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Green Mountain National Forest

Land and Resource Management Plan

Chapter 4 Monitoring and Evaluation



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Rain Gauge Monitoring in Lincoln, Vermont



Bat Monitoring

4.1 MONITORING AND EVALUATION

4.1.1 Introduction

The Green Mountain National Forest Land and Resource Management Plan (Forest Plan) provides management direction in terms of desired conditions, goals, objectives, standards, and guidelines at the Forest and Management Area scales. Monitoring and evaluation are separate, sequential activities required by the National Forest Management Act (NFMA) to determine how well this management direction is being met, and to provide a basis for the periodic evaluation of the Forest Plan. The Green Mountain National Forest monitoring and evaluation plan (Chapter 4 of the Forest Plan) describes what we will monitor and what we expect to learn from that monitoring and subsequent evaluation.

Monitoring is the systematic collection of information about resource conditions, management actions, and emerging issues in a way that will reflect changes in conditions and relationships over time and space. The objective of a plan monitoring program is to:

1. Enable the Responsible Official to determine if a change in Forest Plan components or other Forest Plan content may be needed.
2. Inform the management of resources through means such as testing relevant assumptions, tracking relevant changes, and measuring management effectiveness and progress toward achieving or maintaining the Forest Plan's desired conditions or objectives.
3. Support an adaptive land management planning process that includes social, economic, and ecological evaluations.

Evaluation is the analysis and interpretation of the information collected during monitoring. Evaluation results form the basis for adaptively managing National Forests because they:

1. Evaluate the validity of assumptions used in Forest Plan development,
2. Verify the effectiveness of Forest Plan standards and guidelines,
3. Assess program and project effects on resource conditions in relation to management goals and desired conditions, and
4. Determine when desired conditions, goals, objectives, standards, or guidelines need to change.

The Forest Plan monitoring program falls into three general areas of focus, depending on whether they examine the *implementation* or *effectiveness* of management actions, or the *validity* of the underlying assumptions on which management is founded (Table 4.1-1).

Table 4.1-1: Monitoring Categories

Monitoring Focus	Purpose
Implementation	Is the overall direction in the Forest Plan being implemented? This includes goals and objectives, desired conditions, standards and guidelines, and management area direction. Or , "Did we do what we said we were going to do?"
Effectiveness	Are the standards and guidelines working? Are there significant changes in productivity of the land? Or "Did it work?"
Validation	Are the assumptions and predicted effects used to formulate the Forest Plan accurate? Or "Were we right in our initial understanding of the situation? Did we look at the right things?"

These three areas of focus are interwoven with the monitoring program as a means of measuring the Forest Service's success in achieving Forest Plan goals and objectives, and applying Forest Plan standards and guidelines. Monitoring design and data collection follow accepted national standards. Monitoring is not performed on every activity, nor is most of it expected to meet the statistical rigor of formal research.

Implementation monitoring is done primarily at the project level and is completed on a day to day basis. It occurs hundreds of times each year and includes activities such as timber sale inspections, interdisciplinary project reviews, backcountry observations by Wilderness rangers, and construction inspections. Effectiveness and validation monitoring are more programmatic; Forest-wide monitoring that is done annually or every few years to track long-term progress and effects.

4.1.2 Adaptive Management

Knowledge gained through monitoring, evaluation, and associated research provides the basis of adaptive management. The process creates a feedback mechanism (Figure 4.1-1) whereby Forest Service staff can compare observed results and trends with desired goals and outcomes, or examine or test the scientific appropriateness and validity of assumptions used in the development of the Forest Plan.

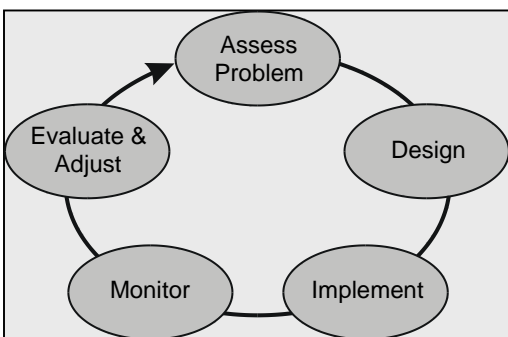


Figure 4.1-1: Monitoring, Evaluation, and Adaptive Management

Using results from monitoring and evaluation as a guide, the Forest Service can develop amendments to management direction as necessary. In this way, monitoring and evaluation help keep the Forest Plan dynamic, relevant, and responsive to changing issues.

4.1.3 Monitoring and Evaluation Components

An integrated and comprehensive monitoring and evaluation program includes four phases or components:

1. Monitoring Plan
2. Monitoring Implementation Guide
3. Annual Monitoring Schedule
4. Biennial Monitoring and Evaluation Report

Monitoring Plan

The *Monitoring Plan*, which is contained in this chapter, provides the conceptual framework for specific monitoring and evaluation elements. It establishes questions to be answered, timeframes for reporting, and indicators for required monitoring topics. Monitoring Plan direction is broad and ties directly to decisions made in this Forest Plan.

Monitoring items and questions included here are intended to provide the basis for more specific and focused monitoring items to be included in the *Monitoring Implementation Guide*. Changing the Monitoring Plan requires an Administrative Change to the Forest Plan (36 CFR 219.13).

Monitoring Implementation Guide

The *Monitoring Implementation Guide* (Guide), sometimes referred to as the *Monitoring Guide* or the *Implementation Guide*, is a procedural document that is external to the Forest Plan. It describes the Forest Service's monitoring program in its entirety. The Monitoring Guide is founded on guidance contained in the

Monitoring Plan, expanded into greater detail. The Monitoring Guide contains specific monitoring elements, along with methods, protocols, and analytical procedures to be followed. The Monitoring Guide incorporates direction found in the Forest Service handbook, technical manuals, scientific literature, or other sources.

Program managers responsible for Forest Plan implementation are involved in updating the Monitoring Guide. The list of monitoring items is beyond that normally funded; final selection of the items to be monitored in a given year is primarily based on available funding and staffing, and the priorities and timing provided in the Monitoring Guide.

The Monitoring Guide is intended to be a flexible component that can change as new methodologies and techniques are developed, or to be more responsive to changing needs and new information. The Monitoring Guide can be modified without amending the Forest Plan.

Annual Monitoring Schedule

The *Annual Monitoring Schedule* outlines monitoring items, time frames, roles, and locations for the upcoming year. The annual monitoring schedule will be linked directly to both the Forest Plan and the Monitoring Implementation Guide. The Forest Service will prepare and revise this schedule annually as part of the annual work planning process. Some elements of the Guide will be performed or measured annually, whereas others will be scheduled with other time intervals that are determined necessary or appropriate for timely and effective evaluation. The Forest Service's annual work planning process also will establish or revise priorities for the monitoring schedule.

Biennial Monitoring and Evaluation Report

Every two years, the Forest will produce and make available a *Biennial Monitoring and Evaluation Report* that shares new information gathered through the plan monitoring program and relevant information

from the broader-scale strategy. The purpose of the biennial report is to:

1. Make the information obtained from monitoring available to the public in a form that is readily understandable.
2. Transform monitoring data into information that supports adaptive management so the Responsible Official can determine whether changes to the Forest Plan, management activities, or the monitoring program are warranted and whether a new assessment may be needed.

4.1.4 Monitoring Plan

The Green Mountain National Forest Monitoring Plan consists of a set of monitoring questions to evaluate whether plan components are effective and appropriate, and whether management is effective in maintaining or achieving progress toward desired conditions and objectives for the plan area. A monitoring question is not necessary for every desired condition, objective, or other Forest Plan component. The scope, scale, and priorities for Forest Plan monitoring must be within the financial and technical capabilities of the administrative unit.

As stated previously, the primary objectives of this Monitoring Plan are to enable the Responsible Official to determine if a change in Forest Plan content is needed, and test assumptions, track changes, and measure management effectiveness and progress toward achieving or maintaining the Forest Plan's desired conditions or objectives.

Much of the monitoring identified in this Monitoring Plan is intended to help answer these questions, which will be evaluated and discussed in the biennial monitoring and evaluation report. Additional implementation and effectiveness monitoring is done at the project level, with Forest-wide reporting to track overall Forest Plan implementation.

4.1.5 Required Monitoring

The National Forest System Land Management Planning Rule (36 CFR

219.12(a)(5)) requires that the Forest Plan monitoring program include at least one monitoring question and associated indicator(s) for each of eight monitoring elements (Table 4.1-2).

Table 4.1-2: Required Monitoring Elements		
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?	<p><u>Indicators:</u></p> <ul style="list-style-type: none"> • Water quality, biological, and physical attributes <p><u>Measurements:</u></p> <ul style="list-style-type: none"> • 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?	<p><u>Indicators:</u></p> <ul style="list-style-type: none"> • Forest structure • Management actions with forest structure objectives <p><u>Measurements:</u></p> <ul style="list-style-type: none"> • 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

Table 4.1-2: Required Monitoring Elements		
Required Element	Monitoring Question	Indicator and Measurement
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?	<u>Indicator:</u> <ul style="list-style-type: none"> • Brook trout <u>Measurement:</u> <ul style="list-style-type: none"> • 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 listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.	What are the population trends for sensitive plants on the Forest and to what extent is management sustaining or enhancing habitat conditions for populations?	<u>Indicator:</u> <ul style="list-style-type: none"> • Population trends for plants listed as Regional Forester Sensitive Species <u>Measurements:</u> <ul style="list-style-type: none"> • Number of ramets or genets • 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?	<u>Indicator:</u> <ul style="list-style-type: none"> • Recreation opportunity settings <u>Measurement:</u> <ul style="list-style-type: none"> • Trends toward desired future condition
	Are we providing high quality recreation services that meet the expectations of the public?	<u>Indicator:</u> <ul style="list-style-type: none"> • Visitor satisfaction from National Visitor Use Monitoring (NVUM) <u>Measurement:</u> <ul style="list-style-type: none"> • Mean visitor satisfaction compared to mean importance to visitor

Table 4.1-2: Required Monitoring Elements		
Required Element	Monitoring Question	Indicator and Measurement
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?	<u>Indicators:</u> <ul style="list-style-type: none"> • Tree health • Ecosystem complexity <u>Measurements:</u> <ul style="list-style-type: none"> • 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?	<u>Indicator:</u> <ul style="list-style-type: none"> • Insect or disease infestations <u>Measurements:</u> <ul style="list-style-type: none"> • 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?	<u>Indicator:</u> <ul style="list-style-type: none"> • Projected outputs for resource activities or practices listed in Table D-5 in the Forest Plan <u>Measurement:</u> <ul style="list-style-type: none"> • 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?	<u>Indicators:</u> <ul style="list-style-type: none"> • Soil sustainability • Hydrologic function • Soil productivity <u>Measurements:</u> <ul style="list-style-type: none"> • 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

4.1.6 Other Monitoring

The general requirements for Forest Plan monitoring pertain to the implementation and effectiveness of Forest Plan management direction. General monitoring provides a tool for periodic, broad-scale assessment of the effects and effectiveness of management practices. General monitoring requires evaluation of how well objectives are being met and how closely

standards and guidelines are being applied. In addition, general monitoring will evaluate the effects and effectiveness of management prescriptions contained within management area direction. Whereas these elements in the Monitoring Plan represent a general assessment of management effects, the Monitoring Guide provides monitoring questions that examine management effects in greater detail. The broad monitoring questions that address

implementation and effectiveness of the Forest Plan on a regular basis include:

1. To what extent have Forest Plan objectives been attained?
2. To what extent have Forest Plan standards and guidelines been applied?
3. What are the effects of management practices prescribed by the Forest Plan?

The monitoring goals listed in Table 4.1-3

are based on broad goals from the Forest Plan. The questions highlight additional detail from monitoring the effectiveness of the Forest Plan and validation of assumptions underlying the Forest Plan to assist with adaptive management. The questions provide a foundation for the Monitoring Guide which include supplemental questions that collectively respond to the goals and questions included in this table.

Table 4.1-3: Other Monitoring	
Monitoring 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?

Table 4.1-3: Other Monitoring	
Monitoring Goal	Monitoring Questions
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?

4.1.7 Biennial Monitoring and Evaluation Report

Monitoring forms the basis for continuous improvement of the Forest Plan and provides information for adaptive management. Biennial evaluations use monitoring to develop information that helps the Responsible Official determine if and where changes are needed in Forest Plan components, other Forest Plan content, and projects and activities. Monitoring also provides feedback to prioritize and improve the plan monitoring program and broader-scale monitoring strategy.

The biennial evaluation of monitoring is intended to collect, evaluate, and report on new data or results. The report does not need to evaluate all questions or indicators on a biennial basis but must focus on new data and results that provide new information for adaptive management. Data collected in accordance with the Monitoring Plan must be evaluated and interpreted before they provide useful information. Evaluation of monitoring data addresses three basic questions:

1. Is the Forest Plan implemented properly? (Implementation)
2. Is the Forest Plan achieving the desired outcomes? (Effectiveness)

3. Does the Forest Plan need to be changed? (Validation)

Every two years, the Forest Service will summarize what monitoring has been completed and the most recent evaluation results. At a minimum, the evaluation must:

1. Enable the Responsible Official to assess if there have been significant changes in the condition of the land or the demands of the public that indicate a need for changes to the Forest Plan, management activities, or the monitoring program.
2. Be used to inform adaptive management of the plan area.
3. Provide a basis for determining management effects.
4. Consider how well goals, objectives, outputs, and services have been met and how closely standards and guidelines have been applied.
5. Assess the effects of specific types of vehicles off roads on National Forest System lands.
6. Assess consistency with the requirements of the National Forest Management Act, including maintenance of forest productivity.