



Data Quality Standards for Appalachian National Scenic Trail Forest Health Monitoring Protocol

Natural Resource Report NPS/NETN/NRR—2018/1805



ON THE COVER

Photograph of NPS biologists sampling marine birds from a boat in Alaska.

Photograph courtesy of the National Park Service

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Introduction and Summary

The purpose of this report is to document the standards used by the Northeast Temperate Network (NETN) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in the Appalachian National Scenic Trail Forest Health Monitoring Protocol (Dieffenbach 2018). The policies and procedures documented in this quality-assurance plan for activities complement the quality-assurance plans for other monitoring activities conducted by the NETN and supplement National Inventory & Monitoring Division Quality Management Plan (DeVivo *in review*). The plan also serves as a guide for all NETN personnel who are involved in protocol/program activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

Protocol Overview

Knowing the condition of natural resources is fundamental to the National Park Service's mission to manage park resources "unimpaired for the enjoyment of future generations." Park managers are confronted with increasingly complex and challenging issues that require a broad-based understanding of the status and trends of park resources. Specifically, forest health was selected for monitoring because forests are the dominant ecological communities associated with the Appalachian National Scenic Trail (APPA).

The large, but narrow, configuration of APPA makes the administration of a ground-based plot monitoring program infeasible. In light of that reality, the NETN developed a protocol to track the overall condition of forest resources along the Appalachian Trail using pre-existing data collected by and publicly available from the US Forest Service's (USFS) Forest Inventory and Analysis Program (FIA). The primary objectives of this protocol are generally to monitor the status and trends in a variety of metrics based on forest composition and structure. Data acquired from FIA are constrained to the HUC10 Shell and further by distinct ecoregions intersecting the APPA. The HUC10 Shell (see protocol narrative) is a buffer surrounding the APPA land area that is based on hydrologic units defined by the USGS at the watershed level (USGS 2017).

This protocol, along with the associated standard operating procedures (SOPs), provides the framework and guidance for assessing the condition of forest resources at APPA. Data gathered as part of this protocol are stored locally in databases and uploaded to national databases maintained by NPS on an annual basis. Reporting on these data occurs at regular intervals and has multiple applications for management decision-making, park planning, research, education, and promoting public understanding of park resources.

Protocol Activities and Modules

Data are acquired and processed from U.S. Forest Service (USFS) FIA program through 14 different activities (Table 1) to support the objectives of the Appalachian National Scenic Trail Forest Health monitoring protocol (Dieffenbach 2018). Metrics describing Forest Health are derived from FIA data for each area of analysis (e.g., ecoregional subsection) within the HUC10 Shell (SOP 4). The periodicity of new data availability varies between states but is typically annual.

Table 1. Protocol activity matrix for the Appalachian National Scenic Trail Forest Health monitoring protocol (Dieffenbach 2018).

Activity Type	Activity #	Activity	Description
Site Recon, Establishment, and Maintenance	1	Area of Analysis	Identification and generation of area of analysis (AOA) polygons for use in generating statistics for forest health monitoring (e.g., HUC10 Shell, ecoregions) SOP1; Dieffenbach, 2018)
External Data	2	Preprocess Forest Health Data	Acquire and staging of appropriate forest health data used in the derivation of forest health metrics and calculation of ecological integrity (SOPs 2 and 3; Dieffenbach 2018)
Derived Data	3	Assign Land Ownership	For each AOA, calculate proportion of land by ownership from the HUC10 Shell polygon (SOP 3; Dieffenbach 2018).
	4	Assign Protection Status	For each AOA, calculate proportion of land by protection status category (e.g., Protected and Forested) (SOP 3; Dieffenbach 2018).
	5	Calculate Structural Class	For each AOA and time period, calculate stand structural class composition as the percentage of plots classified within each category (e.g., late successional, mature, etc) (SOP 3; Dieffenbach 2018)
	6	Calculate Snag Abundance	For each AOA and time period, calculate live and dead (snag) standing tree abundance as stems/ha and snags as a proportion of live tree density per plot. Calculate average and standard deviation among plots. Assign condition based on assessment points (SOP 3; Dieffenbach 2018)
	7	Calculate Coarse Woody Debris Volume	For each AOA and time period, calculate volume of live tree and coarse woody debris as m ³ /ha and coarse woody debris volume as a proportion of live tree volume per plot. Calculate average and standard deviation among plots. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).
	8	Calculate Live Basal Area	For each AOA and time period, calculate basal area of all living trees (m ² /ha) per plot. Calculate average and standard deviation among plots. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).
	9	Calculate Tree Species Composition	For each AOA and time period, estimate canopy tree species composition of 10 most abundant species (SOP 3; Dieffenbach 2018).
	10	Calculate Tree Regeneration	For each AOA and time period, calculate seedling density (seedlings per ha) and ratio off tall (30-200cm) to short seedlings (<30 cm) for all species and by species per plot. Calculate average and standard deviation among plots. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).
	11	Calculate Tree Condition	For each AOA and time period, calculate the percentage of individuals of the top 10 most abundant species with > 50% of their canopy damaged per plot. Calculate average and standard deviation among plots. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).

Table 1 (continued). Protocol activity matrix for the Appalachian National Scenic Trail Forest Health monitoring protocol (Dieffenbach 2018).

Activity Type	Activity #	Activity	Description
Derived Data (continued)	12	Calculate Invasive Plant Presence	Identify species (presence only) in plot that are on an accepted list of invasive species (e.g., state noxious weed list) (SOP 3; Dieffenbach 2018).
	13	Calculate Tree Mortality Rates	For each AOA and time period, calculate the percentage of individuals of the top 10 most abundant species that died from one survey to the next by species and for all species per plot. Calculate average and standard deviation among plots for each species and all species together. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).
	14	Calculate Tree growth Rates	For each AOA and time period, calculate tree growth of individuals of the top 10 most abundant species as the difference in the diameter at breast height (DBH) of all individuals recorded between two successive surveys. Growth rates are calculated by species and for all species per plot. Calculate average and standard deviation among plots for each species and all species together. Assign condition based on assessment points (SOP 3; Dieffenbach 2018).

Sampling Design

The FIA program uses permanent plots located throughout the conterminous United States to monitor status and trends in forest area, timber volume, and forest health. Methods are scientifically rigorous with FIA data analyzed in numerous peer-reviewed publications nationwide and specific to eastern US forest (e.g., Woodall et al. 2011). Plot sampling is based on a rotating panel design, where plots are sampled on a 4- or 5-year cycle with one panel of plots sampled each year. Plots are located on properties managed by federal and state governments and private landowners and sampled following rotating panel design (4- or 5-year cycle with one panel of plots sampled each year). For a full description of the sampling approaches please refer to the [USFS FIA Data Mart page](#) (accessed October 2017).

The FIA program refreshes their data on a state-by-state basis; however, not all states are refreshed at the same time. The FIA program displays the [Most recent FIA data by State and Collection Year page](#). The procedures described in NETN’s Appalachian National Scenic Trail Forest Health Monitoring Protocol (Dieffenbach 2018) will recur every 1 to 5 years depending on data availability.

Data Quality Objectives

Data quality values and standards for implementation are provided in Table 2 through Table 4.

Table 2. Data Quality Values (DQVs) for Appalachian National Scenic Forest Health monitoring protocol (Dieffenbach 2018).

Category	Data Quality Value	Definition	Protocol Considerations
Intrinsic Data Quality	Accuracy	Measurements reflect the true value of the parameter being observed. This applies to measures (length, width, position) or classes (species, types, or categories). Includes components of precision and bias.	This protocol does not affect the accuracy of the in-field data collection process. The accuracy of the acquired data is evaluated in the context of previously acquired data. Checks for accuracy completed under this protocol involve examining summary statistics and diagnostic plots (e.g. boxplots) of the downloaded data to determine the presence of outliers, statistically comparing how new data relate to previously acquired data, and whether all data acquired may be used to address protocol objectives.
	Representativeness	Measurements represent conditions at the time of sampling. Combined with accuracy, leads to repeatable data collection.	Following acquisition of new data, data are checked to determine whether new plots have been added to the database and their location (state and ecoregional subsection). Checks are also completed to evaluate the presence of repeat surveys so that calculations evaluating change over time can be conducted.
Contextual Data Quality	Comparability	The degree to which data, that have been swapped and fuzzed, can be compared among sample locations, data sources, or periods of time.	Following acquisition of new data, data are checked to determine whether new plots have been added to the database and their location (state and ecoregional subsection). Due to the swapping and fuzzing process, we acknowledge that data used during one analysis may differ from data used during the next analysis. An examination of the summary metrics and associated error will help in assessing how new data acquisition affects data comparability. If there are sufficient sample sizes for each time period or in each Area of Analysis being compared, acquisition of new data should have little bearing on comparability. The appropriate accommodations will be made when needed to ensure data comparability in space and over time. When not possible, caveats and other acknowledgements concerning data changes will be announced and made clear in data products.
	Timeliness / Currency	How recent the data need to be considered valid for their intended use. Data represents conditions and/or is available and in a format for use at the appropriate time in the decision-making process.	The acquisition of new data is checked periodically, typically every 1 to 3 years.

Table 2 (continued). Data Quality Values (DQVs) for Appalachian National Scenic Forest Health monitoring protocol (Dieffenbach 2018).

Category	Data Quality Value	Definition	Protocol Considerations
Contextual Data Quality (continued)	Completeness	All data/measures required to evaluate accuracy representativeness are present; incomplete data sets (either at a location, across sampling locations, or over time) lose utility or relevance. Data records contain values as planned across the period of record.	Data sources used for metric calculation are checked to determine that they cover the majority of the Area of Analysis (typically ecoregional subsection) being evaluated and/or the entire period of record being analyzed. Following acquisition of new data, data are checked to determine whether new plots have been added to the database and their location (state and ecoregional subsection).
Representational Data Quality	Consistent Representation	Use of standard definitions when describing data quality or resource quality based on data	Terminology used throughout this protocol are consistent with terminology used in the USDA Forest Service FIA Program (U.S. Department of Agriculture Forest Service 2016). For any given Area of Analysis, definitions of derived metrics will remain constant over time, regardless of source data used or methods used for calculation.
Data Accessibility	Secure	Access to data, products, and systems limited to appropriate audiences.	There are no security concerns with this dataset. These data are already publicly available from the USFS.

Table 3. Measurement Quality Objectives for the Appalachian National Scenic Forest Health monitoring protocol (Dieffenbach 2018). Measure number refers to row numbers in Table 1.

Measure	Quality Indicator	Quality Objective
1. Area of Analysis Definition	Location Accuracy	AOA is defined to be the ecoregional provinces, sections, and subsections that intersect the APPA footpath within the HUC10 Shell.
3-4. Land ownership and Protection Status Quality Objectives	Completeness	Metrics calculated for 100% of AOAs when possible
	Precision	Metrics for area are reported with a precision of +/- 0.1 km ² for vector-based calculations.
5-14 Shared Forest Health Metrics	Completeness and Accuracy	Metrics calculated for 100% of AOAs when sufficient data are available. Calculations are accurate; comparisons are made to test data calculated using more than one process to ensure results are the same.

Taxonomic Standards

Standards related to taxonomic information pertaining to biological data (e.g., tree species identifications) collected in association with this protocol follows the USFS FIA program's standards (USFS 2008).

Protected Data Standards

Standards for handling protected data are set by the USFS FIA program and summarized in Table 4. All data downloaded from FIA and used in this protocol are already publicly available and FIA has conducted the appropriate procedures to meet their data protection standards. For example, plot locations are swapped and fuzzed to protect land owner identity and the names and locations of sensitive species are not part of this dataset.

Table 4. Data Protection standards for Appalachian National Scenic Trail Forest Health monitoring protocol (Dieffenbach 2018). With the exceptions noted, all data collected are to be made publicly available in a timely fashion.

Category	Type of Data	Level of Protection	Rules for Dissemination
Location Data and Information	Permanent Sampling Locations	No Protection Needed	Data obtained from FIA for this protocol are swapped and fuzzed. The actual sampling locations are legally protected and cannot be identified by this dataset.
Sensitive Species	Threatened and Endangered Species	No Protection Needed	Data obtained from FIA are publicly available and do not contain T&E species
Personally Identifiable Information	Staff Information	No Protection Needed	No PII is found in database

Literature Cited

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