

In 2015, the national wilderness program adopted the Wilderness Stewardship Performance (WSP) protocol. The WSP contains metrics used by the Forest Service to track management accomplishments in designated wilderness areas, with each national forest selecting ten core elements annually. The WSP framework aims to measure the Forest Service's effectiveness in preserving wilderness character by tracking management actions, such as implementing invasive species plans. Examples of WSP elements include Wilderness Character Baseline, Education, Invasive Species, Air Quality, Recreation Sites, and Trails. A possible 10 points per 10 elements are possible in WSP following the WSP guidebook. A wilderness is considered to meet national standard and “meet baseline performance for preserving Wilderness character" when it achieves 60 WSP points.

In fiscal years 2017 and 2018, eight GMNF wilderness areas did not meet the National Standard 60 out of a possible 100 points (10 points per element) following the WSP guidebook. National Standard 60 WSP points = Wilderness is "Meeting Baseline Performance for Preserving Wilderness Character"

For each of the eight GMNF wilderness areas, the following elements were selected and monitored annually for each fiscal year with point values achieved as identified:

Big Branch Wilderness: Fiscal Year 2017 = 32 points, Fiscal Year 2018 = 32 points

E1 – Invasive Species
E2 - Air Quality Values
E3 - Recreation Sites
E4 - Agency Management Actions
E5 - Opportunities for Solitude
E6 - Cultural Resources
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Breadloaf Wilderness: Fiscal Year 2017 = 32 points, Fiscal Year 2018 = 36 points

E1 - Air Quality Values
E2 - Water
E3 - Recreation Sites
E4 - Trails
E5 - Agency Management Actions
E6 - Opportunities for Solitude
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Bristol Cliffs Wilderness: Fiscal Year 2017 = 38 points, Fiscal Year 2018 = 34 points

E1 - Invasive Species
E2 - Air Quality Values
E3 - Water
E4 - Recreation Sites
E5 - Agency Management Actions
E6 - Opportunities for Solitude
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

George D. Aiken Wilderness: Fiscal Year 2017 = 28 points, Fiscal Year 2018 = 32 points

E1 - Air Quality Values
E2 - Water
E3 - Recreation Sites
E4 - Motorized Equipment / Mechanical Transport Use Auths
E5 - Agency Management Actions
E6 - Opportunities for Solitude
E7 - Opportunities for Primitive and Unconfined Recreation
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Glastenbury Wilderness: Fiscal Year 2017 = 26 points, Fiscal Year 2018 = 34 points

E1 - Air Quality Values
E2 - Recreation Sites
E3 - Trails
E4 - Agency Management Actions
E5 - Opportunities for Solitude
E6 - Cultural Resources
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Joseph Battell Wilderness: Fiscal Year 2017 = 30 points, Fiscal Year 2018 = 36 points

E1 - Air Quality Values
E2 - Water
E3 - Recreation Sites
E4 - Non-Compliant Infrastructure
E5 - Agency Management Actions
E6 - Opportunities for Solitude
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Lye Brook Wilderness: Fiscal Year 2017 = 32 points, Fiscal Year 2018 = 32 points

E1 - Invasive Species
E2 - Air Quality Values
E3 - Recreation Sites

E4 - Agency Management Actions
E5 - Opportunities for Solitude
E6 - Cultural Resources
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Peru Peak Wilderness: Fiscal Year 2017 = 28 points, Fiscal Year 2018 = 36 points

E1 - Air Quality Values
E2 - Water
E3 - Recreation Sites
E4 - Trails
E5 - Agency Management Actions
E6 - Opportunities for Solitude
E7 - Outfitters & Guides
E8 - Workforce Capacity
E9 - Education
E10 - Wilderness Character Baseline

Evaluation and Conclusions: Since the transition to the WSP protocol in 2015, Forest Service staff have not been able to meet the WSP national standards due to workforce capacity and developed recreation demands on the Recreation Program staff. The GMNF Wilderness Program Manager position was vacant for a number of years which also had an impact on the WSP progress towards meeting national standards. Although WSP national standards were not achieved during fiscal years 2017 and 2018, the Forest Plan goals, objectives, standards and guidelines and desired conditions were met for all project activities.

Recommendations: No recommended change to this monitoring question.

4. List of Preparers

Table 4-1 provides the Forest Service monitoring team that collected, evaluated, or compiled data for the *Green Mountain National Forest Fiscal Years 2017 and 2018 Biennial Monitoring and Evaluation Report*:

Table 4-1. Preparers of the Fiscal Years 2017 and 2018 Biennial Monitoring and Evaluation Report.

Name	Position or Resource Responsibility
Jay Strand	Monitoring Team Leader/Forest Planner
Holly Knox	Recreation Program Manager/Public Services Staff Officer
Suzanne Gifford	Ecologist
Jeremy Mears	Fisheries Biologist
John Mccann	Watershed Program Manager
Angie Quintana	Soil Scientist
Jeffrey Tilley	Silviculturist
MaryBeth Deller	Botanist
Steven Pytlik	Recreation Planner/Wilderness Coordinator
Karen Bucher	Archaeologist and Heritage Resource Specialist
Marty Knipe	Fire Management Officer
Lindsay Rae Silvia	Fire and Fuels Technician
Ralph Perron	Air Quality Specialist
Brian Austin	Engineer
Ethan Ready	Public Affairs Officer
Briana Shepherd	Public Affairs Specialist
Pat D'Andrea	Lands Specialist
Jennifer Edmonds	Special Uses Coordinator

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Appendix A: Payments to Towns

There are two types of federal payments reaching municipalities that have National Forest System (NFS) lands: 1) Payments in Lieu of Taxes (PILT); and 2) Public Law 106-393, Secure Rural Schools and Community Self-Determination Act of 2001, reauthorized in 2008. Payments in lieu of taxes funds are directed to towns, and the Public Law 106-393 funds are directed to school districts.

Payments in Lieu of Taxes

Generally, federal lands may not be taxed by state or local governments unless they are authorized to do so by Congress. Since local governments are often financed by property or sales taxes, the inability to tax the property values or products derived from the federal lands may significantly affect local tax bases. Instead of authorizing taxation, Congress created various payment programs designed to make up for lost tax revenue.

Under current federal law, local governments are compensated through various programs for losses to their tax bases due to the presence of most federally owned land. The most widely applicable program, while run by the Bureau of Land Management, applies to many types of federally owned land, and is called "Payments in Lieu of Taxes" or PILT. The level of PILT payments is calculated under a complex formula which considers figures such as acres of eligible lands, population, and previous year payments from other federal agencies. The PILT, made in or around October, is indexed by the inflation rate and set by federal law.

Table A-1 shows PILT payments and entitlement acres for Vermont towns and counties. Each town can receive additional PILT dollars if they contain other federal lands, such as National Park Service or Army Corps of Engineer lands. Not all federal acres within towns are entitled to PILT payments.

Table A-1. Vermont Payments in Lieu of Taxes (PILT) and acreage for fiscal years 2017 and 2018.

Government Unit [1]	2017 PILT Payment	2017 Entitlement Acres [2]	2018 PILT Payment	2018 Entitlement Acres [2]
ARLINGTON TOWN	$ 11,116	4,191	$11,349	4,191
BARNARD TOWN	$ 1,724	650	$1,858	686
BENNINGTON COUNTY	$ 52,814	26,718	$61,405	26,718
BENNINGTON TOWN	$ 3,632	1,369	$3,706	1,369
BRANDON TOWN	$ 233	88	$238	88
BRIDGEWATER TOWN	$ 3,249	1,225	$6,720	2,482
BRISTOL TOWN	$ 14,949	5,636	$15,262	5,636
CHITTENDEN TOWN	$ 78,110	29,449	$79,743	29,449
CLARENDON TOWN	$ 0	30	$279	103
DANBY TOWN	$ 0	3	$0	3
DORSET TOWN	$ 14,954	5,638	$15,267	5,638
DOVER TOWN	$ 13,564	5,114	$13,848	5,114
GOSHEN TOWN	$ 20,326	7,663	$20,750	7,663
GRANBY TOWN	$ 4,498	1,696	$4,593	1,696
GRANVILLE TOWN	$ 39,067	14,729	$39,885	14,729
HANCOCK TOWN	$ 52,748	19,887	$53,851	19,887
HARTFORD TOWN	$ 3,013	1,136	$3,764	1,390
HARTLAND TOWN	$ 1,644	620	$1,679	620
JAMAICA TOWN	$ 4,984	1,879	$5,087	1,879
KILLINGTON TOWN	$ 15,026	5,665	$15,340	5,665
LANDGROVE TOWN	$ 2,157	813	$2,201	813

Government Unit [1]	2017 PILT Payment	2017 Entitlement Acres [2]	2018 PILT Payment	2018 Entitlement Acres [2]
LEICESTER TOWN	$ 7,161	2,700	$7,312	2,700
LINCOLN TOWN	$ 28,778	10,850	$29,381	10,850
LONDONDERRY TOWN	$ 1,862	702	$1,901	702
MANCHESTER TOWN	$ 14,344	No Data	$14,712	5,433
MENDON TOWN	$ 8,034	No Data	$8,204	3,030
MIDDLEBURY TOWN	$ 8,278	3,121	$8,452	3,121
MOUNT HOLLY TOWN	$ 8,989	3,389	$9,176	3,389
MOUNT TABOR TOWN	$ 45,731	25,491	$46,853	25,491
NORWICH TOWN	$ 1,783	672	$3,658	1,351
PERU TOWN	$ 45,329	17,090	$46,277	17,090
PITTSFIELD TOWN	$ 20,251	7,635	$20,674	7,635
POMFRET TOWN	$ 3,557	1,341	$7,326	2,705
POWNAL TOWN	$ 10,960	4,132	$11,189	4,132
READSBORO TOWN	$ 24,514	9,242	$25,026	9,242
RIPTON TOWN	$ 58,803	22,170	$60,033	22,170
ROCHESTER TOWN	$ 31,503	11,877	$32,161	11,877
ROXBURY TOWN	No Data	No Data	$0	37
RUPERT TOWN	$ 446	168	$455	168
RUTLAND COUNTY	$ 5,776	2,178	$0	0
SALISBURY TOWN	$ 10,076	3,799	$10,287	3,799
SEARSBURG TOWN	$ 19,114	7,707	$19,507	7,707
SHAFTSBURY TOWN	$ 3,382	1,275	$3,453	1,275
SHREWSBURY TOWN	$ 5,917	2,231	$11,743	4,336
SPRINGFIELD TOWN	$ 535	202	$547	202
STAMFORD TOWN	$ 32,367	12,203	$33,043	12,203
STOCKBRIDGE TOWN	$ 2,363	891	$2,413	891
STRATTON TOWN	$ 37,514	18,003	$37,555	18,003
SUNDERLAND TOWN	$ 57,865	21,816	$59,074	21,816
THETFORD TOWN	$ 2,592	977	$2,645	977
TOWNSHEND TOWN	$ 2,628	991	$2,684	991
WALLINGFORD TOWN	$ 25,025	9,435	$25,549	9,435
WARDSBORO TOWN	$ 8,283	3,123	$8,457	3,123
WARREN TOWN	$ 18,707	7,053	$19,470	7,190
WASHINGTON COUNTY	$ 0	37	$0	0
WEATHERSFIELD TO	$ 2,947	1,111	$3,008	1,111
WESTON TOWN	$ 23,935	9,024	$24,436	9,024
WILMINGTON TOWN	$ 4,387	1,654	$4,479	1,654
WINDHAM COUNTY	$ 19,192	9,644	$22,164	9,644
WINDSOR COUNTY	$ 10,076	3,799	$0	0
WINHALL TOWN	$ 41,916	15,803	$42,792	15,803
WOODFORD TOWN	$ 67,952	25,619	$69,372	25,619
WOODSTOCK TOWN	$ 1,472	555	$2,069	764
TOTAL	**$ 1,062,152**	**422,346**	**$1,094,362**	**422,509**

Source: https://www.doi.gov/pilt/resources/annual-reports

[1] Not all towns listed are within the National Forest Proclamation boundary, however they still receive PILT payments based on the presence of other federal lands within their boundaries.

[2] Entitlement acres are those lands that were not tax exempt (such as owned by state or local government) prior to when the land was conveyed to the United States.

Secure Schools Act

Table A-2 provides the payments to Vermont towns by county in fiscal years 2017 and 2018. The Secure Rural Schools (SRS) and Community Self-Determination Act of 2001 (Secure Schools Act) was reauthorized for four years in 2008. This law was promulgated by Congress to restore stability and predictability to the annual payments made to states and counties containing NFS lands for the benefit of schools and roads. Prior to the passage of the Secure Schools Act, these payments were based upon income generated by the USDA Forest Service, typically through timber sales. As this timber sale-related income fluctuated and generally waned, communities that relied on the annual payments for the support of their schools suffered from a lack of funding stability and predictability to the detriment of their educational systems. The Secure Schools Act severs the tie between rural school funding and timber sale income to offer rural school systems continual, level funding.

Table A-2. Secure Rural Schools payments by Vermont town/county for fiscal years 2017 and 2018.

Town by County	Fiscal Year 2017 Payment Amount	Fiscal Year 2018 Payment Amount
Addison County		
Goshen	$5,913.71	$5,256.28
Middlebury	$2,478.77	$2,203.21
Lincoln	$8,755.97	$7,782.56
Leicester	$2,083.65	$1,852.01
Granville	$11,493.27	$10,215.56
Bristol	$4,349.43	$3,865.90
Ripton	$17,123.76	$15,220.10
Hancock	$15,347.25	$13,641.09
Salisbury	$2,931.77	$2,605.85
Total	**$70,477.58**	**$62,642.56**
Bennington County		
Stamford	$7,979.49	$7,394.81
Arlington	$2,740.48	$2,539.68
Bennington	$895.18	$829.59
Dorset	$3,808.29	$3,529.25
Woodford	$17,790.54	$16,487.00
Winhall	$10,403.48	$8,195.02
Manchester	$3,616.04	$2,848.43
Rupert	$109.85	$86.53
Searsburg	$5,039.58	$3,969.77
Sunderland	$14,296.78	$11,261.84
Shaftsbury	$833.72	$656.73
Glastenbury	$17,470.79	$16,190.67
Readsboro	$6,043.31	$5,600.51
Peru	$11,207.77	$10,386.55
Landgrove	$534.23	$495.09
Pownal	$2,701.90	$2,503.93
Total	**$105,471.43**	**$97,743.33**
Essex County		

Town by County	Fiscal Year 2017 Payment Amount	Fiscal Year 2018 Payment Amount
	$1,759.23	$1,784.19
Total	**$1,759.23**	**$1,784.19**
Rutland County		
Killington	$2,318.44	$2,333.68
Danby	$1.91	$1.92
Mount Tabor	$16,231.62	$16,338.29
Brandon	$56.03	$56.40
Wallingford	$5,683.07	$5,720.42
Mount Holly	$2,157.98	$2,172.16
Chittenden	$18,751.91	$18,875.14
Mendon	$2,123.59	$2,137.55
Shrewsbury	$1,340.38	$1,349.19
Pittsfield	$4,861.65	$4,893.60
Clarendon	$46.48	$46.79
Total	**$53,573.06**	**$53,925.14**
Washington County		
Warren	$3,956.59	$3,472.71
Roxbury	$19.95	$17.51
Total	**$3,976.54**	**$3,490.22**
Windham County		
Dover	$3,494.34	$3,436.04
Stratton	$12,301.25	$12,096.02
Wardsboro	$2,133.91	$2,098.31
Non-Township	$6,657.97	$6,546.89
Londonderry	$298.60	$293.62
Wilmington	$1,130.16	$1,111.30
Jamaica	$792.61	$779.39
Total	**$26,808.84**	**$26,361.57**
Windsor County		
Stockbridge	$501.46	$482.94
Rochester	$6,709.34	$6,461.46
Norwich	$383.44	$369.27
Hartford	$143.44	$138.14
Pomfret	$770.27	$741.81
Barnard	$20.33	$19.58
Bridgewater	$709.84	$683.62
Weston	$5,095.96	$4,907.69
Woodstock	$118.02	$113.66
Total	**$14,452.10**	**$13,918.17**
Grand Total	**$276,518.78**	**$259,865.18**

Source: https://www.fs.usda.gov/working-with-us/secure-rural-schools/payments

Appendix B: Threatened, Endangered and Sensitive Species (Fauna and Flora)

Table B-1 lists federally listed threatened and endangered wildlife species specific to the Green Mountain National Forest per the Endangered Species Act during the fiscal years 2017 and 2018 monitoring period. Table B-2 lists the Green Mountain National Forest 2017 Regional Forester Sensitive Species (fauna and flora).

Table B-1. Wildlife species listed as threatened or endangered under the Endangered Species Act with current or historic occurrence in Vermont and on National Forest System lands.

Scientific Name	Common Name	ESA Status	Status on GMNF
Canis lupus	Gray wolf	Endangered	Historic only
Lynx canadensis	Canada lynx	Threatened	Historic only
Myotis septentrionalis	Northern long-eared bat	Threatened	Current
Myotis sodalis	Indiana bat	Endangered	Current
Puma concolor couguar	Eastern mountain lion	Endangered	Historic only

Table B-2. Fauna and flora species listed on the Regional Forester Sensitive Species List specific to Green Mountain National Forest (scientific name in italics, followed by common name).

MAMMALS	
Myotis leibii	Eastern Small-footed Myotis
Myotis lucifugus	Little Brown Myotis
Perimyotis subflavus	Tri-colored Bat

BIRDS	
Catharus bicknelli	Bicknell's Thrush
Euphagus carolinus	Rusty Blackbird
Falco peregrinus anatum	American Peregrine Falcon
Gavia immer	Common Loon

AMPHIBIANS	
Ambystoma jeffersonianum	Jefferson Salamander
Ambystoma laterale	Blue-spotted Salamander
Hemidactylium scutatum	Four-toed Salamander

REPTILES	
Clemmys guttata	Spotted Turtle
Glyptemys insculpta	Wood Turtle

INVERTEBRATES - BIVALVES	
Alasmidonta varicosa	Brook Floater
Lasmigona compressa	Creek Heelsplitter

INVERTEBRATES - INSECTS	
Bombus terricola	Yellow-banded Bumble Bee
Cicindela ancocisconensis	Appalachian Tiger Beetle
Danaus plexippus	Monarch
Gomphus descriptus	Harpoon Clubtail
Lanthus vernalis	Southern Pygmy Clubtail
Pieris virginiensis	West Virginia White

NON-VASCULAR PLANTS	
Metzgeria crassipilis	A liverwort
Sphagnum pulchrum	Sphagnum

VASCULAR PLANTS	
Agrostis mertensii	Small-flower False Foxglove
Arabis drummondii (syn = Boechera stricta)	Eastern Dwarf-mistletoe
Arceuthobium pusillum	Poke Milkweed
Asclepias exaltata	Smooth Yellow False Foxglove
Aureolaria pedicularia	Fernleaf Yellow False Foxglove
Blephilia hirsuta	Hairy Woodmint
Botrychium oneidense	Drummond's Rockcress
Calamagrostis stricta ssp. inexpansa	Leathery Grapefern
Cardamine parviflora var. arenicola	Bluntlobe Grapefern
Carex aestivalis	New England Northern Reed Grass
Carex aquatilis var. aquatilis	Twoheaded Water-starwort
Carex argyrantha	Large Toothwort
Carex backii	Sand Bittercress

VASCULAR PLANTS	
Carex bigelowii	Summer Sedge
Carex foenea	Water Sedge
Carex haydenii	Hay Sedge
Carex lenticularis	Rocky Mountain Sedge
Carex michauxiana	Bigelow's Sedge
Carex oligosperma	Northern sedge
Carex schweinitzii	Dryspike Sedge
Carex scirpoidea	Shore Sedge
Ceratophyllum echinatum	Michaux's Sedge
Clematis occidentalis var. occidentalis	Fewseed Sedge
Collinsonia canadensis	Schweinitz's Sedge
Conopholis americana	Bulrush Sedge
Cryptogramma stelleri	Wiegand's Sedge
Cynoglossum virginianum var. boreale	Sweet Pignut Hickory
Cypripedium parviflorum var. pubescens	Prickly Hornwort
Cypripedium reginae	Purple Clematis
Desmodium paniculatum	Canada Horse-balm
Desmodium perplexum	Squaw-root
Diplazium pycnocarpon	Fragile Rockbrake
Draba arabisans	Greater Yellow Lady's-slipper
Dryopteris filix-mas	Showy Lady's-slipper
Eleocharis intermedia	Long-bract Green Orchis
Eleocharis olivacea v. olivacea (=E. flavescens v. olivacea)	Panicledleaf Ticktrefoil
Eleocharis ovata	Perplexed Ticktrefoil
Equisetum pratense	Glade Fern
Eupatorium purpureum (=Eutrochium purpureum)	Rock Whitlow-grass
Galium kamtschaticum	Male Fern
Glyceria septentrionalis	Matted Spikerush
Hackelia deflexa var. americana	Bright Green Spikerush
Helianthus strumosus	Ovate pikerush
Hieracium venosum	Marsh Willowherb
Huperzia appalachiana	Rough Cotton-grass
Isotria verticillata	Sweet Joe-pyeweed
Juglans cinerea	Rough Wood-aster
Juncus trifidus	Boreal Bedstraw
Lespedeza hirta	Floating Mannagrass
Lespedeza violacea	Northern Stickseed
Littorella uniflora (=L. americana)	Harsh Sunflower

VASCULAR PLANTS	
Lobelia siphilitica	Rattlesnakeweed
Mimulus moschatus	Appalachian Clubmoss
Muhlenbergia uniflora	Western Lake Quillwort
Myriophyllum farwellii	A Quillwort
Nyssa sylvatica	Large Whorled Pogonia
Panax quinquefolius	Butternut
Peltandra virginica	Highland Rush
Phegopteris hexagonoptera	Hairy Lespedeza
Physostegia virginiana	Violet Lespedeza
Pinus rigida	American Shoregrass
Platanthera orbiculata	Great Blue Lobelia
Polemonium vanbruntiae	Hairy Honeysuckle
Potamogeton bicupulatus	Farwell's Water-milfoil
Potamogeton confervoides	Low Water-milfoil
Potamogeton hillii	Blackgum
Prenanthes trifoliolata	American Ginseng
Pyrola chlorantha	Bog Fern
Pyrola minor	Green Arrow-arum
Quercus muehlenbergii	Broad Beechfern
Ranunculus pensylvanicus	Pitch Pine
Rhodiola rosea	Fragrant Green Orchid
Sanicula canadensis	Lesser Roundleaved Orchid
Saxifraga paniculata	Large Roundleaf Orchid
Scheuchzeria palustris ssp. americana	Bog Jacob's-ladder
Selaginella apoda	Whorled Milkwort
Selaginella rupestris	Snail-seed Pondweed
Sisyrinchium angustifolium	Algae-like Pondweed
Sisyrinchium atlanticum	Hill's Pondweed
Solidago patula	Tall Cinquefoil
Solidago simplex ssp. randii	Snowline Wintergreen
Solidago squarrosa	Pennsylvania Buttercup
Stellaria alsine	Roseroot Stonecrop
Symphyotrichum prenanthoides	Hoary Willow
Trillium cernuum	Bog Willow
Utricularia resupinata	Canadian Black-snakeroot var. canadensis
Vaccinium uliginosum	White Mountain Saxifrage
Woodsia glabella	American Scheuchzeria

Table B-3. Monitoring results for species listed on the Regional Forester Sensitive Species list (flora) specific to the Green Mountain National Forest (species with an asterisk were added to the list in fiscal year 2017, species with a superscript are aquatic). NM = not monitored.

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
VASCULAR PLANTS				
Agalinis paupercula var. *paupercula (=A. paupercula)* Smooth agalinis* (2)	ATV use and NNIP are limiting habitat and plants are declining at Dutch Hill site	NM	Declining	Control ATV use and keep controlling purple loosestrife at Dutch Hill site
Arabis drummondii (=Boechera stricta) Drummond's rock-cress (3)	NM	1 of 3 monitored and increasing	With one missing and one expanding, the species may be stable on GMNF	Site not monitored (and not found in 2011) needs to be searched for again; keep other site on a 7-year monitoring cycle
Arceuthobium pusillum Eastern Dwarf-mistletoe (7)	2 of 7 monitored and no concerns	2 of 7 monitored and 1 is unhealthy and in marginal habitat, and 1 fine but NNIP could move into site after logging	Apparently stable	Check for NNIP at Castle Meadow site. Keep on a 7-year monitoring cycle
Asclepias exaltata Poke milkweed (8-->7)	3 of 8 populations monitored; 2 not found, 1 threatened by NNIP	4 of 8 populations monitoring including 1 not found previous year, and determined to not have very suitable habitat; the other 3 with no concerns	More or less stable over the years, despite some not found	Control NNIP; keep on a 7-year monitoring cycle; consider whether future canopy opening might be useful in sties not reproducing
Aureolaria flava (=Aureolaria flava var. *flava)* Smooth false-foxglove* (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Aureolaria pedicularia var. *pedicularia* Fernleaf yellow false-foxglove (1)	NM	Keep an eye on deer-browse at this site; also, this may be variety *intercedens* instead of *pedicularia*, which would be 1st in Vermont	Apparently stable	Keep on a 7-year monitoring cycle
Blephilia hirsuta Hairy woodmint (8)	NM	1 of 7 monitored and not found	Uncertain	Search again for the population not found; keep on a 7-year monitoring cycle; if other populations not found, search more frequently

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Botrychium multifidum Leathery grapefern* (7)	2 of 5 monitored, no concerns	1 of 5 monitored; 1 fine but pulled NNIP; at Griggs Mountain, unable to monitor subpopulation outside AT corridor	Apparently stable	Check to see if NNIP previously controlled has been eradicated at Bragg Hill site; determine landowner for subpopulation outside the AT corridor; seek permission to monitor.
Botrychium oneidense Blunt-lobed grapefern (4)	2 of 4 monitored; identity difficult to confirm because too early in season	NM	Uncertain	Visit earlier in season at both sites to confirm identity
Calamagrostis stricta ssp. *Inexpansa* New England northern reed grass (1)	NM	Herbivory and drought are a concern, but no management recommendations	Uncertain; one small population could be vulnerable to loss	Keep on a 7-year monitoring cycle
*Callitriche heterophylla** Large water-starwort (1)	Monitored, no concerns	NM	Apparently stable	Keep on a 7-year monitoring cycle.
Cardamine maxima Large toothwort* (5)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Cardamine parviflora (= C. parviflora var. arenicola) Small-flower bitter-cress (5)	2 monitored, no concerns	2 monitored, 1 no concerns, the other not found	Apparently stable	Search in a wider area for the one not found
Carex aestivalis Summer sedge (7)	1 of 7 monitored and location information incorrect, NNIP are a concern	1 of 7 monitored and fine, but may be more nearby	Apparently stable	Edit location info for site referred to as Dorset Mountain and treat garlic mustard there. For McGinn Brook site, search wider area
Carex aquatilis var. *substricta* Water sedge[a] (3)	NM	NM	Unable to assess	Keep on 10-year monitoring cycle because aquatic in remote habitat
Carex argyrantha Hay sedge (8)	1 of 7 monitored and no concerns; another not found, may be gone, and it is near but not on NFS land	3 of 7 monitored, 2 fine, 3rd could use canopy opening	Uncertain; be aware that this species declines as shade develops	Keep on a 7-year monitoring cycle; consider opening canopy
Carex backii Rocky mountain sedge (4)	NM	1 monitored, no concerns	Apparently stable	Keep on 7-year monitoring cycle
Carex bigelowii ssp. bigelowii Bigelow sedge (1)	NM	NM	Unable to assess	Continue educating hikers

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
*Carex cryptolepis** Northeastern sedge (4?)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Carex foenea (=*aenea*) Bronze sedge (4)	1 of 4 sites monitored, plants not found, habitat likely no longer suitable	1 of 4 sites monitored, not found, more subsites to be searched	May be declining; be aware that this species declines as shade develops	Search again for populations not found; consider opening canopy
Carex lenticularis Shore sedge (9, 1 not NFS land)	2 of 8 monitored, no concerns	1 monitored, fine but not NFS land, and extent of population not known	Assumed stable	Survey both shores of Somerset Reservoir east site
Carex michauxiana Michaux sedge (5)	Monitored 1 of 5 sites; no concerns	1 historical site monitored and not found	Apparently stable	Keep on 10-year monitoring cycle, since it is associated with wetlands near high elevation ponds
Carex oligosperma Few-seeded sedge (6, 1 not NFS land)	1 monitored and not found	NM	Unable to assess	Search again for the population not found
Carex schweinitzii Schweinitz's sedge (2)	1 monitored; succession of wildlife opening may be an issue	NM	Possibly declining; no quantitative comparison made	Consider maintaining opening where succession may be a concern
Carex scirpoidea Bulrush sedge (1)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Carex wiegandii Wiegand's sedge* (1)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Carya glabra Pignut hickory* (1)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Ceratophyllum echinatum[a] Prickly hornwort (1)	NM	NM	Unable to assess	Keep aquatic species on a 10-year monitoring cycle (not prioritized, since near but not on GMNF land)
Clematis occidentalis var. *occidentalis* (=*verticillaris*) Purple clematis (3)	NM	2 of 3 sites monitored; 1 still has potential for trampling; 1 not found, but might reappear if canopy opens	Vulnerable to decline	Site that's decline is immediately adjacent to GMNF; work with landowners to protect if possible; search again for the site that was not found
Collinsonia canadensis Canada horsebalm (2)	1 monitored that is on and off NFS land; deer herbivory & NNIP are a problem	NM	Vulnerable	Consider collaborative NNIP control
Conopholis americana Squaw-root (5)	NM	Population declining; may need canopy more open or to be farther from trail	Declining	Consider habitat management or trail relocation

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Cryptogramma stelleri Steller's cliffbrake (6)	3 of 6 monitored; 1 no concerns, 1 affected by recreation and NNIP, 1 may be declining due to cave use	2 monitored and affected by drought	Vulnerable to disturbance by climbers	Consider educational signs at 2 sites
Cypripedium parviflorum var. *pubescens* Large yellow lady's-slipper (10)	2 sites of 10, 1 not found, 1 may be threatened by NNIP	2 of 9 monitored, and not found (1 is same one not found in FY 2017)	Possibly declining	Continue to search for those not found.
Cypripedium reginae Showy lady's-slipper (1)	NM	1 of 6 monitored and may be slightly smaller due to encroaching cattails	Uncertain	Recheck the site with lots of cattails and get a good count and assessment of space occupied.
Dactylorhiza viridis (=Coeloglossum viride) Long-bract green orchis* (5, 2 are historical)	NM	1 monitored: identity still needs confirmation; deer browse is a concern	Unable to assess	Revisit site where identity needs confirmation
Desmodium paniculatum Paniculate tick-trefoil (4)	1 of 4 monitored and stable	2 of 4 monitored and no concerns	Apparently stable	Keep on 7-year monitoring cycle
Desmodium perplexum Perplexed tick-trefoil (2)	Both sites monitored, 1 no concerns, 1 with NNIP a concern	Both sites monitored; 1 has subpopulation needing identity confirmed; 1 still has NNIP concern	Apparently stable	Control NNIP at GMP ROW site; confirm identity of all subpopulations
Diplazium pycnocarpon Glade fern (5)	1 of 4 sites monitored and NNIP are in general area	NM	Apparently stable	Watch to see if NNIP encroach at one site
Draba arabisans Rock whitlow-grass (3)	NM	1 monitored and not found; rock too crumbly to get closer; identity needs confirmation.	Uncertain	Uncertain; crumbly rock may be too unsafe to revisit; monitor other sites
Dryopteris filix-mas Male fern (5, though not all on NFS land)	1 monitored, no concerns	NM	Apparently stable	Keep on 7-year monitoring cycle
Eleocharis intermedia Matted spikerush (4 sites)	2 monitored, no concerns, though map show NNIP that may be encroaching	1 monitored, not found, but perhaps due to high water; 1 monitored, no concerns	Stable but vulnerable to NNIP	Monitor sooner than 7 years if there's a good low-water year; control NNIP where needed

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Eleocharis olivacea (=E. flavescens var. olivacea) Capitate spikerush or olive spikerush (1)	1 monitored and not found	NM	Possibly declining	Keep monitoring to see if site changes or plants move elsewhere
Eleocharis ovata Ovate spike-rush (12, not all on GMNF)	1 monitored and not found	1 monitored and no concerns	Probably stable; plant locations change as hydrology changes	Monitor sooner than 7 years if there's a good low-water year
Epilobium palustre Marsh willow-herb* (7)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Eriophorum tenellum Rough cotton-grass* (5, 1 not near NFS land)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Eupatorium purpureum Sweet joe-pye weed (6, 1 not NFS land)	1 monitored and not found, but not right location	2 monitored: 1 small but no concerns, 1 with NNIP but not NFS land	Uncertain	Search again in right location at one site; consider collaborating to control NNIP where plant not on NFS land
Eurybia radula (=Aster r.) Rough-leaved aster* (2, 1 not NFS land)	1 monitored, not found, not NFS land	NM	Uncertain	Keep on 7-year monitoring cycle.
Galium kamtschaticum Boreal bedstraw (9, 1 historical)	1 monitored, not found, historical	NM	Uncertain	No need to search again for the historical site; continue others on 7-year cycle
Glyceria septentrionalis Floating mannagrass (2)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Hackelia deflexa var. americana Northern stickseed (1)	NM	No management recommendations, but note that repeated drought may be too much for this population over time	Vulnerable; up and down over the years	Keep on 7-year monitoring cycle
Helianthus strumosus Pale-leaved sunflower (2)	Both monitored: 1 identity uncertain, 1 no concerns	1 monitored, not all on NFS land and shrubby NNIP are a problem	Uncertain, because identity problematic	Keep track of taxonomic research on this species; consider collaborative NNIP where plant not entirely on NFS land

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Hieracium venosum Rattlesnakeweed or rattlesnake hawkweed (5)	NM	1 monitored, population declined, most likely because trail re-routed, and conditions changed; NNIP encroaching; Consider treating NNIP and moving plants	Possibly declining	Consider treating NNIP and relocating trail
Huperzia appalachiana Appalachian fir-clubmoss (2)	NM	NM	Unable to assess	Keep the remaining site on 7-year monitoring cycle
Isoetes lacustris (=I. macrospora) Lake quillwort*[a] (2)	NM	1 historical site monitored, not found	Uncertain	Could either search again and go beyond north shore or, since not seen since 1910, could decide not to search again
*Isoetes viridimontana** Green Mountain quillwort*[a] (1)	NM	NM	Unable to assess	Keep the remaining site on 7-year monitoring cycle
Isotria verticillata Large whorled pogonia (3 sites, 1 just off GMNF)	NM	1 site monitored, NNIP concerns	Apparently stable/in*creasi*ng	At the site monitored, treat the many encroaching NNIP
Juglans cinerea Butternut (many)	9 sites monitored; 1 looked healthy and may be in way of culvert replacement; for another, only nuts were found; the rest had no concerns other than the ongoing butternut canker disease	2 sites monitored; 1 had no concerns other than the butternut canker, the other has not been found since 1994 and is likely gone	Species are declining range-wide due to butternut canker, for which we have no known cure; populations are not prioritized for monitoring	Monitor sites when in the vicinity
Juncus trifidus Highland rush (1)	NM	Monitored, no concerns	Apparently stable	Keep on 7-year monitoring cycle
Lespedeza hirta Hairy bush-clover (1 & 1 just off GMNF)	1 site monitored, no concerns	1 site monitored, no concerns	Apparently stable	Keep on a 7-year monitoring cycle
Lespedeza violacea Violet bush-clover (2)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Littorella americana (= Plantago Americana, Littorella uniflora) American shore-grass (3)	NM	1 site monitored, determined to be a misidentification	Unable to assess	Keep on a 7-year monitoring cycle, but remove from the cycle one site where species was misidentified

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Lobelia siphilitica Great blue lobelia (1)	Monitored, NNIP continue to be a concern	Monitored; NNIP, trampling, and soil compaction are a concern	Apparently stable, although there are concerns	Continue to monitor and control NNIP; survey from this population south to other known population in Sunderland to look for subpopulations; monitor trampling and soil compaction from anglers using the site
Lonicera hirsuta Hairy honeysuckle* (1)	NM	Monitored; not a lot of flowers, possibly due to canopy closing in	Apparently stable, although there are concerns	Open the canopy over these plants and re-monitor afterward for flowering; be sure trail crews know not to cut back these shrubs
Myriophyllum farwelliia Farwell's water-milfoil [a] (3)	NM	1 site monitored and not found	Uncertain	Search again at the site not found, following instructions in the monitoring form
Myriophyllum humile Low water-milfoil* [a]	1 new site found; entire extent of populations there not known	1 site monitored and not found	Uncertain	At Somerset, survey entire reservoir looking for more subpopulations; at north end of Grout, search again
Nyssa sylvatica Black gum or Tupelo (2)	NM	1 site monitored and found, but NNIP a concern	Assumed stable	Map and control glossy buckthorn at the site monitored
Panax quinquefolius Ginseng (many)	6 sites monitored: 2 not found, 1 partially missing, and 3 with NNIP concerns	2 sites monitored: 1 repeatedly not found and probably missing, 1 smaller than previously	Possibly declining	Search again for those not found, control NNIP where these is a concern, monitor sooner than usual the one that is shrinking
Parathelypteris simulata (=Thelypteris simulata) Massachusetts Fern* (2)	1 monitored and no concerns	NM	Assumed stable	Keep on 7-year monitoring cycle
Peltandra virginica Green arrow-arum (2)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Phegopteris hexagonoptera (=Thelypteris hex*agonoptera)* Broad beech fern (6)	1 monitored: NNIP a concern	2 monitored: NNIP a concern	Apparently stable but NNIP are a concern	Treat NNIP at sites where they are a concern
Pinus rigida Pitch pine (6)	1 site monitored: no concerns	1 site monitored: no concerns	Apparently stable	Keep on a 7-year monitoring cycle

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Platanthera huronensis (=P. hyperborea var. huronensis) Huron orchid* (4)	NM	NM	Unable to assess	Keep on 7-year monitoring cycle
Platanthera *orbiculata Round*-leaved orchis (8+)	NM	1 monitored and not found, another possibly new site found (identity needs confirmation)	Possibly declining	Search again for those that are missing; monitor others more frequently; seek to understand difference between varieties
Platanthera orbiculata var. macrophylla (=*P. macrophylla*) Large roundleaf orchid* (7)	1 monitored and not found	1 monitored and not found; concern since near water where people fishing might dump bait	Possibly declining	Search again for Route 30 population not found; confirm which species if found; educated people about environmental harm associated with dumping live bait
Polemonium vanbruntiae Appalachian Jacob's ladder (many)	1 monitored: location of points and polygons confusing	1 introduced site extremely dense, wonder if population will crash	Apparently stable or increasing	Remap the Cobb Hill site so subpopulations are less confusing to find; monitor the dense site sooner than 7 years to see if it remains stable
Polygala verticillata (=P. v. var. v.) Whorled milkwort* (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Potamogeton bicupulatus[a] Snail-seed pondweed (1)	NM	1 site monitored and no concerns	Assumed stable	Keep aquatic species on a 10-year monitoring cycle
Potamogeton confervoides[a] Tuckerman's pondweed (10)	2 sites monitored: entire extent not known for either	1 site monitored and not found, most likely gone	Uncertain	Bring boat and determine entire extent of populations where not known
Potamogeton hillii[a] Hill's pondweed (1, may not be on GMNF)	NM	3 sites monitored: all are near but not on NFS land; their extent is not known, and there may be concerns at all of them	Uncertain	Notify state of the concerns, since not on NFS land
Potentilla arguta (=Drymocallis a.) Tall cinquefoil* (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Pyrola minor Lesser wintergreen (2 historical)	NM	NM	Unable to assess	Continue to search when time is available
Ranunculus pensylvanicus Pennsylvania buttercup or bristly crowfoot (2)	1 monitored: NNIP are a concern	1 monitored: NNIP are a concern	Vulnerable	Control nearby NNIP

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Rhodiola (=Sedum) rosea Roseroot stonecrop (1)	Monitored and no concerns	Monitored and no concerns	Stable, but at risk	Keep on a 7-year monitoring cycle
Salix candida Hoary willow* (2)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
*Salix pedicellaris** Bog Willow (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Sanicula canadensis var. canadensis Short-styled snakeroot* (4)	1 monitored and Identity needs confirmation	1 monitored and not found	Uncertain	Confirm identity at Bristol Cliffs site; search again at site where not found
Saxifraga paniculata (=*aizoon*) ssp. *Neogaea* White mountain saxifrage (1)	NM	Monitored and no concerns	Apparently stable	Keep on 7-year monitoring cycle
Scheuchzeria palustris ssp. *americana* Pod-grass (4)	NM	NM	Unable to assess	Keep on a 10-year monitoring cycle, since only occurs in wetlands associated with high-elevation ponds, which are on a 10-year cycle
Schoenoplectus torreyi (=Scirpus t.) Torrey's bulrush*[a] (2)	NM	1 monitored and no concerns	Apparently stable	Keep aquatics on a 10-year monitoring cycle
Selaginella apoda Meadow spike-moss (1)	Monitored and not found	NM	Possibly declining	Search again
Selaginella rupestris Rock spikemoss (3)	NM	NM	Unable to assess	Still need to search at site where location info was incorrect
Sisyrinchium angustifolium Pointed blue-eyed grass (7, though some with questionable identity)	2 monitored: 1 a little early in season, may occur in a wider area, and there are NNIP concerns; the other is potentially vulnerable to site maintenance	1 that's vulnerable to site maintenance was monitored and not found;	Vulnerable	Share location info with Green Mountain Power to be sure Silver Lake site not disturbed by maintenance; search more widely and earlier in year for French Hollow site
Sisyrinchium atlanticum Eastern blue-eyed grass (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle.
Solidago patula *Roundleaf* goldenrod (3?)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Solidago simplex ssp. randii var. monticola Rand's goldenrod (4)	2 sites monitored: 1 no concerns, 1 had NNIP nearby and deer browse is a concern	Same 2 monitored, no new concerns	Apparently stable	Treat NNIP at site where they are a concern; develop a chart for comparing trends over time for subpopulations, which are currently hard to track
Solidago squarrosa Stout goldenrod (3)	3 monitored; no concerns, but missing monitoring form for Bristol Cliffs	2 sites monitored; no concerns	Apparently stable	Find missing monitoring form; keep on a 7-year monitoring cycle
Sparganium natans (=S. minimum) Lesser bur-reed*[a] (1)	NM	NM	Unable to assess	Keep aquatic species on a 10-year monitoring cycle
Stellaria alsine Bog chickweed (5+)	2 sites monitored: identity concerns exist at both sites	3 sites monitored: 1 no concerns, 1 with NNIP concerns, 1 not found, may be underwater	Uncertain	Revisit sites that need identity confirmed, and site that may have been underwater; control NNIP at site where needed
*Symphyotrichum prenanthoides** Crooked-stem aster (2)	1 monitored: no concerns	NM	Apparently stable	Evaluate whether these roadside populations are naturally occurring
*Trillium cernuum** Nodding trillium or whip-poor-will flower (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Utricularia resupinata[a] *Northeastern* bladderwort (1)	NM	Monitored; concern because of trampling by swimmers	Vulnerable	Continue to monitor effect of trampling by swimmers
Uvularia perfoliata Perfoliate bellwort* (1)	NM	1 site monitored and confirmed to be misidentified; now just 1 remaining site on NFS land	Unable to assess	Stop monitoring site where confirmed to be a misidentification
Vaccinium uliginosum *A*lpine bilberry (1)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle; check to see if delineation successful
Viburnum rafinesquianum (=*V. r.* var. *r.*) Downy arrowwood* (3)	NM	NM	Unable to assess	Keep on a 7-year monitoring cycle
Woodsia glabella Smooth woodsia (1)	Monitored: no concerns	Monitored: no concern	Apparently stable	Keep on a 7-year monitoring cycle
NONVASCULAR PLANTS				
Metzgeria crassipilis A liverwort (1)	Monitored; still questions about identity	NM	Uncertain	Revisit to confirm identity

Species (number of populations in parenthesis)	FY 2017 Monitoring Results	FY 2018 Monitoring Results	Trend	Recommended Action
Sphagnum pulchrum Sphagnum (2)	NM	1 monitored; more extensive survey needed	Uncertain	Survey the entire fen and record baseline data to determine full extent of population; search for other RFSS that might occur in fen

Appendix C: Rare or Uncommon Natural Communities

Table C-1 shows the rare or uncommon natural communities recognized as significant as listed in the Green Mountain National Forest - Land and Resource Management Plan (Forest Plan) Final Environmental Impact Statement, Table 3.11-6.

Table C-1. Rare or uncommon natural communities that are recognized as significant.

Site Name	Management Area Designation
Manchester Ranger District	
Beebe Pond	Ecological Special Area
Big Branch	Wilderness
Big Mud Pond	Wilderness
Bourn Pond	Wilderness
Branch Pond	Ecological Special Area
Colebrook Trail Swamp	Escarpment
Devil's Den	White Rocks National Recreation Area
Downer Glen	Wilderness
Fifield Pond	White Rocks National Recreation Area
French Hollow	Ecological Special Area
Glastenbury Mountain	Wilderness Study Area
Green Mountain Ridge	White Rocks National Recreation Area
Griffith Lake	White Rocks National Recreation Area
Grout Pond	Ecological Special Area
Little Mud Pond	Wilderness
Little Pond	Wilderness Study Area
Little Rock Pond	White Rocks National Recreation Area
Lost Pond Bog	Wilderness
Lye Brook Headwaters	Remote Backcountry
Lye Brook Ledge	Wilderness
McGinn Brook	Wilderness
Moses Pond	Diverse Forest Use
Mt. Tabor Work Center Swamp	Ecological Special Area
Peabody Hill	Ecological Special Area
Somerset Fen	Ecological Special Area
Stamford Meadows	Ecological Special Area
Stamford Stream Wetland Complex	Ecological Special Area
Stratton Mountain	Ecological Special Area
The Burning	Wilderness
Thendara Camp Fen	Ecological Special Area
Wallingford Pond	White Rocks NRA
West of Mt. Tabor	Wilderness
West River Headwater Cove	Diverse Forest Use

Site Name	Management Area Designation
White Rocks	White Rocks National Recreation Area
Winhall River Headwater Flowage	Wilderness/Remote Backcountry
Rochester and Middlebury Ranger Districts	
Beaver Meadows and Abbey Pond	Ecological Special Area
Blue Ridge Fen	Candidate Research Natural Area
Breadloaf Mountain	Wilderness
Bristol Cliffs	Wilderness/Escarpment
Bryant Mountain	Escarpment
Bryant Mountain Hollow	Ecological Special Area
Burnt Mountain	Escarpment
Chandler Ridge	Escarpment
Crystal Brook Glacial Kettle	Wilderness
Dutton Brook Swamp	Ecological Special Area
Elephant Mountain	Ecological Special Area
Gilmore Pond	Wilderness
Hat Crown/Silent Cliff	Wilderness
Leicester Hollow	Eligible Scenic River
Lincoln Ridge	Alpine Subalpine Special Area
Middlebury Gap	Wilderness Study Area
Monastery Mountain	Wilderness Study Area
Mount Abraham	Alpine Subalpine Special Area
Mount Moosalamoo	Escarpment
Mt. Horrid	Candidate Research Natural Area
Mt. Roosevelt to Mt. Wilson	Wilderness
North Pond	Diverse Backcountry Forest
Rattlesnake Point	Ecological Special Area
Skylight Pond	Wilderness
Texas Falls	Ecological Special Area
The Cape	Research Natural Area