National Park Service
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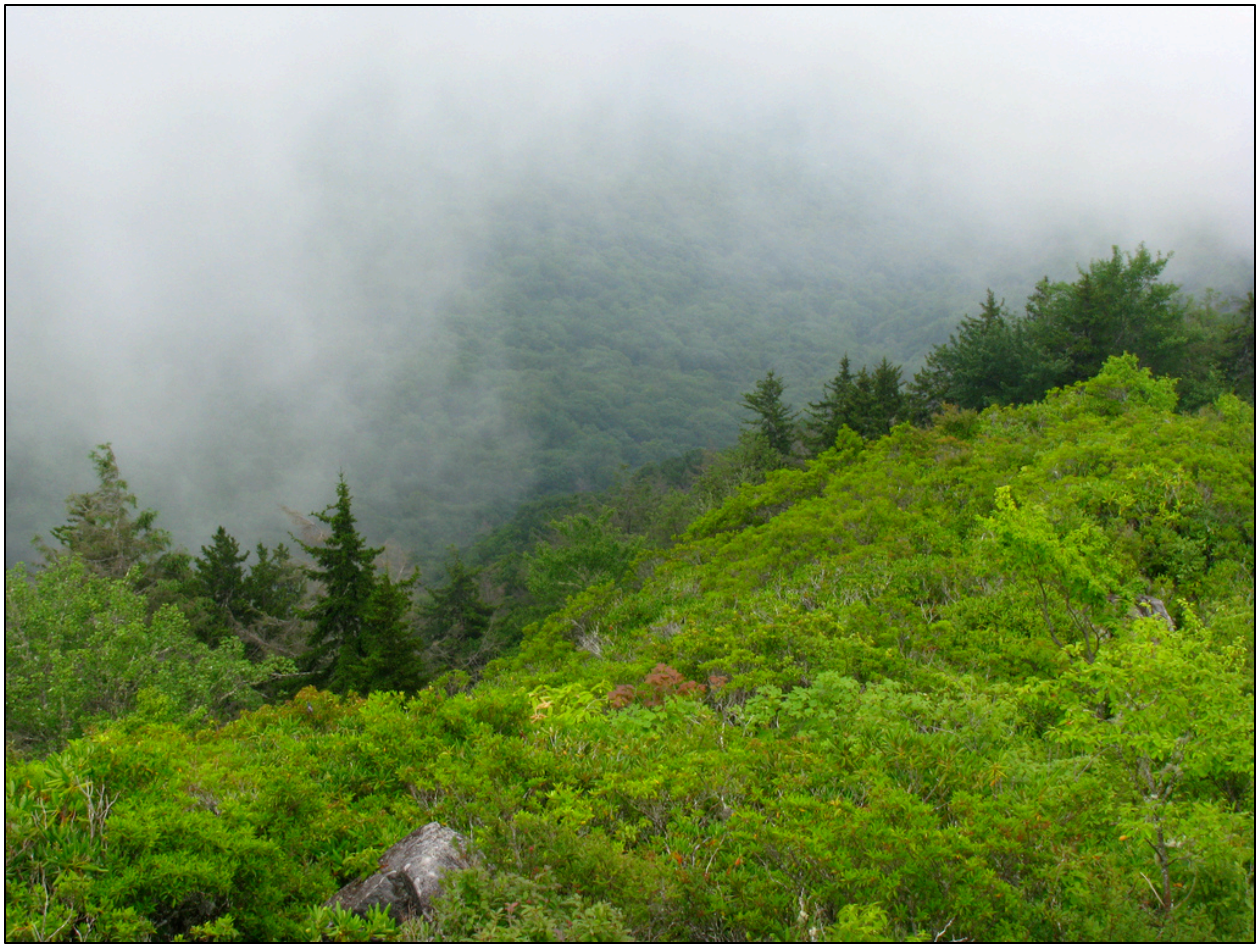
Natural Resource Stewardship and Science

Appalachian National Scenic Trail Rare Plant Monitoring Protocol

2015 Revision

Natural Resource Report NPS/NETN/NRR—2015/943



ON THIS PAGE
Photograph of Mt. Cammererr along the AT in Great Smoky Mountains National Park.
Photograph courtesy of Alex Ford

ON THE COVER
Photograph of Gray's Lily, Roan Highlands, Tennessee.
Photograph courtesy of t Jon Ericsonn.

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Natural Resource Report NPS/NETN/NRR—2015/943

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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This report received formal, high-level peer review based on the importance of its content, or its potentially controversial or precedent-setting nature. Peer review was conducted by highly qualified individuals with subject area technical expertise and was overseen by a peer review manager.

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NPS 632/128352, April 2015

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number. Individual Standard Operating Procedures (SOPs) contain their own Revision History Logs and are updated as needed.

Revision History Log

Version #	Date	Revised by	Changes	Justification
1.00	April 2008	Geri Tierney	Initial draft.	
1.01	June 2008	Geri Tierney, Fred Dieffenbach	Revised Appendix III, added Appendix IV. Revised objectives and field methods.	Response to initial review.
1.02	Sept. 2008	Geri Tierney	Streamlined SOPs and data forms by combining separate Site and Species components. Added two Appendices. Revised objectives and field methods.	Response to second review.
1.03	Oct 2010	Geri Tierney	Reformatted. Editorial changes.	
1.04	Sept 2011	Geri Tierney, Fred Dieffenbach, Casey Reese, Ed Sharon	Restructured SOP 1. Deleted Appendix A, Monitoring Sites. Inserted App. B, Prioritized Occurrences. Substantially updated and expanded App. D as Volunteer Manual. Rare Plant Occurrences. Added App. H. Picture posts, and GPS and Digital Camera SOPs. Added descriptions of Field season preparation and End of season procedures. Added alternative Contractor Implementation option. Added Operating budget. Reorganization and editorial changes. Added Ed Sharron to author list.	Redirected SOP 1 towards program administration, to provide necessary guidance to Coordinators.
1.05	January 2012	Fred Dieffenbach	Added safety and prioritization SOP's. Removed 'comments' appendices. Revised text throughout in response to John Karish's comments.	Response to John Karish review.
1.06	May 2012	Fred Dieffenbach	Many revisions per Brian Mitchell's recommendations, extensive changes to the prioritization and safety SOPs, inclusion of a data management SOP, and inclusion of reporting methodology with analysis SOP.	
1.07	July 2012	Fred Dieffenbach	Revised data sheet (now 1.04) by removing the distinction between	

Version #	Date	Revised by	Changes	Justification
			spatial data collected for small versus large occurrences. Now, just point data will be collected and a plan to more accurately delineate occurrences will be developed.	
1.08	November 2012	Fred Dieffenbach	Revised data sheet (now 1.05) by reorganizing order and generally cleaning format	
1.09	January 2013	Ed Sharron	Minor edits and final formatting	
1.10	April 2014	Fred Dieffenbach	Adjustments to data sheet (now 1.06). GPS coordinates only collected for new occurrences, or if clearly inaccurate.	Reduce redundant data collection
1.11	March 2015	Fred Dieffenbach	Added caution about excessive monitoring; Inserted need to ensure monitoring occurs during optimal period; Reinforced the need for timely notification of urgent threats; Implementation of a monitoring assignment and field data status document to track various steps of the process; set a November 30 date for data submission to Natural Resource Mgr; Revised end of season procedures; Revised resampling by deferring implementation until a later date; Changed data analysis and reporting process; added Deviations and Major Changes SOP.	Changes needed to align protocol with actual procedures and to address deficiencies.

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Background and Objectives

The Appalachian National Scenic Trail (APPA) is a treasured national icon. This extended footway traverses the Appalachian uplands of the eastern United States for more than 2,100 miles from Georgia to Maine, providing a unique and rich opportunity for outdoor enjoyment and an appreciation of natural and cultural resources. It is managed cooperatively by the National Park Service (NPS), the Appalachian Trail Conservancy (ATC, a private, non-profit organization), more than 31 local trail clubs, the US Forest Service (USFS), and more than 75 local land management agencies through the 14 states which the Appalachian Trail footpath (Trail) corridor passes.

Rationale

Rare species are an important APPA resource. In 2004, the NPS Northeast Temperate Inventory & Monitoring Network (NETN) convened a meeting of APPA resource managers and monitoring staff to prioritize "Vital Signs" for resource monitoring. Vital Signs are defined as "a subset of physical, chemical, and biological elements and processes of park ecosystems that are selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, or elements that have important human values." The convened group selected Priority Rare, Threatened, or Endangered (RTE) Species as a "Category 2" Vital Sign, to be monitored after higher priority "Category 1" Vital Signs (Shriver et al. 2005).

The importance of 'rare' species to the APPA has been recognized for many years. For the purpose of this protocol, 'rare' is defined as any species that has a NatureServe conservation status rank of G1 (critically imperiled, on a global scale), G2 (imperiled, on a global scale), or G3 (vulnerable, on a global scale). Starting in 1989, a series of surveys were undertaken in cooperation with state Natural Heritage offices to inventory rare, and less rare but noteworthy species (e.g., species with a state conservation rank of critically imperiled, imperiled, or vulnerable, or possibly an occurrence that does not meet the rarity criteria but is unique or special in some other way) within the Trail corridor.[1] Between 1989 and 2001, APPA rare plant inventories were conducted in each of the 14 APPA states. These inventories varied slightly among states as a result of working with different state Natural Heritage offices. Vascular plants and exemplary natural communities were inventoried in all states, rare vertebrates were inventoried in some states, and rare non-vascular plants and invertebrates were inventoried in just a few states. These inventories combined with subsequent additions identified 1,846 species occurrences[2] of rare and less rare but noteworthy species and 297 exemplary vegetation communities at 482 sites, with a site being defined as a 'general' location that may contain

[1] The APPA corridor varies greatly in width, but is nominally 1,000 ft. wide (500 ft. on either side of the centerline).

[2] The number of occurrences is difficult to conclusively determine because of inconsistencies in the way occurrences were reported by the individual states. In some instances occurrences were split into multiple parts and given their own occurrence numbers when they should have been kept together, while in other instances occurrences may have been aggregated when they should have been kept separate. Consequently, the reported number of occurrences (1,846) is the best available accounting using currently available information.

single or multiple species occurrences and/or single or multiple exemplary vegetation communities. Out of the 1,878 occurrences, 254 are of rare plant species (ranked G1, G2 or G3). Within these rare species occurrences, 13 are federally endangered plant species[3] (five are *Geum radiatum*, six are *Gymnoderma lineare*, and two are *Houstonia purpurea var. montana*) and one is a federally threatened plant species (Isotria medeoloides).

Most of the species occurrences are vascular plants (1,662). While rare (G1, G2, or G3) species are found in almost every APPA state, notable hotspots or clusters occur in the Presidential Range of the White Mountains of NH, the Mt. Rogers -Whitetop area of southwest VA, and the Roan Highlands along the border of NC and TN.

The rare plant inventories included descriptions of each species, as well as a map, description of threats, and management recommendations for each site or occurrence. The threats most frequently observed by these inventories were trampling, trail maintenance activities, invasive exotic plant species, and exotic insect pests. Additional threats noted included erosion, all-terrain-vehicles (ATVs), and plant competition or succession (Schwarzkopf and Tierney 2005).

Program History and Review

In 1989, the APPA and ATC began a program to monitor rare plant species occurrences identified through the APPA rare plant inventory program[4] using volunteer monitors. Because insufficient resources were available to monitor all occurrences, occurrences were selected for monitoring based on perceived degree of threat, species rarity, and accessibility of site (Casey Reese, unpublished data). Actual numbers of sites and occurrences monitored fluctuates from year-to-year, but about 23% of the documented occurrences have been monitored at least once since monitoring began (i.e., 489 out of the 2,118 documented occurrences). Most monitored plants are understory herbs, but trees, shrubs, vines, ferns, grasses, sedges, and non-vascular plants have all been monitored.

The goals of the APPA Rare Plant Monitoring Program are to:

- Contribute to the protection of rare plants on APPA lands
- Improve natural resources management and stewardship capacity by providing essential information in a timely fashion to land managers and decision-makers
- Develop an appreciation for rare plants and animals in the APPA community through volunteer involvement

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[3] In addition to federally endangered plants, there are 4 federally endangered animal species that account for 9 occurrences (*Acipenser brevirostrum*, *Glaucomys sabrinus coloratus*, *Glaucomys sabrinus fuscus*, and *Plethodon Shenandoah* at 1, 2, 3, and 3 occurrences, respectively).

[4] This program was known as the A.T. Natural Heritage Monitoring Program. The program took its name from the series of rare plant inventories conducted by the Natural Heritage programs associated with states through which the APPA passes.

- Raise public awareness of the APPA as a protected refuge for significant biodiversity

In 2007, the ATC launched a review of the ongoing rare plant monitoring program after more than 10 years of operation. A committee comprised of both internal and external reviewers reviewed program goals and objectives, responsibilities, priorities, operation, and coordination, and made many recommendations (Dufour 2008). Recognizing the importance of standardized methods for monitoring programs, the review recommended the development and use of a written protocol, including detailed Standard Operating Procedures (SOPs). Such a protocol is a key tool for ensuring that procedures do not vary unintentionally among regions or over time, that monitoring procedures including updates are archived, and that real trends may be detected (Elzinga et al. 1998). The present document seeks to address this key recommendation.

Many of the recommendations included in the program review are relevant to this protocol and a few examples are listed below. See Dufour (2008) for a full list of recommendations.

Data collection and monitoring form:

- Photographs are useful for verification of plant identity, developmental stage, site condition and onsite threats; taking digital photos should be encouraged and methods should be clearly described.

- Photos showing site conditions should also be taken.

- Measuring vigor is important, but the current measure is not quantitative enough and too subjective. Quantitative criteria for judging vigor could be developed for the different life forms monitored, and the feasibility of having volunteers use them could be evaluated. Photos can also help to confirm vigor assessments.

- Eliminate the question "How does the size and vigor of the population compare with your last visit?" This information is too subjective and is entirely dependent on the same monitors visiting the same occurrences.

- It would be helpful to monitor within a particular seasonal window tied to plant development and reproduction; this window will vary by species.

- Procedures for counting, measuring area, etc. should be standardized and clearly described.

- Use of a minimum search time for counting plants may increase accuracy [sic; should be "repeatability"].

- Methods may vary by plant life-form (i.e., herb/forb, tree, shrub, grass/sedge, non-vascular plant).

- Use of GPS should be encouraged and methods should be clearly described.

- Some 'site' characteristics may be useful to collect.

QA/QC:

- A small % of sites could be revisited each year by carefully selected monitors to assess quality of monitoring data.

Volunteer training:

- Training should include species identification, monitoring methods, a visit to the site that will be monitored, and, if possible, GPS training.
- Training materials should include a map of the site to be monitored, and pictures and description of species to be monitored.
- More than one monitor may be assigned to a site.
- Providing volunteer assistance should be a program priority.
- If possible, assign a backup monitor to each site or group of sites in case of illness or other problem with a primary monitor.

Data analysis and reporting:

- Each year, monitoring data should be entered into a database and analyzed.
- Each year, monitoring results should be shared with program staff[5], volunteers, and the larger AT community.

Monitoring Objectives and Priorities

This protocol sets forth the following specific monitoring objectives to achieve the goals of the APPA Rare Plant Monitoring Program for selected occurrences:

- Determine long-term trends at rare plant occurrences, including variability in number of individuals and life-stage distribution.
- Identify threats to occurrences of rare plant species.

This program focuses monitoring efforts on occurrences of rare plants within the APPA corridor, a ribbon on the landscape that is generally about 500 feet on either side of the Trail, and any adjacent land acquired by the APPA. Since it is not possible to monitor all 2,118 species and community occurrences that have been documented within this region, plant species occurrences are selected for monitoring using a prioritization method developed by the APPA Environmental Monitoring Coordinator (SOP 9: Prioritization). The prioritization approach considers three factors:

1) Occurrences "qualify" for monitoring if they are not being monitored by another agency or NPS unit, and if the species in question is not considered too difficult to identify by program staff or volunteers.

[5] "Program staff" includes the APPA Natural Resource Manager, APPA Environmental Monitoring Coordinator, ATC Regional Coordinators, and ATC Volunteer Coordinators.

2) The ecological significance of an occurrence using a combination of: a) NatureServe global conservation status rank, b) NatureServe sub-national conservation status rank, c) Federal status under the Endangered Species Act, if any, d) sub-national protection status, if any, and e) rank assigned to the occurrence itself during the original APPA surveys performed during 1989-2001.
3) a) Distribution and abundance of the species within the Trail region, b) any detectable trend in the species' distribution and abundance within the Trail region, and c) data from recent monitoring including the difficulty of monitoring this occurrence, observable threats, and the recorded condition of the occurrence.

In addition to the above factors, a supplemental consideration for monitoring is convenience. In some instances an occurrence that is assigned a low priority might be in close proximity to another occurrence that is a high priority. In such cases, a monitor may be asked, or may voluntarily monitor the low priority species. During training, monitors should be cautioned against visiting occurrences more frequently than necessary to avoid damaging potentially fragile species.

Based on the three factors, each occurrence is assigned a numerical score which corresponds to one of five monitoring priorities (Very High, High, Moderate, Low, or Very Low; Table 1 and SOP 9: Prioritization). At this time, 125 occurrences prioritized as Very High are designated for monitoring (Appendix A). In addition to these occurrences, program staff may select additional occurrences for monitoring as resources permit. For example, an occurrence with a lower prioritization may be selected for monitoring if nearby trail work is scheduled that may threaten the occurrence, or if the occurrence lies near and is easily monitored in conjunction with another occurrence that is designated for monitoring. Reasons for inclusion or exclusion of occurrences from the monitoring program are documented in the program database[6].

Table 1. Number of APPA rare plant occurrences by region and monitoring priority. NERO, MARO, VARO, and SORO refer to the Appalachian Trail Conservancy's New England, Mid-Atlantic, Southwest and Central Virginia, and Southern Regions, respectively.

Priority	NERO	MARO	VARO	SORO	Total
Very High	29	2	4	74	109
High	61	25	29	81	196
Moderate	321	81	32	250	684
Low	213	99	40	114	466
Very Low	94	8	18	87	207
Total	718	215	123	606	1,662

[6] The rare plant monitoring program database is really a combination of 5 separate databases that interact with each other in a variety of ways: Q_ATPO_Database_NaturalHeritage_Monitoring_be.mdb, Q_ATPO_Database_NaturalHeritage_Monitoring.mdb, TandE_master.mdb, StdClass_master.mdb, NETN_Plant_List.mdb. See SOP 6: Data Management & Quality Assurance/Quality Control for more information.

The APPA Natural Resource Manager and the APPA Environmental Monitoring Coordinator review and update NatureServe conservation ranks and monitoring priority as the APPA states update their rare plant lists. When possible, new reports of rare plant species occurrences within the APPA corridor are obtained from the state Natural Heritage offices and added to the program database.

Sampling Design

Monitoring approach and rationale

In choosing a monitoring approach, it is important to consider monitoring goals and objectives, the nature, size and scope of the resource to be monitored, and the resources available for monitoring (Elzinga et al. 1998). The intensity of monitoring will be determined both by the monitoring objectives and the level of resources available. This program is focused on rare plant species, and the size and scope are quite large due to the length of the APPA and the large number of occurrences documented within the APPA corridor. Financial and staff resources available to this program for monitoring are modest, but the program has traditionally drawn upon valuable human resources – the large cadre of committed APPA volunteers willing to participate in rare plant monitoring.

Rare plant monitoring typically employs some combination of: 1) monitoring the distribution or spatial extent of rare plant populations; 2) monitoring the size, condition, and/or vigor of rare plant populations; and 3) intensive demographic monitoring of specific populations to document and predict population trends (e.g., population viability analysis) (Palmer 1988, Menges and Gordon 1996). The level of effort and resources required for monitoring increases with progression from the first to the third approach. While the most intensive level – demographic monitoring – is the only one that can be used for predictive assessment of population viability, the level of time and manpower required to employ that level of monitoring are substantial (Elzinga et al. 1998).

Subjective measures related to the condition of a rare plant population are obtained by monitoring population size, the percentage of individuals in various life-stages (e.g., seedling or flowering), and/or evidence of specific threats to the population. Plant vigor is obtained by monitoring features such as individual plant size, number of leaves, or reproductive output. Indicators of plant vigor are strongly influenced by annual weather patterns (Elzinga et al. 1998). For this reason, monitoring vigor can be less useful than monitoring condition, particularly for short-lived plants.

Many governmental and private organizations engage in rare plant monitoring, and these existing programs are a useful resource. The present protocol draws upon the APPA Natural Heritage Monitoring Program, as well as the Chicago Botanical Garden's Plants of Concern (POC) Program (http://www.plantsofconcern.org/), the University of Washington's Rare Care Program (http://courses.washington.edu/rarecare/), and the Shenandoah National Park Rare Plant Monitoring Program. Both the POC and Rare Care programs employ volunteer monitors.

This protocol seeks to provide methods for collecting useful and cost-efficient information on a large number of rare plant occurrences, but these methods will not provide the intensive demographic monitoring necessary to predict population viability. That level of monitoring would require more resources than currently are available to this program. If resources permit, the program may decide to undertake demographic monitoring by a trained biologist for highly significant, threatened, or endangered occurrences. However, consideration should be given to whether scarce resources will be over-allocated to just a small number of occurrences (Elzinga et al. 1998).

Sampling locations

Due to the large size of the area of interest (that is, the entire length of the Appalachian National Scenic Trail), monitoring is restricted to locations documented to harbor High and Very High priority occurrences of rare plants, as described above. In addition to rare plant occurrences documented by the original rare plant inventories, new occurrences are documented and evaluated for inclusion in the monitoring program as they are discovered by monitors or others in the area, or as new information is obtained from the state Natural Heritage offices. While this sampling design will not allow statistical inference to non-sampled areas, it will provide managers with useful information regarding the status of specific occurrences that can be collected by volunteer monitors.

Sampling frequency

Frequency of monitoring varies based on the site location, vulnerability of the occurrence, and management activity, in addition to the significance and rarity of the occurrence, as recommended in the recent program review (Dufour 2008). The APPA Natural Resource Manager and Environmental Monitoring Coordinator determine the appropriate frequency in conjunction with available resources using the guidelines contained in SOP 9: Prioritization. Annual sampling is indicated for occurrences in areas that are undergoing management activity, or are considered vulnerable due to observed or perceived threats or problems noted by previous monitoring. For occurrences that a) appear stable, b) are without obvious risk from threats, and c) are not subject to current management activity, staff may decide to relax monitoring frequency, particularly for occurrences at remote sites. This frees up monitoring resources for Very High priority occurrences, in addition to limiting trampling impacts from monitoring. The APPA Natural Resource Manager and Environmental Monitoring Coordinator may decide to include lower priority occurrences in the monitoring program at a lower frequency or in conjunction with a co-located higher priority occurrence. Decisions about sampling frequency are documented in the program database. An automated database query is used prior to sampling each year to flag occurrences potentially in need of altered monitoring frequency due to changed status (deteriorating), threats, or management. Occurrences that previously showed a problem[7] are monitored more frequently (e.g., annually), if possible, until two successive sampling intervals show improvement or stability. Improvement occurs when an occurrence shifts from poor to average (or to excellent) condition or from average to excellent condition in subsequent monitoring periods, whereas stability occurs when no change in condition is observed between sampling cycles.

Endangered species

Monitoring occurrences that are subject to the Endangered Species Act (ESA) requires special consideration to ensure that species are not harmed during monitoring activities. Currently, four plant species that are federally listed under the ESA are prioritized for monitoring in this program. Three species are endangered – rock gnome lichen (*Gymnoderma lineare*), Roan Mountain bluet (*Houstonia purpurea* var. *Montana*), and spreading, or Appalachian avens *(Geum radiatum*), and one is threatened – small whorled pogonia (*Isotria medeoloides*). Prior to monitoring species subject to ESA (including candidate species or species of special concern), the APPA Natural Resource

[7] Occurrences that were previously “red flagged.”

Manager contacts staff in both the NPS Biological Resource Management Division's Endangered Species Program (http://www.nature.nps.gov/biology/endangeredspecies/) and USFWS Endangered Species Program (http://www.fws.gov/endangered/) to discuss monitoring procedures and needs for each species. In addition, prior to monitoring any species subject to the ESA on or adjacent to USFS land, the APPA Natural Resource Manager will also consult with local USFS botanists working on that species. Likewise, prior to monitoring any occurrences within another NPS park, the APPA Natural Resource Manager will coordinate with natural resource staff at the applicable NPS park. If we determine that an occurrence is monitored by another agency or another NPS park, that occurrence is removed from the prioritization list to avoid duplication of effort. Depending upon the advice given by these experts, it may be necessary to remove species subject to the ESA from the volunteer monitoring program, and instead monitor these species using professional staff or alternative methods.

Detectable amount of change

The new rare plant monitoring protocol is conducted as a census of Very High priority occurrences, so a power analysis (which assumes a sampled population rather than a census) is not strictly appropriate. Nevertheless, there will be some minimum level of change that can be statistically detected as monitoring data are collected over time. Major factors that will affect the ability to detect change are annual variation, observer error in census counts, and the subjective nature of the methodology[8]. The methods used in this protocol have not been used long enough at APPA or similar areas to allow us to estimate the minimum level of detectable change, but we should be able to examine this after approximately three to five years of data collection for those occurrences that are monitored annually.

In developing this protocol, our intent has been to design qualitative methods that, while subjective, produce a reliable index of occurrence condition while minimizing variability due to observer judgment. We are confident that these methods, if used faithfully over time, will produce a dataset that can be used to assess rare plant occurrence health and trends.

[8] The rare plant monitoring protocol incorporates quantitative measures such as stem count, as well as qualitative measures such as observed condition.

Field Methods

The field methods were carefully designed for implementation by trained volunteer monitors. This protocol uses a combination of straightforward quantitative and qualitative measurements to track size and condition of rare plant occurrences, and to track spatial extent of the occurrence, important site variables, and visible threats. The protocol has been kept simple and requires only a few basic pieces of equipment. It was designed to be used for monitoring a wide variety of plant life forms, including herbs/forbs, trees, shrubs, graminoids (grasses and sedges), and non-vascular plants, and methods vary only slightly for applicability to different life forms.

While this program has traditionally been implemented by volunteer monitors, the APPA Natural Resource Manager and the APPA Environmental Monitoring Coordinator may decide to contract monitoring professionals to supplement or replace volunteer monitoring for specific occurrences (e.g., federally endangered species) or regions (e.g., a region with inadequate volunteer capacity).

Field season preparation

The APPA Natural Resource Manager is primarily responsible for planning the upcoming season. Preseason planning will occur primarily during the winter months (January – March; figure 1). To support this planning phase, the APPA Environmental Monitoring Coordinator updates the APPA rare plant program database with updated information on species global and sub-national rank, federal and state status, and previous year's monitoring data such as condition and presence of impacts, as needed, and prepares a prioritized list of occurrences to be monitored during the field season[9]. At this time any new occurrences within APPA that have been obtained from the state Natural Heritage offices are also added to the database.

ATC monitoring coordinators[10] begin volunteer recruitment and coordination, networking with local natural history or botanical organizations, and contacting all continuing monitors to verify their commitment to the upcoming season, as described in SOP 2: Program Administration and Volunteer Support. ATC monitoring coordinators make sure that all program equipment (GPS units and digital cameras) are in good working order, and that sufficient tally counters, data forms, and training materials are ready to distribute. ATC Regional Coordinators[11] arrange for training of new volunteers

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[9] Prioritization lists vary yearly based on the results of previous monitoring cycles. For example, if previous monitoring efforts indicate that a species occurrence is declining that occurrence will receive higher monitoring priority. Conversely, species occurrences that show improvement or stability might be monitored less frequently. As a result, the number of occurrences on the prioritization list may increase or decrease.

[10] The term ATC monitoring coordinator is a collective that includes ATC Regional Coordinators as well as ATC Volunteer Coordinators. Most are volunteers with expertise and experience monitoring rare plants, and are generally associated with an individual trail club. They assist less experienced volunteer monitors. Whether volunteer monitors work with an ATC Volunteer Coordinator or with an ATC Regional Coordinator is regionally dependent and may vary from one season to the next.

[11] Regional Coordinators are paid employees of ATC associated with one of the four ATC regions.

on site at the plant occurrence when the species has begun flowering, if possible, as described in the Program Administration and Volunteer Support SOP (SOP 2).

Data collection

The monitoring season coincides with peak flowering times of the rare plant species monitored, and varies by region and species. Monitoring coordinators should endeavor to schedule visits during the optimal monitoring period for an occurrence, ensure that monitors are aware of this period, should document the date on the monitoring assignment form, and revise the optimal period for an occurrence as necessary. The optimal monitoring period is established for about 36% of all occurrences, and these periods are included on the priority list. In general, monitoring occurs during the spring and summer months, running approximately from April to September. When an urgent threat to a rare plant occurrence is seen during a visit, volunteers must immediately contact their ATC monitoring coordinator to report the threat. ATC monitoring coordinators then immediately contact the APPA Natural Resource Manager to determine if further evaluation or management actions are needed. Monitoring coordinators should emphasize the importance of prompt notification when an urgent threat is identified.

The number of individual plants is counted (for occurrences comprised of ≤ 250 plants), or estimated (for larger occurrences). Alternatively, percent ground cover is estimated for non-vascular or densely-matted plants which cannot be readily counted. Both methods are detailed in SOP 6: Occurrence Measurement. The distribution of individuals in different life-stage classes (vegetative, flowering, fruiting, and senescent)[12] and presence of juvenile plants is visually assessed. Area covered by the rare plant occurrence is measured for small occurrences (< 1,000 ft^2 or < 50-ft long), or estimated from GPS coordinates for larger occurrences. Monitors describe rare plant occurrence condition and note threats or disturbances affecting the occurrence. Site wetness, as well as dominant and invasive exotic species on the site, is recorded.[13] Management actions that may help protect the rare plant are noted. Monitors are encouraged to use GPS to document rare plant locations, and digital photography to verify species identification and provide a visual record of the site and species. Specific procedures are included in SOP 6: Occurrence Measurement and a list of necessary equipment is included in SOP 3: Equipment. Data are recorded on the APPA Rare Plant Monitoring Data Form (Appendix B), available in paper or electronic format (pdf).

Monitors submit data to ATC monitoring coordinators as soon as possible following data collection (ideally within three weeks). Upon receipt of a data form, ATC monitoring coordinators review data forms (ideally within 10 days) for a) obvious blank entries, b) occurrences that were not found, and c) occurrences in which < 6% of individuals were flowering AND < 6% of individuals were fruiting.

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[12] These classes are defined in SOP 6: Occurrence Measurement.

[13] Additional site variables that were collected during initial inventories (elevation, slope, aspect, and terrain) are not typically repeated.

If discrepancies are found, the ATC monitoring coordinator must work with the volunteer monitor[14] to resolve the problem before sending the form to the APPA Natural Resource Manager. Waiting longer than 3 weeks to submit a form, and/or more than 10 days to review a form could result in the loss of information or a lost opportunity to revisit an occurrence (i.e., volunteer monitors will have difficultly recalling missing information and it becomes harder to schedule a repeat visit as time passes). If necessary and possible, ATC monitoring coordinators arrange for a repeat visit by an experienced volunteer monitor to resolve outstanding questions about an occurrence. To better understand the sequence of events related to monitoring, including occurrences to be monitored, and when field forms are verified and submitted, we have developed a "monitoring assignment and field data status" document to be filled out by the monitoring coordinators as occurrences are assigned and data forms are submitted (Appendix C).

Optional panorama monitoring

For interested volunteer monitors, additional occurrence monitoring may be undertaken using repeat panoramic photography (Paquette and Dieffenbach in prep).

End of season procedures

ATC monitoring coordinators forward data to the APPA Natural Resource Manager by November 30 of the monitoring year[15]. Monitoring assignment forms and all safety acknowledgement forms should accompany the data when they are submitted.

Monitoring coordinators are responsible for entering data into the data transfer spreadsheet as soon possible (and no later than three months) after submission of the forms by the volunteer monitors. During the first three months of the year (January – March), the APPA Environmental Monitoring Coordinator run a series of database queries to identify missing information or data falling outside an acceptable range of values, and promptly contacts ATC monitoring coordinators and/or monitors to locate missing data or clarify questionable data if it is possible to do so.

After the monitoring season, ATC monitoring coordinators survey participating monitors to solicit feedback on the program, including any problems encountered as well as the adequacy of training and volunteer support.

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[14] Volunteer monitors comprise the majority of the rare plant monitoring workforce. They are typically affiliated with a local trail club, but in some instances they may volunteer directly for ATC.

[15] Timeliness of data submittal is critical to making data available for resource management. The review of the previous rare plant monitoring program by ATC (Dufour 2008) found that data were not regularly submitted following collection and that in some instances years passed between data collection and entry. The report also found that volunteer data were not typically reviewed following collection.

Data Handling, Analysis, and Reporting

Data submission

Data are recorded on site by volunteer monitors using pre-printed monitoring data forms included in Appendix B. Volunteers submit completed paper data forms or electronic files (.pdf) to their monitoring coordinator within three weeks of data collection. In the future, it may be useful to develop a system of online data submission.

Quality Assurance/Quality Control (QA/QC)

The use of volunteer monitors requires special consideration for quality control because more monitors are likely to participate in the program than if only professionals are used, and the background knowledge and skills of the volunteer monitors will be variable. However, careful adherence to these QA/QC procedures will help assure the quality of data procured from volunteers. The present protocol incorporates several QA/QC measures: established and documented methods, preprinted data forms, monitor training, photographs, resampling, data entry procedures, and database queries.

Careful and accurate collection of data using established and documented protocols is essential to the success of any monitoring program. Adherence to documented protocols reduces variability in methods among monitors, across regions and over time, and improves the ability to detect trends. This protocol uses quantitative and objective methods wherever possible in order to reduce variation by subjective assessment. Detailed, step-by-step descriptions of each measurement are provided in the SOPs. Use of monitoring data forms, with as much information pre-printed as possible, improves accuracy and efficiency. Collection of digital photographs is encouraged to verify species identification and other measurements.

Training is an integral part of the program. New volunteers participate in a required training workshop where they are introduced to the protocol and perform at least one rare plant site visit. Specific guidance on training and supporting volunteers is provided in the Program Administration and Volunteer Support SOP (SOP 2). This guidance will be updated as the program grows and program managers learn what training methods are most effective.

At the present time, the program does not randomly select occurrences for "re-sampling." This is a valuable QA/QC measure that will help identify potential monitoring problems. When implemented, the following process shall be followed: during each field season of full program implementation, a random sample of approximately 5% of monitored occurrences in each of the four ATC regions should be resampled for QA/QC by program staff or experienced monitors. Resampling for QA/QC must not include the original monitor(s), and should occur within two weeks[16] of the original sample date in order to reduce seasonal variability. Examination of this QA/QC data will help to quantify observer error, and may identify methods in need of improvement. In order to control trampling

[16] QA/QC sampling shall be scheduled independently of the primary monitoring to ensure that it occurs during the optimal sampling period and is not delayed due to the submission of field forms.

impacts, an occurrence selected for QA/QC re-measurement is ineligible for QA/QC re-measurement again for five years. However, this does not affect regular monitoring activities, which continue to occur annually or as otherwise scheduled.

Each year following data entry, database queries are used to identify missing or 'unsure' information and data falling outside an acceptable range of values, as described below.

Data analysis and reporting

Each year, the Environmental Monitoring Coordinator analyzes, summarizes and reports monitoring data for the APPA Natural Resource Manager using the program database[17]. The objective is to flag events that may need attention or correction. The following are a few examples of findings that the database will be used to identify:

- Occurrences with missing or 'unsure' information, or values outside of acceptable ranges
- Occurrences that were not found
- New occurrences
- Occurrences with < 6% of plants characterized as flowering AND < 6% of plants characterized as fruiting[18]
- New threats, including invasive species, that were noted

The Environmental Monitoring Coordinator will also use database functions to 'red flag' occurrences that meet any of the following criteria:

- Occurrences in which juveniles are noted as absent
- Occurrences for which condition is rated as poor
- Occurrences for which the portion of rare plants affected by any disturbance was reported to be 'most'
- Occurrences for which new threats were noted
- Occurrences for which management action is recommended

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[17] The full array of analytical steps will follow full implementation of the new protocol. Until full implementation, some measures may not be possible because prior data collection efforts did not capture the requisite data.

[18] ATC Regional Coordinators will check field forms for % plant flowing and % plant fruiting prior to submitting data forms to the APPA Natural Resource Manager. The ≤ 5% threshold for flowering and fruiting is used to determine if the occurrence was monitored at an appropriate time. Automated checks will supplement checks by ATC Regional Coordinators.

For all occurrences, program staff reviews relevant data describing the occurrence from the current and previous visits, including whether the occurrence extends beyond the APPA boundary, life stage distribution, description of occurrence condition, wetness, and common species, threats noted, explanatory notes, and any QA/QC problems. To the extent possible, program staff determines if further evaluation (including a follow-up visit or additional monitoring) or management action is needed. The outcome of this evaluation, including the reason management action was or was not taken, is noted in the program database.

Based on current information and overall program constraints, the APPA Natural Resource Manager and Environmental Monitoring Coordinator develop a monitoring list for the following year.

Annual summary data include:

1. Proportion of prioritized[19] occurrences monitored by region or state

2. A list of prioritized occurrences designated for monitoring that year that were not monitored, including reason(s) they were missed

3. Histograms of occurrences showing a) number of individuals (or % cover class) by occurrence and b) monitoring records over the last 10 years

4. A list of threats observed, including invasive species, and the percentage of occurrences affected by each threat

Annual reports shall include:

1. Summary data described above, for distribution to interested parties including partner land management agencies such as USFS and state agencies

2. A 'red flag' list of occurrences that required further evaluation, including the reason each occurrence was flagged by these criteria and the outcome

3. Information of particular interest to volunteers, including the number of participants and examples of how their work aided management

SOP 8: Analysis and Reporting SOP contains a more complete listing of the analytical and reporting objectives for the APPA rare plant monitoring program.

Data storage

Data are maintained in a Microsoft Access database designed for this program. All submitted data forms are archived for future reference[20]. The APPA Natural Resource Manager is responsible for getting data entered into the program database as soon as possible (and no later than three months)

[19] The proportion of prioritized occurrences monitored in a geographic area and prioritized occurrences that were not monitored are used to assess the effectiveness of the monitoring program.

[20] Field forms will be scanned and posted to the NPS Integrated Resource Management Application (IRMA).

after receipt from ATC monitoring coordinators. In the future, it may be useful to develop a system of online data submission so that monitors enter data directly into the program database.

Personnel and operational requirements

The APPA Rare Plant Monitoring Program has operated using volunteer field monitors since the inception of its predecessor program in 1989. While this model has worked well overall, there is regional and temporal variability in the quantity and quality of the resulting monitoring dataset (Dufour 2008). This protocol assumes that the program will continue to use volunteers to accomplish rare plant monitoring (volunteer implementation), but this section also presents an alternative operational scenario utilizing contractor labor (contractor implementation). The APPA Natural Resource Manager, in consultation with the APPA Environmental Monitoring Coordinator, may decide to contract monitoring professionals to supplement or replace volunteer monitoring for specific occurrences (e.g., federally endangered species) or regions (e.g., a region with inadequate volunteer capacity).

Personnel

General

The rare plant monitoring program is currently overseen by the APPA Natural Resource Manager who is primarily responsible for setting annual goals and objectives, to include identifying occurrences to target for monitoring. The APPA Natural Resource Manager works closely with the APPA Environmental Monitoring Coordinator to manage and analyze data, identify monitoring priorities, and report results. The NETN also makes the network Science Communication Specialist available to assist in the development of training materials and preparation of reports.

Volunteer Implementation

Throughout the existence of the APPA rare plant monitoring program, most of the monitoring has been accomplished by volunteers recruited by ATC. Under the volunteer implementation scenario, the APPA Natural Resource Manager provides overall program coordination, and regularly collaborates with the ATC Regional Coordinators to set priorities to focus the annual monitoring cycle. In turn, ATC's Regional Coordinators work with a small number of ATC monitoring coordinators (<10) who organize a variable number of volunteer monitors (≥ 75 total volunteers across all regions in 2006) who collect and submit data. Some ATC monitoring coordinators are themselves volunteers while others are paid ATC staff. In order to annually monitor the 125 Very High priority occurrences using volunteer monitors, the program needs approximately 60-80 volunteer monitors.

Contractor Implementation

Although it is not an approach that has been widely employed, APPA has occasionally hired contractors to monitor rare plant occurrences. Under the contractor implementation scenario, the APPA Natural Resource Manager would hire professionals to collect monitoring data using this protocol. While this scenario would likely cost more than the volunteer implementation scenario, it would give the APPA Natural Resource Manager greater control over program management, could improve the quantity and quality of data, should reduce data variability, and may reduce the number of regional coordinators and monitors needed to run the program.

Personnel Requirements

APPA Natural Resource Manager – The APPA Natural Resource Manager should have strong GIS skills, good project management and budgeting skills, and moderate database skills. Attention to detail is required while reviewing data forms. Good plant identification skills and an understanding a basic ecological principals are beneficial. Skill using word processing and presentation applications such as PowerPoint are necessary to prepare materials for training workshops.

APPA Environmental Monitoring Coordinator – The APPA Environmental Monitoring Coordinator should have strong GIS, database, and analytical skills. This role is largely supportive of the program and does not require extensive field work. Direct interaction with field monitors is uncommon, though the ability to support individuals at all levels of the program is essential.

ATC Regional Coordinators – ATC's Regional Coordinators should have good GIS skills, the ability to review and validate collected field data, strong organizational and interpersonal skills, and intermediate plant identification skills. The work is both office and field oriented and requires good physical conditioning.

ATC Volunteer Coordinators – The ATC Volunteer Coordinator's responsibilities vary seasonally, requiring a few weeks prior to the start of the monitoring season for recruitment and coordination activities, while being available throughout the monitoring season for training and support. During the field season, the ATC Volunteer Coordinator must actively track the status of the assigned monitoring activities to ensure that all data forms are completed and submitted. A substantial amount of the work is field oriented and requires good physical conditioning. ATC Volunteer Coordinators should have strong plant identification skills as well the ability to instruct volunteers who may not have equally strong plant identification skills.

ATC Volunteer Field Monitors – Volunteer field monitors must be physically fit, able to work independently in remote locations, attention to detail, and have strong plant identification skills or the ability and willingness to learn to identify several rare species. The ability to use a computer to enter their collected data is beneficial.

NETN Science Communication Specialist – The role of the NETN Science Communication Specialist is infrequent, with involvement being limited to about 1 month during the off-season after the previous monitoring season's data has been analyzed. The role requires attention to detail, and the ability to use word processing and other layout applications to generate reports.

Contractors – If utilized, contractors could be used to replace just the volunteer monitor role, or they could be used in a broader fashion by replacing either (or both) ATC coordinator role(s). Even though the exact requirements of a contractor are dependent on how this approach is implemented, contractors would in general be expected to possess strong plant identification skills, and be independent and self-sufficient, physically fit, and able to implement this rare plant monitoring protocol without significant direct supervision.

Under the alternative Contractor Implementation scenario, the configuration of the contract team would depend on the size of the team involved. One or two person operations would not require all of

the levels required for volunteer operations. The roles of regional and volunteer coordinators, and volunteer monitor could be consolidated. Conversely, larger contract operations could be configured analogously to the volunteer approach, with one member of the contract team functioning as a regional coordinator, another functioning as a monitoring coordinator, and the remaining members of the team working as "paid" monitors. For the purpose of this discussion, one member of the contract team, whether the team is one person or many people, will be the primary contact and will be identified as the lead contractor.

Training

Careful training of volunteer monitors is an integral part of this program. Each year, new volunteers participate in a highly recommended training workshop[21] conducted by ATC Regional Coordinators. Specific guidance on training and supporting volunteers is provided in SOP 2: Program Administration and Volunteer Support. This guidance is regularly updated as the program grows and learns what training methods are most effective. In addition, we have developed a Volunteer Guide that is less technical than the current document and that will help volunteers implement the monitoring program as designed (NETN in prep).

Annual workload and field schedule

The amount of time required to monitor rare plant occurrences along the APPA is difficult to predict because of the great variability in the time it takes to travel to and monitor the full extent of each occurrence. A review 43 records from 2009 – 2011 (the only period where data were available) indicate that volunteers spend approximately 5.4 hours traveling to and monitoring each occurrence[22], with a range of 30 minutes to 16 hours. The wide range in time is due to a number of factors, including ease of access, size of the occurrence, proximity to other occurrences, and skill of the monitor. Based on a goal of monitoring 100 occurrences per season, approximately 540 volunteer hours would be logged annually. The APPA Natural Resource Manager will spend approximately 40 – 80 hours annually, the APPA Environmental Monitoring Coordinator will spend approximately 40 hours, ATC Regional Coordinators will devote 60 – 100 hours each, and ATC Volunteer Coordinators will devote 80 – 120 hours (Figure 1).

Program review

Periodic review of the monitoring program by a team of external and internal reviewers is essential to evaluate effectiveness of monitoring and program management, and to determine if the program is fulfilling stated goals (Kleiman et al. 2000). This was done on the program that preceded the current rare plant monitoring protocol (Dufour 2008). The report from that review identified most, if not all of the issues that the current protocol attempts to address. The current protocol has been reviewed at

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[21] Training for new monitors is highly recommended versus required because scheduling training sessions has been sporadic in the past. If training sessions are scheduled more predictably we can consider making training a requirement for new monitors. Returning monitors are also encouraged to participate in training.

[22] Time traveling to, hiking to, and monitoring an occurrence were not reliably differentiated for the evaluated time period so a combined time to travel and monitor was calculated instead.

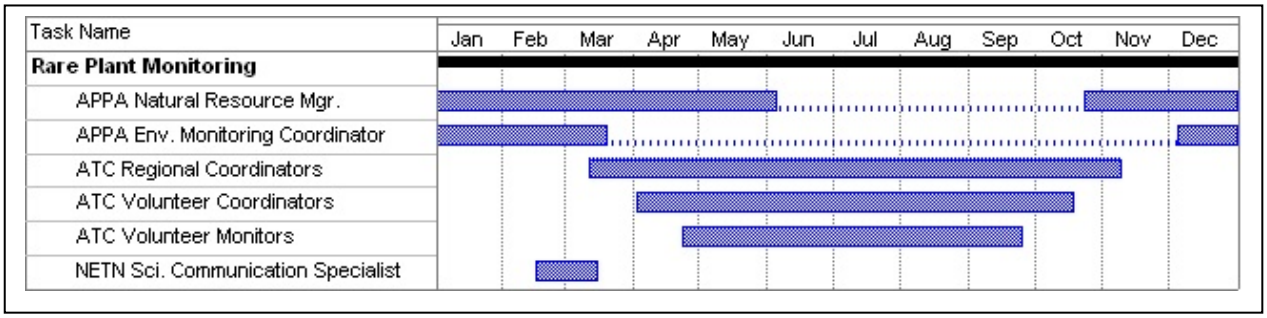

Figure 1. Hypothetical time lines showing likely periods when workload would be concentrated for different roles, assuming a volunteer implementation.

several points during the preliminary implementation, and that approach will continue into the future even after being officially implemented. A formal, more extensive review will occur five years after the protocol has been finalized and officially implemented[23]. Regardless of when they are made, changes to the protocol must be carefully considered so that newly collected data remain comparable to previous data, and changes must be clearly documented in the protocol. Previous protocol versions must be archived as a record of previous data collection.

Equipment

Necessary equipment has been kept to a minimum to allow for maximum participation by volunteers. Volunteer monitors use some of their own equipment. The monitoring program maintains GPS units, digital cameras, and tally counters for use by volunteer monitors who do not have this equipment. A complete list of monitoring equipment needed is provided in SOP 3: Equipment.

Under the alternative Contractor Implementation scenario, monitoring equipment would be the responsibility of the contractor. Data, including field forms, would continue to be maintained by the APPA Natural Resource Manager and Environmental Monitoring Coordinator.

[23] Official implementation is currently anticipated for the 2013 field season.

Budget considerations

The operating budget for this program is modest but supplemented by in-kind contributions of labor from volunteer monitors. The operating budget covers staff time for NPS staff overseeing the project, ATC field staff carrying out monitoring workshops and baseline documentation, as well as a modest amount to cover time for contracting regional botanists, equipment purchase and maintenance. Under the alternative contractor implementation scenario, additional costs may be incurred to hire contractor staff to monitor specific occurrences or regions.

Budget allocation (2012):

ATC Field Staff (through Cooperative Agreement)	$35,000
Contract Regional Botanists	$5,000
Equipment Purchases	$1,000

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Appendix A. APPA "Very High" Priority Plant Species

This appendix lists the APPA "Very High" priority plant species by region for 2013. The numerical score corresponds to monitoring priority and is calculated by the program database; scores of 59 and above are "Very High" priority. The count is the number of occurrences of each species prioritized as "Very High" in the region, with each occurrence receiving the same score. The ESA column reports if a species is currently listed as threatened ("listed threatened" or LT) or endangered ("listed endangered" or LE) under the federal Endangered Species Act.

New England Region (ME, NH, VT, MA and CT)

Species, Latin name	Score	Count	ESA
Potentilla robbinsiana	90	2	
Prenanthes boottii	90	3	
Isotria medeoloides	88	1	LT
Prenanthes boottii	88	2	
Prenanthes boottii	85	1	
Geum peckii	84	2	
Geum peckii	82	7	
Prenanthes boottii	81	1	
Geum peckii	69	1	
Geum peckii	67	7	
Carex tuckermanii	64	1	

Mid-Atlantic Region (NY, NJ, PA, MD, WV and northern VA)

Streptopus lanceolatus var. *roseus*	61	1	
Paxistima canbyi	60	1	

Southwest and Central Virginia Region

Abies fraseri	75	1	
Cardamine clematitis	64	1	
Hypericum mitchellianum	60	1	

Southern Region (Georgia, North Carolina and Tennessee)

Houstonia purpurea var. *montana*	95	1	LE
Cephaloziella obtusilobula	90	1	
Frullania appalachiana	90	1	
Geum radiatum	90	2	LE
Gymnoderma lineare	90	1	LE
Buckleya distichophylla	88	1	
Houstonia purpurea var. *montana*	88	1	LE
Abies fraseri	85	3	
Geum geniculatum	85	1	
Geum radiatum	85	3	LE

Gymnoderma lineare	85	5	LE
Geum geniculatum	78	1	
Buckleya distichophylla	76	1	
Drepanolejeunea appalachiana	75	1	
Abies fraseri	73	1	
Buckleya distichophylla	73	1	
Glyceria nubigena	70	10	
Rugelia nudicaulis	70	15	
Stachys clingmanii	70	6	
Brachydontium trichodes	67	1	
Carex manhartii	67	1	
Geum geniculatum	67	2	
Helianthus glaucophyllus	66	2	
Geum geniculatum	65	1	
Hypericum buckleii	64	1	
Geum geniculatum	63	1	
Lilium grayi	63	1	
Bazzania nudicaulis	62	2	
Brachydontium trichodes	62	2	
Gentiana austromontana	61	1	
Scutellaria montana	61	1	
Geum geniculatum	60	1	
Krigia Montana	60	1	

Appendix B. Data Forms, Version 1.06

Please avoid trampling rare plants and the site in general. Remain as still as possible and step carefully. During your visit, refer to the monitoring report and rare species occurrence map given to you during training. Fill out this form as directed in the AT Rare Plant Standard Operating Protocol (SOP) and volunteer guide given to you during training. If you see an urgent threat or disturbance to the rare plants, please contact your coordinator immediately!

Visit date: ____/____/____ **Site name:** _____

Site number: _____ **Occurrence ID:** _____

Common name: **Scientific name:**

	Monitor name	Email	Phone
1			
2			
3			
4			
5			

If you were unable to bring a GPS unit, please **sketch**, on the rare species occurrence map provided to you, the approximate area covered by rare plants this year, or if not found, please sketch the area searched. Preferred units are in **BOLD**. Be sure to record all measures and circle units used, even if they are the preferred values.

NPS GPS Unit: # _____ **GPS Accuracy:** _____ **GPS Accuracy Units: Feet** or Meters

Coordinate System: Lat/Long or UTM or Other **Datum :** NAD27 or NAD83 or **WGS84**

Y Coordinate (Latitude: _____ **X Coordinate (Longitude):** _____

Area Covered: _____ **Units:** Acres or ft^2 or M^2

Rare Plant Info

Found? Yes or No or Unsure **If unsure or no, why (use comment section)?**

Count unit: Stem or Clump or Rosette **% Vegetative:** 0 1-5 6-25 26-50 51-100

Plant count: **% Flowering:** 0 1-5 6-25 26-50 51-100

Count time: _____ minutes **% Fruiting:** 0 1-5 6-25 26-50 51-100

OR Estimate: _____ 251-500 501-1000 >1000 **% Senescent:** 0 1-5 6-25 26-50 51-100

OR % Cover: 0 1-5 6-25 26-50 51-100 **Seedlings or Immature present?** Yes No Unsure

What is the condition of this rare plant occurrence?

Please note the characteristic(s) considered and what you observed: Excellent Average Poor Unsure

Associated Site Conditions (wetness, Sun, other species, impacts, etc.)

Wetness (Circle one) **Sun exposure on rare plants (estimate)**

Water on site: Flooded Wet Moist Dry **Sunlight (% sun):** >95% 51-95% 5-50% <5% Unknown

List the most common species growing together with or immediately adjacent to the rare plants:

Trees		Shrubs		Understory	
1		1		1	
2		2		2	
3		3		3	
				4	
				5	

Associated Site Conditions (wetness, Sun, other species, impacts, etc.) Continued

List any invasive exotic species seen on site during your visit. Note degree of infestation as low, medium or high.

	Species	Invasiveness		Species	Invasiveness
1			6		
2			7		
3			8		
4			9		
5			10		

Note any disturbance seen affecting, or potentially affecting the rare plants. Record details in the comments, and, if indicated, record the portion of rare plants affected**:**

Trampling:	None Trace Some Most		**Trail maintenance?**	Yes No Unsure	
Browsing:	None Trace Some Most		**ATV tracks?**	Yes No Unsure	
Insect damage or disease:	None Trace Some Most		**Social trails?**	Yes No Unsure	
Competition/ succession:	None Trace Some Most		**Campsite?**	Yes No Unsure	
Drought?	Yes No Unsure		**Plant collection?**	Yes No Unsure	
Erosion?	Yes No Unsure		**New development?**	Yes No Unsure	
Other disturbance (please describe) and disturbance specific comments, if any:					

Photo Log (record additional on back)

Photo Number	Photo File Name	Feature Photographed (e.g., flower , juvenile, unknown, insect)	Location and Direction of Photo (e.g., from center of colony looking North)

Monitor Name:_____ Date: _____ Occurrence ID: _____

1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Time spent (minutes): Monitoring: _____ Travel (to and from trailhead): _____ Hiking (to and from occurrence): _____

Certification

Monitor: I certify that **ALL** data entered on this form are complete and accurate and that I have personally reviewed all entries

Monitor Name (signature): _____ Date: _____

Reviewer: I have reviewed **ALL** data on this form and certify them to be complete and accurate.

Name (printed): _____ Signature: _____ Date: _____

Purpose	Date	Name
Entered into Spreadsheet		
100% Check		
10% Check		
Validation		

Please submit completed form to your monitoring coordinator within 3 weeks of your visit.

Thank you for your help!

Monitor Name:_____ Date: _____ Occurrence ID: _____

Notes about site:

Management Recommendations:

Monitor Name:_____ Date: _____ Occurrence ID: _____

Comments:

Monitor Name: _____ Date:_____ Occurrence ID: _____

Field forms must be filled out completely. DO NOT assume that if you enter your name, site, and date for one occurrence you do not need to do the same for other nearby occurrences. Every form is independent of all others, and incomplete forms will be rejected.

1) Date: Month, Day and Year of the observation in the following format: MM/DD/YYYY

2) Site name: If you know the name, record it. If you do not know the name, enter "Unknown."

3) Site number: Site codes ordinarily start with a 2 letter state acronym (e.g., VT for Vermont) followed by a 2 digit sequence number (e.g., 01 – 99).

4) Occurrence ID: All occurrences are assigned a number (e.g., CT-01 or CT-01-12). If you do not know the Occurrence ID, you must determine this information BEFORE monitoring the site. Data sheets without a valid Occurrence ID will be rejected.

5) Monitor Name: Enter names of up to 5 monitors last name first (Lastname, Firstname).

6) Email & Phone**:** Enter your preferred method of contact (or both). Full email including provider name (e.g., email_address@ficticious.com), or phone with areas code.

7) Common name: If you know the common name enter it here, if not enter "Unknown."

8) Scientific Name: Record the name as accepted when the monitoring was conducted. If you do not know the scientific name of the species, obtain it BEFORE monitoring the occurrence.

9) NPS GPS Unit: Record the number of the NPS GPS unit and its accuracy. "N/A" if using a non-NPS unit.

10) Coordinate system/Datum: Decimal degrees / WGS-84 are the default values. Do NOT use another system. Entries that are not in decimal degrees (dd.ddddd, -dd.ddddd) and/or not in the WGS-84 datum AND that are not justified by a valid explanation will be rejected.

11) GPS coordinates: Use existing coordinates to navigate to a location. Unless specifically asked to do so by your monitoring coordinator, there is no reason to record new coordinates on the data sheet. There are two exceptions: 1) if the occurrence is new, and 2) when the coordinates you used to navigate to the occurrence are clearly inaccurate. When recording coordinates, record the location of the occurrence based on a central point (using care not to trample the species in the process). Validate coordinates listed on page 3 of field form. Coordinates that accurately locate the occurrence should be designated with the word "confirmed," whereas coordinates that are inaccurate shall be identified with the word "invalid."

$1ft^2 \approx$ a large dinner plate
$10\ ft^2 \approx$ a small card table (3.2' x 3.2')
$100\ ft^2 \approx$ a dump truck (5' x 20'; 10' x 10')
$1{,}000\ ft^2 \approx$ a small/medium sized house (10' x 100'; 25' x 40')

12) Area covered by rare species: Record the area covered by the occurrence. Circle the appropriate values (acres, ft^2 or m^2).

13) Found: Circle one, Yes, No, or Unsure. If "Unsure or No," record your reasons for uncertainty. Use the "Comments" section for additional space.

14) Count unit: Select only one – stem, clump, or rosette. The values for plant count, estimate, or % cover will be in the selected units. Occurrence data without units shall be rejected.

15) Plant count: The number of "count unit" items. If > 250, estimate. If the number of items counted exceeds 250 after completing the count, record the actual number.

16) Count time: Record the number of minutes needed to complete an actual count.

17) Estimate: Circle the appropriate range 251-500, 501-1,000, > 1,000.

18) % Cover: An estimate of the area, in percent (%), the species covers the monitoring location. This method is only used in very specific circumstances. For example, this method may be used for non-vascular or matted plants, or when the occurrence is extensive in size and possibly discontinuous and accurately estimating or counting individuals is impractical.

19) % Vegetative: Select the category that accurately describes the portion of the occurrence that is in vegetative condition (live leaves on during the growing season).

20) % Flowering: Select the category that describes the portion of the occurrence that is flowering.

21) % Fruiting: Select the category that describes the portion of the occurrence that is fruiting.

22) % Senescent: Select the category that describes the portion of the occurrence that is Senescent (dying at the end of the normal seasonal life-cycle).

23) Seedlings or immature present: Circle only one – Yes, No, or Unsure.

24) What is the condition of this rare plant occurrence: Describe as excellent, average, or poor based on evidence of herbivory or disease, leaf color or retention, plant or flower size, number of leaves or flowers, or evidence of disturbance, as appropriate. Please note, in the comments section, the characteristic(s) considered and what you observed. For example, "Excellent condition, no problems seen and many leaves/flowers"; or, "Poor condition, leaves with many insect holes, and few flowers." If you are unsure, circle unsure.

25) Associated site condition: Record as Flooded (standing water present), Wet (saturated but no standing water), Moist (feels moist but water does not emerge when soil is squeezed), or Dry (Circle one).

26) Sun exposure on rare plants (estimate): The amount of sun affecting this occurrence on sunny days. Ignore shading from clouds, but consider shading by vegetation and other site features.

27) List the most common species: Within 10 feet (3 meters) of the occurrence, record up to 3 trees, 3 shrubs and 5 understory plant species in order of declining abundance.

28) List any invasive exotic species: Record the scientific or common name of any invasive exotic species growing nearby. Note the degree of infestation as low, medium, or high.

29) Disturbance:

    a) For the following measures, trace is 1 to 5%, some is 6 to 50%, and most is more than 50%.

        i) Trampling: Estimate how many plants in occurrence are affected. Do not include any trampling that may have occurred during your visit.

        ii) Browsing: Estimate how many plants in this occurrence are affected.

        iii) Insect damage or disease: Look for and record evidence of disease or insect damage including damage to leaves, twigs, stem, buds or other plant parts.

        iv) Competition/succession: Look for evidence that other plant species are hurting this occurrence due to competition to include shading associated with plant succession.

    b) For the following measures, circle Yes or No or Unsure

        i) Drought: Do you see wilted plants or extremely dry soil that may indicate drought stress?

        ii) Erosion: Do you see patterns on the ground occupied by rare plants indicating erosion?

        iii) Trail maintenance: Do you see evidence that trail maintenance (including mowing and clipping of vegetation) has affected this occurrence?

        iv) ATV tracks: Do you see ATV tracks within or nearby (within sight) of this occurrence?

        v) Social trails: Are there unofficial "social trails" leading to or through this occurrence?

        vi) Campsite: Do you see a campsite nearby? How far away is the site (record in comments)?

        vii) Plant collection: Do you see any evidence that plants have been collected?

        viii) New development: Do you see evidence that new development nearby may be affecting this occurrence? How far away is the development (record in comments)?

        ix) Other disturbance: Do you see evidence of any other disturbance? If yes, describe on reverse of form and take a photograph.

30) Photo Log: Record each photograph. Include a description of what feature was photographed, and the location and direction of the photo. Use the back of the form if necessary.

31) Time Spent: Time spent

    a) Monitoring this occurrence (excluding travel time),

    b) Traveling to and from the trailhead.

    c) Hiking to and from the occurrence.

32) Certification: Forms that have not been signed and dated will be rejected.

    a) Monitors sign and date form to acknowledge that they have entered all data accurately and completely to the best of their knowledge. Forms should be sent to their coordinator within 3-weeks of completion.

    b) Reviewers sign and date the form after entering data into the import spreadsheet and promptly send to APPA Natural Resource Manager.

Management recommendations and Comments: Record any other observations about this rare plant occurrence, or information that required additional space to document. If using this as “extra space,” be sure to identify the item to which this information relates.

Appendix C. Monitoring Assignment and Field Data Status Log, Version 1.00

Appalachian National Scenic Trail
Rare Species and Exemplary Community
Monitoring Assignment and Field Data Status Log

ID	Priority Order	Lead Monitor	Safety	Date						Digital Field Form File Name
				Optimal	Monitored	Submitted	Reviewed	Entered	Forwarded	
VA-59-1	4	Julia Mancuso	MC	Jun-Sep	7/9/2004	11/2/2012	12/1/2013	1/2/2014	2/2/2014	APPA_VARO_Va-59-1_20121102.pdf
			LM							
			MC							
			LM							
			MC							
			LM							
			MC							
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			MC							
			LM							

Data Year: _____ **Sheet _____ of _____**

ID: Enter the element ID for the occurrence that is assigned to the monitor (e.g., Vt-05-02). When reports are returned, if the monitor delivers field forms that were not assigned at the beginning of the season, insert them at the bottom of the list.

Priority Order: Enter the sequence number associated with the occurrence from the priority list. This is not the calculated priority score. Rather, this number would be 1 for the highest priority occurrence and increase in sequence through the entire list.

Lead Monitor: This is the name of the primary monitor to whom this occurrence has been assigned for monitoring. Other monitor names are not necessary. Safety: The initials of the monitoring coordinator (MC) and the lead monitor (LM) are entered into this box signifying that SOP 1 -- Safety, and any specific safety related issues relevant to the assigned occurrence have been discussed.

Dates:

Optimal: This corresponds to the ideal date range to monitor this occurrence, if known. This date range should be made known to the monitor when the occurrence is assigned.

Monitored: The date that monitoring actually occurred

Submitted: The date that the monitor delivered the field form to the monitoring coordinator

Reviewed: The date that the monitoring coordinator reviewed the field form for correctness

Entered: The date that the field data were entered into the field data spreadsheet

Forwarded: The date that the field data were delivered to the APPA natural resource manager.

Digital Field Form File Name: This is the name given to the pdf version of any field forms delivered in that format. The name must follow the approved naming convention described in SOP 6 to include the NPS park code, the ATC region from which the data were collected, the element ID (occurrence ID), and the sampling date. For example, the file name for data collected on July 10, 2013 in New Jersey at an occurrence known as NJ-02-02 would be: APPA_MARO_NJ-02-02_20130710.pdf.

Data Year: The four digit year when monitoring was conducted

Sheet of : Enter the individual sheet number and the total number of sheets in the "packet."

SOP1 - Safety

APPA

Version 1.03

Definitions (alphabetical)

Designated office staff (DOS): Refers to the individual who receives daily field work plans and initiates emergency response services for the field monitors, including the volunteer field monitors. The default DOS for volunteer field monitors is an ATC monitoring coordinator. This person is usually a volunteer coordinator but depending on the ATC region, the DOS may be an ATC regional coordinator.

Field monitor: Refers to all personnel engaged in field activities related to this protocol who may or may not be compensated for their work. Volunteer field monitors are required to have read and signed an ATC Volunteer Agreement and all field monitors who work or volunteer directly for NPS are required to read the Job Safety Analysis and sign the Safety Acknowledgment Form before participating in any surveys.

Project leader: Refers to the individual responsible for coordinating implementation of the rare plant monitoring protocol. In general, this would be the APPA Natural Resource Manager, but may be someone else if the protocol is implemented by a contractor. The project leader is responsible for ensuring that rare plant monitors are properly trained in NPS safety procedures.

Volunteer coordinator: Refers to the immediate supervisor for a volunteer field monitor. A volunteer coordinator is responsible for assigning occurrences for monitoring and (if also the DOS) ensuring that daily check-in procedures are followed.

Overview

The Appalachian National Scenic Trail (APPA) and Northeast Temperate Network (NETN) considers the occupational health and safety of anyone collecting data, regardless of whether they are NPS employees, cooperators, or volunteers to be of paramount importance. Accordingly, we are committed to ensuring that all field crews are made aware of potential hazards and risks, and receive adequate guidance on pertinent safety procedures including, but not limited to incident reporting and emergency response. This SOP is intended to provide an introduction to safety issues that should be considered prior to commencing field work, and serves as a reference in case of an incident. Topics covered include emergency procedures and contacts, incident reporting, field preparation, and safe field procedures, but this SOP does not cover first aid and is not intended to supplant guidance provided by a medical or emergency professional.

Prior to commencing field work, volunteer coordinators must check with the local Appalachian Trail Conservancy regional office to determine if there are any trail closures or other important advisories that might affect the safety of the work. The regional office should also be consulted for the location of the nearest hospital to the area where field work will be conducted. It is imperative to determine

the directions to the nearest hospital and determine the best and most reliable way to establish contact in the event of an emergency. Field monitors may need to determine this information themselves but they should first attempt to obtain this information from their volunteer coordinator, or the applicable ATC regional office.

We recognize that individuals collecting rare plant data have traditionally done so “solo” and that this is consistent with the hiking community culture. However, due to the remote nature of the Appalachian National Scenic Trail, working in pairs is strongly and always encouraged.

Responding to an Incident

Life-Threatening Medical Emergency

1. Call 9-1-1.

2. As soon as it is practical to do so, inform your DOS. The DOS will notify NPS staff.

3. Complete Worker's Compensation paperwork.

Non-Emergency Incidents

1. Contact DOS immediately after incident. The DOS will contact other individuals that may need to know of the incident, such as the field monitor’s volunteer coordinator.

2. Complete Worker's Compensation paperwork.

NOTE: Never discard original paperwork related to worker’s compensation claims (including information from doctor's visits, CA-1, CA-2, CA-16 or CA-17 forms).

Preparation

Field monitors are in the best position to assess a situation, and are ultimately responsible for maintaining a safe work environment. This document is intended to reinforce that responsibility and empower the field monitor to make appropriate decisions. Because much of the work will be performed in remote locations, field monitors are entrusted to make the final decision regarding safety, and under no circumstance should anyone attempt to perform work at a pre-designated location, or any other location if there are any questions about safety.

First Aid Kits

Prior to beginning any field work, field monitors must verify that they have a first aid kit and that it is fully stocked with supplies. Each first aid kit should have an itemized list of the supplies it should contain. Used items should be promptly replaced.

Communication and Planning

Carry a charged cell phone and / or two-way radio at all times while in the field. If available, carry a Personal Locator Beacon (PLB). Know in advance if there are areas where cell coverage along the APPA definitely does, or does not exist. If cell coverage does not extend to the planned work area and radio communication is not possible, know where coverage does exist and be prepared to evacuate to that location in the event of an emergency. Plans should include identifying the nearest emergency services and emergency contact information (figure S1.1) for the planned work area. This must be done on an ad-hoc basis due to the conformation of the APPA.

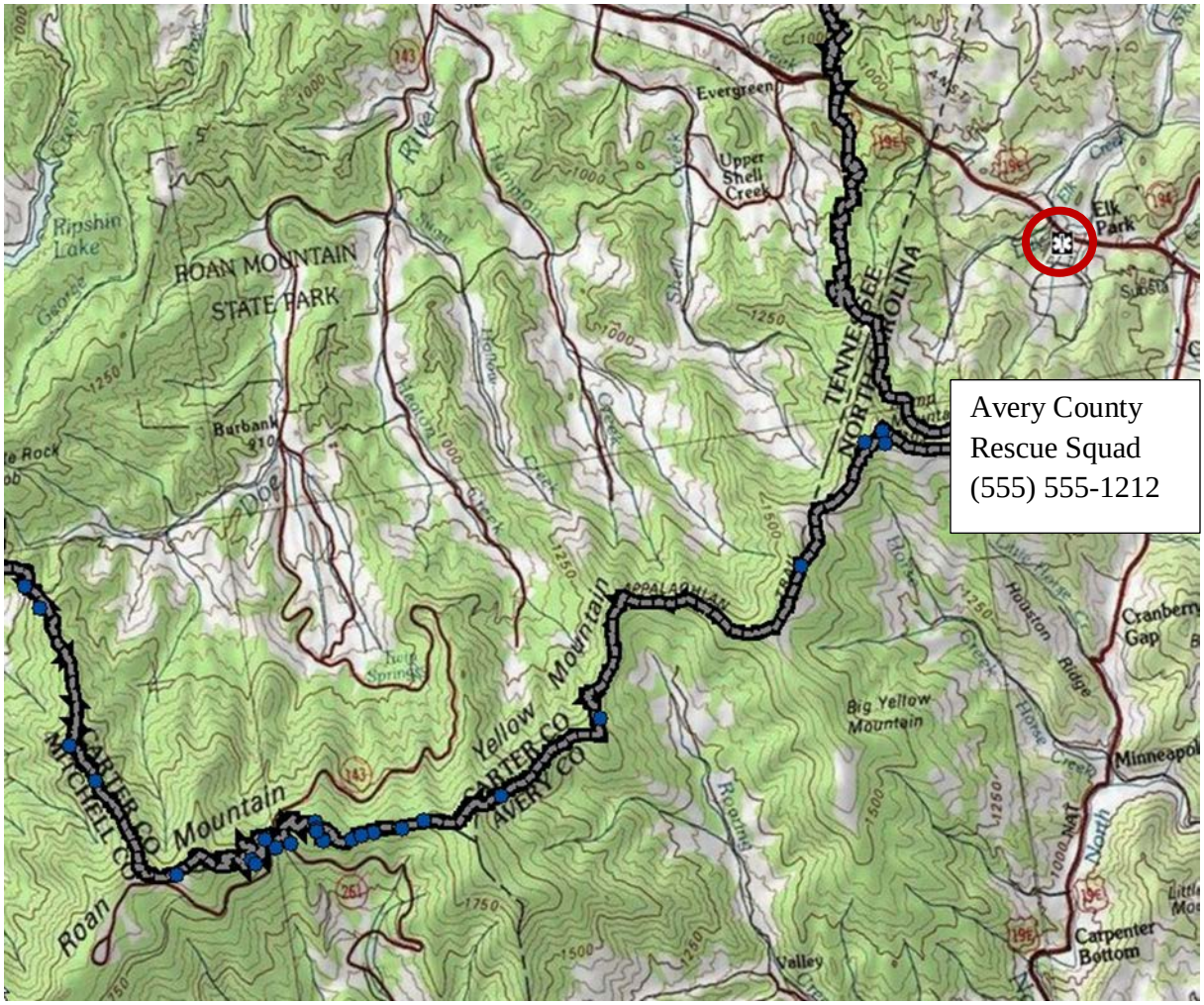

Figure S1.1. Rare plant monitoring locations on Roan Mountain with nearest rescue squad contact information.

When working in pairs, be sure to establish a plan before splitting up. The plan does not need to be lengthy, and may simply establish a meeting place and time at the end of the field day. If plans change while in the field, field monitors must notify each other (via radio, cell phone, or in person) AND under no circumstances should it be assumed that all field monitors know about changes unless the change has been confirmed by EVERY field monitor (via radio, cell phone, or in person).

Field monitors must check in with a designated office staff (DOS) at the end of each field mission[24], and field monitoring teams shall not leave for home at the end of the mission until everyone involved with the mission is accounted for.

[24] At the end of the day following a single day mission, or upon completion of a multi-day trip.

Personal Gear

Each field monitor shall wear field appropriate clothing and footwear such as long pants, a hat and hiking boots. Depending on the weather, rain gear or warm clothing should be taken into the field and we strongly recommend that an extra set of clothing be packed at the start of the mission.

Backpacks

Field monitors may need to carry small to medium sized packs over uneven terrain, and it is important to understand appropriate ways to pack, lift and carry a heavy backpack to avoid serious back, neck and shoulder injuries. To avoid injury, field monitors should adhere to the following guidelines:

- Use a sturdy pack with padded and adjustable hip and shoulder straps
- Put heavy items in the center of the pack and close to your back, with weight evenly distributed from side to side
- Once packed, tighten the compression straps to minimize movement inside the pack during travel
- Use your legs to lift the pack, and use slow, smooth movements. Keep your back straight, and keep the pack close to your body. Do not twist or bend at the waist to lift the pack, and do not swing the pack quickly over one shoulder
- Always use both shoulder straps as well as the hip belt and chest straps
- The pack should be positioned near the center of the back, and most of the weight should rest on your hips
- Keep your pack organized, and only carry the necessary equipment, food and water to reduce weight

Field Safety

Slip, Trip, Fall Prevention

Uneven terrain, slippery rocks, dense brush, time of day, and fatigue are all hazards that individually, or in combination can result in a slip, trip, or fall. The following guidelines can help minimize accidents (and injuries) related to slips, trips, or falls:

- Always wear appropriate footwear such as sturdy hiking boots
- Maintain situational awareness -- pay attention to where you are going, and remain alert of potential hazards
- Walk at an appropriate pace that is suitable for all members of the field team and adjust pace for changes in terrain (e.g., slow down and take smaller steps on slippery surfaces)
- When hiking long distances, take breaks to avoid fatigue

- When navigating to a location off trail, choose the safest route (this may not be the shortest or most direct route). Avoid river crossings, excessively steep terrain and sudden drop-offs. Always be careful when navigating over piles of scree, and alert others of falling rocks

Weather

Weather conditions in the eastern U.S. can be hazardous and can change quickly. The field monitors are responsible for planning their day according to the local weather forecast and for being aware of their surroundings and changing conditions. Know the location of nearby designated shelters, campsites, or alternate access points.

Thunderstorms

Thunderstorms may produce strong winds, rain, hail, lightning, tornadoes, or any combination thereof. All thunderstorms should be considered dangerous and should be avoided. If caught in a thunderstorm, seek shelter as soon as possible. Avoid high elevations, conductive materials, and tall structures such as trees or telephone poles. For more information on thunderstorms and ways to avoid injury, refer to the National Weather Service publication Thunderstorms, Tornadoes, Lightning: Nature's Most Violent Storms (http://www.nws.noaa.gov/om/severeweather/resources/ttl6-10.pdf).

Excessive Heat and Sun

Field monitors should avoid "excess" exposure to the sun by wearing sunscreen and/or protective clothing. Field monitors should always carry ample water (2-3 liters) and food when working in the field. When working in hot weather, be sure to drink plenty of fluids and eat foods that replace electrolytes. It is important to frequently drink liquid to maintain hydration on a warm day, even if you don't feel thirsty.

Over exposure to heat and sun can cause dehydration, heat exhaustion, and /or heat stroke. While all are serious life threatening conditions, they are also preventable. Wear loose and light colored clothing, including a hat to block the sun's rays. If necessary, shift the field schedule to avoid working outside during the hottest part of the day. If a heat related issue is suspected, move into a shaded location and seek medical help.

Poor Air Quality

Summer ozone and particulate matter levels occasionally exceed federal health standards, even along relatively remote locations of the Appalachian Trail. Young children, seniors, and those suffering from asthma, chronic bronchitis, chronic obstructive pulmonary disease, or heart problems are especially sensitive to poor air quality and should minimize outdoor activity when poor air quality warnings are posted. The risks of occasional exposure to ozone and fine particulate matter are generally minimal for healthy individuals.

When poor air quality warnings occur, it is advisable for field monitors to avoid overly strenuous activities during the hottest part of the day (pollution levels tend to be lowest early in the morning), and to stick to lower elevations under a forest canopy.

To check local air quality forecasts, or learn more about health risks of air pollution, visit the AIRNow intergovernmental agency website: http://www.airnow.gov/.

Poisonous Plants and Animals

Both for safety and protection of park resources, it is never advisable for field monitors to eat wild plants while working on the Appalachian Trail, regardless of your confidence in plant identification. Field monitors should also keep a safe distance from wildlife and never handle potentially dangerous wildlife.

Deer ticks and Lyme Disease

Several species of ticks are commonly encountered in the eastern U.S., including the deer tick (*Ixodes scapularis*) which is a known vector of Lyme disease and Ehrlichiosis. The Center for Disease Control (CDC) maintains a clearinghouse of information about ticks, and the many diseases associated with tick bites (http://www.cdc.gov/Features/StopTicks/). Field monitors are advised to take the precautions outlined by CDC as well as those described below:

- Treat clothes with tick and insect repellent as described by the CDC
- Always follow manufacturer's guidance before using repellents
- Wear long pants tucked into your socks and tuck your shirts into your pants. Long sleeves and gaiters may help
- Check clothes and skin for ticks at the end of every field day. The earlier ticks are found and removed, the better your chances of NOT acquiring a tick-borne illness
- If you find a tick that is already embedded, use a specialized tick extraction device or fine-tipped tweezers to firmly grasp the tick close to your skin. Slowly and steadily pull the tick's body away from your skin. Be careful not to crush the tick's body to minimize the chances of it regurgitating fluids into the wound. Clean the bite area once the tick is removed with soap and water
- If you receive a tick bite, file a worker's compensation CA-1 claim to get a CA-16. If you start to notice symptoms of Lyme or any other illness, use the CA-16 to get medical treatment. If you are a volunteer working with an APPA club, you should follow their guidance
- Keep an eye out for any early symptoms of tick borne diseases. Refer to the CDC web site for current information. New tests, currently under development including urine analyses, may be more reliable than existing methods at determining if you have contracted a tick-borne illness. If you develop any combination of symptoms identified by the CDC soon after a tick bite, seek medical attention

More information on ticks and tick-borne ailments:

Center for Disease Control:

http://www.cdc.gov/lyme/

(also a free webinar on tickborne diseases)

American Lyme Disease Foundation:

http://www.aldf.com/

Tick Management Handbook:

http://www.ct.gov/caes/lib/caes/documents/publications/bulletins/b1010.pdf

Bees, Wasps, and Yellow Jackets

If any field monitors are allergic to bee stings, they should alert their DOS and any other field monitors they will be working with. They must make sure to carry appropriate medications. If they carry an epinephrine injector, they should make sure anyone in the field with them knows where it is carried and how to administer it. Maintain situational awareness, and be alert to potential hive and nest locations while hiking to monitoring sites and working at monitoring sites. Look for insects travelling in and out of one location (e.g., brush, ground holes, and hollow logs). If someone is stung, Benadryl and a cold compress may bring relief. If stinger is left behind, scrape it off of skin. If the victim develops hives, asthmatic breathing, tissue swelling or a drop in blood pressure, seek medical help immediately.

Black Bears

Black bears range throughout the Appalachian region, but an encounter with a bear in the field is uncommon. Nevertheless, be alert for bears near dawn or dusk, and be especially aware of mother bears with cubs. Never approach cubs or come between a mother bear and her cubs. If a bear is encountered, face the animal but avoid eye contact, continually make noise, and slowly back away. Appear larger by standing tall, waving arms or jacket over your head. Do not freeze or remain silent, and NEVER run from a black bear. If charged or attacked, throw non-food objects and shout loudly. If you are attacked, fight back aggressively.

Poison Ivy

Poison ivy (*Toxicodendron* spp.) is present throughout the Appalachian Trail region, and can be very abundant in localized areas. When working in the vicinity of poison ivy, field monitors should avoid skin contact with any part of the poison ivy plant. Using a pre-exposure cream and wearing long sleeves and long pants, hats, and work or rubber gloves can help reduce skin contact with the plant, and if needed, use poison ivy wipes after contact. Field monitors should avoid rubbing their faces when working around poison ivy. After working in an area with abundant poison ivy, field monitors should gently wash exposed skin in cool water with poison ivy soap (not provided), and should change into fresh field clothes. At the end of a field day, field monitors should also wash potentially contaminated equipment. If a field monitor has a minor allergic reaction, use poison ivy cream to neutralize the irritant. If a serious allergic reaction occurs, the field monitor should seek medical attention, notify the DOS as soon as possible, and file a workers compensation claim.

Poisonous Snakes

The following species of poisonous snakes may occur along the Appalachian Trail: copperhead (*Agkistrodon contortrix*), cottonmouth (*Agkistrodon piscivorus*), and timber rattlesnake (*Crotalus horridus*). The best course of action is to avoid all snakes by keeping them at a safe distance. When

in poisonous snake country, maintain situational awareness – pay attention to where you put your hands and feet, and be aware around rock piles and bedrock outcrops.

- Treat all bites as if envenomation has occurred
- Time is of the essence
- Call for assistance. Clearly identify the emergency as a snakebite incident, and identify the victim's location and the closest possible point of access for responders
- In treating the victim, quickly remove rings, watches, shoes etc., before swelling begins
- Provide first aid in accordance with level of training and get the victim to a hospital as quickly as possible
- Reassure the victim by remaining calm – this benefits both the victim as well as others involved
- If emergency services cannot reach the victim in a timely way, render first aid (to the level of training), and lead the victim slowly to an evacuation point. Encourage the victim to move slowly to maintain a normal heart rate
- If working solo (not recommended), establish radio contact and relay pertinent information as you walk slowly out of the woods. Focus on remaining calm and maintaining a normal heart rate

Job Safety Analysis

JOB SAFETY ANALYSIS: Rare Plant Monitoring Field Work on the Appalachian National Scenic Trail	JOB TITLE: APPA Rare Plant Monitoring DEPARTMENT: Northeast Temperate Network ANALYSIS BY: Fred Dieffenbach, APPA Environmental Monitoring Coordinator	☐ **NEW** ☐ **REVISED** ☒ **REVIEWED** John Karish, NER I&M Program Manager
Required and/or Recommended Personal Protective Equipment: Required: At least one method of communication (i.e., cell phone or two way radio), first aid kit, condition-appropriate footwear and clothing. Highly recommended: Personal Locator Beacon (PLB)		

Tasks	Potential Hazards	Recommended Action or Procedure
Planning and Communication	Not being prepared and not following plan/itinerary. Communication breakdowns.	Plan ahead. Know where you will be going, the route to be surveyed, and any particular hazards associated with the monitoring route. Check the weather forecast and plan accordingly. Check in with ATC regional office before and after field work to confirm the work is safely completed. Establish a Designated Office Staff (DOS) who you will advise about any changes, including cancellation of field work. If return will be delayed, contact the DOS before agreed-upon check-in time to establish a new check-in time. Always carry at least one method of communication, preferably two, and verify that they are operational before starting field work.
Emergency Preparedness	Not knowing emergency procedures. Not having emergency supplies.	Know who to contact and how to reach them in the event of an emergency. Have current CPR and first aid certification. Carry an appropriately well-supplied first aid kit.

Tasks	Potential Hazards	Recommended Action or Procedure
General foot travel	Falling or tripping due to wet areas, poor footing, uneven terrain, loose/rolling rocks and heavy pack.	Use caution at all times. Walk carefully, watching footing. Wear appropriate boots for conditions. Stay aware of your feet. Address blisters and hot spots promptly. Avoid carrying excessive weight loads or unbalanced loads. Use extreme caution traversing wet rocks, streams, steep slopes or blowdown areas.
Working outdoors during storms	Being struck by falling trees or branches; being struck by lightning	Listen to the weather forecast each morning (television, radio and/or internet). Plan or adjust field work to avoid being caught in heavy weather. Postpone work if safety will be compromised by storm conditions. If you see or hear a thunderstorm coming, retreat from high ground and exposed areas. Go inside a sturdy building or vehicle, if possible. Make yourself the smallest target possible and minimize contact with the ground. During a thunderstorm, members of the crew should stay separated by at least ten feet.
Poisonous plants, especially poison ivy	Contamination/toxicity from contact with poisonous plants	Learn to identify poison ivy in its many growth forms. Wear long sleeves and pants. Be aware of poison ivy and avoid coming in direct contact with it. Thoroughly wash hands, equipment, and clothes with Tecnu or similar specialized soap if you come into contact with poison ivy.

Tasks	Potential Hazards	Recommended Action or Procedure
Working in bear territory	Black bear encounter	Be especially alert near dawn or dusk. Be especially aware of mother bears with cubs. Never approach cubs or come between a mother bear and her cubs. Face the animal, continually make noise – do not freeze or remain silent. Appear larger by standing tall, waving arms or jacket over your head. Slowly back away – do not approach a bear. Never run from a bear. Throw things and shout loudly. Fight back aggressively.
Bee, wasp, or yellow-jacket stings	Multiple stings from disturbing or stepping into nest areas	Be alert to hives in brush, ground holes, or hollow logs. Watch for insects traveling in and out of one location. If you are allergic to bee stings, advise team members before starting field work. Make sure you carry emergency medication with you at all times and that your partner knows where you keep it. Wear long sleeve shirts and trousers, tuck in shirt. Bright colors and metal objects may attract bees or wasps. If you are stung, apply a cold compress to reduce swelling. If stinger is left behind, scrape it off of skin. Do not use tweezers as this squeezes the venom sack, worsening the injury. If the victim develops hives, asthmatic breathing, tissue swelling or a drop in blood pressure, seek medical help immediately.

Tasks	Potential Hazards	Recommended Action or Procedure
Bites from mosquitoes, black flies, and other insects	Itchy reactions to multiple bites	Wear long sleeves and pants. Avoid sitting on the ground or on logs, especially in dry sunny grassy areas. Use insect repellants in accordance with manufacturer's recommendations. Carry after-bite medication to reduce skin irritation.
Ticks	Contracting diseases transmitted from ticks	Use tick avoidance precautions, including pre-treating clothing with repellant, tucking pants into socks and shirt into pants when hiking. Wear clothes (including pants and long-sleeved shirts) that are light colored and check for ticks on clothing after traveling through vegetation. Conduct a thorough tick check every evening after completing field work. Know how to identify tick life forms, and the signs & symptoms of tick-borne diseases.
Venomous snakes	Being bitten by a venomous snake	Be alert for snakes in thick vegetation and rocky habitats. Look **before** putting hands or feet in places out of immediate view. Treat all bites as if envenomation has occurred. Immobilize the bitten area and keep it lower than the heart. Remove rings, watches, shoes, etc. before swelling begins in earnest. Seek medical attention immediately and/or call for help. Remain calm.

Tasks	Potential Hazards	Recommended Action or Procedure
Walking through thick vegetation	Cut, scratched, or bruised by vegetation; eye or ear injuries	Shield your eyes and face with your hands, glasses, or hat when moving through tall thick brush. Keep your head and eyes pointed somewhat downward so your head hits obstacles before your eyes. Wear pants and long-sleeved shirts to protect bare skin. Look before you grab vegetation to avoid grasping thorny stems. Do not follow closely behind other people to avoid having branches snap back and hit you.
Crossing streams	Injuries from falling and/or drowning	Do not cross streams that are flowing quickly and higher than mid-calf; find another route. Thoroughly investigate area to find safest crossings. Wear appropriate foot gear for stream crossings. It is safer to wade through water, rather than rock hop across a stream trying to keep your boots dry. Unbuckle your pack and be prepared to jettison gear should you lose your balance or fall in. Use a sturdy pole or walking stick for balance.
Working in heat, humidity, or cold	Heat exhaustion, sunburn, dehydration, hypothermia	Evaluate the weather forecast each morning and plan field work accordingly. Carry and drink plenty of water. Take extra breaks during extreme weather events. Adjust the work routine to minimize exposure to extreme heat and humidity. Take adequate garments for all possible weather conditions. Choose clothing that will keep you warm even if it gets wet.
Hazard trees	Being struck by falling trees or branches	Look up. Be alert for widow-makers, storm damaged trees with large broken limbs, and unstable standing dead trees. Do not spend extended time in an area with hazard trees.

Tasks	Potential Hazards	Recommended Action or Procedure
Carrying a pack and other equipment	Injuries from improper packing, adjustment, and lifting of backpacks. Injuries from improper carrying of gear	Learn how to properly pack, adjust, lift, and carry a pack. When hand-carrying gear, keep one hand free. If carrying long equipment, be aware of other people and never swing around quickly. Avoid allowing a long piece of equipment to project up and behind you, where you cannot see it.

Appendix S1.A. Safety Forms

Safety Acknowledgment Form

By signing below, I certify that I have read the safety section of the Appalachian National Scenic Trail Rare Plant Monitoring Protocol, including the Job Safety Analysis. I have shared any safety concerns or suggestions with the project proponent (APPA Natural Resource Manager, ATC regional coordinator, or volunteer coordinator) and they have been addressed to my satisfaction.

Print Name: _____

Signature: _____

Date: _____

Please return this form to the designated monitoring coordinator.

This form only needs to be completed once for each field monitor, prior to any field monitoring activities. An annual review of the Job Safety Analysis is recommended for all field monitors.[25]

[25] Monitoring coordinators and volunteer monitors must "initial" the monitoring assignment form to indicate that safety issues in general, as well as issues specific to each assigned occurrence have been discussed. This is in addition to completing the safety acknowledgement form.

Appendix S1.A. Safety Forms (continued)

Rare Plant Monitoring Trip Plan

This form must be completed and e-mailed to the Designated Office Staff in advance of your monitoring trip.

Name of monitor:_____

Cell phone number:_____

Home phone number:_____

Name of monitoring partner (if applicable):_____

Partner cell phone number (if applicable):_____

Partner home phone number (if applicable):_____

Personal Locator Beacon (PLB) serial number (if applicable):_____

Primary contact and contact numbers for PLB (if applicable):_____

Secondary contact and contact numbers for PLB (if applicable):_____

Date of trip:_____

Start time:_____

End time:_____

Check-in time:_____

NOTICE: if you do not check in by this date and time, an attempt will be made to reach you by phone; if you do not respond, emergency services will be notified. Do not forget to check in!

Vehicle make, model, and license plate:_____

Planned parking location(s):_____

Route and site(s) to be monitored:_____

Note: the person receiving this trip plan must have a map of the route and monitoring sites.

Appendix S1.B. Green-Amber-Red (GAR) Risk Assessment

This section of the Safety SOP describes application of the GREEN-AMBER-RED (GAR) Risk Assessment Model as outlined in the NPS Operational Leadership Student Manual (Version 2; July 2011) to the APPA Rare Plant Monitoring Protocol. This GAR was written by the APPA Environmental Monitoring Coordinator (Fred Dieffenbach) on 4 May 2012, reviewed by the NETN Program Manager on 5 November 2012, and approved by the NPS Northeast Region I&M Program Manager (John Karish) on 10 January 2013.

The GAR model allows for a general assessment of a task or operation and generates communication concerning the risks of an activity (in this case, conducting the field-based activities of the APPA Rare Plant Monitoring Protocol). The most important part of the process is the team discussions leading to an understanding of the risks and how they will be managed, and monitoring staff at all levels (field monitors to project leader) should be involved in revising this GAR when monitoring is implemented.

The GAR is a seven step process. Each step is defined and explained in the context of the APPA Rare Plant Monitoring Protocol below.

Step 1: Define the Mission or Task

The APPA Rare Plant Monitoring Protocol includes a field-based monitoring activity: collecting rare plant data at predetermined locations along the APPA. Monitoring staff are not likely to be NPS employees or volunteers working directly for NPS, NETN, or APPA. Rather, individuals collecting data in accordance with this protocol are likely to be volunteers working for ATC or an affiliated trail club. Despite the likelihood that field staff will work for an entity other than NPS, NETN, or APPA, we highly recommend that they work in groups of two or more. Work under this protocol is generally conducted away from roads, and at time away from the trail itself. Potential safety hazards (along with mitigation measures) have been identified in a Job Safety Analysis (JSA, above). Of specific concern is that field staff may be working in fairly remote areas with limited communication options in the event of an emergency. A serious injury due to a trip and fall while traversing uneven or steep terrain is possible and is the most significant risk encountered when conducting this activity.

Step 2: Define the Threats

The threats/hazards for this activity along with mitigation measures are described in the associated JSA.

Step 3: Assess Risk and Assign a Numerical Value

The numerical ranks (Table S1.1) were assigned by Fred Dieffenbach, the APPA Environmental Monitoring Coordinator.

The GAR process is described in the NPS Operational Leadership Student Manual (Version 2; July 2011).The activity risk can be visualized using the colors of a traffic light. If the total risk value falls in the GREEN ZONE (1-35), risk is rated as low. If the total risk value falls in the AMBER ZONE (36-60), risk is moderate and you should consider adopting procedures to minimize the risk. If the

Appendix S1.B. Green-Amber-Red Risk Assessment (continued)

total value falls in the RED ZONE (61-80), you should implement measures to reduce the risk prior to starting the activity.

The ability to assign numerical values or "color codes" to hazards using the GAR Model is not the most important part of risk assessment. What is critical to this step are team discussions leading to an understanding of the risks and how they will be managed.

Table S1.B.1. APPA Forest Monitoring Protocol assigned risk codes of 0 (For No Risk) through 10 (For Maximum Risk) to each of the eight Green-Amber-Red Risk Assessment elements.

Element	Rating
Supervision	6
Planning	6
Communication	8
Contingency Resources	7
Team Selection	6
Team Fitness	5
Environment	6
Event/Evolution Complexity	7
Total Risk Score	51

Step 4: Identify Risk Control Options

Supervision

The APPA rare plant monitoring protocol will likely be implemented by individuals working for the ATC, and not NPS, NETN, or APPA. Consequently, NPS, NETN, and APPA will have little direct ability to supervise work being conducted under this protocol. So, while the protocol identifies personnel, roles and responsibilities, and a chain of command, the ATC will have control over its implementation. NPS, NETN, and APPA highly recommend that field monitors follow check-in and check-out procedures and carry multiple forms of communication. A score of 6 was assigned because of the inability to ensure an adequate amount of supervision.

Planning

The APPA rare plant monitoring protocol includes numerous SOPs that explain training, personal safety, emergency communication (equipment and contacts), and appropriate field activities. Field monitors are asked to review the volunteer manual, which summarizes relevant field procedures and provides a summary of the safety SOP. Whenever work is performed under this protocol by NPS staff or volunteers, they will be required to sign an acknowledgement that they have reviewed the safety SOP, including the JSA. However, when this methodology is used by someone working on the APPA, but not for NPS, we can only encourage that the documents be reviewed and the acknowledgment signed. Field monitors are highly encouraged to have first aid and CPR training. The advance planning, written documentation, and training procedures promote a safe working

environment suggest a low score (4), but the inability of NPS to enforce these steps when the protocol is implemented by an entity like ATC demands a moderate score (6).

Communication

Routine and emergency communication procedures are explained in the relevant SOPs, and field monitors are encouraged to coordinate with their DOS and the nearest ATC regional office. The procedures include a daily check-out/check-in procedure for field monitors to ensure that a responsible party knows if someone has not returned from the field activity in a timely manner. However, there are many places along the APPA where radio and cell phone communication is not possible. Despite the advance planning, written documentation, and training procedures, a high score (8) was assigned because of the known communication problems.

Contingency Resources

Contingency resources include communication equipment and procedures that explicitly involve park rangers, park dispatch, and 9-1-1. Volunteer monitors are required to carry a cell phone or other communication device, but coverage is not available in many locations. Personal Locator Beacons may alleviate some issues but are not currently required equipment. In the worst case scenario, an incident involving a solo individual in an area with no cell phone coverage could result in a long delay before emergency services are alerted. However, field monitors use marked sites and routes that are generally on or near established trails. They also set up explicit check-in times, so if a search is initiated after a missed check-in the individual should be located within a few hours of starting a search. A score of 7 was assigned for this worst-case scenario.

Team Selection

The monitoring protocol identifies the essential skills and abilities required to execute this protocol in a competent manner, but one of the features of this protocol is that significant experience is not required. Field monitors may have limited experience with research and field work, and some may be retirees. There is also variation in their orienteering and hiking experience. Field monitors are strongly encouraged to obtain basic first aid and CPR certification, and to work with a partner. A score of 6 was assigned because some field monitors may have limited experience with off-trail hiking and navigating.

Team Fitness

The nature of the rare plant monitoring protocol should ensure an overall high level of team fitness. The monitoring itself is not difficult, although significant travel/hiking time may be needed for some sites. A score of 5 was assigned because the monitoring does require long hikes that may be strenuous. Monitoring staff must be diligent about adequate rest and nourishment to ensure that fatigue does not become a factor.

Environment

Environment was assigned a moderate score (6) because the work may involve some travel off of established trails, on uneven terrain. Activities may occur during a variety of weather conditions, although field monitors are told not to monitor if the weather forecast calls for severe weather.

Appendix S1.B. Green-Amber-Red Risk Assessment (continued)

Incident Complexity

Incident complexity was also assigned a medium score (7) because much of the APPA is relatively remote, field conditions change due to weather, and emergency evacuation logistics could be complicated. Individual field monitors must use judgment and experience to respond appropriately.

Step 5: Evaluate Risk vs. Gain

The scores for this assessment fall in the mid-to-upper range of the "amber" zone, indicating a moderate risk activity. While it is theoretically possible to make changes to reduce risk even further, the risks associated with monitoring along the APPA tend to be more complicated due to the remote setting. Planning and preparation is the key to minimizing risk. The APPA Environmental Monitoring Coordinator feels that the current procedures provide a good balance that encourages field monitors to be safe, but also acknowledges that APPA, NETN and NPS may have limited control over those utilizing this protocol and that monitoring may occur with disregard for many of the considerations outlined in this SOP, despite our efforts to the contrary. Regardless, the APPA Environmental Monitoring Coordinator and NETN feel that this monitoring activity, if carried out in accordance with all SOPs, has a manageable level of risk.

Step 6: Execute Decision

The decision made by the APPA Environmental Monitoring Coordinator is to promote the use of the APPA Rare Plant Monitoring Protocol.

Step 7: Supervise – Watch for Change

The APPA Environmental Monitoring Coordinator will encourage feedback from those who implement this protocol on safe execution of the protocol including risk control options not considered thus far.

References and Additional Information

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Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
1.00	December 2011	Fred Dieffenbach	Modified from MIDN/NETN SOP	Specific needs of APPA
1.01	May 2012	Fred Dieffenbach	Revised to conform with Operational Leadership Training	Improved
1.02	November 2012	Fred Dieffenbach	Revision of some weights by Brian Mitchell	
1.03	January 2013	Ed Sharron	Minor edits and formatting	
1.04	January 2015	Fred Dieffenbach	Added full name of Personal Locator Beacon on contact form, Added reminder to initial the monitoring assignment form to acknowledge that safety related to each occurrence has been discussed; Comments added	

SOP 2 - Program Administration and Volunteer Support

APPA

Version 2.03

Overview

This SOP provides guidance to ATC monitoring coordinators for administering the APPA Rare Plant Monitoring Program including recruiting, training and supporting volunteer monitors as well as proper handling of data. Successful monitoring programs learn and improve over time. This SOP is updated periodically to improve procedures, and to incorporate useful suggestions from field monitors, ATC monitoring coordinators and other staff.

Recruiting volunteers

ATC monitoring coordinators recruit new volunteer field monitors as needed from existing trail club membership, as well as through word-of-mouth and targeted postings in local media and on the web. Coordinators may also target natural history and botany enthusiasts by visiting, and when possible, making presentations about the program to local native plant clubs, nature centers, and state Master Naturalist Programs (e.g., www.virginiamasternaturalist.org).

Volunteer recruitment is tied to the program's goals. Volunteer field monitors greatly expand the monitoring program's reach, allowing more sites to be included and more visits to occur. At the same time, volunteer field monitors expand the program's outreach, facilitating public engagement and creating opportunities for public education. While the former is best achieved by recruiting the most capable and dependable volunteers, the latter is best achieved by recruiting as many volunteers as possible regardless of ability. The APPA Rare Plant Monitoring Program seeks to balance these goals. Monitoring methods have been carefully crafted for volunteer field monitors. However, in order to protect data quality it will be important to assess volunteer capabilities during recruitment and task assignment.

Training provides an opportunity for staff and ATC monitoring coordinators to begin assessing volunteer capabilities. ATC monitoring coordinators seek to identify volunteers with background or skills in natural history or botany, or in orienteering or long-distance hiking. The former can be preferentially assigned to monitoring species which are more challenging to identify or monitor (i.e., inconspicuous plants or grasses/sedges) or for occurrences which are more significant, whereas the latter may be assigned to occurrences which are more remote or further off-trail. Likewise, ATC monitoring coordinators should attempt to identify volunteers who are not physically capable of accessing monitoring sites, or who are not able to identify species or follow monitoring protocols, and gently steer these individuals into other APPA volunteer opportunities that better match their abilities.

ATC monitoring coordinators should plan ahead for occasional illness or other problems that prevent a monitor from completing their assignment. Whenever possible, occurrences should have a backup monitor designated, who could monitor if the primary monitor is unable to do so.

Training/supporting volunteers

Volunteer training and support are essential to developing a successful volunteer monitoring program, and require substantial staff support and careful planning. New volunteers participate in a required training workshop.

The following materials will be provided to each monitor during training:

- A Volunteer Guide for Rare Plant Monitoring on the Appalachian Trail, including a safety section that excerpts key points from SOP 1 - Safety
- Monitoring data forms
- Rare species description with photographs or illustrations for each species to be monitored
- Previous year monitoring report with species occurrence map and directions to the site
- Descriptions of common invasive exotic species in the region
- A copy of the Job Safety Analysis from SOP 1 - Safety

Training includes the following:

- Completion of basic paperwork, including volunteer agreements and signing an acknowledgment that the Job Safety Analysis has been read.
- Reinforcing the importance of communication, in particular when urgent issues are identified.
- Presentation and discussion of the Rare Plant Protocol
- Discussion of monitoring data forms, including the importance of completing each section
- Visit to a monitoring site accompanied by ATC monitoring coordinator, or other person familiar with the site and species
- Observation of monitored species, and discussion of identification characteristics
- Practice counting or estimating number of individuals
- Discussion of how to identify juveniles and stage classes (vegetative, flowering, fruiting, senescent)
- Discussion of techniques to limit trampling impacts during monitoring
- Observation of most common species, and invasive exotic species at the site
- Discussion of hazards, such as steep slopes or deer ticks
- Instructions for timely submittal of completed monitoring data forms
- Opportunity for volunteer questions

If time permits, training could also include:

- Training in use of GPS equipment or digital camera
- Training in site panorama monitoring, for interested volunteers

Responsive volunteer support is a program priority. The program will only succeed if volunteers are given timely assistance in species identification, proper methods, site location, and other areas as requested. ATC monitoring coordinators provide the first level of contact for volunteer assistance requests. If they are unable to respond in a timely fashion for any reason, requests are promptly forwarded to the APPA Natural Resource Manager. The APPA Natural Resource Manager should seek outside help as necessary to respond to requests for volunteer assistance.

Data submission and handling

Volunteer field monitors submit data to ATC monitoring coordinators within 3 weeks of data collection. As soon as possible (within 10 days), ATC monitoring coordinators survey the data forms for a) obvious blank entries, b) occurrences that were not found, and c) occurrences in which < 5% of individuals were flowering AND < 5% of individuals were fruiting. If necessary and possible, ATC monitoring coordinators arrange for a repeat visit by a trusted monitor or program staff. ATC monitoring coordinators forward data to the APPA Natural Resource Manager no later than 1 month after receiving the data forms.

Quality Assurance / Quality Control

A small number (~ 5%) of randomly-selected occurrences in each region should be resampled by program staff or trusted field monitors for QA/QC, as described in SOP 6: Data Management & Quality Assurance/Quality Control. Although not currently implemented, this QA/QC sampling would occur within two weeks of the original sample date. QA/QC sampling should be conducted for occurrences monitored by contractors as well as by volunteer field monitors.

Follow-up

After the monitoring season, ATC monitoring coordinators survey participating volunteer monitors to solicit feedback on the program, including any problems encountered as well as the adequacy of training and volunteer support. Suggestions are considered by the APPA Natural Resource Manager and Environmental Monitoring Coordinator, and useful suggestions are incorporated into the protocol.

Each year, a brief summary of program results is provided to volunteers, either on the web or as a handout. This feedback may encourage enthusiasm for the program and foster volunteer retention.

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
0.00	June 2006	Geri Tierney Fred Dieffenbach	Initial version.	
1.00	May 2010	Geri Tierney	Editorial changes.	
1.01	Aug 2011	Geri Tierney	Added optional panorama monitoring training. Editorial changes.	
2.00	Sept 2011	Geri Tierney, Fred Dieffenbach, Casey Reese	Redesigned this SOP to focus on Program Administration by Regional Monitoring Coordinators, including data handling as well as volunteer support.	Needed to provide guidance to coordinators.
2.01	January 2012	Fred Dieffenbach	Minor changes to text	Clarity
2.02	January 2012	Ed Sharron	Minor edits and formatting	
2.03	February 2015	Fred Dieffenbach and Brian Mitchell	Emphasize importance of training volunteers to communicate important issues Note that QA/QC sampling is not currently implemented	Clarification and reflection of current procedures

SOP 3 - Equipment

APPA

Version 1.03

Overview

This SOP lists equipment needed to monitor rare plant occurrences on APPA lands. ATC monitoring coordinators will supply the following items except those marked by an asterisk (*) which are to be provided by the Field Monitor.

Monitoring equipment:

- Recent monitoring report with species occurrence map
- Rare species description with photographs or illustrations
- Invasive Species Identification Guide (USDA)
- Blank data forms (1 per occurrence)
- Clipboard and pencils
- Tally counter
- Small flags
- Watch*
- Compass
- GPS unit (optional, but strongly encouraged)
- Digital camera (optional, but strongly encouraged)
- Charged cell phone (required, for safety)*
- Spare batteries for GPS and digital camera

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
0.1	April 2008	Geri Tierney	Initial draft.	
0.2	April 2008	Geri Tierney	Editorial changes.	
0.3	June 2008	Geri Tierney Fred Dieffenbach	Added USDA Invasive Species guide and ruler. GPS unit and digital camera designated optional but strongly encouraged.	Guide will be useful; ruler needed for vigor.
0.4	September 2008	Geri Tierney Fred Dieffenbach	Ruler removed from list.	Vigor removed from protocol.
1.00	May 2010	Geri Tierney	Editorial changes.	.
1.01	Oct 2010	Geri Tierney	Editorial changes.	
1.02	Aug 2011	Geri Tierney	Editorial changes.	
1.03	November 2012	Fred Dieffenbach	Revised list. Removed measuring tape, made some elements optional	

SOP 4 - Using the Global Positioning System (GPS)

APPA

Version 1.11

Overview

This SOP explains methods to use the Garmin 76CS Global Positioning System (GPS). GPS equipment is used to navigate to known occurrences, record the size of large occurrences, record the location of new occurrences, and confirm the location of old occurrences. Detailed steps for setting up and using the GPS unit are presented below.

Supplemental Reading

Garmin GPSMAP 76CSx Owner's Manual and Quick Reference Guide
(http://static.garmincdn.com/pumac/GPSMAP76CSx_OwnersManual.pdf)

Setting up the GPS Unit

1. Set the GPS to WGS84. Under the main menu, select 'Setup', then toggle to 'Units' and set the 'Position Format' to Decimal degrees (use hddd.ddddd^{o} option), the 'Map Datum' to GCS_WGS_1984. Hit the 'Quit' button to return to the 'Setup' menu.

2. Make sure the GPS is set to True North. Toggle to 'Heading' on the Setup menu and set the 'North Reference' to True.

Note: These settings will be saved on the GPS and should not have to be re-entered each time the unit is turned on.

3. As soon as you turn the unit on, it starts to look for satellites. You can track the status of the satellites on the GPS information page. The GPS is most accurate when it has at least four satellites and a 3D position. The location of satellites in the sky changes from day to day and thus sometimes satellite reception is more difficult to achieve. Openings in the canopy of the forest can increase the strength of satellite signals reaching the GPS unit.

4. The current estimated accuracy of the receiver is also displayed on this page. The accuracy fluctuates as satellite signals are gained and lost. An accuracy of + or – 10 m (30 ft) or better is desirable to precisely document location.

Navigating to a Site

The ATC monitoring coordinator is responsible for loading waypoints of occurrences onto project GPS units. Once the waypoints are loaded, these procedures can be used to aid navigation to occurrences.

1. After the receiver is turned on and has adequate reception, press the 'FIND' button, highlight 'Waypoints' and press 'ENTR'.

2. Press ‘Menu’ then ‘Find by Name’ or ‘Find by Nearest’ to find the appropriate waypoint name and press ‘Enter’. The name of the waypoint is the name of the rare plant occurrence. For example, is you are navigating to an occurrence named CT-02-22, the waypoint would be CT-02-22. Type in the name of the desired point, or press ‘Page’ to scroll through all the options. The waypoint screen will give you detailed information about the waypoint including distance to the point. Select ‘Go To’.

3. At the top of the Map Page, the distance and bearing to the waypoint will be displayed. The Map Page, Compass Page or Highway Page can be used to navigate to the waypoint. As the distance to the waypoint decreases, the bearing and distance numbers will begin to jump around as the accuracy varies. As the waypoint nears, the use of a hand compass and measurement by pacing will help locate the point. Use caution as you approach the waypoint and the rare plant occurrence to avoid accidentally trampling the resource you are planning to monitor.

Marking a Waypoint

Use these procedures to document the location of a new occurrence, or to document the correct location for an occurrence with suspect coordinates.

1. Hold down the Enter button until the ‘Mark Waypoint’ Screen appears.

2. The default name of a waypoint is a sequential number. If you are documenting the location of an occurrence that has not previously been documented, or one where the coordinates are suspect, use the known ‘site’ number (e.g., CT-02) followed by the word “new” plus a sequence number in the case of a new occurrence (e.g., CT-02-new-1). After a new occurrence has been validated and entered into the program database, a new ‘permanent’ occurrence number will be assigned. If you are establishing a waypoint to record the coordinates of a known occurrence (e.g., CT-02-22) where the existing coordinates are suspect, use the existing occurrence number as the waypoint name and add the word “new” (e.g., CT-02-22-new) to clearly differentiate the newly acquired coordinates from the suspect coordinates.

3. To change the default name toggle to the number and press ‘ENTR’. Toggle up and down through the numbers and letters and left and right between characters. Once the last letter or digit has been selected, press ‘ENTR’ to save the name and highlight the whole name field. Enter the plot number as described above or as directed by your monitoring coordinator.

4. The most accurate way to document a location is to collect a waypoint position that averages at least 100 points. To do this select ‘Menu’ and then choose ‘Average Location’.

5. The ‘Average Location’ screen appears and measurement counts automatically begin. After the ‘Measurement Count’ reaches 100, press enter to save. Press ‘OK’ on the Mark Waypoint screen to return to the Map Page.

6. Before leaving the point, make sure that it has been recorded. Press ‘FIND’ and toggle to ‘Waypoints’ and press ‘ENTR’. Does the new waypoint appear on the list?

Navigating

You can navigate using the Map Page, Compass Page or Highway Page. When navigating using the GPS, remember that directional signals you receive from GPS are only valid while you are moving. Unlike a compass, if you stop and turn to face a different direction, the GPS will not reposition until you move again. A compass may be used to determine the correct direction to continue after stopping, and care must be taken to hold the compass sufficiently far from the GPS handheld unit to avoid influencing the compass needle.

Connecting to a Computer

These procedures are used by ATC regional coordinators to upload waypoints from a computer into a GPS and download waypoints from the GPS to a computer. The following instructions assume that the user has access to ArcMap and DNR Garmin. DNR Garmin is a free utility that is available from the Minnesota Department of Natural Resources and may be obtained at the following location (http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html).

1. Connect the Garmin unit to a computer using a USB cable.
2. Turn the unit on.
3. There are two ways to open DNR Garmin. You should be using version 5.3.2 or higher.
    a. Open DNR Garmin from the Start menu or
    b. Open DNR Garmin from the DNR Garmin toolbar in ArcMap. If the toolbar is not loaded, select View > Toolbars > DNR Garmin Toolbar from the ArcMap menu.
4. Confirm that DNR Garmin recognizes the unit.
    a. If the unit is not recognized, ‘Not Connected’ will appear in the lower left corner (Figure S4.1).
    b. If the unit is recognized, ‘Connected’ will appear in the lower left corner and the GPS unit information should appear on the screen (Figure S4.2).
5. If the unit is not recognized, make sure the Port is set to USB by selecting GPS > Set Port > USB. To refresh the connection, select GPS > Open. Note: this will only work if the GPS is not connected.

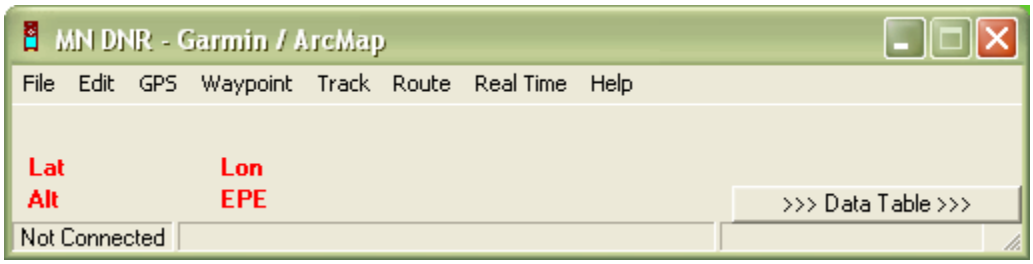


Figure S4.1. MN DNR—Garmin/ArcMap with GPS not connected.

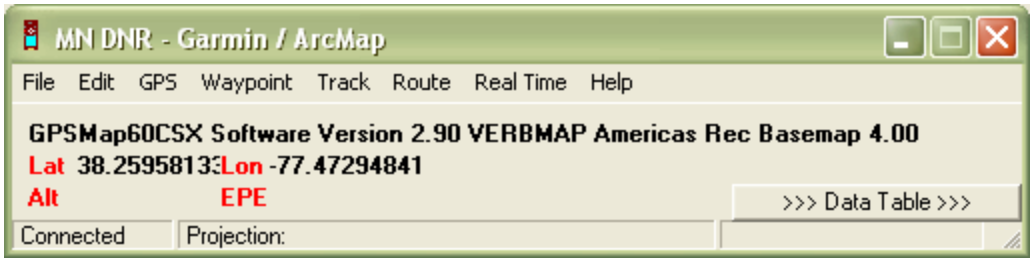


Figure S4.2. MN DNR—Garmin/ArcMap with Garmin unit connected.

6. Set the default projection to WGS84. To open the DNR Garmin Properties window; select File > Set Projection. You will need to set the projection three times.

The Projection will now appear at the bottom center of the main MN DNR—Garmin/ArcMap screen.

Uploading Waypoints to the Garmin Unit

In order to navigate to existing plot locations, waypoints may be uploaded from a GIS layer to the GPS receiver. The steps for this procedure are as follows:

1. Turn on the computer and open an ArcGIS map that contains the GIS layer with the desired coordinates. Make sure the GIS layer that contains the coordinates is selected (Figure S4.3). It should be highlighted.

2. Connect the GPS unit to the computer using the USB cable and turn the unit on.

3. Open MN DNR Garmin.

   Select File > Load From > ArcMap > Layer. The Identify Fields dialog box will appear and you will need to select an Ident and Comment field. The Ident field should correspond to the Occurrence.

   Note: If the shapefile already has a comment field, MN DNR Garmin will default to the existing comment field and ignore the field selected. You will need to either copy the field you want to use into the existing comment field or delete it.

4. To upload the waypoints to the GPS unit. Select Waypoint > Upload.

5. The GPS will beep when the upload is complete and a small box on the computer screen will read ‘Transfer Complete. Waypoints uploaded.’ Click OK. Now, you are ready to take the GPS into the field.

6. Note that the default symbol for uploaded waypoints is a blue flag. Press ‘FIND’ on the Garmin unit and select ‘Waypoints’ and then press ‘ENTR’ to see the waypoints that you just uploaded.

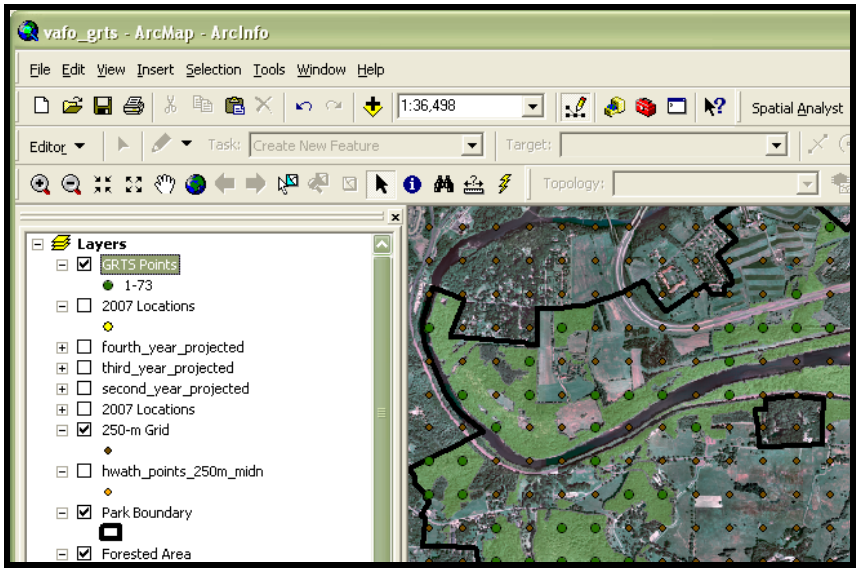


Figure S4.3. GIS project with layer containing coordinates selected (GRTS Points).

Downloading Waypoints

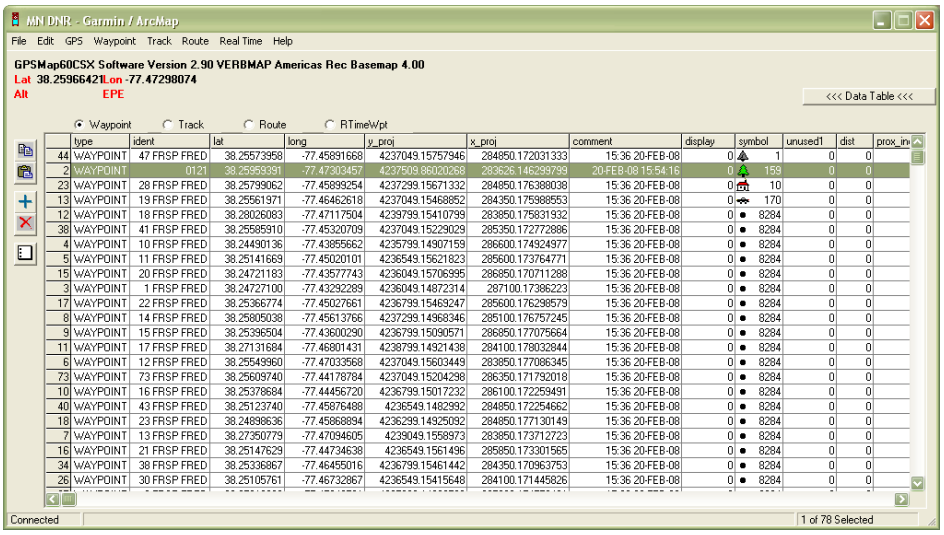
Waypoints documenting the size of larger occurrences, or locating potential new occurrences will be downloaded onto the computer upon return to the office from the field by the ATC monitoring coordinator.

1. Open an ArcGIS map that spans the geographic area and that contains the waypoints recorded on the GPS.

2. Connect the GPS unit to the computer with a USB cable and turn it on.

3. Open DNR Garmin and verify that the GPS is acknowledged and that the projection is set correctly. If you need help, see the section above on setting up DNR Garmin.

4. To download waypoints, select Waypoint > Download. The saved waypoints from the GPS will display in table (Figure S4.4).



	type	ident	lat	long	y_proj	x_proj	comment	display	symbol	unused1	dist	prox_in
44	WAYPOINT	47 FRSP FRED	38.25573958	-77.45891668	4237049.15757946	284850.172031333	15:36 20-FEB-08	0	1	0	0	
2	WAYPOINT	0121	38.25959391	-77.47303457	4237509.86020268	283626.146299799	20-FEB-08 15:54:16	0	159	0	0	
23	WAYPOINT	28 FRSP FRED	38.25799062	-77.45899254	4237299.15671332	284850.176388038	15:36 20-FEB-08	0	10	0	0	
13	WAYPOINT	19 FRSP FRED	38.25561971	-77.46462618	4237049.15468852	284350.175988553	15:36 20-FEB-08	0	170	0	0	
12	WAYPOINT	18 FRSP FRED	38.28026083	-77.47117504	4239799.15410799	283850.175831932	15:36 20-FEB-08	0	8284	0	0	
38	WAYPOINT	41 FRSP FRED	38.25585910	-77.45320709	4237049.15229029	285350.172772886	15:36 20-FEB-08	0	8284	0	0	
4	WAYPOINT	10 FRSP FRED	38.24490136	-77.43855662	4235799.14907159	286600.174924977	15:36 20-FEB-08	0	8284	0	0	
5	WAYPOINT	11 FRSP FRED	38.25141669	-77.45020101	4236549.15621823	285600.173764771	15:36 20-FEB-08	0	8284	0	0	
15	WAYPOINT	20 FRSP FRED	38.24721183	-77.43577743	4236049.15706995	286850.170711288	15:36 20-FEB-08	0	8284	0	0	
3	WAYPOINT	1 FRSP FRED	38.24727100	-77.43292289	4236049.14872314	287100.17386223	15:36 20-FEB-08	0	8284	0	0	
17	WAYPOINT	22 FRSP FRED	38.25366774	-77.45027661	4236799.15469247	285600.176298579	15:36 20-FEB-08	0	8284	0	0	
8	WAYPOINT	14 FRSP FRED	38.25805038	-77.45613766	4237299.14968346	285100.176757245	15:36 20-FEB-08	0	8284	0	0	
9	WAYPOINT	15 FRSP FRED	38.25396504	-77.43600290	4236799.15090571	286850.177075664	15:36 20-FEB-08	0	8284	0	0	
11	WAYPOINT	17 FRSP FRED	38.27131684	-77.46801431	4238799.14921438	284100.178032844	15:36 20-FEB-08	0	8284	0	0	
6	WAYPOINT	12 FRSP FRED	38.25549960	-77.47033568	4237049.15603449	283850.177086345	15:36 20-FEB-08	0	8284	0	0	
73	WAYPOINT	73 FRSP FRED	38.25609740	-77.44178784	4237049.15204298	286350.171792018	15:36 20-FEB-08	0	8284	0	0	
10	WAYPOINT	16 FRSP FRED	38.25378684	-77.44456720	4236799.15017232	286100.172259491	15:36 20-FEB-08	0	8284	0	0	
40	WAYPOINT	43 FRSP FRED	38.25123740	-77.45876488	4236549.1482992	284850.172254662	15:36 20-FEB-08	0	8284	0	0	
18	WAYPOINT	23 FRSP FRED	38.24898636	-77.45868894	4236299.14925092	284850.177130149	15:36 20-FEB-08	0	8284	0	0	
7	WAYPOINT	13 FRSP FRED	38.27350779	-77.47094605	4239049.1558973	283850.173712723	15:36 20-FEB-08	0	8284	0	0	
16	WAYPOINT	21 FRSP FRED	38.25147629	-77.44734638	4236549.1561496	285850.173301565	15:36 20-FEB-08	0	8284	0	0	
34	WAYPOINT	38 FRSP FRED	38.25336867	-77.46455016	4236799.15461442	284350.170963753	15:36 20-FEB-08	0	8284	0	0	
26	WAYPOINT	30 FRSP FRED	38.25105761	-77.46732867	4236549.15415648	284100.171445826	15:36 20-FEB-08	0	8284	0	0	

Figure S4.4. Data table displaying downloaded waypoints (Note: the above described waypoint naming convention does not appear in this example).

5. Note that the default is for all the waypoints on the GPS to be downloaded. You can sort through these by clicking on any of the column headings. For example, click on 'symbol' to sort the waypoints by their symbol.

6. You can either save all the waypoints or select specific waypoints to save. What you choose to do may depend on the project you are working on. If you do not highlight any of the waypoints, they will all be saved. To highlight waypoints, click on the row identifier. In the above image, clicking on '2' highlighted the row which is Plot 0121.

7. These waypoints need to be saved twice, once as a text file and once as a shapefile.

    a. To save as a text file, select File > Save To > File…

    b. To save as a shapefile, select File > Save To > ArcMap > Shapefile Layer...

    This file will automatically appear in the Table of Contents of the ArcGIS Map Document that you have open.

8. Close DNR Garmin and verify the contents of the new shapefile in the map document to ensure that your data were properly transferred.

Deleting Waypoints from the GPS Unit

The GPS receiver can hold up to 500 waypoints. While it is unlikely that you will exceed this limit on any single trip, you should routinely delete downloaded waypoints from the GPS to keep it from becoming full. Waypoints can either be deleted individually or the entire table can be deleted at once.

1. Deleting a single waypoint using DNR Garmin:

    a. From the 'Main Menu' screen, press 'Find' to open the Find screen.

b. Select ‘Waypoints’ to open the Waypoints screen.

c. Toggle to highlight the waypoint you would like to delete and Press ‘ENTR’ to open the Waypoint screen.

d. Toggle to highlight ‘Delete’ in the lower left corner and press ‘ENTR’

e. When prompted ‘Do you really want to delete waypoint xxx?’ highlight ‘Yes’ and press ‘ENTR’

2. Deleting all waypoints:

a. Press ‘Find’ to open the Find screen.

b. Select ‘Waypoints’ to open the Waypoints screen.

c. Press ‘MENU’ to open the Menu screen.

d. Select ‘Delete All’ to delete all of the saved waypoints from the GPS Unit. Be sure that all of the waypoints have been downloaded and backed up before doing this!

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
1.00	April 2010	Geri Tierney	Adapted from SHEN LTEM GPS SOP ver. 1.2 and MIDN/NETN GPS SOP ver.2.01	
1.10	Sept 2011	Geri Tierney, Fred Dieffenbach, Casey Reese	Updated for use by volunteers and coordinators in APPA Rare Plant program. Selected WGS84 and decimal degrees as default coordinate system and datum. Editorial changes.	
1.11	May 2012	Fred Dieffenbach	Clarification of procedures following review	

SOP 5 - Digital Camera Use

APPA

Version 1.00

Introduction

Digital photography is an easy and inexpensive way to accurately document the condition of resources at a specific point in time. Comparing images taken at different times makes it possible to clearly see changes in resource condition. For example, photos taken before and after a fire event dramatically document changes to the natural community. Likewise, historic photos can be used to contrast the condition or successional status of resources such as glaciers and forests over long periods of time.

Digital images destined for monitoring purposes should be collected in a standardized and consistent fashion just as any other environmental data are collected. This SOP outlines a series of important considerations to review prior to performing field work. Each ATC field office was supplied with two Canon PowerShot SX100IS cameras, and these cameras will be made available to volunteer monitors who do not have a digital camera of their own. While the following procedures were written with the Canon PowerShot SX100IS camera in mind, they may be used as a guide for other equipment. Manuals for the Canon PowerShot SX100IS cameras were distributed with the cameras in printed format or may be obtained at the following link: (http://camera.manualsonline.com/manuals/mfg/canon/powershot_sx100_is_camera.html).

Initial Preparation

Batteries

Prior to using the camera for monitoring, all rechargeable batteries should be charged. Battery life is dependent upon air temperature as well as condition of the batteries. For this reason, it is important to bring an extra set of fully charged batteries in addition to those stored in the camera itself.

Memory Card

The PowerShot SX100 cameras were distributed to ATC field offices with two memory cards: the standard 16MB, and a 2GB expanded memory card. The expanded memory card should be sufficient to store more than 200 high resolution images. Regardless of the capacity, it is important to delete existing images from the card after they have been downloaded onto an office computer, and prior to collecting new images, thereby eliminating the possibility that images from one monitoring period become associated with another monitoring period. If images are present, remove them to a safe storage location on a local computer so they may be properly associated with the correct project.

Date and Time

Date and time should be verified against a reliable reference and then formatted in YY/MM/DD 24hr format (Note: the Canon PowerShot SX100IS camera allows you to select the year in 4-digit format (i.e., 2012), but the embedded format that appears in images is limited to 2-digit). Set the default so that the photo time and date data ARE embedded (this setting will make the time and date appear on the picture itself).

Photo Quality

Images should be captured at the highest possible quality; cameras capable of at least 5 megapixel images are recommended. For the PowerShot, set the compression value to "Superfine," with the number of pixels set to L (Large). This setting is suitable for printing 8.5 x 11 in. or larger images. For other cameras, use settings intended to capture the highest quality images.

Image Stabilization

Image stabilization is intended to eliminate blurring due to camera shaking and should be turned "ON."

Image Handling

Special software is not needed to download images from the PowerShot camera, though Canon does offer software for that purpose. If using the Canon software, follow the detailed instructions contained in the user manual. Alternatively, use a USB cable to connect the camera and your computer. Turn the camera "ON," open Windows Explorer, and navigate to the entry labeled "Canon PowerShot SX100IS" (or, if using another camera look for the name of that model/brand) at the bottom of your drive listing. Your photos are all contained in this "directory," and may be handled like any other computer directory or file. Select your images and transfer them to an empty directory on your computer. Once your images are in this directory, rename each of your files using the following naming convention:

APPA_Image_Monitoring_RarePlant_XX-XX-XX_####_YYYYMMDD where XX-XX-XX is the occurrence ID (e.g., CT-01-01), #### is a four digit sequence number starting with 0001, and YYYYMMDD is the Year, 2 digit numerical value for month, and 2 digit value for day of the month (e.g., 20120704 is July 4, 2012). So, the fifth image taken of occurrence NC-05-08 on August 7, 2012 would be: APPA_Image_Monitoring_RarePlant_NC-05-08_0005_20120807.

Other

Record any difficulties you had with the photo monitoring process, with the equipment you were using and please provide any recommendations you have for improving the process.

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
1.00	May 2012	Fred Dieffenbach	Initial version	

SOP 6 - Data Management & Quality Assurance/Quality Control

APPA

Version 2.16

Acknowledgements

This SOP benefited greatly from the content and ideas expressed in these documents:

Heartland Network. 2004. Standard operating procedure #11: Data management. *In* Vegetation community monitoring protocol for the Heartland I&M Network and Prairie Cluster Prototype Monitoring Program. Version 1.0. National Park Service, Heartland Inventory and Monitoring Network and Prairie Cluster Prototype Monitoring Program, Republic, Missouri.

Northeast Temperate Network. 2012. SOP 5 - Data Management & Quality Assurance/Quality Control. Pages 167–173 *in* Northeast Temperate Network long-term forest monitoring protocol: 2012 revision. Natural Resource Report NPS/NETN/NRR—2012/507. National Park Service, Fort Collins, Colorado.

Thomas, S., and B. Moore. 2007. Standard operating procedure #6: Data management. *In* A protocol for monitoring Allegheny woodrats (*Neotoma magister*) at Mammoth Cave National Park. Version 2.1. National Park Service, Cumberland Piedmont Inventory and Monitoring Network, Mammoth Cave, Kentucky.

Southeast Coast Network. 2008. Quality assurance/quality control & field data collection standards. Version 1.0. National Park Service, Southeast Coast Inventory and Monitoring Network, Atlanta, Georgia.

Overview

Careful, accurate collection of data as directed in these SOPs is critical to the success of rare plant monitoring. There are several steps in the data management and QA/QC process. This SOP describes the database used to house data and report findings, how to complete quality assurance/quality control (QA/QC) procedures for accurate data collection, transcription and stewardship, and methods to assess data quality (Appendix S6.A). In addition, the instructions outlined below offer guidance on how to import data from the data entry spreadsheet into the Rare Plant and Exemplary Community database, where to obtain updates for species conservation codes, and who to contact for recently added rare plant occurrences.

The Rare Plant and Exemplary Community database is a “system” that is a combination of 5 independent files:

1. Q_ATPO_Database_NaturalHeritage_Monitoring_be.mdb is the Microsoft Access file that stores all monitoring data and analysis parameters.

a. Q_ATPO_Database_NaturalHeritage_Monitoring.mdb is the user interface with various management and analysis forms and functions, including the occurrence prioritization system described in SOP 9.

2. Rare Plant Monitoring Data Form_PreVisit_Merge_1.05.docx is a version of the current field form (Appendix B) that can be partially pre-populated with occurrence data in advance of the field season.

3. Q_APPA_Rare_Plant_Data_Entry.xlsm is the blank rare plant data entry form.

4. Rare Plant Monitoring Data Form_PostVisit_Merge_1.05.docx is the post-entry data form that is used during the data verification process.

Pre-Season

Keeping the Rare Plant and Exemplary Community Database Current

If new occurrences are located, or global and subnational conservation values change, use the following procedures to update the database.

Adding New Occurrences

There are 14 state Natural Heritage programs that need to be consulted periodically to determine if any new occurrences have been added within the APPA region. Because obtaining Natural Heritage data typically requires a data sharing agreement between NPS and the state Natural Heritage program office, the APPA Natural Resource Manager is primarily responsible for obtaining this information. There are no established standards for obtaining new data as each state administers their own data management system and none of them are the same. Some states may be able to constrain their output spatially, while other states may not. Likewise, some states may be able to quickly identify new occurrences, while others may not. Consequently, every request to the particular state Natural Heritage office is unique, and entering newly acquired data into the Rare Plant and Exemplary Community database is a manual process and must be handled on a case-by-case basis. Other data acquisition processes have been explored, including working through NatureServe to obtain a single dataset for the entire region, and none have proven to be better than obtaining data directly from the Natural Heritage offices directly. The first reason that using NatureServe as a conduit for obtaining Natural Heritage data is untenable is cost. We tried this approach in 2005 and while we did obtain a dataset that included most states, the cost was $25,000.00. The second reason is that even though the Natural Heritage programs were

Figure S6.1. NatureServe Explorer taxonomic group selector.

initially launched by NatureServe, some state programs are legally prohibited from releasing their data back to NatureServe if it is destined to go to a third party, in this case NPS. As a result, we were not able to obtain any occurrence data for Massachusetts or Pennsylvania[26]. Data for these two states must always be obtained directly.

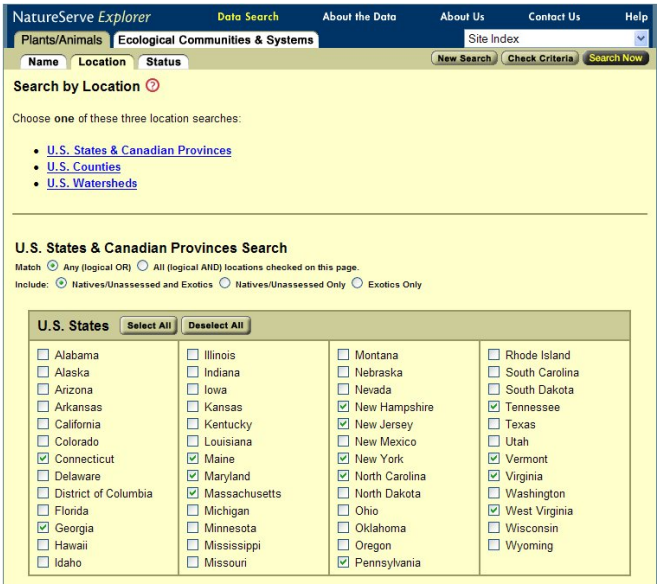


Figure S6.2. NatureServe Explorer "search by location."

New occurrences are not always added every year, but it is advisable to contact each individual Heritage Program every 3 to 5 years to determine if new occurrences have been added. To determine if new occurrences have been added, data obtained from the individual Heritage Programs are "spatially" compared to existing records in a GIS. Occurrences from the new data that do not coincide closely[27] with existing occurrences of the same species are generally new records. Conversely, occurrences of species not contained in the existing system are always new records. Historically, new occurrences have been uncommon and have been manually entered; however, methods to automate the process are under development. While it is still possible to enter records manually, due to the number of tables where data are stored a more standardized approach is warranted. For example, if a new species is added to the system, it is also necessary to enter reference information for that species since the database limits reference information to species currently in the system. Thus, simply adding a species occurrence record alone is not always sufficient to update the system.

Adding Updated Conservation Data

Conservation data contain two "status" groups both of which (confusingly) are found on the "Status page" of the NatureServe Explorer web site (http://www.natureserve.org/explorer/). The first is an assigned value that attempts to describe the rarity and vulnerability of a species on both a global and subnational level. We refer to this as a species' "rank" in an attempt to differentiate it from the other type of "status." The second "status" relates to the legal protection afforded to a species by the Federal government.

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[26] Data for New Hampshire was also excluded from the 2005 data dump, but that was because NH was revising some of their internal procedures and could not provide the requested data in a timely manner.

[27] Occurrence locations can change, hence the reason for identifying records that coincide closely versus occurrences that coincide exactly.

Rank

NatureServe assigns Global, or "G" ranks, while state Natural Heritage programs assign subnational[28], or "S" ranks. The NatureServe Explorer website makes it possible to download conservation data based on species group, geographic range, and how recently the value has been revised[29] (figures S6.1, S6.2, and S6.3 respectively). After the desired parameters are selected the system will prompt for the desired output format. Choose the xml output format. After the query is executed (a step that also involves entering a valid email address), NatureServe will send a link to download the newly generated dataset.

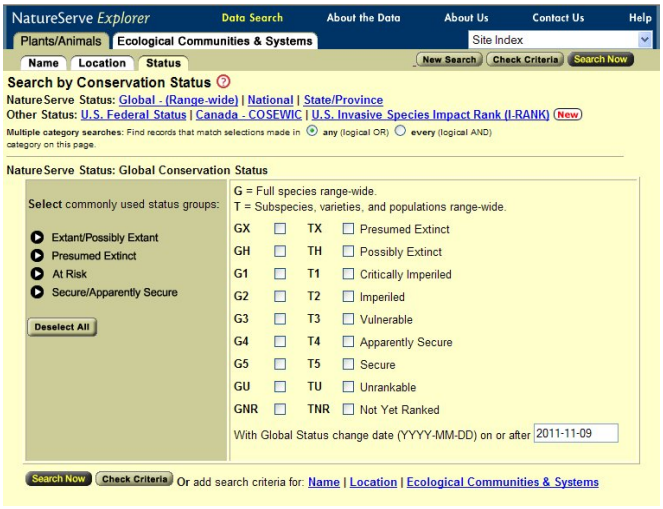


Figure S6.3. NatureServe Conservation Status selector.

Open the newly generated xml file in Excel[30]. In Excel, sort the records into two groups using the "unformattedname" field (figure S6.4). The first sort will identify all records that are "not null." Accomplish this by clicking the "select all" option and then de-selecting "blank" at the bottom of the list. Select all records and copy them to a new Excel workbook. The records in this list identify all of the species names, while the other list (blanks in the unformattedname column) contains global and subnational data. The two lists will be linked back together in Access using the "speciescode" field. The second selection is the reverse of the first – select only blanks from the "unformattedname" field. Select all of the records from the second list and copy them into individual txt files (multiple workbooks cannot be moved into a

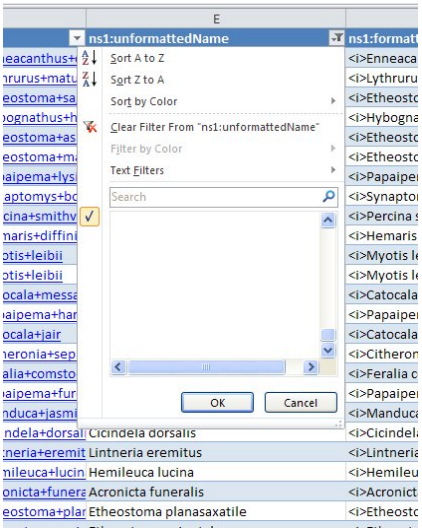


Figure S6.4. Sorting "unformattedname" field in Excel

[28] In the United States, state Natural Heritage programs assign subnational (S) values. In other nations, the level at which subnational values are assigned varies.

[29] NatureServe Explorer does not currently make it possible to identify species subnational changes by date. Consequently, subnational changes must be located on an individual basis or by obtaining a mass data dump.

[30] Access advertises the ability to directly import xls files, but it has not worked with NatureServe datasets. While using Excel introduces an intermediate step, it works.

single txt file)[31]. Open the Rare Plant and Exemplary Community user interface (Q_ATPO_Database_NaturalHeritage_Monitoring.mdb) and the two text files. Data from the txt file containing species names should be named tbl_Import_SN whereas data from the file that does not contain species names will be named tbl_Import_Data. If either (or both) table exist, it is OK to over write them.

The import process is completed by running two queries: qry_app_Import_NS_Global_Data and qry_app_Import_NS_State_Data. Both queries limit the data to be added by state and only to species that are already in the system. As a result, a list of 75 species obtained from NatureServe may only result in a single conservation rank update, as was the case when updates were performed in November 2012.

Status

Values that identify a species' legal 'status' under Federal or state jurisdictions are updated when the qry_app_Import_NS_State_Data is executed. However, because the data that are imported by that routine are actually constrained by when the Global rank was updated, it is important to periodically scan the Federal threatened and endangered species list for recent updates. This list does not change frequently, so updates will be infrequent.

State status values are more difficult to locate. They are not presented in the download file from NatureServe but their values can be found by searching the NatureServe Explorer web site for the species in question. New state status values can be entered into the responses to questions 2 and / or 4 of the prioritization system, as appropriate (appendix S9.1).

Prioritization

In preparation for the field season, occurrences must be prioritized as outlined in SOP 9 to identify occurrences that are to be monitored during the subsequent field season. Information contained on the prioritization list is used to complete the monitoring assignment form (Appendix C).

Field Procedures

When working in pairs (highly recommended), monitors shall use the following procedure to record data in the field:

1. The measurer shall clearly call out a data value to be recorded
2. The recorder shall clearly repeat the value aloud as it is recorded, to ensure the value was heard and recorded accurately
3. If the measurer does not hear a response from the recorder, the measurer shall repeat calling out the measurement until a response is obtained

[31] Saving to a txt file may seem to be an unnecessary step, but in 2014 multiple errors were encountered while attempting to import the xml format file. Adding the intermediate step to convert to a txt file proved to be more reliable and quicker than the xml approach.

Datasheets

Monitors are strongly encouraged to use datasheets copied onto Rite-in-Rain paper. Datasheets will contain as much preprinted project information as possible, including general data such as site name and number, occurrence, and species to be monitored. Datasheets will clearly identify all required information, using examples where needed to ensure that the proper data are recorded. After paper datasheets have been signed as having been filled out in their entirety the originals should be forward to the appropriate Monitoring Coordinator without delay. If possible, photo-copy or scan the original data sheet prior to sending them to the Monitoring Coordinator to safeguard against loss. Scanned field sheets shall be considered the equivalent of original field sheets and should be delivered in pdf format using a naming convention that incorporates the NPS park code, the ATC region from which the data were collected, the element ID (occurrence ID), and the sampling date. So, for data that were collected in New Jersey at an occurrence known as NJ-02-02 on July 10, 2013, the appropriate file name would be: APPA_MARO_NJ-02-02_20130710.pdf. Digital forms that are not named appropriately shall be renamed by the monitoring coordinators prior to submitting them to the APPA Natural Resource Manager.

Most post-field collection data entry notes and remarks shall be made only on the copies, not to the original datasheets. Post-field collection remarks added to either the original (e.g., unknown species identifications) or copies of the datasheets should be written using a different colored pencil. Using the template at the top of the datasheet, all individuals (including the field monitor) who make modifications to the datasheet shall indicate their identity (initials), date of modifications, purpose of their review, and the color used to provide comments or make changes (Figure S6.5).

Purpose	Date	Name
Entered into Spreadsheet		
100% Check		
10% Check		
Validation		

Figure S6.5. Verification log found at the bottom of the datasheets. Log is used to track changes and record the verification and validation status of datasheets for each occurrence.

- Datasheets should be protected within an enclosed clipboard
- All information added to a datasheet must be printed using pencil and clearly legible
- While manually recording data, and if working in a pair, the field monitor recording the data will verbally double check all field values for accuracy and completeness with the field monitor collecting/announcing the data. All discrepancies will be corrected prior to moving to the next data field
- Information shall never be erased and incorrect or older information shall never be overwritten
- Revisions shall be accomplished by crossing out the erroneous data with a single line

- Upon completing data collection at each site, original datasheets shall be reviewed and checked for legibility and completeness. The field monitor responsible for completing this field verification should initial the datasheet in the appropriate location

Data Verification

Data quality and verification involve checking the accuracy of field data at each stage it is transcribed from its original source. To minimize the possibility of carrying entry errors forward into analysis, the data quality and verification process for this protocol involve multiple checks. After computerized data are verified to accurately reflect the original field data (i.e., the entered data match the collected data), the paper forms will be archived and remaining data manipulation shall be done in the database.

Paper Data Transcribed to Computer

During the process of transcribing data from paper datasheets into the database, the person entering the data will double check all entries and correct discrepancies prior to advancing to the next datasheet. The data entry system (Figure S6.6; Q_APPA_Rare_Plant_Data_Entry.xlsm) contains a series of controls that limit the values entered into every field and ensures that all required data elements have been entered. However, such a system cannot determine if an incorrect – but valid – entry has been made. For this reason, it is of paramount importance that the person entering data into the system double check all entries to ensure they are correct. Fields that permit free form data entry, like comment fields, are particularly vulnerable.

Following data entry into the spreadsheet, a Monitoring Coordinator shall review 100% of the records entered to ensure that values present on the field forms were accurately and completely transcribed into digital form. This is accomplished by generating a post-entry copy of the datasheet by opening the file named Rare Plant Monitoring Data Form_PostVisit_Merge_1.06.docx that can be compared to the completed field form. This file is a “mail merge” version of the field form and will automatically connect to the data entry spreadsheet and populate the field form with data previously entered. This field form can then be compared side-by-side with the original field form. The person who originally entered the data should not conduct the 100% verification check. Notes or changes should only be made on the post-entry datasheets.. If discrepancies are detected, they can be resolved by using the data review portion of the Rare Plant Data Entry system.

As a quality control measure, ten percent of records are reviewed a second time by the APPA Natural Resource Manager. All comments and changes should be recorded on the copies of the datasheets. If a significant transcription error (e.g., incorrect values or missing records) is found in one out of 10 datasheets during the 10% review, then the entire data set will be verified again (i.e., repeat the 100% and subsequent 10% checks until the APPA Natural Resource Manager is satisfied with the data quality).

Field QA/QC

Approximately 5% of sampled occurrences should be re-measured annually to determine reliability of field data collection. Although plots are not currently being re-measured, this approach is strongly encouraged for future implementation since it provides crucial data on the repeatability of

observations. When implemented, field QA/QC will occur as close as possible to original sample date of the occurrence to reduce seasonal variability. Re-measurement must not be accomplished by field monitors who originally measured the occurrence. In order to control trampling impacts, re-measurement should not occur at occurrences that are particularly sensitive (e.g., moss dominated ground-layer), and field occurrences will not be selected for field QA/QC more than once in any five year period.

Data Validation

Although data may be correctly transcribed from the original field forms, their values may not always be accurate or logical. For example, some plant species found in southern parts of the APPA do not occur in the northern portion of the APPA. If a southern plant is identified erroneously to be present in a northern area, this would represent a logic error. As often as possible, components of the data validation process have been built into the database (e.g., value range restrictions and species pick-lists). Although many validation problems can be addressed by a well-designed database, the APPA Natural Resource Manager must also review and validate the data after verification is complete.

Data Import

Transferring data from the data entry spreadsheet to the Rare Plant data storage and analysis system is accomplished by the following steps.

1. Open the Rare Plant and Exemplary Community database and click the “Excel” option under the External Data tab (figure S6.7) and navigate to the directory where the data entry spreadsheet (Q_APPA_Rare_Plant_Data_Entry.xlsm) is located.

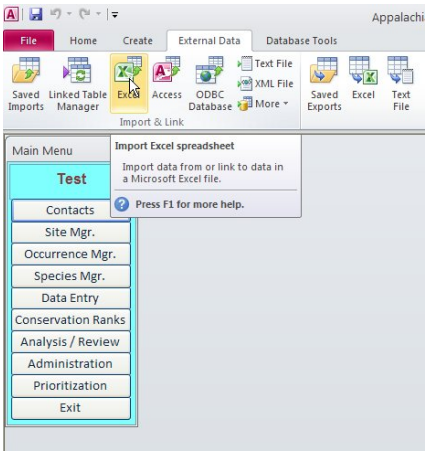


Figure S6.7. Import spreadsheet into the Rare Plant and Exemplary Community database.

2. Import the “Rare Plant Data” worksheet (figure S6.8), click next; then check the box for “first row contains headings, click next; select “No Primary Key,” then click next; and finally accept the offered table name, then click next.

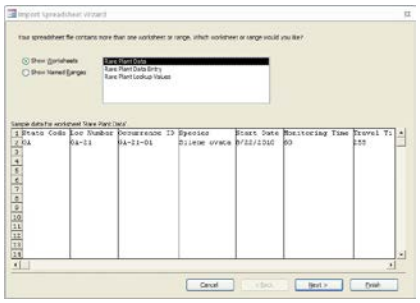


Figure S6.8. Selecting correct workbook.

3. If asked to “overwrite existing table or query ‘Rare Plant Data’?, click “Yes” (figure S6.9).

Figure S6.9. Overwriting existing table.

4. Click “Administration” on the main menu. If the system is configured for “test” data, open the linked table manager and switch to “live” data. Then, from the Administration switchboard, select “Import Field Data” (Figure S6.10)

Figure S6.10. Menu items.

5. If one or more monitor names appear on the "New Monitor" list (Figure S6.11), double click each name to add them to the list of monitors in the system. If no names appear on the list, or after entering the names of all new monitors, click "Import Data From Field Form Table."

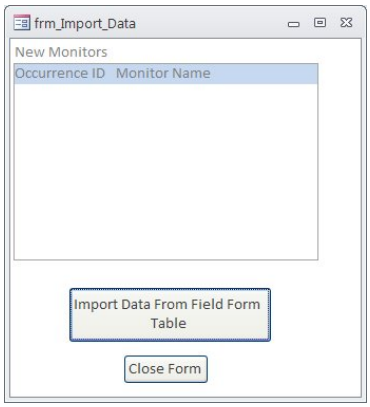


Figure S6.11. New monitor identification form.

After following the above directions, your new data have been added and should now appear on the various analysis components.

Data Stewardship

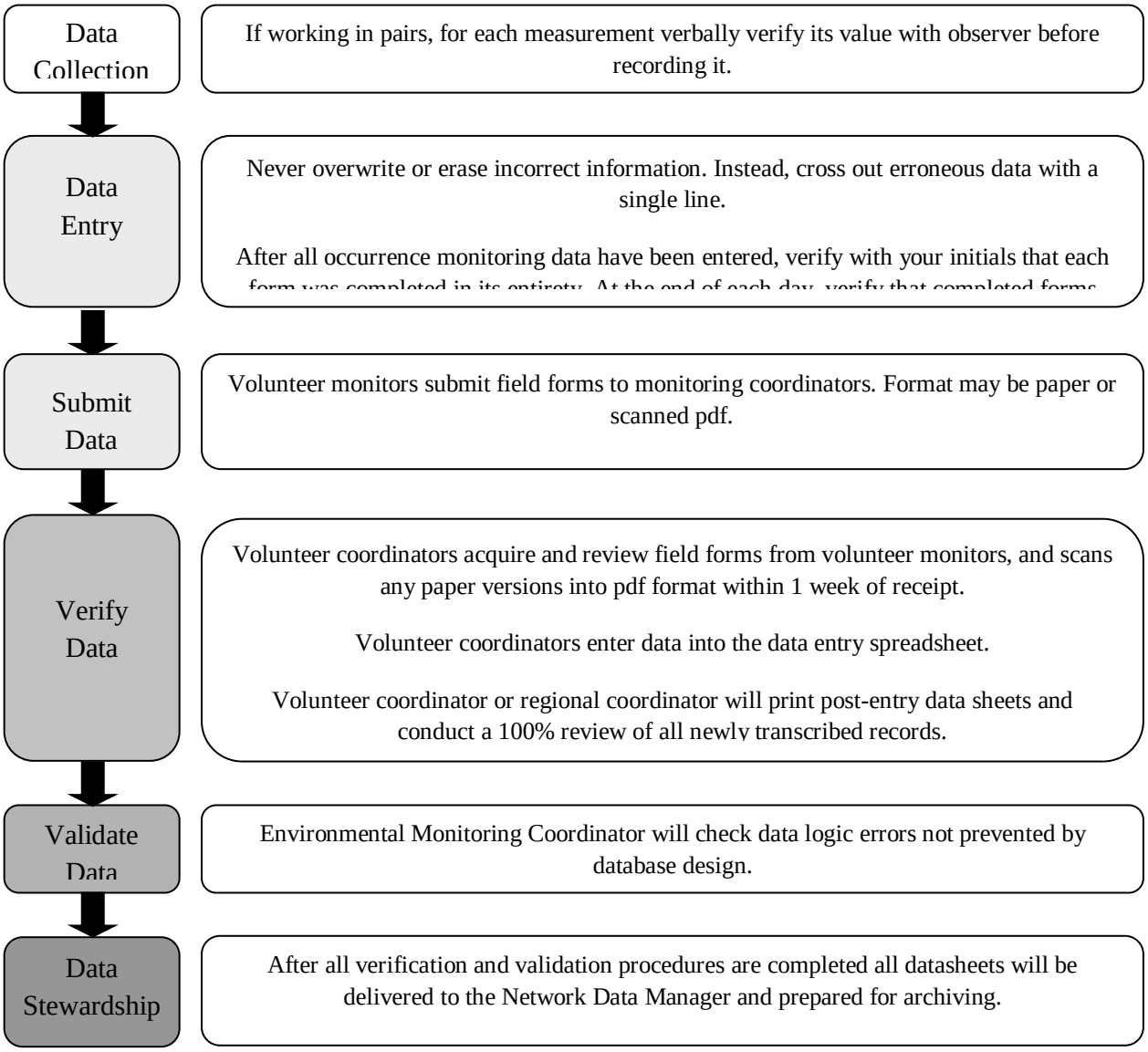
Good data stewardship practices play a critical role in long term data security and help prevent irretrievable loss of information.

- The monitoring coordinator shall review submitted data sheets to ensure that all original data are present and legible. If the data sheets were submitted on paper, the monitoring coordinator shall scan the field data sheets to pdf format. Scanned data sheets shall be stored on IRMA.

- The monitoring coordinator enters all submitted data into a spreadsheet specifically designed to transfer monitoring data into the rare plant database.

- Once data entered into the spreadsheet are verified as accurately reflecting the original field data and validation is complete, the pdf field forms shall be delivered to the APPA Natural Resource Manager. The version of the data contained in the spreadsheet shall be used for all subsequent data activities.

Appendix S6.A. QA/QC steps quick-reference.



Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version	Date	Revised By	Changes	Justification
2.11	May 2012	Fred Dieffenbach	Adapted version 2.10 of Forest Health Protocol Data Management SOP for use by volunteers and the Appalachian National Scenic Trail	
2.12	July 2012	Fred Dieffenbach	Revised figure S5.1 and added figure S5.2. Removed mention of field computers from text and added a footnote (20) indicating that the data verification process is under development.	
2.13	December 2012	Fred Dieffenbach	Added steps related to data entry spreadsheet, and those related to keeping the storage, analysis and prioritization system current.	
2.14	January 2014	Fred Dieffenbach	Minor revisions to data form and revised process for updating NatureServe data.	
2.15	April 2014	Fred Dieffenbach	Revisions intended to remove elements that are impractical.	
2.16	January 2015	Fred Dieffenbach	Minor wording change in data sheet handling and submission;QA/QC sampling is optional but highly encouraged; revised flowchart by adding a data submission step; revised flowchart to include field form scanning.	Clarification and reflection of current procedures

SOP 7 - Occurrence Measurement

APPA

Version 1.05

Overview

This SOP describes how to monitor rare plant occurrences within the APPA. Please take care to follow these step-by-step instructions closely, in order to collect high quality data that is comparable over years and among sites.

Procedure

A training workshop will provide personal instruction in these monitoring methods and identification of your assigned species, and will allow you the opportunity to ask questions. During training, you will receive a monitoring report for this rare species, including a map of the area covered by rare plants. Please bring this report and map with you when visiting the site. The report contains valuable information and the map will help you locate the rare species occurrence. You will also receive a description of the rare species including pictures or illustrations that will help you identify the rare plants.

It is best to visit when the plant is at or near peak reproduction (that is, flowering and fruiting). If the last visit occurred when many plants were flowering or fruiting, the next visit should be within 10 calendar days of the former visit date, or as otherwise directed by your ATC monitoring coordinator. Establishing the optimal time to monitor will be accomplished, in part, on information learned from prior visits. The prioritization list compiled prior to the field season contains an optimal monitoring period for 36% of all occurrences and should be referenced when scheduling a monitoring visit. If the established monitoring period is inaccurate or missing, a new period should be established.

It is useful to use a GPS to verify the location and a digital camera to take photographs. If you do not have a GPS unit or digital camera, you can borrow one from your ATC monitoring coordinator. The coordinators have been provided with several of each. If you were unable to bring a GPS unit, please sketch, on the rare species occurrence map provided to you, the approximate area covered by rare plants this year, or if not found, please sketch the area searched.

Pack the tools and materials listed in the equipment list (see SOP 3: Equipment). Using a GPS or compass, navigate to the area shown on your rare species occurrence map. Search the whole area delineated on the map as part of the rare species occurrence. The area occupied by rare species may shift over time, and it is important to document this area during each visit. Search only within the Trail corridor, which is “broadly” defined to be 500 feet on either side of the Trail, unless otherwise instructed by your ATC monitoring coordinator. This may be the case on steep terrain (where a narrower boundary may be used) or where the APPA owns more land in which case a wider boundary may apply (e.g., portions of Maine). If you see additional nearby areas containing plants of this rare species, please note the location in the comments section of your monitoring form.

All data should be recorded on data forms provided by your ATC monitoring coordinator. Please complete a separate data form for each occurrence you monitor. Try your best to respond to each question. If a measurement does not apply, reply "NA" (not applicable). If you don't know the correct response, record "Unsure," take a photograph if possible, and ask your monitoring coordinator for assistance. Some information may be pre-printed on your datasheet. If any pre-printed information is incorrect, please make a correction.

It is very important to do all you can to avoid trampling rare species and the site in general. When you leave established trails to approach your site, please take a slightly different route each time to avoid creating a new "social trail." At the monitoring site, try to remain as still as possible, limiting your movement to only what is needed to collect information. Please do not bring pets to the occurrence, or more than one companion, unless first discussing this with your ATC monitoring coordinator.

Once you have located and identified the rare plant occurrence, try to place temporary flags around the perimeter to help mark the whole occurrence as you collect data. For large occurrences, this may not be feasible. **Take care to remove and pack out all flags before leaving.**

Please submit completed data forms, any sketches you have drawn, and digital photographs to your ATC monitoring coordinator within 3 weeks of visiting your site. If any problems arise, please contact your ATC monitoring coordinator as soon as possible to get assistance. **If you see an urgent threat to the rare plant occurrence, please contact your ATC monitoring coordinator immediately**.

Datasheets should be printed on Rite-in-Rain™ paper that contains as much preprinted project information as possible. Datasheets will clearly identify all required information, using examples where needed to ensure that the proper data are recorded. Use pencil, do not erase mistakes (use a single line through an entry instead), and print in block lettering.

Section 1: Basic information

Monitor name

Record your name.

Email or phone

Record contact information for your preferred method of communication, either your telephone number or email address.

Visit date

Record the date of your visit as month/day/year.

Site name, site number, and occurrence ID

Record the site name, number, and occurrence ID provided to you.

Common name

Record the common name of the monitored species.

Scientific name
Record the scientific name of the monitored species.

Found?
Did you find the rare plant occurrence? If you are unsure whether you found the correct occurrence, please record the reason. If possible, take a close-up photograph of a flowering or mature plant in this occurrence for your monitoring coordinator. Whether or not you found the occurrence, please document where you searched and provide any information that will help explain why the occurrence could not be found. For example, if the site was damaged, or flooded that might explain why the occurrence was not present.

Sketch
If you were unable to bring a GPS unit, please sketch, on your species occurrence map, the approximate area covered by rare plants this year, or if not found, please sketch the area searched. Your ATC monitoring coordinator has several GPS units available to lend.

NPS GPS unit
Please record the NPS unit number of the GPS, if borrowed from your ATC monitoring coordinator.

[32]Coordinate system/datum
We prefer latitude/longitude in **decimal degrees** referenced to WGS-84 and recorded to four places of accuracy (for example, 42.4910°, -76.4584°). If you have borrowed an NPS GPS unit, it will be preset to that coordinate system and datum. If you are using your own GPS, please set the coordinate system to decimal degrees and the datum to WGS-84, and circle the default on your data form. If you must use a different coordinate system or datum, specify which on your data form.

GPS coordinates
Record the GPS coordinates near the center of the occurrence, taking care not to trample the occurrence.

GPS Accuracy
Record the positional accuracy in feet or meters for these coordinates from your GPS unit.

Area covered by rare species
Estimate the entire area of the occurrence. If possible, mark the edges of the occurrence with temporary flags and visualize a square that contains the entire occurrence.

[32] Effective 2014, we are no longer requiring monitors to obtain coordinates during every monitoring cycle. Over time we have acquired a multitude of spatial data and it is generally inconsistent with prior data and impossible to reconcile. Coordinates should be taken when an occurrence is new, or if specifically requested by the monitoring coordinator. As a general rule, monitoring data should be entered into the data entry spreadsheet without spatial reference and with the “no coordinates obtained” box checked.

Section 2: Rare plant data

Occurrence photo

A digital photograph will provide an enduring visual record of plant occurrence condition. To take the photo, stand near the center of the occurrence, taking care not to trample or damage individual plants. Look in all directions to find a good example of a group of plants in flower and fruit, if possible, visible from this location. Capture a digital photograph of the scene. Display the image to check the photo for obvious blurring, and capture a better image if needed. In the Photo Log section of the data form, record the image number (assigned by the camera) and fill in the feature, location, and direction.

Count unit

Record the count unit used as either 1) stems (for trees, many herbs, and some shrubs); 2) clumps (for some grasses, sedges, shrubs); or 3) rosettes (for some herbs). Use the same counting unit recorded on the form from the most recent observation, unless your ATC monitoring coordinator has given other instructions. A stem is a single stalk emerging from the ground that is separate from other stems (for example, a tree). A clump is a group of stalks emerging together (for example, many grasses and shrubs). A rosette has a dense cluster of basal leaves, from which a flowering stem will emerge when the plant matures (for example, a dandelion).

Plant count

For occurrences comprised of less than or equal to approximately 250 stems, clumps or rosettes, count using a tally counter and record the number of stems, clumps or rosettes. When counting plants, it is easy to overlook small or juvenile plants, especially in dense cover. Search as thoroughly as possible, without trampling the rare plants. As you count, make note of the portion of the rare plants are vegetative, flowering, fruiting, and senescent (see definitions below). For non-vascular plants (mosses or lichens) or densely matted plants (some grasses and shrubs), omit this measurement. Percent cover will be measured instead (see below).

Count time

How long did you count? Record approximately how many minutes you spent searching for and counting plants. This is not the same as the amount of time you spend monitoring (see below). Count time should reflect only that portion of the monitoring activity that you spend enumerating the occurrence. Time spent looking for impacts to the occurrence, characterizing the area around the occurrence as well as any other monitoring activity should NOT be included in this time.

Plant estimate

For occurrences of more than 250 stems, clumps or rosettes, estimate as 251-500, 501-1000, or > 1000. For non-vascular plants (mosses or lichens) or densely matted plants (some grasses and shrubs), omit this measurement. Percent cover will be measured instead (see below).

% Cover non-vascular or matted plants

For non-vascular plants (mosses or lichens) or densely matted plants (some grasses and shrubs), record the average % ground covered by this species within the occurrence area using these classes: 0, 1-5, 6-25, 26-50, or 51-100%.

Life-stage classes - % vegetative, % flowering, % fruiting, % senescent

While you are counting (above), examine the plants for flowers and fruits. Keep in mind that a single plant may have both flowers and fruits at the same time. Plants that have not yet produced flowers or fruits will be classed 'vegetative.' Plants that are withering or drying up and show no evidence of flowers or fruits are classed 'senescent.' Estimate the % of plants within each of these categories (vegetative, flower, fruit, senescent) using these classes: 0, 1-5, 6-25, 26-50, or 51-100%. Often, the classes will not sum to 100% because flowering and fruiting may occur on the same plant.

Seedlings or immature present?

Can you see seedlings or immature plants? These provide evidence that the plant is successfully reproducing. It may take time and careful looking to determine if there are small, vegetative plants with the same leaf characteristics as the adult plants. Carefully move aside other vegetation to look near the ground. If you are not sure, record "Unsure". Please try to take a digital photo of a seedling or immature plant. If a photo is taken, record details in the Photo Log section of the data form.

[33]What is the condition of this rare plant occurrence?

In your opinion, what is the condition of this rare plant occurrence compared to others you have seen? Describe as excellent, average, or poor based on evidence of herbivory or disease, leaf color or retention, plant or flower size, number of leaves or flowers, or evidence of disturbance, as appropriate. Please note the characteristic(s) considered and what you observed. For example, "Excellent condition, no problems seen and many leaves/flowers" or "Poor condition, leaves with many insect holes, and few flowers." If you are unsure, circle unsure.

Section 3: Associated site conditions

Water on site

Observe how wet or dry the soil is beneath this occurrence. Record as Flooded (standing water present), Wet (saturated but no standing water), Moist (feels moist but water does not emerge when soil is squeezed), or Dry.

Sunlight

Observe the amount of sun affecting most of the plants in this occurrence **on sunny days**. To do so, ignore shading from clouds, but consider shading by vegetation and other site features. Record as > 95% sun, 51-95% sun, 5-50% sun, or < 5% sun.

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[33] Occurrence condition is a qualitative assessment that takes into consideration many factors, some of which are independently recorded (e.g., trampling, invasives, herbivory, etc.) Careful consideration must be given to ALL aspects of an occurrence before assigning a condition. For example, an occurrence that appears to be in otherwise excellent condition might not be rated excellent if there are invasive species in the immediate vicinity, but this assessment must take into consideration the effect that the invasive species is having on the rare plant – some species are more invasive than others, and the fact that an invasive species is present may not be sufficient to warrant dropping the condition of a rare plant occurrence.

Common species

Dominant species exert a strong influence on the site, and site conditions affecting rare species can change substantially as these species change due to succession or other processes. Please list the most common plants of other species growing together with and near this occurrence within 10 feet (3 meters). Record up to 3 trees, 3 shrubs and 5 understory plant species in order of declining abundance. Use scientific names if known, otherwise use common names. If you do not know a plant, collect a twig (if plant is a tree or shrub) or a photograph (if plant is not woody) of a mature individual (preferably flowering) for your ATC monitoring coordinator who will identify the species or will find a local expert who can provide an identification.

Non-indigenous species

Record the scientific or common name of any non-indigenous species growing intermingled with or nearby (within sight) of this occurrence. For each species, note the degree of infestation as low (only a few individuals seen), medium, or high (invasive species dominates the site).

Disturbance

Look for evidence that these common disturbances may be affecting this rare plant occurrence. Record threats which are obvious as you visually survey the site. Do not trample rare plants by making an exhaustive search.

Trampling

Look for trampled vegetation within sight of this occurrence. Estimate how many plants in this occurrence are affected as None, Trace, Some or Most (0, 1 – 5%, 6 – 50%, and 51 – 100%, respectively). Do not include any trampling that may have occurred during your visit.

Browsing

Look for stems that have been browsed, and estimate how many plants in this occurrence are affected as None, Trace, Some or Most.

Insect damage or disease

Look for and record evidence of disease or insect damage including damage to leaves, twigs, stem, buds or other plant parts. If possible, take a photograph and record the photo information in the photo log. If you recognize the disease or insect, write it down. Estimate how many plants in this occurrence are affected as None, Trace, Some or Most.

Competition/succession

Look for evidence that other plant species are hurting this occurrence due to competition or due to shading associated with plant succession (that is, change in the plant community, often progressing from shorter to taller species). Estimate how many plants in this occurrence are affected as None, Trace, Some or Most.

Drought

Do you see wilted rare plants or extremely dry soil that may indicate drought stress?

Erosion
Do you see tracks of bare soil on the ground occupied by rare plants indicating erosion?

Trail maintenance
Do you see evidence that trail maintenance (including mowing and clipping of vegetation) has affected this occurrence?

ATV tracks
Do you see ATV tracks within or nearby (within sight) of this occurrence?

Social trails
Are there unofficial "social trails" leading to or through this occurrence?

Campsite
Do you see a campsite nearby? How far away is the site?

Plant collection
Do you see evidence of digging that may indicate plants from this occurrence have been collected?

New development
Do you see evidence that new development nearby may be affecting this occurrence? How far away is the development?

Other disturbance
Describe evidence of any other disturbance you see that may be affecting this plant occurrence. If possible, take a photograph and record the photo information in the photo log. Record specific comments describing any disturbance noted above.

Comments, suggestions and/or management actions that may benefit the rare plants
In your opinion, what management action, if any, may benefit this rare plant occurrence? Record any other useful observations about this rare plant occurrence. Add anything that seems relevant and be thorough in your statement. Incomplete statements or statements that are partially based on what the author believes to be “common knowledge” are generally not useful without some additional follow-up by the monitoring coordinator.

Photo log
While at the site, record each photograph in this log. Include the camera-generated photo number, a description of what feature was photographed, and the location and direction in which the photo was taken.

Time spent
Record the time spent a) monitoring this occurrence, and b) traveling (to the trailhead, hiking to and from the occurrence, and returning to home).

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version #	Date	Revised by	Changes	Justification
0.10	April 2008	Geri Tierney	Initial draft.	
0.20	April 2008	Geri Tierney	Editorial changes.	
0.30	June 2008	Geri Tierney Fred Dieffenbach	Eliminated estimate of % area in 'box' covered by rare plants. Added vigor measurement. Changed numerical scale for estimating influence of disturbance to qualitative scale. Editorial changes.	Feedback from reviewers.
0.40	Oct 2008	Geri Tierney Fred Dieffenbach	Added question about occurrence extending beyond boundary. Replaced vigor measurement with qualitative assessment of plant condition. Added plant collection and insect damage to list of potential disturbances. Added question about management needs. Editorial changes.	Feedback from reviewers.
0.41	April 2009	Fred Dieffenbach Geri Tierney	Eliminated question asking if occurrence extends beyond AT boundary. Eliminated option of selecting "same as previous visit" for species. Eliminated new occurrence check box. Reversed shading measurement to sunlight measurement. Added time spent traveling to trailhead and site. Editorial changes.	Feedback from program personnel.
1.00	May 2010	Geri Tierney Fred Dieffenbach	Added default value for Coordinate system/Datum. Replaced small occurrence N-S and E-W distance measurements with length and width. Eliminated visual estimate of large occurrence acreage. Revised photo	Feedback from Kevin Caldwell after 2009 field season.

Version #	Date	Revised by	Changes	Justification
			log. Editorial changes.	
1.01	Oct 2010	Geri Tierney, Brian Mitchell	Editorial changes. Clarified procedure without GPS, sum of % classes, and sun measurement.	
1.02	Aug 2011	Geri Tierney	Updated default GPS coord. system. Editorial changes. Removed option for circling “same as previous” for Common Species.	
1.03	November 2012	Fred Dieffenbach	Revised the travel time to include “return” time	Requested by ATC
1.04	April 2014	Fred Dieffenbach	Revised coordinate data collection via footnote and a few other clarifications to improve thoroughness of data collection.	
1.05	January 2015	Fred Dieffenbach	Additional clarifications to 1.04 changes, including a revision to the effect the presence of an invasive species might have on the assessed condition of an occurrence; added a statement to refer to the prioritization list when scheduling monitoring and to revise the optimal monitoring period if it is inaccurate	

SOP 8 - Analysis and Reporting

APPA

Version 1.04

Overview

Each year, the APPA Environmental Monitoring Coordinator analyzes, summarizes, and reports monitoring data using the program database. The intent is twofold with the first objective to assemble a series of reports on the status and trend of monitored occurrences, and the second resulting in a list of occurrences that warrant additional attention or correction (i.e., 'red flag'). Prior to publication, the Environmental Monitoring Coordinator will share the preliminary results with the APPA Natural Resource Manager.

General

For all occurrences, the APPA Natural Resource Manager and Environmental Monitoring Coordinator review relevant data describing the occurrence from the current and previous visits, including whether the occurrence extends beyond the APPA boundary, life stage distribution, description of occurrence condition, site conditions including common species, threats noted, explanatory notes, and any QA/QC problems. If needed, the APPA Natural Resource Manager contacts volunteer field monitors or ATC monitoring coordinators for additional information or clarification. Under optimal circumstances, data forms are submitted and reviewed shortly after data are collected. In such instances, the APPA Natural Resource Manager will determine if an immediate follow-up visit is warranted. However, it is more common for field forms to gradually arrive long after the field season, making return visits during the season impossible. When this happens, the identified problems are recorded as "lessons learned" for future training sessions and program management. The outcome of this evaluation, plus a determination regarding whether additional monitoring or a management action is needed and why, is recorded and made available for future program operation.

Figure S8.1. Database function selection ribbon with Admin functions exposed.

The APPA Natural Resource Manager and Environmental Monitoring Coordinator run a series of database functions available through the data review and analysis module of the program database (Figures S8.1 and S8.2) to identify occurrences that are and are not on the 'red flag' list and

are not currently subject to management action. Based on current information and overall program needs, these results are used to determine an appropriate monitoring interval for each occurrence.

Condition and change

For each occurrence, staff calculates or assesses the following using database functions[34] to identify a 'red flag' list of occurrences needing further evaluation due to meeting any of these criteria:

- Occurrences which changed dramatically (> 50%) since the last visit in number or area, or, for estimated occurrences, those which changed ≥ 2 classes
- Occurrences which show a decline in number of individuals over the last 10 years
- Occurrences in which juveniles are noted as absent
- Occurrences for which condition is rated as poor
- Occurrences for which the portion of rare plants affected by any disturbance was reported to be 'most'
- Occurrences for which new threats or new non-indigenous species were noted
- Occurrences for which management action is recommended

[34] The program database is not fully developed, and is not currently able to identify all criteria (2012).

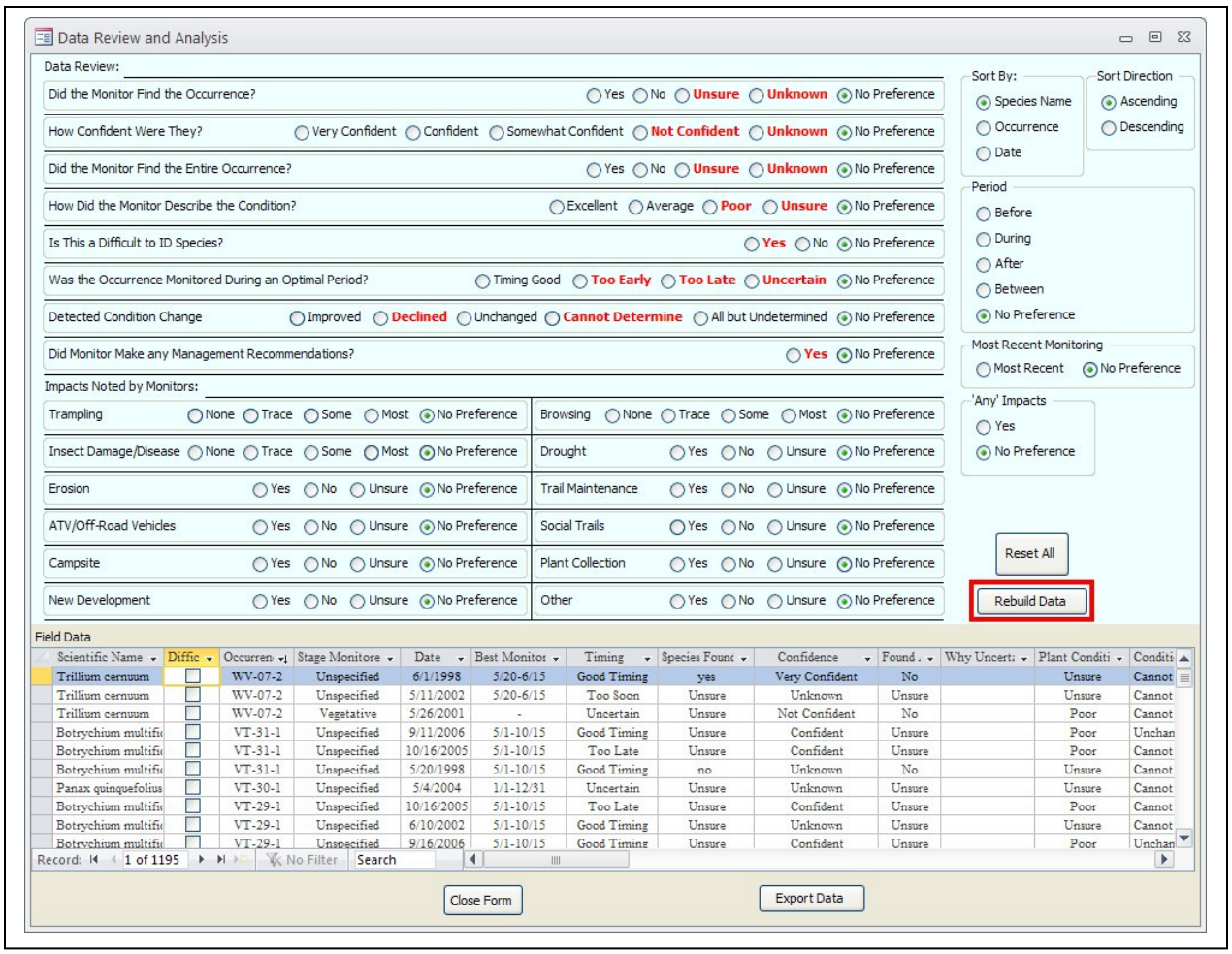

Figure S8.2. Data review and analysis functions.

Annual data summaries

Annual data summaries will include:

- Proportion of prioritized occurrences monitored by region or state
- A list of prioritized occurrences designated for monitoring that year that were not monitored, including reason(s) they were missed
- Histograms of occurrences showing a) number of individuals (or % cover class) by occurrence and b) average rate of change in number of individuals (or % cover class) over the last 10 years
- A list of threats observed and the percentage of occurrences affected by each threat
- A list of non-indigenous species noted and the percentage of occurrences at which each was seen

Annual reporting documents

Reports are generated in web format and are made publicly available on the resource brief section of the Appalachian Trail Environmental Monitoring website (http://go.nps.gov/k0uxa4). The annual reports include:

- Summary data described above, for distribution to interested parties including partner land management agencies such as USFS and state agencies;
- A 'red flag' list of occurrences that required further evaluation based on the criteria above, including the reason each occurrence was flagged by these criteria and the outcome; Information of particular interest to volunteers, including the number of participants and examples of how their work aided management

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version	Date	Revised By	Changes	Justification
1.00	January 2012	Fred Dieffenbach	Original draft	
1.01	May 2012	Fred Dieffenbach	Revisions to include addition of detailed analysis elements (taken from main text)	
1.02	November 2012	Fred Dieffenbach	Revised menu image to display new design	
1.03	April 2014	Fred Dieffenbach	Removed reporting items that are either not practical, or that have been replaced by our on-line reporting process.	
1.04	March 2015	Fred Dieffenbach	Revised address of web report	

SOP 9 - Prioritization

APPA

Version 1.03

Introduction

The method we use to prioritize rare plant occurrences is an adaptation of an invasive species prioritization system developed by NatureServe (Morse et al. 2004). Our system, like the NatureServe system, factors responses from a series of questions associated with four categories ('themes') to generate a single priority rank. Although the individual questions contained in the rare plant prioritization system are different[35] than those developed for the NatureServe system, the four thematic categories and the multi-tier ranking methodology are the same.

Prioritization Questions

The rare plant prioritization system relies on 16 questions plus 3 qualifying questions (Appendix S9.1) to build a priority rank. Qualifying questions determine if a rare plant occurrence should be excluded from the prioritization process based on work by another agency or park, or if the occurrence is particularly difficult to identify. If the response to each of the qualifying questions is 'No,' the responses to each of the subsequent questions are used to build a priority rank. However, if the response to any of the qualifying questions is 'Yes,' the associated occurrence is omitted from the final priority list (after a rank has been established).

Of the 16 prioritization questions, the first 5 assess the ecological significance of the species at that occurrence using global and sub-national ranks assigned by NatureServe, the federal and sub-national status of a species, and the significance of that occurrence relative to other occurrences of the same species. The next 4 questions address distribution and abundance as well trends in distribution and abundance for the species at that occurrence. The final 7 questions relate to monitoring observations during the last monitoring visit (Appendix S9.1).

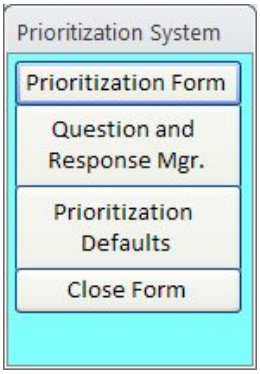

Figure S9.1. Prioritization system opening form

User Interface

Responses to the aforementioned questions are entered into a Microsoft Access based utility which opens with a series of selection buttons (Figure S9.1). To begin the prioritization process, select the "Open Prioritization Form" button to open the Prioritization form (Figure S9.2). The system also includes utilities that allow users to make adjustments to the ranking

[35] The invasive species assessment protocol (Morse et al. 2004) uses 20 questions to generate a rank score, whereas the rare plant prioritization system relies on 16.

parameters.

Score Building

The final prioritization rank that managers use to allocate resources is a descriptive term that represents one of five priority groups (very high, high, medium, low, and very low). The term is assigned at the conclusion of a multi-step process that generates a numeric priority value. The following describes the steps that the system automatically follows as questions are answered.

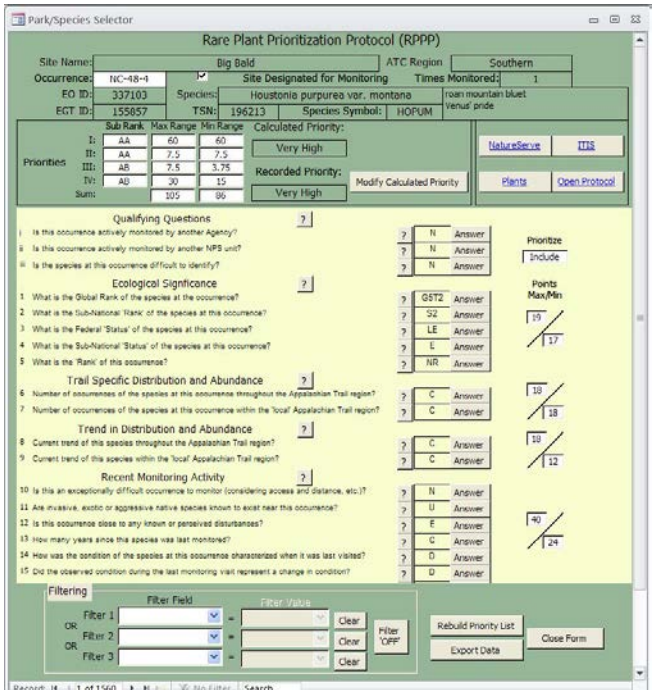

Figure S9.2. Rare plant prioritization form.

Step 1

Users of the system begin the prioritization process by answering all 16 questions[36]. Associated with each question is a series of permissible responses (Figure S9.3) that can be reviewed by selecting the "Question and Response Manager" button on the opening form (Figure S9.1). Each response is assigned one max (maximum) and one min (minimum) numeric value. As responses are selected, the max and min values are recorded and summed within each thematic group. For example, the max and min values for questions 1 through 5 are summed to generate max and min scores for the ecological significance theme. This two value approach enables the system to account for uncertainty associated with individual responses. So, if the response to a given question is "unknown," the max value would be the maximum possible for that question while the min value would be zero. In such an instance, unknown represents complete uncertainty with the "real" answer being somewhere within that entire range. Conversely, if the answer to a question is clearly known, the max and min values would be equal for that response.

Step 2

As questions are answered, the max and min points that each thematic group accumulates are converted to 2-letter 'sub-rank' values (Figure S9.2). The first letter in the combination represents the max point sum and the second letter represents the min point sum (from step 1), with 'A' indicating a high sum and 'D' indicating a low sum. The two sub-rank values are derived by dividing the accumulated max and min numeric sub-rank scores by the total number of points that could possibly be earned for a given theme (max ratio and min ratio, respectively). The letters A through D are

[36] Scores are built automatically as questions are answered. Consequently, prioritization scores will begin to appear but will also change throughout the question answering process. As a result, prioritization scores should not be relied upon until all 16 questions have been answered.

assigned to the max ratio and the min ratio based on the currently set threshold values (Figure S9.3). If 0.5 is the threshold setting for an 'A' value, any ratio (max or min) that is ≥ 0.5 is assigned an 'A,' and a ratio of 0.45 would get a 'B' if the threshold between 'B' and 'C' is set at 0.4, etc. All threshold values can be viewed by pushing the "Set Prioritization Defaults" button on the opening form (Figure S9.1) to open the defaults manger (Figure S9.4). The results of this process are four 2-letter sub-rank scores for each occurrence. Although sub-rank scores are an intermediate step in the process, they can be used to assess the value of each individual thematic category as well as the certainty of that assessment. For example, a sub-rank score of AA for a given theme would suggest high value and great certainty for that theme because both the Min and Max letter values are high ('A' is the highest value) and are the same. Conversely, a sub-rank rating of AD would suggest uncertainty about the value of the occurrence for that particular theme because the max and min letter values are widely divergent – the occurrence could be highly valuable, but it could also be of relatively low value. Finally a sub-ranking of DD would imply relatively low value but great certainty because 'D' is the lowest value.

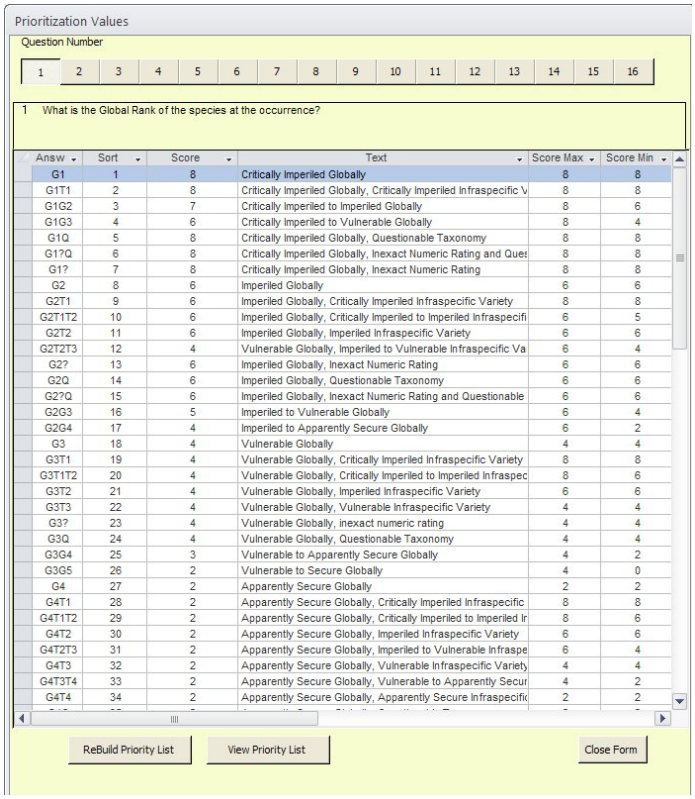

Figure S9.3. Prioritization question and response manager.

Step 3

The letter values generated in step 2 are assigned a new set of numeric values that are independent of the values derived during step 1. The new values represent the relative importance of each letter. In the current system, 'A' (60 points) is twice as desirable as 'B' (30 points), 'B' is twice as desirable as 'C' (15 points), and 'C' is twice as desirable as 'D' (7.5 points). Choosing A = 8 points, B = 4 points, C = 2 points, and D = 1 point would produce the same results, provided that the values set in step 5 are adjusted accordingly; what is important for this step is the ratio between the different values. While the process of converting numbers to letters and then back to numbers again is admittedly convoluted, assigning new numeric values makes it possible to incorporate the relative value of different letter scores.

Step 4

The numeric values derived in Step 3 are subsequently adjusted by 'weights' assigned to each of the four themes. This makes it possible to fine-tune the influence that each of the themes has on the final priority calculation. Weights are simply numeric 'multiplier' values assigned to each theme. Ecological significance is the most important and most reliable[37] thematic category so the weight associated with it is the greatest. The multiplier assigned to this theme is 1 (Figure S9.4), which means that the numeric values (max and min) associated with the sub-rank score are each multiplied by 1[38]. The second and third themes (distribution and abundance, and trends in distribution and abundance) are the most subjective themes and are weighted the least, with multipliers of 0.125. The final theme (recent monitoring) has a multiplier of 0.5. Using this approach, a sub-rank of AA for the ecological significance theme would have a max and min result of 60 and 60, respectively. However, a sub-rank of AA for the distribution and abundance theme would have a max and min result of 7.5 and 7.5. The reason for the difference in the number of points for two themes that both have an AA sub-rank is explained by the multipliers associated with each theme.

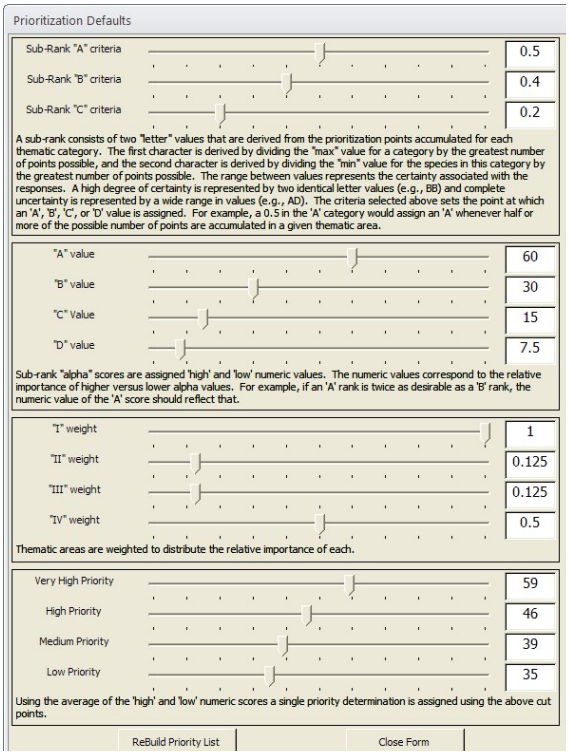

Figure S9.4. Prioritization defaults manager

Step 5

The max and min values for each theme are subsequently summed, and these sums (max and min) are averaged to produce a final numeric priority value. The maximum possible value will usually not be 100, and can be determined by multiplying the "A" value from Step 3 by the sum of the weights in Step 4. Using the values in Figure S9.4, the maximum occurrence value is 105. The full range of numeric values is then 'bracketed' with each bracket corresponding to one of the five descriptive terms (very high, high, medium, low, and very low). The final descriptive priority rank is determined by finding the prioritization bracket within which the final numeric value falls. For example, 'very low' (priority) would be used to describe an occurrence that has a final numeric priority value

[37] Ecological significance is thought to be the most reliable theme because data from trustworthy sources are available to answer 4 of the 5 questions. The remaining 3 themes are thought to be less valuable because they rely on data from past monitoring activities and judgments on abundance and trends.

[38] Thematic weights can only range from 0 to 1, and the sum of the 4 weights can exceed 1.

between 0 and 35 points because the 'break point' between very low and low is set to 35. Similarly, an occurrence with a final priority value of 59 or more points would be given a very high priority because the break-point between 'high' and 'very high' is set at 59 points.

System Adjustments

The system allows the user to adjust the weights of all potential answers (Figure S9.4) as well as the ability to redistribute the weight given to each of the different question 'themes'. Altering question weights should be done with care as excessively high or low weights can disproportionately shift the final prioritization list. The theme balance can be changed to reflect the different values as well as the different level of confidence placed upon a particular theme.

Question weight as well as theme weight settings are recorded whenever a priority list is rebuilt. This makes it possible to determine if a change in priority is due to real changes at an occurrence, or if changes are due to system settings.

qry_RPPP_Record_Output

Latin Name	Value	kingdom_na	Site ID	ElementID	EO_ID	EGT_ID	T&E Status	Priority
Phlox buckleyi	48	Plantae	VA-995	VA-995-30919	192618	143335		Moderate
Pycnanthemum torrei	48	Plantae	VA-990	VA-990-32656	192529	141413		Moderate
Arnoglossum muehlenber	47	Plantae	VA-51	VA-51-3				Moderate
Muhlenbergia glomerata	47	Plantae	VA-39	VA-39-1				Moderate
Buckleya distichophylla	45	Plantae	VA-61	VA-61-1				Moderate
Cardamine clematitis	45	Plantae	VA-70	VA-70-5				Moderate
Carex polymorpha	45	Plantae	VA-52	VA-52-1	194599	128460		Moderate
Ilex collina	45	Plantae	VA-67	VA-67-6				Moderate
Ilex collina	45	Plantae	VA-68	VA-68-2				Moderate
Phlox amplifolia	45	Plantae	VA-62	VA-62-1	191377	154147		Moderate
Polanisia dodecandra	45	Plantae	VA-54	VA-54-5				Moderate
Saxifraga caroliniana	45	Plantae	VA-72	VA-72-1	196631	129571		Moderate
Silene nivea	45	Plantae	WV-04	WV-04-1				Moderate
Solidago simplex ssp. rand	45	Plantae	VA-51	VA-51-2				Moderate
Lythrum alatum	42	Plantae	WV-01	WV-01-4				Moderate
Potentilla arguta	42	Plantae	VA-42	VA-42-3	199076	148723		Moderate
Sanicula trifoliata	42	Plantae	VA-46	VA-46-1				Moderate
Scutellaria saxatilis	42	Plantae	WV-05	WV-05-6				Moderate
Diphylleia cymosa	41	Plantae	VA-71	VA-71-1				Moderate
Diphylleia cymosa	41	Plantae	VA-73	VA-73-1				Moderate
Minuartia glabra	41	Plantae	VA-47	VA-47-1	198007	144359		Moderate
Solidago simplex var. rand	41	Plantae	VA-50	VA-50-2				Moderate
Carex oklahomensis	40	Plantae	VA-990	VA-990-39727	193025	128917		Moderate
Castanea dentata	40	Plantae	VA-69	VA-69-30				Moderate
Cypripedium reginae	40	Plantae	VA-990	VA-990-43538	195221	159904		Moderate
Huperzia appalachiana	40	Plantae	VA-38	VA-38-1				Moderate
Malanthemum stellatum	40	Plantae	WV-03	WV-03-3				Moderate
Melica nitens	40	Plantae	WV-05	WV-05-4				Moderate

Record: 1 of 1606 | No Filter | Search

Figure S9.5. Prioritization output report.

Prioritization Report

You can generate a report to view a prioritized list of occurrences (Figure S9.5). This is accomplished by pressing the 'export data' button on the prioritization form (Figure S9.2). Prior to generating an output list, it is important to rebuild the priority list (Figures S9.2 or S9.4). When the list is rebuilt, the system makes adjustments based on changes to question and theme weights as well as any changes in responses to questions.

The list sorts by Kingdom, then by region, and then by the priority value starting with the highest priority occurrences.

References

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. NatureServe, Arlington, Virginia.

Appendix S9.A - Prioritization Questions

Qualifying	
i	Is this occurrence actively monitored by another Agency?
ii	Is this occurrence actively monitored by another NPS unit?
iii	Is the species at this occurrence difficult to identify?
Ecological Significance (57% of final priority)	
1	What is the Global Rank of the species at the occurrence?
2	What is the Sub-National 'Rank' of the species at this occurrence?
3	What is the Federal 'Status' of the species at this occurrence?
4	What is the Sub-National 'Status' of the species at this occurrence?
5	What is the 'Rank' of this occurrence?
Distribution and abundance along Appalachian Trail (7% of final priority)	
6	Number of occurrences of the species at this occurrence throughout the Appalachian Trail region?
7	Number of occurrences of the species at this occurrence within the 'local' Appalachian Trail region?
Trend in distribution and abundance along Appalachian Trail (7% of final priority)	
8	Current trend of this species throughout the Appalachian Trail region?
9	Current trend of this species within the 'local' Appalachian Trail region?
Recent Monitoring (29% of final priority)	
10	Is this an exceptionally difficult occurrence to monitor (considering access and distance, etc.)?
11	Are invasive, exotic or aggressive native species known to exist near this occurrence?
12	Is this occurrence close to any known or perceived disturbances?
13	How many years since this species was last monitored?
14	How was the condition of the species at this occurrence characterized when it was last visited?
15	Did the observed condition during the last monitoring visit represent a change in condition? (positive or negative)
16	Divergence from predicted site priority and actual site priority?

Appendix S9.B - Prioritization Weights

Date Set	Rank Category	Weight
2/28/2012	Sub-Rank "A" criteria	0.5
	Sub-Rank "B" criteria	0.4
	Sub-Rank "C" criteria	0.2
	Sub-Rank "D" criteria	<0.2
	"A" value	>=60
	"B" value	30-59
	"C" Value	15-29
	"D" value	7.5-14
	"I" weight	1
	"II" weight	0.125
	"III" weight	0.125
	"IV" weight	0.5
	Very High Priority	>=59
	High Priority	46-58
	Medium Priority	39-45
	Low Priority	35-38
	Very Low Priority	<35

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.30 to 2.00) when a change is made that significantly affects requirements or procedures. Version numbers will be increased incrementally by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version	Date	Revised By	Changes	Justification
1.00	December 2011	Fred Dieffenbach	Original draft	
1.01	May 2012	Fred Dieffenbach	Revised focus of section to include explanation of prioritization process	Previous approach did not adequately explain prioritization methodology, but instead focused on installation of Microsoft Access database.
1.02	November 2012	Fred Dieffenbach	Revised prioritization menu image	
1.03	January 2013	Ed Sharron	Minor edits and formatting	

SOP10 – Deviations and Major Changes Standard Operating Procedure

APPA

Version 1.00

Overview

This SOP documents:

- Known deviations from established methods. Deviations are situations where data were collected or procedures were executed in a manner that is substantially different from the methods documented within the protocol (including the SOPs) used during a particular field season.

- Major changes in the protocol. Major changes are fundamental shifts in procedures that may make it difficult to rectify with earlier data, or that represent differences in the steps that are followed. Major changes are not deviations, provided that the changes are documented in the SOPs. Ideally, any time there is a major change in methods the network will use both methods long enough to determine whether the results from the different methods are sufficiently correlated to allow old data to be corrected. In some cases (especially early in the use of the protocol), the small amount of data lost by the protocol change will not be worth the cost of overlapping methods.

Known Deviations and Major Changes

Narrative: Monitoring Objectives and Priorities

The stated objective for the rare plant monitoring program is to monitor high priority plant occurrences. Efforts have been made to identify high priority occurrences and create lists of occurrences to direct seasonal monitoring. In practice, however, monitoring is directed by convenience as much as by priority. Sometimes monitored occurrences that are not "high priority" are near high priority occurrences, while in other instances occurrences have been "adopted" by a monitor who prefers to monitor these locations. In both of these instances, a monitor collects data at an occurrence that would otherwise not be considered high priority. While this results in the acquisition of additional rare plant data, it may also redirect scarce monitoring resources away from occurrences that should be monitored. This is a deviation that will persist because it does not have a realistic solution. The protocol already acknowledges that opportunistic and convenience monitoring occurs so there is no need to change the protocol.

Narrative: Data Collection & End of Season Procedures
SOP 6: Data Stewardship

1. The optimal monitoring time has been identified for approximately 36% of occurrences. For these occurrences, the most recent observations were within the optimal monitoring window

approximately 72% of the time. The importance of monitoring during an optimal period is obvious, but whether this is emphasized to the volunteer monitors is not clear. Ensuring that monitoring occurs during the optimal time period requires that the optimal monitoring period is documented and that the monitor is directed to the occurrence during this period. Priority lists available in 2015 identify the optimal monitoring date when known..

2. The protocol originally called for field sheets to be copied onto acid free paper and any changes or edits were ONLY to be made on the copies. Monitors have begun to submit their field forms in pdf format so Monitoring Coordinators do not have access to the originals. The protocol also specified that copies and originals were to be scanned and entered into the IRMA system. While these steps have not been strictly followed, a change to the process is warranted. If the originals arrive in pdf format, making copies seems unnecessary (accepting pdf forms is mentioned as a submittal option under ***Narrative: Data Submission***). The pdf version can be viewed as equivalent to the original. If edits or changes are needed, the pdf can be printed. In such instances, the printed/edited/commented version must be scanned and forwarded for eventual storage in IRMA along with the original pdf version. For field sheets that are submitted on paper, the protocol now instructs the Monitoring Coordinators to scan them into pdf format.

3. Following review, forms are supposed to be submitted to the APPA Natural Resource Manager for another level of review. This step of the process is supposed to occur within 1 month, but generally does not occur at all. Instead, data have been submitted directly to the APPA Environmental Monitoring Coordinator, skipping the second step of the data verification/validation process. The protocol originally described data entry as the responsibility of the APPA Natural Resource Manager, but this part of the process is currently being completed by the ATC Monitoring Coordinators. Though the sequence is different than described in the protocol, this deviation is not problematic and should not interfere with the second step of the data verification/validation process to be completed by the APPA Natural Resource Manager. Recommend changing protocol to indicate that data will be entered and reviewed by Monitoring Coordinators, then forwarded to the APPA Natural Resource Manager. Protocol (and associated SOPs) should be changed to reflect a change to the timing when data are forwarded to the Natural Resource Manager. Instead of "within 1 month," it should be changed to "by November 30" of the monitoring year. Completing the 10% spot check and validation are important steps in the process and should be re-emphasized (not changed).

Narrative: Data Analysis and Reporting
SOP 8: Analysis and Reporting

1. The protocol indicates that monitoring effort will be tracked and analyzed. We do track monitoring time that ATC and APPA use for reporting, but the protocol suggest that these data may offer a way to determine if an adequate amount of monitoring effort is being applied, and that monitoring is somehow not getting sufficient attention. Recommend removing the scatterplot stuff.

2. The protocol describes a process where the APPA Natural Resource Manager and the APPA Environmental Monitoring Coordinator work together to analyze and report the results of seasonal monitoring. In practice this step is largely completed by the APPA Environmental Monitoring Coordinator. The results are relayed to the Natural Resource Manager, but the process is not collaborative like described in the protocol. The protocol should be changed to indicate that analysis and reporting will be done by the Environmental Monitoring Coordinator who will share preliminary results with the APPA Natural Resource Manager prior to publication.

3. Listing the proportion of high priority occurrences that were monitored and identifying those occurrences that were supposed to be monitored but were not, has not been done. Creating such lists is conceptually simple but difficult in practice because a "set" list of occurrences to be monitored during a season does not exist. The new monitoring log that is to be used during 2015 will help to identify occurrences that were specifically targeted for monitoring. This is not a 100% solution, but goes far toward determining the percentage of occurrences that were to be monitored in a given year, and those that were actually monitored.

4. The protocol discusses formatting for traditional written reports that are not being generated. Instead, reporting and communication is via web documents. The language also talks about information that would be made available for each monitored occurrence. In general, specific monitoring details are not publicly available, so listing occurrence specific detail is impractical for publicly available report or resource briefs. These details are available from the rare plant database, however. Recommend changing protocol to discuss resource brief approach.

Appendix S1.A.: Safety Acknowledgment Form: Appendix C

There is currently no mechanism to determine whether the safety acknowledgement form has been given to monitors. The new monitoring assignment log form has a place for the monitor and monitoring coordinator to initial, and thereby signify that safety in general and specifically in reference to the occurrence in question has been discussed.

Revision History

Version numbers will be incremented by a whole number (e.g., Version 1.3 to 2.0) when a change is made that significantly affects requirements or procedures. Version numbers will be increased incrementally by decimals (e.g., Version 1.06 to Version 1.07) when there are minor modifications that do not affect requirements or procedures included in the protocol. Add rows as needed for each change or set of changes tied to an updated version number.

Revision History Log

Version	Date	Revised By	Changes	Justification
1.00	March 2015	Fred Dieffenbach	Original draft	

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 632/128352, April 2015

National Park Service
U.S. Department of the Interior

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